

**68. JAHRESTAGUNG
DER DEUTSCHEN GESELLSCHAFT
FÜR NEUROCHIRURGIE (DGNC)**

**7. JOINT MEETING
MIT DER BRITISCHEN GESELLSCHAFT
FÜR NEUROCHIRURGIE (SBNS)**



DGNC

Deutsche Gesellschaft
für Neurochirurgie



**68th ANNUAL MEETING
OF THE GERMAN SOCIETY OF NEUROSURGERY (DGNC)
7th JOINT MEETING
WITH THE SOCIETY OF BRITISH NEUROLOGICAL SURGEONS (SBNS)**

ABSTRACTS

www.dgnc.de/2017

**14.-17. Mai 2017
MESSE MAGDEBURG**

Vorwort

Sehr geehrte, liebe Kolleginnen und Kollegen,

die Kongreßmannschaft der Universitätskliniken für Neurochirurgie und Stereotaxie in Magdeburg hat gerne die ehrenvolle Aufgabe übernommen, die kommende 68. Jahrestagung unserer Fachgesellschaft 2017 zu organisieren.

Dies ist die zweite Tagung von Neurochirurgen, die in Magdeburg stattfinden wird. Die erste war vor 81 Jahren. Damals war es das erste Mal überhaupt, dass sich neurochirurgisch spezialisierte Ärzte in Deutschland zu einer Konferenz zusammenfanden, welches anlässlich der 26. Tagung Mitteldeutscher Chirurgen organisiert wurde. Ein Jahr später, 1937, fand die Jahrestagung der schon 1926 gegründeten Society of British Neurological Surgeons (SBNS) erstmals außerhalb von Großbritannien, nämlich in Berlin und Breslau zusammen mit deutschen Neurochirurgen statt. Nach einer Reihe weiterer gemeinsamer Tagungen in Großbritannien und Deutschland findet nun die 7. Gemeinsame Tagung der SBNS und der Deutschen Gesellschaft für Neurochirurgie 80 Jahre später in Magdeburg statt. Diese Kontinuität über einen bemerkenswerten Zeitraum bezeugt eine ernsthafte gegenseitige Wertschätzung des internationalen Erfahrungsaustausches. Zu diesem runden Datum wurde für einen Rückblick auf die weltweite stürmische Entwicklung der Neurochirurgie als eines der Hauptthemen in Magdeburg der Fortschritt der letzten 80 Jahre gewählt. Die Darstellung der erstaunlichen Neuerungen, mit denen wir unseren Patienten helfen können, die durch technischen Fortschritt, der Entwicklung der Bildgebung, klinischer Erfahrungen und Studien möglich wurden, soll dazu ein Anreiz sein, neue Wege zu finden. Für die geschichtlichen Betrachtungen unseres Fachgebietes konnten Kollegen gefunden werden, die sich mit der Historie internationaler aber auch spezifisch britischer und deutscher Beiträge zur Wissenschaft Neurochirurgie beschäftigt haben und unsere Entwicklung unterhaltsam darstellen werden. Auch für die anderen Hauptthemen, pädiatrische Neurochirurgie, vaskuläre Neurochirurgie und Stereotaxie ist es gelungen, jeweils 4 international bekannten Kollegen zu gewinnen, die ihr Wissen in den speziellen Plenarsitzungen mit uns teilen wollen.

Bei den weiterhin ansteigenden Mitgliederzahlen werden auch die Aufgaben zur Organisation einer Jahrestagung umfangreicher. Unsere Mannschaft in Magdeburg ist daher für die professionelle und immer erreichbare Hilfe unserer Geschäftsstelle in Berlin bei den Vorbereitungen sehr dankbar.

Unstreitig ist der Austausch wissenschaftlicher Mitteilungen eine Kernaufgabe unserer Fachgesellschaft. Von vielen Mitgliedern wurde seit Jahren die begrenzte Annahmequote eingereichter Beiträge beklagt. Es wurde daher erneut versucht, viele Vorträge soweit räumlich möglich anzunehmen, zusätzlich wurden auch die Zeiten für die Plenarsitzungen ausgedehnt, da diese besondere Beachtung erfahren. Dies war nur durch eine Ausweitung der Anzahl der Parallelsitzungen möglich. So konnten von 662 eingereichten Vorträgen 564 angenommen werden - die Ablehnungsquote betrug somit 14,8%. Zusammen mit 215 angenommenen Postern erreicht insgesamt die Anzahl der angenommenen wissenschaftlichen Beiträge einen erneuten Höhepunkt.

Die Neurochirurgen aus Magdeburg freuen sich auf eine hochinteressante wissenschaftliche Tagung mit Ihnen.

Mit vielen kollegialen Grüßen
Ihr
Prof. Raimund Firsching
Tagungspräsident 2017

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Montag *Monday*, 15.05.2017, 08.00 – 09.00 Uhr *hrs*

- MO.01.01 *Dynamics of thyroid hormones in the acute phase of subarachnoid hemorrhage*
J. Scheitzach* (Regensburg, Deutschland), S. Bele, K. Schebesch, A. Brawanski,
M. Proescholdt
-
- MO.01.02 *Glucocorticoids as a part of the treatment algorithm in sever (WFNS IV and V) non-traumatic subarachnoidale hemorrhage*
E. Suero Molina* (Münster, Deutschland), B. Ellger, D. Glöckner, M. Boschin, A. Gottschalk,
W. Stummer
-
- MO.01.03 *Low-dose versus therapeutic range intravenous unfractionated heparin administration in the treatment of patients with severe aneurysmal SAH*
M. Kunz* (München, Deutschland), C. Nell, R. Schniepp, F. Dorn, J. Tonn, H. Pfister,
C. Schichor
-
- MO.01.04 *Prothrombin complex concentrate for coumadin anticoagulation reversal in traumatic intracranial haemorrhage*
C. Beynon* (Heidelberg, Deutschland), M. Nofal, M. Laible, T. Rizos, A. Potzy, A. Unterberg
-
- MO.01.05 *Early Hypothermia attenuates neurological deficits and brain damage after experimental SAH*
N. Lilla* (Würzburg, Deutschland), C. Rinne, J. Weiland, S. Köhler, R. Ernestus, T. Westermaier
-
- MO.01.06 *Trauma Induced Coagulopathy in Young Patients and Old Patients with Anticoagulation: Comparison and Predictors of Poor Outcome*
K. Sltoci-Ficici* (Dresden, Deutschland), J. Klein, M. Dengl, S. Sobottka, G. Schackert,
T. Juratli
-

Dynamics of thyroid hormones in the acute phase of subarachnoid hemorrhage

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Objective: Thyroid hormones are probably important for neurological recovery after acute brain injury but the dynamics of these hormones after subarachnoid hemorrhage (SAH) are actually not well understood. Objective of the present study was the evaluation of the dynamics of TSH and fT3 levels during the first days after SAH and the possible correlation to the severity of the SAH and the clinical outcome of these patients.

Methods: Since 2013 we prospectively included all patients with non-traumatic SAH admitted to our Department of Neurosurgery within the first 24h after onset of bleeding. All patients were evaluated with a computed tomography (CT) angiogram and a conventional invasive angiography within the first 24 hours. Aneurysms were secured by clipping or coiling. Exclusion criteria were age under 18 years and any endocrine disease (except diabetes mellitus). Serum concentrations of TSH, thyroxin (fT4) and T3 were measured once on day 1, 3, 5 and 10 after the onset of the bleeding. Values were correlated to the severity of SAH (according to Hunt and Hess, HH), location of the aneurysm, neurological condition on admission and outcome at hospital discharge using the Glasgow Outcome Scale (GOS).

Results: 83 patients could be included in the last 4years (60 female/ 23male) with an mean age of 56,6 years. In 78 cases an aneurysm was detected and adequately secured (Clip 18,07%, Coil 69,88%, Clip+Coil 2,41%). 5 (7,23%) patients had an SAH without detection of an aneurysm. 51 patients (61,25%) showed a decrease of TSH between day 1 and day 3. Interestingly TSH values on day 10 were significantly higher compared to day 1 ($p=0.001$). The time course of T3 differed, showing a decrease between day 3 and 10 compared to day 1 ($p=0,001$). In addition 25 (80%) of the patients with a suppressed TSH on day 3 also had subthreshold values of T3 on that day. When we compared the TSH values to the outcome we found that the GOS values were significantly lower in patients with decreasing TSH compared to stable or increasing TSH values between day 1 and 3 ($p < 0.03$).

Conclusion: In general there was a decrease in mean TSH and fT3 values between day 3 and 10 after SAH. In addition a suppressed TSH on day 3 was often combined with subthreshold levels of T3. That possibly indicates a central dysregulation and argues against reflex testing and contrast agent induced relative hyperthyroidism. Patients with poor clinical course showed a more significant decrease of TSH and fT3. Due to this TSH and fT3 could be used as an additional factor to predict outcome.

Glucocorticoids as a part of the treatment algorithm in severe (WFNS IV and V) non-traumatic subarachnoid hemorrhage

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Objective: Treatment of patients suffering from non-traumatic subarachnoid hemorrhage (SAH) remains challenging. Given that inflammation seems to play a key role in the etiology of vasospasms, the concept of suppression of inflammation by glucocorticoids appears promising. However, data undermining this notion is scarce except for the proven benefits of hydrocortisone to counteract deleterious hyponatremia, neither positive nor negative effects are clearly proven. Therefore, we conducted a study to evaluate benefits and side-effects of corticosteroids as part of a treatment algorithm for patients with SAH.

Methods: We performed a retrospective single center study analyzing electronic patient charts treated at our university hospital for non-traumatic SAH between May 2001 and November 2011. Diagnostics and therapy were done following international recommendations and according to clinical needs. Prior to 2009, patients were treated without Dexamethasone (Dexa); since 2009 Dexa (3 x 4 mg daily for 7 days) was part of our standard operating procedure. We investigated the impact of Dexa on patient's outcome parameters such as hospital mortality, length of hospital stay (LOS) and on intensive care unit (ICU), daily Simplified Acute Physiology Score (SAPS 2), Glasgow Coma Score (GCS) upon admission and discharge, and possible infectiological complications.

Results: Clinical data of 379 patients with non-traumatic SAH were analyzed. Despite in the all over population only a trend for a better survival was seen ($p=0.068$), data show a significant better survival rate in patients with severe SAH (WFNS III and IV) when patients were treated with dexamethasone ($p=0.003$). This survival benefit was seen in coiled, clipped, and non-interventional treated patients. Median leucocyte counts was significantly higher in the Dexa group. Median CRP - as a marker of inflammation - in the first 2 days of ICU stay as well as the median CRP in the first 7 days were significantly lower in patients with a favorable neurologic outcome (GCS 13-15 at discharge) in both groups. Median procalcitonin - as a marker of infection - did not differ significantly between groups. Despite equal blood-glucose control algorithms in both groups, there was higher incidence of hyperglycemia in the Dexa group.

Conclusion: In our retrospective single-center cohort study, despite evident side effects Dexa, appears to have positive effects with respect to mortality and neurological outcome as a part of a multimodal therapy for patients with non-traumatic SAH.

Low-dose versus therapeutic range intravenous unfractionated heparin administration in the treatment of patients with severe aneurysmal SAH

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Objective: After severe aneurysmal subarachnoid hemorrhage (SAH) intensive care treatment necessitates intravenous heparin administration to prevent thromboembolic events. However, data on optimized administration dosages of heparin to prevent thrombembolism but also to avoid the risk of bleeding complications are still lacking. Aim of our study was to compare two cohorts of patients harboring severe SAH, treated with low-dose (activated partial thromboplastin time aPTT <40 sec.) unfractionated heparin (UFH) versus therapeutic range (aPTT in the range of 50-60 sec.) UFH with regard on thrombembolic or bleeding complications. Special focus was set on patients with additional intracerebral hemorrhage (ICH) at admission.

Methods: Data analysis of 410 patients with acute SAH Fisher Grade III and IV treated at the neurological or neurosurgical intensive care units (ICU) between 2005 and 2015 was conducted. Retrospective data analysis was done on the basis of medical and radiological records. Cut-off point between low-dose/therapeutic range UFH administration was aPTT of 40 sec..

Results: 298 patients were treated with low-dose (median aPTT 30 sec.) and 112 patients with therapeutic range UFH (aPTT 47 sec.; $p < 0.001$). 136 patients (33%) presented with SAH associated relevant ICH at admission – 89 (30%) of patients treated with low-dose and 48 (43%) of patients treated with therapeutic range UFH ($p = 0.02$). An increasing ICH was radiologically proven in 3 patients under low-dose and in 9 patients under therapeutic range UFH ($p = 0.006$). New cerebral hemorrhage in general occurred in 58 patients (14%) – in 37 patients (12%) treated with low-dose and in 21 patients (19%) treated with therapeutic range UFH ($p = 0.2$) with no significant difference between treatment modalities. Bleeding complications were associated with relevant mortality ($p = 0.03$) and worse outcome (mRS) ($p = 0.007$). Thrombembolic events occurred in 23 patients (6%) – in 16 patients (5%) treated with low-dose and in 7 (6%) patients with therapeutic range UFH ($p = 0.9$). Bleeding and thrombembolic complications delayed significantly length of stay at the ICU and in-hospital stay ($p = 0.01$). Independent risk factors for bleeding complications in overall in the multivariate analysis were the presence of SAH associated ICH at admission ($p = 0.035$, OR 1.9) and values of the highest reached aPTT of more than 55 sec. ($p = 0.046$; OR 1.8); for respective thromboembolic events the positive detection of a HIT ($p < 0.001$; OR 6.6) revealed to be a risk factor.

Conclusion: Compared to low-dose, therapeutic range UFH application in critically ill patients after acute aneurysmal SAH does not prevent thrombembolic events. Bleeding complications were associated with relevant mortality and worse outcome. Especially in case of SAH associated intracerebral hemorrhage at admission therapeutic range UFH application should be avoided.

Prothrombin complex concentrate for coumadin anticoagulation reversal in traumatic intracranial haemorrhage

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Objective: Several guidelines recommend administration of prothrombin complex concentrate (PCC) for anticoagulation reversal in cases of severe bleeding. However, there is only limited data on its use for anticoagulation reversal in anticoagulated patients with traumatic intracranial haemorrhage (tICH). Here we present our experiences with PCC administration for rapid anticoagulation reversal in these patients.

Methods: We retrospectively analysed our institutional database of patients receiving PCC between 2005 and 2014 (n>1000). Data from anticoagulated patients (vitamin k antagonists) referred to our hospital for treatment of tICH and who received PCC for anticoagulation reversal were included in this analysis. Patient characteristics as well as treatment modalities were analysed with specific focus on results of laboratory examination, modalities of PCC administration and neurosurgical procedures as well as bleeding / thromboembolic complications during the further course.

Results: A total of 101 patients were included in this analysis. The median age was 78 years and the median GCS score on admission was 12 (Interquartile range [IQR]: 7-14). Computed tomography had evidence of subdural haematoma in 65 patients and traumatic intracerebral/subarachnoid haemorrhage in 64 patients. Median INR on admission was 2.56 [IQR: 2.1-3.6] and decreased to 1.20 [IQR: 1.13-1.3] following administration of a median dose of 2000 I.U. PCC [IQR: 1500-2750]. Neurosurgical procedures were carried out in 55 patients (55%). The in-hospital mortality rate was 14% and median GCS of survivors at discharge was 14 [IQR: 13-15]. There were no thromboembolic events during the further course of patients.

Conclusion: PCC administration rapidly normalises INR and facilitates urgent neurosurgical procedures in anticoagulated patients with tICH. The risk of thromboembolic events is low and justifies the use of PCC for anticoagulation reversal in light of this potentially life-threatening condition.

Early Hypothermia attenuates neurological deficits and brain damage after experimental SAH

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Objective: Metabolic exhaustion in ischemic tissue is the basis for a detrimental cascade of cell damage eventually ischemic cell death. In the acute stage of subarachnoid hemorrhage (SAH), a sequence of global and focal ischemia occurs threatening brain tissue to undergo ischemic damage. This study was conducted to investigate whether early therapy with moderate hypothermia can offer neuroprotection after experimental SAH in rats.

Methods: 20 male Sprague-Dawley rats were subjected to SAH by the endovascular filament model and treated by active cooling (34° C) from 15 to 180 minutes after vessel perforation or served as controls by continuous maintenance of normothermia (37.5° C). Mean arterial blood pressure (MABP), intracranial pressure (ICP), and local CBF over both hemispheres were continuously measured. Neurological assessment was performed 24 hours later. Hippocampal damage was assessed by H.E.- and Caspase-3 staining.

Results: By a slight increase of MABP in the cooling phase and a significant reduction of ICP, hypothermia improved cerebral perfusion pressure (CPP) in the first 60 minutes after SAH. Accordingly, a trend to increased CBF was observed during this period. Thereafter, CBF was lower in hypothermic animals. The rate of injured neurons was significantly reduced in hypothermia-treated animals (4.5 ± 3 %) compared to normothermic controls (20.8 ± 4 %). The number of Caspase 3 positive neurons in the hippocampal CA1-field was reduced but did not reach the level of significance.

Conclusion: In this study, the effects of very early temporary hypothermia was investigated. The results of this series cannot finally answer whether this form of treatment permanently attenuates or only delays ischemic damage. In the latter case, slowing down metabolic exhaustion by hypothermia may still be a valuable treatment during this state of ischemic brain damage and prolong the therapeutical window for possible causal treatments of the acute perfusion deficit. Therefore, it may be useful as a first-tier therapy in suspected SAH.

Trauma Induced Coagulopathy in Young Patients and Old Patients with Anticoagulation: Comparison and Predictors of Poor Outcome

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Objective: Trauma induced coagulopathy (TIC) is a therapeutic challenge in patients with isolated blunt traumatic brain injury (iTBI). TIC is a separate entity from other causes of coagulopathy such as preinjury anticoagulation. We undertook this observational prospective study 1) to assess the impact of TIC on neurological outcome, 2) to elucidate predictive factors for hemorrhagic progression (HP). We compared TIC with two other cohorts: patients with a preinjury anticoagulation (referred to as medication induced coagulopathy MIC) and patients with an intact coagulation (referred to as non-coagulopathic NC).

Methods: 314 adult patients with an iTBI were included in the study between 2008-2015. Three cohorts were built: TIC (n92), MIC (n112) and NC (n110). Coagulation test included INR, aPTT, fibrinogen, Factor XIII, D-Dimers and platelet count. TIC was defined as any deviation from the norm. Patient demographics, GCS, pupillary status, CT scans, coagulation tests, substitution of procoagulant factors and platelets, patient outcome at discharge and at 6 months were analyzed. Multiple logistic regression, log rank test, Cox regression were performed to identify the predictors for a poor outcome, survival and HP. The analysis was also conducted after adjustment for age (<60 yrs; ≥60 yrs; data not shown in the abstract).

Results: We saw a significant association between severity of iTBI and TIC ($p=0.001$). 51.4% of deaths attributed to iTBI was associated with TIC ($p=0.006$). Patients with MIC were older than the other cohorts (median age 75 vs 50 in TIC and 56 in NC, $p<0.001$). Overall, patients with MIC had shorter cumulative survival than the other cohorts, but there was no significant difference between TIC and MIC. Besides, Cox regression revealed that MIC and NC had significant higher odds of survival when compared to TIC. The higher age of MIC might have biased the results. 51.1% of patients with a poor outcome at 6 months was in the TIC ($p=0.005$). Age >60 yrs, GCS3-12, HP and brain contusions were independent predictors of a poor outcome at 6 months. Contrary to our expectations, we did not observe a significant difference in the frequency of HP in the cohorts; TIC, MIC and NC had comparable distributions (57.6% vs 56.2% vs 43.6%). The urgency to substitute procoagulant factors, age > 60 yrs, brain contusions were significant independent predictors for HP. A separate analysis excluding MIC showed that a sustained TIC was an independent predictor of death and poor outcome; only normalization of TIC was an independent predictor of a favorable outcome (OR 16.95).

Conclusion: In this first prospective observational study comparing TIC and MIC, our results underline the importance of detecting TIC and its urgent therapy. Although prospective, the study was observational and did not stick to a treatment regime. Further prospective research will shed more light on pathophysiology and treatment algorithms.

MO.02 Vaskuläre Neurochirurgie 1

Montag Monday, 15.05.2017, 08.00 – 09.10 Uhr hrs

- MO.02.01 *Dynamic 4D CT angiography for detection of macrovascular vasospasm following subarachnoid haemorrhage*
A. Abdulazim* (Mannheim, Deutschland), J. Böhme, U. Tokhi, C. Groden, D. Hänggi, N. Etminan
-
- MO.02.02 *Which factors predict the discrepancy between delayed cerebral ischemia in the broader sense and imaging-proven infarcts after subarachnoid hemorrhage ?*
B. Schatlo* (Göttingen, Deutschland), A. Fathi, M. Stienen, C. Fung, D. Zumofen, V. Rohde, A. Weyerbrock, J. Burkhardt, P. Bijlenga, K. Schaller
-
- MO.02.03 *The intraventricular clot size and blood distribution within the ventricular system correlate with delayed cerebral ischemia after subarachnoid hemorrhage*
V. Malinova* (Göttingen, Deutschland), B. Iliev, T. Gasimov, V. Rohde, D. Mielke
-
- MO.02.04 *Radiological and clinical outcome of patients with subarachnoid hemorrhage after angioplasty for treatment of delayed cerebral ischemia based on a CT perfusion-protocol*
V. Malinova* (Göttingen, Deutschland), I. Tsogkas, M. Psychogios, V. Rohde, D. Mielke
-
- MO.02.05 *Delayed cerebral ischemia - contemporary incidence, predictors, management and outcomes based on the Swiss Study on Subarachnoid hemorrhage (Swiss SOS)*
A. Fathi* (Aarau, Switzerland), M. Stienen, C. Fung, J. Burkhardt, J. Beck, V. Rohde, A. Weyerbrock, P. Bijlenga, K. Schaller, B. Schatlo
-
- MO.02.06 *PLOD2 expression in brain arteriovenous malformations (bAVM) and its association with bAVM size*
B. Neyazi* (Hannover, Deutschland), L. Tanrikulu, K. Stein, C. Dumitru, I. Sandalcioglu
-
- MO.02.07 *Refractory vasospasms in SAH-can we assess who is at risk?*
D. Müller* (Essen, Deutschland), R. Jabbarli, B. Kleist, N. El Hindy, U. Sure, O. Müller
-

Dynamic 4D CT angiography for detection of macrovascular vasospasm following subarachnoid haemorrhage

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Objective: Delayed cerebral ischemia (DCI) is a major contributor for poor neurological outcome in patients with aneurysmal subarachnoid hemorrhage (SAH). Even though only 36% of patients with angiographic vasospasm present with clinical features of DCI, angiographic vasospasm remains an important radiological surrogate for DCI. Since, catheter angiography (CA) for detection of angiographic vasospasm carries a risk for procedure-related stroke, CT-Angiography combined with CT-Perfusion (PCT) imaging is increasingly facilitated to detect macro-and/or microvascular spasm.

We investigated the potential of our PCT imaging algorithm using dynamic 4D CT angiography (dCTA) for detection of macrovascular spasm and its correlation with CA.

Methods: A prospective cohort of 26 consecutive SAH patients was subjected to a standardized screening protocol for DCI: Here, CA on admission and on day 7 after SAH ictus was combined with PCT measurements routinely performed 6 to 12 hours after aneurysm treatment, on days 3 to 4 as well as 9 to 11 after SAH ictus or in case of secondary neurological deterioration, that is, occurrence of clinical features of DCI. DCTA images were extracted from the whole-brain PCT dataset and were independently reviewed by a neuroradiologist and a vascular neurosurgeon with respect to presence and degree of macrovascular spasm. Agreement between CTA and CA for the presence of macrovascular spasm was calculated using kappa-coefficients. Sensitivity, specificity, positive and negative predictive values of CTA to detect macrovascular spasm were calculated considering CA as the gold standard.

Results: 26 aSAH patients with a mean age of 56 ± 11 years and Fisher grades 2-4 and WFNS grades 1-5 were prospectively enrolled in this study. Aneurysm sites were middle cerebral (n=12), anterior communicating (n=6), posterior communicating (n=3), internal carotid (n=2), superior cerebellar (n=2), and basilar artery (n=1). 9 patients revealed PCT values suggestive for DCI (defined as a 1.5-fold prolongation of the mean transit time (MTT)); 6 of these patients presented with macrovascular spasm in the subsequent CA. Macrovascular spasm were seen in four more patients on CA without prior MTT prolongation.

A high agreement ($k=0.75$) was found between dCTA and CA for the detection of macrovascular spasm. Sensitivity, specificity, positive and negative predictive values were, 80%, 94%, 89%, and 88%, respectively. Using dCTA as a screening method CA may have been avoided in 94%.

Conclusion: Our data highlight that dCTA derived from PCT imaging data reveals good agreement with CA and may serve as the initial modality to rule out macrovascular spasm so that CA for mere diagnostic purposes may be unnecessary. However, CA may be required to rule out microvascular spasm in the presence of clinical features of DCI and absence of macrovascular spasm in dCTA.

Which factors predict the discrepancy between delayed cerebral ischemia in the broader sense and imaging-proven infarcts after subarachnoid hemorrhage ?

Bawarjan Schatlo¹, Ali-Reza Fathi², Martin N. Stienen³, Christian Fung⁴, Daniel Zumofen⁵, Veit Rohde⁶, Astrid Weyerbrock⁷, Jan-Karl Burkhardt⁸, Philippe Bijlenga⁹, Karl Schaller¹⁰

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Objective: A recent consensus paper on the term delayed cerebral ischemia (DCI) suggested to include clinical and imaging parameters into its definition. DCI may well be a temporary phenomenon since clinical changes lasting longer than an hour already qualify for the use of the term. In consequence, not all patients with DCI necessarily develop cerebral infarcts. Predictive factors could help identify patients who may benefit from advanced neuromonitoring. The goal of the present analysis is to identify factors separating patients who suffer from DCI resulting in infarcts from those without imaging evidence of brain ischemia and DCI.

Methods: The Swiss study on subarachnoid hemorrhage (Swiss SOS) includes all patients treated for SAH since 1st of January 2009 in all eight neurovascular centers in Switzerland. Data collection includes delayed ischemic neurological deficits and infarcts not related to aneurysm-securing treatment. Multivariate binary regression analysis was used to assess which factors are predictive of an infarct after delayed cerebral ischemia.

Results: 1087 datasets matched the inclusion criteria for the current analysis. DIND/DCI occurred in 310 patients (28.6%). Imaging-proven infarcts not related to aneurysm-securing treatment were present in 185 patients (17.0%). In the group of patients with DCI and cerebral infarcts, 61/152 patients (40.1%) had evidence of treatment-related ischemia. In the group of patients with DCI but without infarcts, this figure was lower 53/158 (33.5%; $p=0.026$). However, the significance of this finding abated after multivariate analysis (OR 0.63 CI95% [0.38-1.04]; $p=0.069$). Male sex (OR 0.79 CI95% [0.47-1.31]; $p=0.35$), high WFNS (OR 0.84 CI95% [0.52-1.35]; $p=0.46$), high Fisher grade (OR 1.45 CI95% [0.43-4.88]; $p=0.55$), age >65 years (OR 1.07 CI95% [0.59-1.95]; $p=0.82$), location of the aneurysm in the anterior circulation (OR 1.39 CI 95% [0.67-2.91]; $p=0.37$), surgical aneurysm occlusion (OR 1.07 CI95% [0.65-1.76]; $p=0.79$) and interventional spasmolysis (OR 1.06 CI95% [0.65-1.73]; $p=0.83$) were not associated with the absence of infarct despite DCI.

Conclusion: Peri-interventional ischemia after aneurysm-securing treatment shows a trend towards a correlation with DCI-associated infarcts. Patients suffering early "hits" early in the course of their SAH may be predisposed to increased vulnerability to "delayed hits", warranting an increased vigilance in this subgroup.

The intraventricular clot size and blood distribution within the ventricular system correlate with delayed cerebral ischemia after subarachnoid hemorrhage

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Objective: Intraventricular hemorrhage (IVH) is a frequent condition in patients with aneurysmal subarachnoid hemorrhage (aSAH) associated with a higher incidence of hydrocephalus and poor outcome. While a higher amount of blood within the subarachnoid space leads to a higher incidence of delayed cerebral ischemia (DCI) after aSAH, the role of the amount and distribution of the intraventricular blood for the development of DCI is still not conclusive. The aim of this study was to evaluate the impact of the ventricular clot volume and its distribution on the incidence of DCI after aSAH.

Methods: A patient population with aSAH was retrospectively analyzed for the presence of DCI, defined as new infarction not related to aneurysm treatment. Volumetric measurements of the intraventricular clot based on the initial CT scan were done. For the classification of the amount of blood and its distribution a modification/simplification of the Graeb score (Morgan et al. 2013) was used (<30% ventricular blood related to the ventricle size=1 point, 30-70%=2 points, >70%=3 points; clot size score range 0-12). Furthermore, the blood distribution within the ventricles was documented; for each blood-filled ventricle 1 point was given (clot distribution score range 0-4). Then, we correlated the intraventricular clot size and clot distribution with the incidence of DCI.

Results: A total of 203 patients with aSAH were included in the analysis. The mean age was 55 years. A high initial Hunt & Hess grade was found in 33% (67/203) and a high modified Fisher grade in 91% (185/203) of the patients. 16% (33/203) of the patients developed a DCI. We found a statistically significant correlation of the intraventricular clot size with the incidence of DCI. The mean score in the DCI group was 2.4 vs. 4.8 in the group without DCI (linear regression, $p=0.01$). Furthermore, a significant correlation of the number of ventricles involved with the occurrence of DCI was detected, with a mean score of 1.6 in the DCI group vs. 3.7 in the group without DCI (linear regression, $p=0.01$).

Conclusion: The incidence of DCI increases with increasing clot size of intraventricular blood and with an increasing number of ventricles involved, in patients with aSAH and IVH. Thus, the intraventricular clot might be a possible treatment target (e.g. early and fast thrombolysis) in order to reduce the incidence of DCI after aSAH.

Radiological and clinical outcome of patients with subarachnoid hemorrhage after angioplasty for treatment of delayed cerebral ischemia based on a CT perfusion-protocol

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Objective: Delayed cerebral ischemia (DCI) is a severe complication leading to poor outcome after aneurysmal subarachnoid hemorrhage (aSAH). CT perfusion (CTP) allows the detection of „tissue at risk“ for DCI and might be a helpful diagnostic tool to select patients for endovascular treatment to avoid delayed cerebral infarction. The aim of this study was to evaluate the radiological and clinical outcome of the patients who underwent endovascular intervention based on a CTP-protocol.

Methods: A CTP-protocol consisting of CTP on day 3 after aSAH, CTP in case of increased (>120cm/s) blood-flow-velocity (BFV) measured by transcranial Doppler sonography (TCD), CTP in case of new neurological deficit in awake patients as well as CTP on day 7 in comatose or sedated patients has been applied in our clinic since January 2012. If „tissue at risk“ was identified after qualitative and quantitative evaluation of the CTP an endovascular intervention (angioplasty with or without intraarterial nimodipine application) was performed. The radiological outcome concerning delayed infarction was evaluated based on a CT scan before discharge. The clinical outcome was determined according to the Glasgow outcome score (GOS) and the modified Rankin scale (mRS) six months after discharge.

Results: A total of 203 patients with aSAH were treated according to the CTP-protocol. In 46 of these patients endovascular intervention was performed to treat DCI. 57% of them had an initially good Hunt & Hess grade (1-3) and 94% had a high modified Fisher grade (3-4). Increased BFV was found in 81% (37/46) of the patients (mean BFV right MCA 172cm/s, left MCA 147cm/s). In all but two patients the BFV normalized after the intervention (mean BFV right MCA 99cm/s, left MCA 84cm/s). Delayed infarction occurred in 24% (11/46) of these patients. A good clinical outcome 6 months after the bleeding according to the GOS (3-5) had 80% and according to the mRS (0-3) 74% of the 46 patients.

Conclusion: An elaborated CTP-protocol allows the selection of patients with delayed cerebral ischemia for endovascular treatment, which can reduce the incidence of delayed infarction associated with permanent neurological deficits. Subsequently, it may improve the radiological and clinical outcome of patients suffering from aSAH.

Delayed cerebral ischemia - contemporary incidence, predictors, management and outcomes based on the Swiss Study on Subarachnoid hemorrhage (Swiss SOS)

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Objective: Delayed cerebral ischemia (DCI) remains a feared complication of aneurysmal subarachnoid hemorrhage (SAH). In order to account for novel insights into its pathophysiology, improved interventional management and advances in neurointensive care over the past decade, we reassessed the incidence, predictors and management of DCI based on a contemporary unselected patient population.

Methods: The Swiss study on subarachnoid hemorrhage (Swiss SOS) includes all patients treated for SAH since 1st of January 2009 in all eight neurovascular centers in Switzerland. DCI was defined based on a 2010 consensus as "The occurrence of focal neurological impairment (such as hemiparesis, aphasia, apraxia, hemianopia, or neglect), or a decrease of at least 2 points on the Glasgow Coma Scale (either on the total score or on one of its individual components [eye, motor on either side, verbal]). This should last for at least 1 hour.". In addition to descriptive statistics, predictive factors were identified based on chi² and multivariate binary regression analysis.

Results: 1087 datasets matched the inclusion criteria for the current analysis. DCI occurred in 310 patients (28.6%). After multivariate correction, predictors of DCI included poor WFNS status (3-5) [OR 1.48, CI95% 1.06-2.06, p=0.02], high Fisher grade (3,4) [OR 3.1, CI95% 1.70-5.74, p<0.001] and surgical aneurysm treatment [OR 1.50, CI95% 1.12-2.01, p=0.01]. Interventional balloon or chemical dilation was performed in 127 of 310 cases with DCI (41%). Hemicraniectomy was necessary in 73/310 patients with DCI (23.5%) and 79 out of 774 patients without DCI (10.2%; p<0.001). Outcomes after DCI were worse with higher dependency (166; 53.5%) and mortality (58; 18.7%) compared to patients without DCI (25.5% and 15.5% respectively; p<0.001). Length of stay was longer in patients with DCI (29±16 days) than in those without DCI (22±13 days; p<0.05).

Conclusion: Despite advances in neurointensive care management of SAH, DCI affects more than one in four patients. Besides poor clinical status and amount of blood, our data confirm an association between surgical management and the occurrence of DCI. Interventional dilation appears to play a pivotal role in its management in our cohort. It remains an important factor associated with longer hospital stay, poor outcome and mortality.

PLOD2 expression in brain arteriovenous malformations (bAVM) and its association with bAVM size

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Objective: Brain arteriovenous malformations (bAVM) are severe conditions which, upon rupture, cause debilitating neurological deficits and even death. The exact cellular/ molecular mechanisms associated with bAVM growth and rupture are currently unclear. The objective of this study was to explore the potential role of PLOD2 (Procollagen-lysine, 2-oxoglutarate 5-dioxygenase 2) in bAVM pathophysiology.

Methods: Expression and localization of PLOD2 were assessed immunohistochemically in tissue microarrays from bAVM patients (n=60). Correlations between PLOD2 levels and clinical parameters were assessed with Pearson's test or Spearman's rank correlation coefficient. Comparison between different clinical parameters was performed using t-test or non-parametric Mann-Whitney U-test. Fisher's exact test was used for categorical data.

Results: PLOD2 was mainly expressed within the tunica media of blood vessels. High levels of PLOD2 expression correlated with small bAVM size ($p=0.0083$, $R^2=0.158$). Small bAVM showed an increased frequency of hemorrhage compared to large ones ($p=0.001$). Although PLOD2 was not directly associated with bAVM hemorrhage, high PLOD2-expressing bAVM had a lower frequency of hemorrhage compared to low or medium PLOD2-expressing bAVM (25% versus 63% and 75%, respectively).

Conclusion: Our study reports for the first time that PLOD2 is expressed in bAVM and suggests a role of PLOD2 in bAVM pathophysiology. These findings contribute to a better understanding of the bAVM microenvironment and may foster the development of improved therapeutic strategies against this disease.

Refractory vasospasms in SAH-can we assess who is at risk?

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Objective: Refractory vasospasms remain a hazardous complication in the course of (aneurysmal) subarachnoid hemorrhage (SAH). The aim of this study was to identify risk factors for refractory vasospasms in a single center patient cohort.

Methods: Between 2003 and 2015 a total of 955 consecutive patients with SAH were treated. Vasospasms were detected by transcranial Doppler sonography on the ICU according to predefined criteria and confirmed by digital subtraction angiography (DSA). Vasospasmolysis was done interventionally with nimodipine and / or ballon angioplasty wherever necessary. Patients records were analyzed and the data of patients with only one vasospasm and of patients who suffered from two or more vasospasms, defined as refractory vasospasms, were compared by χ^2 -test in regard to sex, Hunt & Hess grade at admission and concomitant meningitis.

Results: A total of 164 patients (17.2%) with vasospasms was identified by DSA, 119 female (72.6%) and 45 male patients (27.4%) were in this series. In 80 patients two or more vasospasmolyses were performed.

There was no significant association between the number of vasospasms and Hunt & Hess grade at admission ($p=0.157$), sex ($p=0.867$) or accompanying meningitis ($p=0.336$). Nevertheless, amongst patients requiring multiple vasospasmolyses (defined as 5+; $n=12$) were 10 female and 2 male patients.

Conclusion: Despite a very large series of patients suffering from SAH, statistical analysis failed to identify factors that might be associated with refractory vasospasms. The common prejudice that women are more prone to experience vasospasms after SAH in general cannot hold stand according to our data. More research has to be done to identify who is at risk for severe refractory vasospasms.

MO.03 Tumor 1 – Metastasen A

Montag Monday, 15.05.2017, 08.00 – 09.00 Uhr hrs

- MO.03.01 *Molecular pathological profile of brain metastases from a primary adenocarcinoma of the lung*
S. Hernandez Duran* (Göttingen, Deutschland), A. Barrantes-Freer, B. Schatlo, V. Rohde, H. Schildhaus, A. Bleckmann
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- MO.03.02 *Comparison of the early functional outcome after electrophysiological controlled microsurgery versus stereotactic LINAC radiotherapy of cerebral metastasis of the Rolandic area*
B. Pintea* (Bonn, Deutschland), B. Baumert, T. Kinfe, K. Gousias, Y. Parpaley, J. Boström
-
- MO.03.03 *Iodine-125 brachytherapy vs. microsurgical resection in the salvage treatment of brain metastases: a comparative analysis*
A. Romagna* (Salzburg, Austria), C. Schwartz, S. Weis, S. Nachbichler, P. Winkler, F. Kreth
-
- MO.03.04 *Radiosurgery (RS) and multisession radiosurgery (msRS) of brain metastases - treatment strategies and special aspects*
S. Fichte* (Erfurt, Deutschland), H. Herold, G. Surber, K. Hamm
-
- MO.03.05 *Rationale for testing Tumor Treating Fields (TTFields) in Brain Metastases - the METIS trial*
C. Freyschlag* (Innsbruck, Austria), J. Kerschbaumer, D. Pinggera, K. Brawanski, M. Mehta, P. Brown, V. Gondi, C. Thomé
-
- MO.03.06 *Risk factors for local in-brain progression after resection of cerebral metastases*
C. Munoz-Bendix* (Düsseldorf, Deutschland), M. Rapp, H. Steiger, M. Sabel, M. Kamp
-

Molecular pathological profile of brain metastases from a primary adenocarcinoma of the lung

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Objective: Brain metastases (BM) constitute the most common type of central nervous system malignancies, and nearly half of them stem from lung cancers. Driver mutations have been identified in primary lung cancer, which have significantly enhanced the therapeutic options for patients harboring these genetic changes. EGFR mutations have been described in up to 10% of lung adenocarcinomas (ADC), while ALK/EML4 translocation, MET amplification and ROS1 fusion have been identified in up to 7%, 2% and 2%, respectively. To date, no comprehensive analysis of the molecular pathological profile of ADC BM has been performed.

Methods: We conducted a retrospective analysis of the molecular pathological profile of patients harboring BM from ADC who underwent tumor resection at our neurosurgical department from July 2013 to July 2016. EGFR mutations were determined in exons 18, 19, and 21; MET amplification was determined by FISH assays, as well as ALK/EML4 translocation, and ROS1 fusion.

Results: Our cohort included 57 (33 males, 24 females) patients harboring BM from ADC who underwent surgical resection. Of these, 48/57 (84%) underwent EGFR status analysis and three (3/48, 6%) exhibited mutations (two in exon 19, and one in exon 21). MET status was available in 26/57 (46%), of which 11 (42%) exhibited mutations; six were low level, four intermediate level, and one high level gains. ROS1 status was available in 45/57 (79%) patients, with only one mutation. ALK/EML4 translocation was determined in 48/57 (84%) patients, all of them negative.

Conclusion: Our retrospective analysis shows that the distribution of the mutations in ADC BM differs from their primary counterparts. Of note is the increased presence of MET mutations, which may lead to new therapeutic options in patients with ADC BM. Future studies need to address at which point in the natural history of ADC these mutation changes occur.

Comparison of the early functional outcome after electrophysiological controlled microsurgery versus stereotactic LINAC radiotherapy of cerebral metastasis of the Rolandic area

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Objective: To evaluate the advantages and disadvantages regarding the functional outcome and factors of influence of the two standard treatment options for central metastases: electrophysiologically controlled microsurgery or stereotactic radiosurgery (SRS)/stereotactic radiotherapy (SRT).

Methods: We performed a database search for central metastasis treatments during the period from January 2008 till September 2012 in two clinical registers: 1. register for intraoperative neuromonitoring (Department of Neurosurgery) and 2. prospective database for SRS/SRT (Department of Radiotherapy). Neurological status before and after treatment, Karnofsky performance index (KPI), histology, tumor localisation, tumor volume and oncological status were standardized and pooled together. The muscle strength was graded on a scale of 0-5.

Results: We identified 27 microsurgical and 41 stereotactic cases in 68 patients. The microsurgically treated patients had significant less muscle strength in the upper and lower extremities before and after the treatment compared to the patients which received radiotherapy. The muscle strength of the limbs did not change in the patients which received radiotherapy, while operated patients had significant improvement of the muscle strength of the lower extremities ($p=0.05$) and a non-significant improvement in the upper extremities. There was a significant higher improvement rate of hemiparesis but as well a statistical trend for more deterioration of the muscle strength of the limbs after microsurgery compared to SRS/SRT (improvement $p=0.04$, deterioration $p=0.10$).

Conclusion: Electrophysiologically guided microsurgery of central metastases had a significant better functional outcome regarding hemiparesis. However there was also a trend for less secondary neurological deterioration after stereotactic radiosurgery or stereotactic radiotherapy.

Iodine-125 brachytherapy vs. microsurgical resection in the salvage treatment of brain metastases: a comparative analysis

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Objective: The outcome and toxicity profiles of local treatment concepts for recurrent brain metastases after prior multimodal treatment are poorly defined. In this two-institutional study we retrospectively compared the outcome and toxicity profiles of salvage low-activity iodine-125 brachytherapy (SBT) with that of salvage open tumor resection (OTR) of recurrent brain metastases.

Methods: Thirty-five patients with recurrent intracranial disease, prior multimodal treatment and a Karnofsky performance score (KPS) ≥ 70 were considered eligible. Patients underwent either salvage OTR or SBT - after prior histological verification by means of stereotactic biopsy- at two distinct neurosurgical centers. In case of SBT exclusively temporary low activity iodine-125 seeds (activity < 20 mCi, reference dose: 50 Gy, dose rate < 15 cGy/h) were used. Study endpoints were postrecurrence survival (PRS) as well as local and distant tumor control rates after local salvage therapy. The date of SBT/OTR was set as the reference point. The cumulative dose applied to the early and late responding tissue of each SBT patient was assessed by calculation of the biological effective tumor dose (BED) according to the formula of Dale. CNS toxicity was assessed according to the RTOG/EORTC criteria.

Results: The SBT and the OTR cohorts did not differ in terms of their demographic parameters except for tumor size (smaller volume in the SBT group: 2.3 cm^3 vs. 7.5 cm^3 , $p=0.002$). In the OTR cohort, all patients had undergone prior resection with adjuvant radiotherapy in 10 cases. In the SBT cohort, all patients had undergone prior radiotherapy (9 cases fractionated external beam radiotherapy, 14 cases focused high dose radiotherapy). PRS did not differ between the two treatment groups (PRS after one year 46.7% in the SBT group vs. 54.9% in the OTR group; $p=0.7$). The one-year local/distant tumor control rate after salvage SBT and OTR was similar ($p=0.13$ and $p=0.58$ respectively). In the overall analysis, brain metastases originating from pulmonary cancer had a decreased PRS compared to other primary tumor dignities and a higher risk for distant tumor relapse ($p=0.04$ both). One patient in the OTR group suffered from a transiently aggravated visual field defect; two patients of the SBT group with upper-range BED values suffered from RTOG/EORTC grade I/II toxicity (transient headache due to steroid-responsive edema).

Conclusion: Salvage SBT and OTR have a comparable outcome and toxicity profile. In small recurrent brain metastases, preference should be given to low-dose rate iodine SBT due to decreased hospitalization costs and time to convalescence. Brain metastases of pulmonary cancer origin appear to have a particular high risk profile for tumor relapse and should undergo closer follow-up after both salvage treatments.

Radiosurgery (RS) and multisession radiosurgery (msRS) of brain metastases - treatment strategies and special aspects

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Objective: Radiosurgery (RS) is a well-accepted therapeutic option for brain metastases and increasingly used even for multiple metastases. The authors describe the treatment strategies and outcomes of patients treated in our department after implementation of a CyberKnife robotic radiosurgery device, with a special focus on multisession radiosurgery, RS of the resection cavity and repeated radiosurgery.

Methods: From October 2012 to December 2015, 163 patients were treated for brain metastases. Patient data, planning details and imaging were analyzed retrospectively. For follow-ups, contrast-enhanced MRI was fused to the initial imaging. Tumor response was evaluated for each target volume and local control rate was assessed at 3, 6 and 12 months after treatment. Additionally, regional progression (new brain metastases) was documented. Kaplan-Meier estimation was used for statistical analysis of survival and local progression-free survival.

Results: 163 patients underwent radiosurgery for a total of 364 brain metastases (1-9 per session). Multisession RS was used in case of large target volumes and/or neurological deficits in 47 of initial treatments. 23 patients had radiosurgery of resection cavities following neurosurgery. 23, 9 and 2 patients were treated 2, 3 or 4 times, respectively, during the evaluation period. Follow-up was complete for 158 patients. Mean time of follow-up was 12,2 (0,3-45,7) months. Overall survival was 67% and 46% at 6 and 12 months, respectively. Complete imaging was available for 98, 70 and 44 patients at 3, 6 and 12 months. Local control rate was 97,1%, 89,5% and 78,5% at 3, 6 and 12 months. 56 patients had regional progression after a mean time of 7,6 (1-39) months. In 26 patients, repeated radiosurgery was performed up to August 2016.

Conclusion: RS and msRS are safe options for treatment of brain metastases with a good rate of local control. Repeated radiosurgical treatment can be performed in cases of local and distant tumor progression, avoiding or postponing whole-brain radiation. Radiosurgery is also an option for local failure after WBRT.

Rationale for testing Tumor Treating Fields (TTFields) in Brain Metastases - the METIS trial

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Objective: Tumor Treating Fields (TTF) are a novel, non-invasive regional antimitotic treatment modality, based on alternating electric fields. The efficacy of TTFields in GBM treatment has recently been confirmed. NSCLC accounts for approximately 80% of patients with primary lung cancer, and is both the leading cause of death from cancer and the most common source of brain metastases. It has been reported that in 30 to 50% of patients with NSCLC brain metastases occur at some time during the course of their disease and, if untreated, the median survival time (MST) of the patients with brain metastases is approximately 1 month. Moreover, stereotactic radiosurgery (SRS) to well defined small intracranial targets with a very sharp peripheral dose falloff and resulting in minimal exposure of normal surrounding brain, has had a big impact on control of brain metastases (BM) and patient survival. However, the use of radiosurgery for patients with brain metastases has been associated with higher rates of distant failure. This phenomenon has been especially problematic in NSCLC, where available systemic therapies have insufficient intracranial activity to counter the biologically high predilection of NSCLC for metastatic seeding of the brain. Multiple *in vitro* and *in vivo* models and a phase I/II trial have demonstrated promising data when TTF was applied in NSCLC. The efficacy of TTF in brain metastasis of NSCLC will be investigated by the METIS trial.

Results: 270 patients with 1-10 (BM) from NSCLC will be randomized in a ratio of 1:1 to receive stereotactic radio surgery (SRS) followed by either TTFields or supportive care alone. Patients are followed-up every two months until second cerebral progression. Patients in the control arm may cross over to receive TTFields at the time of progression. The objective of the METIS trial is to test the efficacy, safety and neurocognitive outcomes of TTFields in this patient population. Continuous TTFields at 150 kHz will be applied to the brain within 7 days of SRS. The treatment system is a portable medical device allowing normal daily life activities. Patients will receive the best standard of care for their systemic disease. The trial is designed to detect an increase in the time to cerebral progression from 7.7 to 13.4 months (hr 0.57) with 80% power at a 2-sided alpha of 0.05. The sample size was calculated using a log-rank with the competing risk taken as loss to follow up. Patients will be censored at time of death if it occurs prior to cerebral progression or neurological death. Primary endpoint is the time to cerebral progression, whereas the time to neurocognitive failure; overall survival; radiological response rate; quality of life; adverse events severity and frequency are secondary endpoints.

Summary: Antimitotic treatment with TTFields has shown efficacy in solid tumors, and needs to be evaluated in a prospective phase III trial in brain metastasis.

Risk factors for local in-brain progression after resection of cerebral metastases

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Objective: Surgical treatment of cerebral metastases aims to achieve a long-lasting local control with a low morbidity. However, local recurrence occurs in up to 50 – 70% of surgically treated metastases, if not combined with an adjuvant radiation therapy. We aimed to identify risk factors of local brain-progression after surgical metastases resection.

Methods: Two hundred thirteen patients operated on in a seven-year period with cerebral metastases of a carcinoma or melanoma, were retrospectively studied. Occurrence of local in-brain-progression was correlated with primary tumor entity, histopathological subtype, radiological features, adjuvant therapy and degree of surgical resection as assessed by an early post-operative MRI < 72h after surgery.

Results: From the two hundred thirteen patients evaluated, 106 were females. Median age was 63 years. Mean preoperative Karnofsky score was 90%. Most common primary tumors were non-small cell lung cancer (43.2%), melanoma (11.7%), gastrointestinal (11.7%), breast cancer (10.3%). From the histopathological point of view, most patients suffered from adenocarcinoma (68.5%), followed by malignant melanoma (11.7%), small-cell carcinoma (7.5%). A total of 51 (23.9%) patients developed a local recurrence. Univariate analysis showed, that detection of residual tumor in early postoperative MRI (<72hr) was the only risk factor for development of a local in-brain progression ($\chi^2=19.4739 > \chi_{crit}^2=5.991$; $p<0.05$; Chi Square). In contrast, primary tumor, histological type, type of resection, dural involvement, cystic tumor or location were not significant factors for a local in-brain recurrence. Mean local progression free-survival was 9 months (0-74m). Mean follow-up was 12-months.

Conclusion: Our study indicates that detection of residual tumor in an early postoperative MRI < 72h was the only significant risk factor for local in-brain progression of cerebral metastases. Therefore, postoperative MRI < 72h might identify patients at risk for a local in-brain progression and enable a specific therapy of the tumor rest. Further studies are needed in order to evaluate the oncological impact.

MO.04 Hydrozephalus 1

Montag *Monday*, 15.05.2017, 08.00 – 09.00 Uhr *hrs*

- MO.04.01 *The etiology of hydrocephalus is a risk factor for shunt infection*
M. Hohenhaus* (Freiburg, Deutschland), M. Brühl, D. Heiland, M. Shah
-
- MO.04.02 *Detection of the flow of cerebrospinal fluid in ventricular shunt systems using phase-contrast MRI*
R. König* (Magdeburg, Deutschland), D. Stucht, S. Baecke, M. Rashidi, R. Firsching, M. Luchtman
-
- MO.04.03 *Long term follow-up of repeat endoscopic third ventriculostomy in obstructive hydrocephalus*
J. Rediker* (Homburg, Deutschland), S. Vulcu, L. Eickele, W. Wagner, J. Oertel
-
- MO.04.04 *The Miethke Sensor Reservoir for optimization of shunt therapy*
S. Antes* (Homburg/Saar, Deutschland), D. Breuskin, S. Linsler, S. Müller, A. Stadie, J. Oertel
-
- MO.04.05 *Normal pressure hydrocephalus: a single-center experience with 80 patients*
P. Schödel* (Regensburg, Deutschland), K. Kiene, E. Bründl, F. Zeman, A. Brawanski, K. Schebesch
-
- MO.04.06 *A standardized outpatient ICP monitoring using the standing-supine-sitting-paradigm in clinical practice*
S. Müller* (Göttingen, Deutschland), C. von der Brelie, F. Freimann, V. Rohde, B. Schatlo
-

The etiology of hydrocephalus is a risk factor for shunt infection

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Objective: The etiology of hydrocephalus is heterogeneous, whereas the idiopathic normal pressure hydrocephalus (50%), posthemorrhagic (23%) and posttraumatic hydrocephalus (12.5%) are most common. The treatment of choice is the implantation of a ventriculoperitoneal shunt system. Shunt infections are the second most common complications after mechanical dysfunctions and are described in between 2 to 41%. The morbidity in affected patients is highly increased because of the primary infection and the associated surgical revisions. Some risk factors were described for pediatric patients, as previous CSF infections or a younger age, whereas the knowledge of those risk factors in adult hydrocephalus patients is rare. The study aimed to evaluate adult patients with implanted shunt systems concerning the incidence of shunt infections compared to the current literature and to analyze associated risk factors, especially the impact of the underlying hydrocephalus entity.

Methods: We retrospectively analyzed all adult patients who underwent implantation of continuous CSF drainage in our department between March 2010 and May 2014 concerning shunt infections. We calculated the risk of developing an infection in a regression analysis for the different hydrocephalus etiologies. The relative risk of shunt infection was analyzed by an univariate and multivariate regression model. Subgroups were characterized by different hydrocephalus entities based on their origin diagnosis. The alpha-level was determined on 5% to achieve statistical significance with a power of 0.9.

Results: Overall 510 adult patients underwent shunt implantation within the mentioned time period with a median age of 69 years and a range from 18 to 92 years. Therefore 273 patients were male. The idiopathic normal pressure hydrocephalus (n=137) and patients after intracranial tumor surgery (n=113) built the largest populations followed by patients suffered from traumatic brain injury (n=58), intracerebral hematoma (n=80), subarachnoid bleeding (n=81) and other entities (n=41) like aqueduct stenosis or meningitis. Shunt infections with required surgical revisions occurred in 45 (8.8%) of all patients. Concerning the different hydrocephalus entities, patients who underwent shunt implantation after tumor resection showed a significant lower risk for shunt infections (OR 0.3; CI 0.1-0.7; p<0.05), whereas patients suffered from a subarachnoid hemorrhage showed a significant higher risk (2.5; CI 1.3-4.9; p<0.05).

Conclusion: The risk of symptomatic shunt infections seems to be in relation to the underlying hydrocephalus entity, whereas patients after intracranial tumor resection show a reduced number of infections and patients suffered from a subarachnoid hemorrhage have a significantly higher risk.

Detection of the flow of cerebrospinal fluid in ventricular shunt systems using phase-contrast MRI

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Objective: The evaluation of a suspected malfunction of a ventricular shunt is one of the most common procedures in neurosurgery. In practice, the evaluation rely either on the interpretation of the ventricular width using static radiographic images (e.g. cranial CT or MRI) or on invasive techniques (e.g. surgical revision or radionuclide study). During the last decades several attempts have been made to measure the flow velocity of the cerebrospinal fluid (CSF) utilizing different MRI techniques. Particularly the signal to noise ratio of the evaluated 1,5 Tesla MRI scanners and the increasing number of adjustable, magnet containing valves are limiting a more common use. In the present study we evaluated the value of 3-Tesla MRI scanners for the determination of the low flow in ventricular shunt systems.

Methods: All MR-imaging procedures were conducted using a Siemens Prisma scanner with 3-Tesla magnet field strength. The flow was measured with phase-contrast-sequences that were modified to work properly in the expected range of flow rates. As a first step, an MRI-phantom of the brain consisting of a mixture of fatty acids to mimic a brain was used to measure the phase-contrasts at different constant flow rates. The next step was to measure the CSF flow in patients treated with ventricular shunts who were at the time point of the measurement in clinical stable setting without any suspects of a malfunction of the observed shunt.

Results: The phase-contrasts of the phantom showed a linear correlation between the CSF flow and the depending signal intensities. Under these ideal conditions flow rates down to 0,5 ml per hour are reliably quantifiable. First measurements of the flow in patients with shunted hydrocephalus confirm these results. Despite a lot of artifacts due to the valve flow signals of the shunts were measurable within the parenchymal portion of the shunt in all patients. However, the signal intensities of the phase-contrast MR images depend on the underlying cause of hydrocephalus. Thus, the flow rate was always detectable in patients with obstructive hydrocephalus while in patients with normal pressure hydrocephalus the detected signal intensities were close to the limit of measuring.

Conclusion: CSF flow detected within the parenchymal portion of the shunt by phase-contrast MRI may reliably provide information about the flow rate of the ventricular shunt. Even in patients whose hydrocephalus were treated with adjustable valves the CSF flow is detectable using 3-Tesla phase-contrast MRI sequences.

Long term follow-up of repeat endoscopic third ventriculostomy in obstructive hydrocephalus

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Objective: Endoscopic third ventriculostomy (ETV) for obstructive hydrocephalus provides excellent outcome. Nevertheless, repeat ETV in cases of ETV failure is under controversial discussion.

Methods: Between 1993 and 1999, 113 patients with obstructive hydrocephalus underwent a total of 126 ETVs at the Department of Neurosurgery, Mainz University Hospital. A very long-term follow-up of up to 14 years could be achieved. All medical reports of patients who received ETV were reviewed and analyzed retrospectively with focus on ETV failure with following repeat ETV and its initial as well as very long term success.

Results: Of 31 patients with failure of initial ETV, 13 patients underwent repeat ETV: 3 patients during the first 3 months (early repeat ETV), the other 10 patients after 7 to 78 months (late repeat ETV, mean 33 months). All repeat ETVs were performed without complications. Follow-up evaluation after repeat ETV ranged from < 1 month up to 14 years (mean 7 years). Of the three early revisions, two ETV failed and one other patient died during follow-up while only two of the late repeat ETV failed. Very long term success rate of late repeat ETV up to 14 years yielded 80%.

Conclusion: Repeat ETV in cases of late ETV failures represents an excellent treatment option for CSF circulation restoration up to 14 years of follow-up. Repeat ETV in early ETV failure in contrast is disappointing; and factors of ETV failure should be analysed very carefully before a decision for repeat ETV is made.

The Miethke Sensor Reservoir for optimization of shunt therapy

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Objective: Shunt treated patients frequently present with misleading and complex symptoms. Clinical examination and imaging do often not lead to satisfactory results and consecutive valve adjustments even aggravate the situation. Experiences in the past could clearly demonstrate benefits of telemetric ICP devices for such challenging cases. In this series, a new telemetric device to individually adjust shunt valves according to the current ICP was evaluated.

Methods: Between December 2015 and November 2016, 26 patients underwent implantation of the Sensor Reservoir. An initial ICP measurement to confirm the diagnosis was performed in each case. Thereafter, multiple measurements and valve adjustments under ICP control followed.

Results: Initial telemetric measurements revealed shunt overdrainage in 18, underdrainage in 4, suboptimal valve settings in 3, and normal ICP values in one case. In all 26 patients, a total of 174 measurements and 67 valve adjustments were performed. This corresponds to a rate of 6.7 measurements, respectively 2.6 valve adjustments per patient. These efforts led to a clear clinical improvement in almost 70% of the patients. Complications occurred in 4 patients including wound healing disorder (2/4), shunt infection (1/4), and technical failure of the device (1/4).

Conclusion: The first clinical results are promising. The possibility to simultaneously recognize and resolve shunt related problems is the decisive advantage. However, improvements of the system are necessary.

Normal pressure hydrocephalus: a single-center experience with 80 patients

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Objective: This study was conducted to evaluate the short-term clinical course and possible complications of shunting procedures in patients with normal pressure hydrocephalus (NPH).

Methods: 629 patients were screened who presented with hydrocephalus during the ten years interval between 2002 and 2012 and 80 patients (male 47, female 33; mean age 71.1 years) with NPH were included in the study. We reviewed the charts for the utilized hardware, neurological performance pre- and postoperatively according to the Medical Research Council Neurological Performance Score (MRC-NPS), re-operations and valve-adjustments in short-term course, and any shunt-associated complications.

Results: Codman-Hakim-Valves were implanted most frequently (51 pts., 63.7%), followed by Pro-GAV (15 pts., 18.8%) and Delta (14 pts., 17.5%). The initially most frequently used valve opening pressure was 120mmH₂O (45 pts., 56.3%), an adjustment of the valve opening pressure at discharge had to be taken in 6 pts. (7.5%). According to the MRC-NPS, a neurological improvement was registered in 65.0%, no improvement was found in 31.1% and permanent neurological deterioration was registered in 2.5%. During the follow-up, 32.5% of all patients required revision due to malpositioning of the catheters (15.0%), mechanical dysfunction (10.0%) and infection (7.5%). The overall mortality was 0%. The revision rate was highest in implanted Delta-Valves (50.0%), followed by Codman-Hakim (31.4%) and Pro-GAV (20.0%). Infection rates didn't differ between the different valve types.

Conclusion: This study reflects a typical cohort of patients with normal pressure hydrocephalus and presents neurological outcome and complications of the surgical procedure.

A standardized outpatient ICP monitoring using the standing-supine-sitting-paradigm in clinical practice

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Objective: A minority of patients with ventriculoperitoneal shunts suffer from symptoms of positional over- or underdrainage. Fine-tuning shunt settings despite programmable valves and gravitational assistance can be difficult. The introduction of telemetric intracranial pressure (ICP) recordings has allowed us to improve shunt therapy in this subgroup of patients. In order to standardize ICP measurement conditions, we devised a simple and repeatable manoeuvre for outpatient telemetric ICP recording and assessed test-retest reliability and clinical utility.

Methods: The standing-supine-sitting-paradigm requires postural changes in 10-minute intervals over 30 minutes. All ICP measurements (Neurovent-P-tel system, Raumedic) were analyzed using a dedicated freeware tool. Valve adjustments and their clinical impact were assessed. The test re-test reliability was assessed by consecutive measurements without shunt adjustments.

Results: Overall test re-test reliability was excellent (Pearson's correlation coefficient 0.95, $p < 0.001$). We evaluated 165 ICP measurements in 18 patients with a mean age of 36 years (range 25-65). Clinical intracranial hypotension in 21 measurements was associated with a mean ICP of (standing) -12.5 ± 6.5 mmHg, (supine) 4.3 ± 6.5 mmHg and (sitting) -11.5 ± 7.1 mmHg. In patients with moderate symptoms, measurements revealed a standing pressure of -6.4 ± 4.6 mmHg, supine pressure of 10.5 ± 4.4 mmHg and a sitting pressure of -4.8 ± 2.6 mmHg. In patients with assumed intracranial hypertension, 20 measurements were performed and revealed a mean ICP of 1.7 ± 6.4 mmHg in the standing, 15.6 ± 5.1 mmHg in the supine and -0.9 ± 6.0 mmHg in the sitting position. Twenty-nine shunt valve adjustments resulted from these measurements and led to improvement in clinical symptoms in 19 cases (65%) after valve adjustment.

Conclusion: We confirmed the test-retest reliability of the "stand-supine-sit"-paradigm. The interpretation of ICP values in this highly selected patient cohort poses a formidable challenge even on the individual level. Generalizations obtained from this pooled dataset are difficult. However, we obtained modest symptom improvement based on measurements in about two thirds of patients based on our recordings.

MO.05 Joint Meeting Session 1 – Vascular Neurosurgery

Montag Monday, 15.05.2017, 08.00 – 09.20 Uhr hrs

MO.05.01	<i>Keynote lecture - Timing of aneurysm surgery</i> Richard Kerr (London, United Kingdom)
MO.05.02	<i>Keynote lecture - Is aggressive treatment of vasospasm worthwhile?</i> Gerrit Schubert (Aachen, Deutschland)
MO.05.03	<i>Encephaloduroarteriosynangiosis (EDAS) in the management of Moyamoya syndrome in sickle cell disease</i> A. Alamri* (London, United Kingdom), P. Hever, J. Cheserem, C. Gradil, S. Bassi, C. Tolias
MO.05.04	<i>Does multidisciplinary treatment of ruptured cerebral aneurysms with significant surgical contribution offer better outcomes? A single centre experience</i> C. Gradil* (London, United Kingdom), P. Birkeland, J. Ling, M. de Abreu, R. deSouza, D. Walsh, C. Tolias
MO.05.05	<i>Diagnostic pitfalls of vascular malformations within the craniocervical junction</i> J. Kohl* (Magdeburg, Deutschland), R. Firsching, M. Skalej
MO.05.06	<i>Correlating severity of Moyamoya Disease on cerebral angiography and MRI with H2150-PET</i> C. Roder* (Tübingen, Deutschland), F. Ebner, A. Buck, P. Meyer, U. Ernemann, M. Tatagiba, N. Khan
MO.05.07	<i>Long-term results of endovascular treatment of intracranial aneurysms</i> K. Leber* (Graz, Austria), G. Maderbacher, S. Leber, V. Gellner, M. Wehrschütz, G. Klein
MO.05.08	<i>Safety and Efficacy of Surgical and Endovascular Treatment for Distal Anterior Cerebral Artery Aneurysms: a Systematic Review and Meta-analysis</i> O. Petr* (Innsbruck, Austria), L. Coufalová, O. Bradáč, B. Glodny, V. Beneš, R. Rehwald

Encephaloduroarteriosynangiosis (EDAS) in the management of Moyamoya syndrome in sickle cell disease

Alexander Alamri¹, PennyLouise Hever¹, Jebet Cheserem¹, Catia Gradil¹, Sanj Bassi¹, Christos M. Tolias¹

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Objectives: Encephalo-duro-arterio-synangiosis (EDAS) for treatment of Moyamoya syndrome (MMS) has been well described in the literature, however in MMS caused by sickle cell anaemia (SCA), EDAS use remains controversial with poor long-term follow-up. We present a case-series of such SCA patients who have undergone EDAS and describe their clinical, radiographic and psycho-social outcomes.

Methods: A retrospective review of all the paediatric EDAS procedures conducted in our Institution for SCA from 2007 to 2015 and post-operative Strengths and Difficulties Questionnaires (SDQ) were undertaken by two of the patients.

Results: A total of eight patients with MMS secondary to SCA underwent EDAS. The mean age at the time of surgery was 13 years (range 8 to 17). Unilateral EDAS was performed without complication in seven patients. One patient underwent bilateral EDAS but with a two-year gap in between procedures. Follow-up magnetic resonance angiography demonstrated no progression of Moyamoya collaterals or further ischaemic events with regression of collaterals clearly visible in one patient. Both patients undertaking SDQs showed maintenance of their pre-operative baseline in terms of psycho-social functioning. All patients have demonstrated a return to normal school activities.

Conclusions: EDAS is a well-tolerated revascularisation procedure for children with MMS. The prevention of further infarcts in our group with sickle cell disease has allowed these children to resume normal school activities.

Does multidisciplinary treatment of ruptured cerebral aneurysms with significant surgical contribution offer better outcomes? A single centre experience

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Objective: In 2007 we published the early post ISAT neurovascular experience of our unit. Since then, the management of intracranial aneurysms has evolved as individual neurosurgical centres adopt different multidisciplinary approaches in the management of these complex patients. The role of open surgery remains debatable and evolving. We hypothesize that overall recurrence rates of treated aneurysms in our unit to be favoured by the relative contribution of the significant number of surgically managed cases.

Methods: In this retrospective observational study we analyse the demographics of patients with ruptured brain aneurysms admitted to King's College Hospital between January 2007 and December 2013. Data include WFNS and Fisher grading of SAH, time elapsed from ictus to admission and from admission to treatment, location and size of aneurysm, treatment modalities as well as recurrence and rebleed rates.

Results: Overall, 693 consecutive cases of SAH were admitted. For all patients management followed a multidisciplinary decision process. Majority of cases were WFNS grades I and II SAH following rupture of anterior circulation aneurysms ranging 2mm to 48mm in size. Of the 177 cases in which open surgery was performed, the majority entailed clipping, and less frequently bypass reconstructive surgery for complex aneurysms. The endovascular group consisted of 471 cases and 45 cases needed more than one treatment modality.

Our outcomes were amongst the best in the country (30-day mortality), with 6 month GOS not different from the average (NNAP and UK National SAH database). However, the overall population recurrence and retreatment rates were less than expected. The recurrence rate was found to be greater amongst patients within the endovascular treatment subgroup.

Conclusions: We conclude that a multidisciplinary decision process, offering a full complement of endovascular and neurosurgical expertise for the treatment of intracranial aneurysms, as well as a close follow-up, are determinant factors in achieving the best possible outcomes. Such approach appears to continue to recognize surgical treatment as a competitive modality in achieving good and lasting results.

Diagnostic pitfalls of vascular malformations within the craniocervical junction

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Objective: Vascular malformations within the foramen magnum and upper cervical canal are rare. Diagnosis is cumbersome and neurosurgical treatment is hazardous. We report on 6 cases.

Methods: Age ranged from 37 to 77 years, 4 male and 2 female patients. Diagnosis at the time of referral included "normal pressure hydrocephalus" (one case), "subarachnoid haemorrhage" (two cases), "spinal stenosis" (two cases) or "myelitis". Imaging techniques included magnetic resonance (MR) imaging, MR angiography and highly selective segmental cervical angiography with microcatheters. Surgery was performed with electroneurophysiological monitoring.

Results: Angiography revealed three arteriovenous fistulae within the foramen magnum, a giant vertebral artery aneurysm within the foramen magnum and two patients with an intradural arteriovenous malformation at the C2 level.

The fistulae and the aneurysm were occluded using microclips. The edema of the cervical myelon of the patients with the fistulae resolved with marked recovery of gait. The hydrocephalus of the patient with the giant vertebral aneurysm also resolved with good recovery.

The arteriovenous malformations at the C2 level were coagulated. One of these patients subsequently needed a ventriculoperitoneal shunt. The other suffered some transient weakness of the ipsilateral arm..

Conclusion: In all patients suspicion of a vascular malformation was raised after an initially misleading diagnosis. The decisive hint came from scrupulous evaluation of MR imaging data but diagnosis was only confirmed with selective arteriography. For proper identification of the malformation and planning of the surgical procedure a highly selective segmental spinal arteriography appears mandatory.

Correlating severity of Moyamoya Disease on cerebral angiography and MRI with H2150-PET

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Objective: Moyamoya angiopathy is a stenooclusive disease with a progressive spontaneous occlusion of the circle of Willis resulting commonly in ischemic strokes. While conventional cerebral angiography and MRI is a standard in the diagnostic cascade of most treatment centers, functional imaging such as H2150-Positron emission tomography (PET) with acetazolamide challenge is not used routinely. We evaluated the correlation of severity of moyamoya disease on cerebral angiography and MRI with H2150-PET (Baseline and acetazolamide challenge) in the evaluation of surgical indication and planning.

Methods: We analyzed imaging data of adult Moyamoya patients who underwent treatment in our center between 2013-2016. All patients with a complete diagnostic imaging data set (MRI, 6-vessel cerebral angiography, H2150-PET with acetazolamide challenge) before a possible surgical intervention were included. Patients were anonymized and each imaging modality was analyzed separately by a single physician blinded to their identity using a scoring system for severity of disease in each hemisphere and arterial territory. MRI scoring included cortical, subcortical and watershed strokes; stenosis/occlusion of each major artery as well as the presence/absence of collaterals were scored on angiography; and a scoring of the baseline cerebral perfusion and reactivity to acetazolamide was used for H2150-PET. The scores of the three diagnostic imaging were then correlated.

Results: Twenty one adult patients (18 with bilateral Moyamoya disease, 3 with unilateral Moyamoya angiopathy) with 39 affected hemispheres were studied. PET and angiography correlated well in 31/39 (79%) hemispheres, but not in 8/39 (21%). In patients with good collateralization from deep MM collaterals and/or the PCA or ACA into the ACA and/or MCA territory, sufficient acetazolamide reactivity was seen in PET in 5/27 (19%), in patients with partial collateralization in 4/20 (20%) vascular territories. In case of absent collateralization on angiography, acetazolamide reactivity was sufficient in 12/37 (32%) vascular territories. There was no correlation between MRI and reserve capacity in PET.

Conclusion: Our analysis demonstrates that functional perfusion imaging should be obligatory in the treatment of patients with Moyamoya. Absence of functional perfusion imaging such as H2150-PET might lead to wrong treatment decisions in 21% of all hemispheres with stenosis/occlusion present on angiography. Visualizing angiographic collateralization alone might give an incorrect impression on the true perfusion reserves in 89% of all territories. The results show that treatment decision should not be based on the results of angiography and MRI alone.

long-term results of endovascular treatment of intracranial aneurysms

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Objective: Mid-term results of endovascular treatment of intracranial aneurysms yielded promising results. Our study focuses on the long-term results in terms of efficiency, recurrence rates and overall complications over more than a decade.

Methods: We included 131 patients with intracranial aneurysms (74 with ruptured and 57 with unruptured aneurysms). In total, 159 aneurysms were treated by endovascular coiling during a period from 1992 to 1999. Endpoints according to treatment related morbidity and mortality (Glasgow Outcome Scale, modified Rankin Scale) were recorded as well as radiological data according to occlusion rates could be obtained after a mean follow-up of twelve years.

Results: Treatment related mortality was found in 5.3% (7/131), four of these patients had a ruptured aneurysm. Treatment related morbidity was 9.2% (11/131) in patients with unruptured and 12.9% (17/131) with ruptured aneurysms, respectively. A primary total occlusion of the lesion could be achieved in 66% (105/159). In 46.7% (49/105) of the aneurysms a recurrence was noted on average after 3.8 years. Consequences of recurrent aneurysms were further embolization (44.9%), clipping (8.7%) and close observation (46.4%). Recurrences were more often detected in large aneurysms ($p < 0.05$). Re-recurrences were seen in 70% (14/20) after a successful re-treatment.

Conclusion: Long-term stability of endovascular coiling seems not to be as guaranteed as of microsurgical clipping. Especially, large aneurysms need to be observed meticulously for the long run. It seems to be evident that the additional use of stents and/or flow-diverters will help to lower the recurrence rates in the endovascular field. The actual mortality rate in this series reflects to the fact that initially poor grade patients were treated rather by endovascular methods at times.

Safety and Efficacy of Surgical and Endovascular Treatment for Distal Anterior Cerebral Artery Aneurysms: a Systematic Review and Meta-analysis

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Objective: Aneurysms of the distal anterior cerebral artery (DACA) are rare, representing between 1% and 9% of all intracranial aneurysms. The best treatment strategy for these aneurysms continue to be debated.

We conducted a systematic review of the literature to evaluate the safety and efficacy of treatment strategies of DACA-aneurysms.

Methods: A systematic search of Medline, EMBASE, Scopus and Web of Science was done for studies published from 01/2000 to 08/2015. We included studies describing treatment of DACA-aneurysms with ≥ 10 patients. Random-effects meta-analysis was used to pool the following outcomes: complete occlusion, technical success, periprocedural morbidity/mortality and stroke rates, aneurysm recurrence/rebleed, and long-term neurological morbidity/mortality.

Results: 30 studies with 1329 DACA-aneurysms were included. Complete occlusion was 95% (95%CI=91.0%-97.0%) in the surgical group and 68% 95%CI=56.0%-78.0%) in the endovascular group ($P<0.0001$).

Aneurysm recurrence occurred in 3% (95%CI=2.0%-4.0%) after surgery and in 19.1% (95%CI=12.0%-27.0%) after endovascular treatment ($P<0.0001$). Overall neurological morbidity and mortality were 15% (95%CI=11.0%-21.0%) and 9% (95%CI=7.0%-11.0%) after surgery and 14% (95%CI=10.0%-19.0%) ($P=0.725$) and 7% (95%CI=5.0%-10.0%) ($P=0.422$) after endovascular treatment, respectively. Overall long-term favorable neurological outcome was 80% and was equal in both groups (80%; 95%CI=73.0%-85.0% in the surgical group and 80%; 95%CI=72.0%-87.0% in the endovascular group) ($P=0.892$).

Conclusion: Our meta-analysis demonstrated that both treatment modalities are technically feasible and effective with sufficient long-term aneurysm occlusion and acceptable recurrence/rebleed rates. Surgical treatment is associated with superior angiographic outcomes including significantly lower postoperative aneurysm rebleed rates. There were no substantial differences in procedure-related morbidity and mortality. These findings should be considered when deciding the best therapeutic strategy for treatment of DACA-aneurysms. However, the final decision-making should be performed on a selective, case-by-case basis in order to maximize patient benefits and limit the risk of periprocedural complications.

MO.06 Funktionelle Neurochirurgie 1

Montag *Monday*, 15.05.2017, 08.00 – 09.00 Uhr *hrs*

- MO.06.01 *Keynote Lecture - Fasertraktographisch assistierte THS*
Volker Arnd Coenen (Freiburg, Deutschland)
-
- MO.06.02 *Fibertracking in Deep Brain Stimulation: Comparing two sets of regions of interest to delineate cerebellar thalamic fibers*
J. Anthofer* (Regensburg, Deutschland), F. Rupert, M. Lange, A. Brawanski, J. Schlaier
-
- MO.06.03 *Graphical analysis of lead position in regard to outcome for Nucleus accumbens/anterior limb of internal capsule (Nacc/ALIC) deep brain stimulation (DBS) in obsessive compulsive disorder (OCD)*
M. Klehr* (Köln, Deutschland), D. Huys, M. Ryzhkov, R. Nijlunsing, V. Visser-Vandewalle
-
- MO.06.04 *Improving Parkinsonism in DBS Poor-Responders by Surgical Lead Revision of Subthalamic Electrodes*
R. Nickl* (Würzburg, Deutschland), R. Martin, F. Patrick, E. Ralf-Ingo, V. Jens, M. Cordula
-
- MO.06.05 *Interim Analysis of 12 Cases With Peripheral Nerve Field Stimulation (PNFS) for Chronic Lumbar Pain and the Predictive Value of Transcutaneous Electrical Nerve Stimulation (TENS) for Patient Selection*
F. Schwarm* (Gießen, Deutschland), M. Ott, M. Stein, M. Reinges, E. Uhl, M. Kolodziej
-

Fibertracking in Deep Brain Stimulation: Comparing two sets of regions of interest to delineate cerebellar thalamic fibers

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Objective: The thesis of targeting fiber tracts rather than nuclei in deep brain stimulation (DBS) has been discussed for many years now. MRI based diffusion tractography seems to be a thrilling, non invasive tool to depict the fiber tracts of interest and to improve target planning. Here, we present and compare two different methods of tracing cerebellar- thalamic connections and try to validate the methods' anatomic accuracy.

Methods: Data of 6 patients who have received DBS in our center were analyzed. As part of the preoperative MR-imaging, diffusion weighted images (DWI) with 12 and 64 read out directions were performed. On these image data sets, we performed deterministic fiber tracking (iPlan Stereotaxy software, Brainlab) and probabilistic fiber tracking (FSL software) placing the regions of interest (ROI) in the contralateral dentate nucleus, superior cerebellar peduncle and ipsilateral red nucleus (dentate-rubro-thalamic-tract, DRTT). For further comparison, we performed deterministic fiber tracking (12 and 64 read out directions) of the cortico-thalamic-cerebellar-tract, CTC, with ROIs set in the ipsilateral red nucleus and primary motor cortex. We compared the tracts' center of mass and the tracts' closest distance to the atlas based VIM target-point.

Results: The deterministic algorithm could not depict the DRTT in data sets with 64 read out directions in ten of twelve hemispheres. The depiction of the CTC was successful in all hemispheres, with deterministic tractography. Probabilistic tractography presented a robust delineation of the DRTT in all hemispheres. The distance from the atlas based VIM target to the center of mass of the CTC compared to the DRTT was significantly shorter ($p=0.02$) when tracked deterministically with 12 read out directions.

Conclusion: The detection of the CTC with deterministic fibertracking is more robust than the detection of the DRTT especially when DWIs with higher numbers of gradient directions are used. Noteworthy, the courses of CTC and DRTT are not congruent.

Graphical analysis of lead position in regard to outcome for Nucleus accumbens/ anterior limb of internal capsule (Nacc/ALIC) deep brain stimulation (DBS) in obsessive compulsive disorder (OCD)

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Objective: OCD is a sometimes debilitating psychiatric disease with a 2% lifetime prevalence. Up to 10% of patients do not respond to conservative treatment. For severe cases, DBS targeting the Nacc/ALIC is a viable option, receiving CE-mark in 2009. However, because of variable success rates and side effects, 8 different targets have been proposed for OCD in the last 18 years - the search for a hotspot continues.

In this study, using a novel visualization software, we correlated lead position and resulting volume of tissue activated (VTA) with clinical outcome and side effects in order to narrow down the optimal target area.

Methods: We analyzed data for 16 consecutive patients treated at our center over a period of 3 years with DBS of the Nacc/ALIC following a routine targeting procedure. Based on improvement on the Yale-Brown obsessive compulsive scale (YBOCS) and clinical profit at 12 months follow up, four outcome groups were defined. Subgroups were also designated for unexpected side effects.

Individual regions of interest (ROI) from all patient hemispheres were stacked to create a median intensity image, and then registered to the resulting intermediate to create a common anatomical space (patient average MRI, PAM). Using the Suretune Expert Tuning Tool software (Medtronic), the location of the individual contacts used and the resulting VTA were aggregated into the PAM and probabilistic stimulation maps (PSM) were calculated. The adapting Yelnik-Bardinet atlas was aligned to the PAM as an anatomical reference.

Results: The graphical analysis indicates anatomical localization to be correlating with both clinical outcome as well as side-effects. PSM of non- and fair responders were revealed to be distinct from - but nearby to - the PSM of good and excellent responders. All patients reporting unwanted weight-gain had their active contacts clustering in a circumscribed area, independent of their improvement in OCD. These patients are followed up with a multidisciplinary approach to further elucidate the underlying mechanism.

Conclusion: While data and analysis is preliminary, this novel tool shows promise for correlation of lead location and clinical effect in the way that PSM suggest an area of best benefit. The results also open the way for further research into the insufficiently understood side effect of weight gain through DBS in OCD.

Improving Parkinsonism in DBS Poor-Responders by Surgical Lead Revision of Subthalamic Electrodes

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Objective: STN-DBS is a well-established treatment for motor complications in Parkinson's disease (PD). The average improvement of motor symptoms amounts to 50-70%. In this respect the dorsolateral aspect of the subthalamic nucleus is considered as optimal target for stimulation. If subthalamic deep brain stimulation (STN-DBS) results in poor symptom control or adverse side effects at low stimulation threshold surgical lead revision for optimal placement must be discussed as a treatment option

Methods: 9 subjects with PD (Øage 63.7 Hoehn&Yahr St. Ø3.0) were investigated for electrode revision due to **poor clinical** benefit (reduction of 14.9 points in UPDRS III (= **33.8% motor benefit**) or unacceptable adverse effects. Surgical revision was considered if the primary electrodes were placed outside the dorsolateral aspect of the STN (>2mm) using MRI-CT analysis (SureTune & Elekta). Surgical techniques included explantation and reimplantation in two or one sessions or leaving initial leads in place if they had some clinical benefit.

Results: 15 electrodes were revised (6 bilateral, 3 unilateral). Main clinical indication were inadequate improvement with persistent rigidity, fluctuations and freezing (5 patients) and unbearable stimulation side effects (e.g. dysarthrophonia, ataxia, hypomania, hypersexuality). Mean **vector distance** between best active contacts pre-/postrevision was **4.28mm** (range 8.4 – 1.6mm). The mean UPDRS-III improvement **after revision** Stim-On/Meds-Off were **additional 17.7 points** compared to the Stim-On/Meds-Off state before electrode revision (range 28 - 12, p-value 0.001). Resulting **overall improvement** of motor symptoms after lead revision by **41,6 points (67 %)**. Adverse effects of stimulation improved markedly especially hypomania and speech disturbances.

Conclusion: Unsatisfactory stimulation outcome or low-threshold adverse effects of STN-DBS can indicate unfavourable electrode position(s). If malpositioning is confirmed by MRI or MRI-CT-fusion an electrode revision may be a promising procedure according to this case series. Our findings suggest that a **lead replacement aiming at the dorsolateral part of the STN is improving motor symptoms in STN-DBS poor-responders**. The ideal surgical technique, single or two steps is depending on the patients' clinical needs and on surgical aspects such as primary trajectories and ideal target accessibility.

Interim Analysis of 12 Cases With Peripheral Nerve Field Stimulation (PNFS) for Chronic Lumbar Pain and the Predictive Value of Transcutaneous Electrical Nerve Stimulation (TENS) for Patient Selection

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Objective: Peripheral nerve field stimulation (PNFS) is an effective alternative treatment option for patients if conventional therapy does not provide adequate relief of intractable chronic low back pain. Physical therapy with transcutaneous electrical nerve stimulation (TENS) is known for its easy application and thus frequently used in the multimodal pain therapy concept. The aim of this prospective study was to examine TENS use and its impact for later successful PNFS in a follow up of 3 months.

Methods: Between 2014 and 2016 a prospective cohort study of 12 patients with chronic lumbar pain was conducted. All patients were treated with multiple pain medications. Pain intensity (NRS), activity level and health-related quality of life (SF12v2 score), and Oswestry Disability Index (ODI) were assessed before and after TENS use, pre- and postoperatively as well as 3 months after neuromodulative treatment. TENS was applied for 3-5 days. The implantation of a rechargeable PNFS-system with 2 percutaneous leads was performed after 4-7 days of positive testing. Statistical analysis was performed using the Mann-Whitney U and the Wilcoxon rank-sum test.

Results: The cohort consisted of 12 patients (5 females, 7 males) with a median age of 60.3 years (range 50.3-75.4). Overall median numerical rating scale (NRS) preoperatively was 7.5 (range 6-10). Overall median ODI before treatment was 51 (range 26-76). SF12v2 indicated a reduced activity level and lowered quality of life. After positive PNFS testing a neurostimulator was implanted in 4 patients with positive TENS effect and 5 patients with no TENS effect. Three patients had no PNFS effect and the test electrode was explanted. After 3 months median overall NRS was reduced to 3.5 (range 0-9). Overall median ODI improved to 42 (range 14-76). In the TENS positive cohort NRS was reduced from 8 (range 6-9) to 2.5 (range 0-3), ODI from 63 (range 56-68) to 34 (range 14-42). In the TENS negative cohort NRS was reduced from 7 (range 6-10) to 5 (range 3-9). There was no improvement from initial ODI 45 (range 26-76) to 46 (range 26-76) after 3 months. SF12v2 showed a better improvement in the TENS positive cohort. These results showed no statistical significance ($p>0.05$).

Conclusion: This interim analysis shows that PNFS is effective and safe in treating intractable chronic low back pain. TENS seems to have some predictive value for the patient selection in PNFS, as TENS positive patients showed a more effective treatment effect with a greater reduction of NRS, ODI and SF12v2. These preliminary results have to be confirmed in a larger study cohort.

MO.07 Pädiatrische Neurochirurgie 1

Montag *Monday*, 15.05.2017, 08.00 – 09.00 Uhr *hrs*

- MO.07.01 *Safety of concurrent use of intraoperative Monitoring with intraoperative magnetic resonance in children*
S. Dias* (Zürich, Switzerland), J. Sarnthein, M. Neidert, O. Bozinov
-
- MO.07.02 *Intracranial arachnoid cysts in children - own experiences*
E. Januschek* (Offenbach, Deutschland), A. Röhrig, S. Kunze, M. Messing-Jünger
-
- MO.07.03 *Long-term results of endoscopic treatment of arachnoid cysts in children*
C. Vorbau* (Greifswald, Deutschland), S. Fleck, J. Baldauf, H. Schroeder
-
- MO.07.04 *Quality indicators in paediatric neurosurgery: Status quo and future perspectives.*
T. Beez* (Düsseldorf, Deutschland), L. Todd, E. Campbell
-
- MO.07.05 *Vasculopathic brainstem ischemia as presenting symptom of Neurofibromatosis Type 2 in children and young adults*
I. Gugel* (Tübingen, Deutschland), M. Tatagiba, V. Mautner, M. Schuhmann
-
- MO.07.06 *Auditory Brainstem Implantation (ABI) is beneficial in prelingual deaf children*
R. Behr* (Fulda, Deutschland)
-

Safety of concurrent use of intraoperative Monitoring with intraoperative magnetic resonance in children

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Objective: High field intraoperative MRI (ioMRI) has becoming increasingly available in neurosurgery centers. There is little experience when combined with intraoperative neurophysiological neuromonitoring (IONM). We provide a first series of pediatric patients using both systems combined.

Methods: We included all consecutive pediatric cranial procedures operated with intraoperative neuromonitoring and ioMRI combined from October 2013 to April 2016 at our institution.

Results: During a period of 30 months we operated 17 children aged 26 months to 14 years (3 females) with the combined technical addition. A total of 483 needles remained placed during ioMRI. Of the needles, 119 were located on the scalp, 94 above the chest, and 270 below the chest. 2 complications, namely grade I skin burns were reported. In 1 case the MEP-stimulation had to be increased 20 mA and in 2 cases a reduction >50% on the SEP's values were observed.

Conclusion: With the present study we have corroborated the history of relatively safe use for subcutaneous needle electrodes in ioMRI in children as well as the stability of the neuromonitoring records after MRI.

Intracranial arachnoid cysts in children - own experiences

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Objective: Intracranial arachnoid cysts are benign space-occupying lesions, which may be symptomatic with increased size. In a large MR imaging series (11,738 children were included) a prevalence of 2.6% were found with a predominance in males and localization in the temporal fossa on the left. The aim of this study was to analyze all by surgery treated children with intracranial arachnoid cyst regarding size, location, symptoms, revision rates and underlying causes.

Methods: The authors retrospectively evaluated all consecutive patients with intracranial arachnoid cyst treated by surgery between 1/2009 and 12/2015 in a children`s hospital. Children, who were previously operated in another institution were excluded.

Results: In our series 43 children (32 males, 11 females) were included. In 37.2% (n=16) the arachnoid cyst was located in the temporal fossa. The posterior fossa or the suprasellar region were affected in 8 cases each. 5 patients had cysts in the interhemispheric fissure and 2 intraventricular and quadrigeminal cysts. We found as well 1 cyst at the convexity and one with bihemispherical manifestation. In 27 cases, an increase in size could be observed. Most children were conspicuous by macrocephaly (58%) and hydrocephalus, sometimes in combination. Five times clinical signs of an increased intracranial pressure were seen, 2 children show a typical sunset phenomenon. Initially we performed microscopic (19) or endoscopic (17) fenestration, in each three cases a shunt insertion or endoscopic fenestration with shunt insertion and one time an endoscopic fenestration and stent implantation was carried out. In the endoscopic group, 5 secondary shunt implantations became necessary due to insufficient resorption of cerebrospinal fluid, in the microscopic fenestration group 2 shunts. In each group one re-windowing of the openings was required. One cerebrospinal fluid fistula were seen without infection. The follow up period ranges from 3 to 83 month.

Conclusion: As recommended in the literature only children with symptomatic arachnoid cysts have been treated surgically. Symptoms and signs were progressive macrocephalus, hydrocephalus, increased intracranial pressure. Initially we prefer as surgical procedure endoscopic or microscopic fenestration. The revision rate is higher in the endoscopic group, however, a re-windowing is possible without additional risks. In case of insufficient resorption of cerebrospinal fluid implantation of a ventriculo- or cystoperitoneal shunt is the method of choice.

Long-term results of endoscopic treatment of arachnoid cysts in children

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Objective: Long-term results of endoscopic treatment of arachnoid cysts in children

Methods: 15 patients underwent endoscopic treatment of arachnoid cysts in our department over a period of 23 years (1993-2015). The age of the patients at the time of treatment ranged from 6 months to 17 years (average 8,2 years) The location of the cysts were Sylvian (9), suprasellar (3), infratentorial (1), intraventricular (1) and one confined to the internal auditory canal. The patient's symptoms included headache, pathological skull growth, nausea and vomiting, impaired consciousness up to the point of syncope, behavioural disorder and lack of concentration, impaired vision, paraesthesia, speech disorder and precocious puberty. In one patient arachnoid cyst was already diagnosed during perinatal ultrasound. Endoscopic operation techniques were performed by cystocisternostomies (8), ventriculocystostomies (2), ventriculocystocisternostomies (2) and additional partial resection (2). In 5 operations a permanent catheter was used to keep the fenestration hole open. In 2 cases endoscope-assisted microsurgical cystocisternostomies were performed. The cyst in the internal auditory canal was fenestrated by an endoscope-assisted microsurgical procedure.

Results: In 3 of 15 procedures complications appeared as temporary meningitis, which was successfully treated with antibiotics, and one cerebrospinal fluid fistula. Symptoms were completely relieved in 5 patients and improved markedly in 10 cases. The average follow up period was 144.5 months ranging from 6 to 283 months. In 13 patients, MR imaging was performed. All cysts decreased in size. In one patient, an endoscopic revision was required because the first endoscopic attempt failed. After the second surgery, the cyst decreased in size. In two cases shunt placement was required.

Conclusion: Endoscopic treatment is a safe and effective treatment in arachnoid cysts providing excellent long-term results, and should be first treatment option to avoid shunt materials.

Quality indicators in paediatric neurosurgery: Status quo and future perspectives.

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Objective: The French vascular surgeon René Leriche once said “Every surgeon carries about him a little cemetery [...]”, alluding to complications potentially encountered in any surgical procedure. In recent years there has been much greater scrutiny of adverse events in health care systems and a surgeon’s “little cemetery” is required to be formally analysed as a quality indicator of medical care. We sought to review the published classification systems and results for morbidity and mortality in paediatric neurosurgery.

Methods: A systematic literature review was performed for studies reporting morbidity and mortality in patients younger than 18 years of age undergoing neurosurgical procedures. Classification systems and results were analysed and common quality indicators were extracted for comparison.

Results: Seven studies were included in this analysis, reporting data from 8,694 patients. Five studies were limited to resection of paediatric brain tumours and one study to cranial procedures in general, whereas one study included both cranial and spinal operations. The duration of observation was defined as 30 days after index surgery in four studies, as duration of initial inpatient stay in one study and was not specified in two studies. Overall, these studies reported a severe adverse event (morbidity) rate of 33.8% (range 2.0-68.6%), a mortality rate of 3.0% (range 0.8-7.7%), a 30-day unscheduled reoperation rate of 12.5% (range 10.5-14.5%) and a surgical site infection rate of 7.6% (range 3.4-15.4%).

Conclusion: This review of classification systems and outcome data for morbidity and mortality in paediatric neurosurgery identified four key quality indicators commonly reported in all relevant studies: 1) severe adverse event rate, 2) mortality, 3) 30-day unscheduled reoperation rate and 4) surgical site infection rate. However, pooling of data revealed a significant variability between reported rates, arguably related to different definitions of critical events, such as morbidity or infection, or different case mixes. In summary, the literature reflects a consensus on key quality indicators, but lacks common data elements and definitions of critical events. Consensus definitions are essential to allow for prospective surveillance, transparent reporting and meaningful comparison of surgical quality on a national and international scale. Furthermore, paediatric neurosurgery requires specific classifications, definitions and benchmarks to reflect significant age-related and pathology-related differences compared to adult neurosurgery.

Vasculopathic brainstem ischemia as presenting symptom of Neurofibromatosis Type 2 in children and young adults

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Objective: Neurofibromatosis Type 2 (NF Type 2) is an autosomal-dominant tumor-prone disorder characterized by bilateral vestibular schwannomas and other CNS tumors. Less known manifestations of the disease, which are especially in children the first diagnostic hallmarks are bone lesions, NF2 polyneuropathy, peripheral (plexiform) schwannomas, eye muscle paresis, juvenile cataract and retinal hamartomas. Ischemic vasculopathy, a rare but well known phenomenon in Neurofibromatosis Type 1, is so far not described as presenting symptom in NF Type 2.

Methods: We present 3 cases of young adults and children, diagnosed with Neurofibromatosis Type 2 in the course of sudden ischemic vasculopathy of the brainstem (infarctions of pons and cerebral peduncle). The MRI scans patients received because of their ischemic stroke secondarily revealed bilateral vestibular schwannomas which were previously asymptomatic and unknown. Cases were retrospectively analyzed using clinical reports and T2-weighted MRI scans.

Results: Retrospectively all patients fulfill the Manchester (modified NIH) diagnostic criteria for NF Type 2. In all patients the ischemic event in the brainstem (2 patients) plus cerebellum (1 patient) triggered the diagnosis of NF Type 2. At time of the ischemic event patients were 7, 13 and 22 years old and suffered from dysarthria, gait disturbances, dizziness and hemiparesis. One patient has still regredient but residual signs of hemiparesis and dysarthria. The other two fully recovered. In cMRI scans all patients show bilateral vestibular schwannoma and intracranial meningiomas.

Conclusion: This first description of ischemic vasculopathy as presenting symptom in young patients with NF Type 2 needs to be investigated in a larger collective to estimate its true incidence. Also complementary genetic tests or special imaging are needed to verify the presumed vasculopathy on a morphological or biochemical basis in these patients.

Auditory Brainstem Implantation (ABI) is beneficial in prelingual deaf children

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Introduction: Children born with severe cochlear malformation, cochlear aplasia or hypoplasia/aplasia of the cochlear nerve are no good candidates for cochlear implantation (CI). The only possibility for restoration of hearing in these cases is direct stimulation of the hearing pathways at brainstem level.

Objective: To demonstrate the effectiveness of auditory brainstem implantation (ABI) even in very small children with prelingual deafness for restoration of hearing and speech.

Methods: A 12 channel ABI system (MedEl, Austria), which has proven effectiveness and safety in neurofibromatosis patients since the last 16 years was used for implantation. The pediatric ABI program started in 2009. Meanwhile 25 implantations in 294 children, 10 male and 14 female were performed by the first author. Two children had a successful revision surgery after a fall on the implant side or a spontaneous breakdown of an other ABI system. The mean age was 3.3 years, median 2.8. The youngest was 1.25, the oldest 6.5 yrs. Surgery was performed in supine position using a retrosigmoid approach and multimodal neuromonitoring. In all cases intraoperative E-BERA were recorded.

Results: The preoperative evaluation with high resolution MRI and CT revealed in 16 children aplasia of the cochlear nerve. The others had cochlear dys-aplasia together with hypoplasia of the 8th nerve or syndromal lesions like Goldenhar Syndrome. In most cases surgery was difficult due to complete or partial occlusion of the lateral recess of the fourth ventricle (foramen of Luschkae). In 75% branches of the AICA or the vessel itself were crossing the implant site and had to be dissected. In every case the electrode paddle was small enough to fit properly into the recess. E-BERA recordings could be derived in each case. There were no neurologic complications and only minor surgical complications as subcutaneous CSF leaks in 4 children. All children in whom the device was activated so far regained sound awareness and insisted using the implant all day.

The category of auditory performance scores (CAP) showed in 58.8% values better than CAP 3, in 23.5% equal to CAP 3 and in 17.6% below CAP 3.

Conclusion: ABI is a safe and successful surgical procedure for restoration of hearing and speech in prelingual deaf children. Precious time of plasticity of the auditory pathways should be used as early and intensively as possible. Therefore in doubtful CI candidates ABI should be the primary indication.

MO.08 Intensivmedizin 2

Montag *Monday*, 15.05.2017, 08.00 – 09.10 Uhr *hrs*

- MO.08.01 *Factors predicting poor outcome from discharge to one year after subarachnoid hemorrhage. The Swiss Study on Subarachnoid Hemorrhage (Swiss SOS).*
C. Fung* (Bern, Switzerland), M. Stienen, A. Fathi, A. Raabe, V. Rohde, A. Weyerbrock, J. Burkhardt, J. Beck, K. Schaller, B. Schatlo
-
- MO.08.02 *Prognostic value of S100B protein and neuron-specific enolase in patients with poor grade aneurysmal subarachnoid haemorrhage*
T. Abboud* (Hamburg, Deutschland), C. Mende, R. Jung, P. Czorlich, E. Vettorazzi, M. Prießler, S. Kluge, M. Westphal, J. Regelsberger
-
- MO.08.03 *Radiation exposure in the acute phase of aneurysmal subarachnoid hemorrhage*
V. Solomiichuk* (Göttingen, Deutschland), I. Tsogkas, M. Psychogios, D. Mielke, V. Rohde, V. Malinova
-
- MO.08.04 *Does deep sedation prevent delayed cerebral ischemia in patients with aneurysmal subarachnoid hemorrhage?*
S. Hernandez Duran* (Göttingen, Deutschland), D. Mielke, V. Rohde, V. Malinova
-
- MO.08.05 *Incidence and Risk factors for Delirium in patients with aneurysmal Subarachnoid Hemorrhage*
P. Czorlich* (Hamburg, Deutschland), T. Sauvigny, M. Mohme, J. Regelsberger, M. Westphal, N. Schmidt
-
- MO.08.06 *Somatosensory evoked potentials in patients with high grade subarachnoid hemorrhage*
C. Mende* (Hamburg, Deutschland), M. Gelderblom, P. Czorlich, J. Regelsberger, M. Westphal, T. Abboud
-
- MO.08.07 *Computerized ICP Pulse Waveform Analysis: The High Frequency Centroid Revisited*
E. Lang* (Kassel, Deutschland), M. Placek, M. Kasprovicz, P. Smielewski, M. Czosnyka
-

Factors predicting poor outcome from discharge to one year after subarachnoid hemorrhage. The Swiss Study on Subarachnoid Hemorrhage (Swiss SOS).

Christian Fung¹, Martin N. Stienen², Ali-Reza Fathi³, Andreas Raabe⁴, Veit Rohde⁵, Astrid Weyerbrock⁶, Jan-Karl Burkhardt⁷, Jürgen Beck¹, Karl Schaller⁸, Bawarjan Schatlo⁹

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Objective: Predictors of poor outcome after subarachnoid hemorrhage have been amply delineated previously. However, data on factors predicting further long-term recovery for patients discharged in a dependent state are scarce.

Methods: The Swiss study on subarachnoid hemorrhage (Swiss SOS) includes all patients treated for SAH since 1st of January 2009 in all eight neurovascular centers in Switzerland. Poor outcome was defined as a modified Rankin scale 3-5, excluding mortality. We analyzed predictors leading to a lack of improvement from dependent to dependent state using multivariate binary logistic regression with a significance level below 0.05.

Results: 1234 surviving patients matched the inclusion criteria for the present analysis. At discharge, 797 patients (64.6%) were reported as independent, while 437 (35.4%) were dependent. At one year, 1050 patients (85.1%) were independent compared to 184 patients with dependent survival (14.9%). 265/437 patients (60.6%) improved from a dependent state at discharge to independent function at one year. Multivariate analysis identified the following factors to be inversely associated with improvement from discharge to one year: Poor WFNS (3-5) (OR 1.89; CI95% 1.36-2.63, p<0.001), high Fisher grade (3,4) (OR 2.04; CI95% 1.08-3.85; p=0.03), chronic hydrocephalus (OR 1.50; CI95% 1.06-2.13; p=0.02) and delayed cerebral ischemia (OR 1.62; CI95% 1.17-2.23; p=0.003).

Conclusion: A majority of patients who are discharged in a dependent state after SAH will regain independent function at one year. Chronic hydrocephalus and delayed cerebral ischemia are the main potentially modifiable variables affecting long-term outcome.

Prognostic value of S100B protein and neuron-specific enolase in patients with poor grade aneurysmal subarachnoid haemorrhage

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Objective: To investigate the value of S100b protein (S100) and neuron-specific enolase (NSE) in prognosticating outcome in patients with high grade aneurysmal subarachnoid haemorrhage (SAH).

Methods: Between 2012- 2014, patients SAH (Hunt & Hess grade 3-5) who were admitted within 24 hours after haemorrhage were prospectively enrolled. Serum NSE and S100 levels were assayed once daily during the first 3 days after haemorrhage. Patient characteristics, Glasgow Coma Scale, Hunt & Hess and Fisher grade at admission were recorded. Glasgow outcome scale was obtained at 6 months and dichotomized as poor (1–3) or good (4–5). Logistic regression and ROC curve were used to assess the predictive value of S100 and NSE and cut-off values were calculated using conditional interference trees.

Results: 52 patients were included. Hunt & Hess grading was 3 in 23 patients, 4 in 15 and 5 in 14 patients. S100 ranged from 0.07 to 5.62µg/l (mean 0.87±1.06µg/l). NSE range was 5.7 to 94.2µg/l (mean of 16.1±10.5µg/l).

At 6 months follow-up, 23 patients (44.2%) had poor outcome and 29 (55.8%) showed good outcome. Both S100 at day one (p=0.004, cut-off 0.202µg/l) and NSE at day one (p=0.047, cut-off 9.4µg/l) predicted good outcome with a specificity of 100%. The specificity of mean S100 in predicting poor outcome reached 100% (p=0.003) when combined with mean NSE levels.

Conclusion: S100 and NSE measured during the first 3 days after haemorrhage showed separately and combined a significant predictive value in prognosticating clinical outcome in patients with high grade SAH.

Radiation exposure in the acute phase of aneurysmal subarachnoid hemorrhage

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Objective: The acute phase after aneurysmal subarachnoid hemorrhage (aSAH) is associated with high risk for the occurrence of adverse events such as delayed cerebral ischemia (DCI), with the necessity of further diagnostic work-up. The advances of neuroradiological diagnostics such as CT-perfusion (CTP) and CT-angiography (CTA) as well as endovascular techniques led to their increased use possibly resulting in higher radiation exposure. We assessed the cumulative radiation dose in the acute phase after aSAH in order to estimate the risk of radiation exposure in patients with aSAH, since this patient population is younger compared to other stroke forms.

Methods: A patient population admitted to our clinic with aSAH from January 2007 to June 2016 was retrospectively analyzed and the number of CT scans (native CT, CTP and CTA) and diagnostic digital subtraction angiography (DSA) was documented. The effective dose of every radiographic examination was estimated according to the patient protocol of every examination. An average effective dose per examination was calculated. Then, the average patient related cumulative radiation dose was determined.

Results: The data of 200 patients (35% male and 65% female) with mean age of 54.5 ± 13.6 years was analyzed. High Hunt & Hess grade had 29% and a high Fisher grade 80% of the patients. The average number of performed examinations was as followed: CT n=5, CTA n=2 and CTP n=1 and DSA n=1. The mean effective dose of each CT was 2.0mSv, of each CTA 3.4mSv, of each CTP 6.5mSv, of each DSA 22mSv. The mean cumulative radiation dose during the acute aSAH phase was 55.8mSv per patient (range 1.5-193.2mSv). Higher radiation exposure was significantly correlated to higher modified Fisher grade (linear regression, $p=0.004$) but not with higher Hunt & Hess grade (linear regression, $p=0.48$).

Conclusion: The findings of this study suggest a significant imaging-related exposure to radiation of patients with aSAH. This analysis highlights the importance of accurate assessment of radiation exposure and the relevance of elaborated imaging protocols for the management of patients in the acute phase of aSAH in order to reduce the radiation exposure without compromising the quality of treatment.

Does deep sedation prevent delayed cerebral ischemia in patients with aneurysmal subarachnoid hemorrhage?

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Objective: Deep sedation (DS) in patients with severe acute brain injury has been used in the early phase following hospital admission in order to improve cerebral tolerance to ischemia and to limit supply/demand mismatch in conditions of impaired autoregulation. However, DS can also reduce cerebral blood flow by lowering mean arterial pressure, thus leading to secondary brain tissue hypoxia/ischemia. Patients with high grade aneurysmal subarachnoid hemorrhage (aSAH) often undergo DS as part of their treatment, sometimes with the goal of preventing delayed cerebral ischemia (DCI). The goal of this study was to establish whether or not DS has a protective effect against DCI.

Methods: We conducted a retrospective analysis of patients admitted to our center between January 2012 and September 2015 with aSAH. The use of DS was assessed, as well as its duration, medications used, and indication for DS. Furthermore, the incidence of DCI was determined. Bivariate correlation analysis was performed using Spearman's rho. Additionally, ordinal regression was conducted to account for other variables such as age and Hunt and Hess Grade at presentation that could possibly predict the incidence of DCI. For statistical analysis, IBM® SPSS® Statistics Version 21 was used.

Results: A total of 170 patients were included in our analysis. Of these, 82/170 (48.2%) underwent DS. The mean duration of DS was 10 days (range: 2-21 days). All the patients (82/82, 100%) underwent DS with midazolam and ketamine, while 36/82 (44%) and 41/82 (50%) additionally received propofol and sufentanyl, respectively. The most common indication for DS was a high grade at presentation with clinical and imaging findings suggestive of severe acute brain injury/edema (62/82, 75.6%). Other indications included brain edema with elevated intracranial pressure developed over the course of the hospital admission (14/82, 17.1%) and flow accelerations on transcranial Doppler (6/82, 7.3%). DCI occurred in 54/82 (65.9%) of the patients with DS. Correlation analysis showed a statistically significant correlation between DS and DCI (Spearman's rho=0.306, p<0.01). The ordinal regression also revealed DS as a statistically significant predictor of DCI (p=0.03), assuming Hunt and Hess Grade and age were kept constant.

Conclusion: Our analysis shows that DS does not reduce the incidence of DCI. In fact, DS appears to predict a higher incidence of DCI in patients with aSAH, probably due to the changes in cerebral perfusion pressure. Prospective studies need to assess the role of DS in aSAH and its influence on DCI, as it might be more deleterious than previously assumed.

Incidence and Risk factors for Delirium in patients with aneurysmal Subarachnoid Hemorrhage

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Objective: Delirium is a known comorbidity in intensive care patients and especially in patients with neurological diseases such as aneurysmal subarachnoid hemorrhage (SAH). Nevertheless, data on delirium after SAH are rare. The aim of this study was to evaluate the rate of delirium in a cohort of SAH patients and to identify predisposing factors for delirium.

Methods: Patients with SAH treated between 01/2012 and 07/2016 in a single center were retrospectively analyzed using the Richmond Agitation and Sedation Scale (RASS), a highly validated numerative scale representing the gold standard for scoring of delirium in intensive care medicine. The RASS ranges from -5 (unarousable) to +4 (combative) and is recorded at least every 8 hours or in case of an unexpected event. Delirium was defined as a RASS \geq 2. Only patients who reached a RASS of 0 (calm and alert) at least once during the clinical course were included in the analysis for predictive factors. In these patients we performed a univariate regression-, followed by a multivariate analysis. The level of significance was set to 0.05.

Results: In the given period 213 patients had a complete documentation of the RASS. The rate of delirium was 31.0% (n=66/213) for the whole cohort and 35.1% in patients reaching a calm and alert consciousness (RASS of 0). In the univariate analysis, male gender (p=0.023), lower Glasgow Coma Scale at admission (p=0.001), higher Hunt&Hess grade (p=0.003), higher Fisher grade (p=0.025), presence of initial hydrocephalus (p=0.008), intraventricular blood volume measured by Le Roux score (p=0.003), initial signs of herniation (p=0.039), higher Simplified Acute Physiology Scale (p=0.01), microsurgical clipping of the aneurysm (p=0.034) and cerebral infarctions on cranial computer tomography (p=0.017) were associated with a higher rate of delirium. Male gender (p=0.018), microsurgical clipping of the aneurysm (p=0.001) and presence of an initial hydrocephalus (p=0.002) were independent predictors for the occurrence of a delirium in the multivariate analysis. Medical treatment of delirium was necessary in 87.9% of patients (n=58/66).

Conclusion: Delirium is a frequent comorbidity in patients suffering from SAH with a rate of up to 35% and seems to be especially associated with male gender, microsurgical clipping and presence of an initial hydrocephalus.

Somatosensory evoked potentials in patients with high grade subarachnoid hemorrhage

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Objective: The aim of this prospective study was to investigate the value of somatosensory evoked potentials (SEP) in prognosticating outcome in patients with high grade aneurysmal subarachnoid haemorrhage (SAH).

Methods: Between 2013 and 2015, 48 patients with high grade SAH (Hunt & Hess grade 3-5) who were admitted within 3 days after haemorrhage were enrolled in the study. Right and left median and tibial nerve SEP were performed at day 3 after haemorrhage and repeated two weeks later. Glasgow outcome scale (GOS) was obtained at 6 months and dichotomized as poor (1–3) or good (4–5). Results of SEP measurement were dichotomized into “present or missing cortical answers” and “normal or prolonged latencies” for each nerve and side. These variables were summed up and tested using logistic regression and receiver operating characteristic curve assess the value of SEP in predicting long-term outcome.

Results: At 6 months follow-up, 29 patients (60.4%) had good outcome and 19 (39.6%) had poor outcome. First SEP measurement was not predictive of outcome (AUC=0.69, p=0.52). At the second measurement, in median nerve SEP, all patients with good outcome showed present cortical answers bilaterally and none of them had bilateral prolonged latencies (p=0.014 and p=0.003, respectively). 11.5% with “good” GOS showed one or more missing answers vs 64.3% in the “poor” group, p=0.001. In tibia nerve SEP, 11.5% with “good” GOS showed one or more missing cortical answers vs 64.3% in the “poor” group, p=0.001. Prolonged latencies were found in 26.9% bilaterally and 19.2% from one leg in the “good” group compared to 64.3% and 21.4%, respectively in the “poor” group (p=0.034). Second measurement was predictive of outcome regarding each of median and tibial nerve SEP and the combination of both (AUC=0.75, P=0.010 and AUC=0.793, p=0.003 and AUC=0.81, p=0.001, respectively).

Conclusion: Early SEP measurement after SAH was not predictive of outcome, while SEP measurement of median and tibial nerve during the third week after haemorrhage could predict long-term outcome in patients with high grade SAH.

Computerized ICP Pulse Waveform Analysis: The High Frequency Centroid Revisited

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Objective: The ICP pulse waveform changes with rising ICP. This is thought to indicate changing both intracranial and cerebrovascular compliances, which may be clinically useful above the ICP value itself. An increasing High Frequency Centroid (HFC), the power-weighted average frequency within the 4 to 15-Hz band of the ICP power density spectrum has been reported to correlate with rising ICP. We examine this concept and introduce another centroid, the high harmonic centroid HHC, potentially less dependent of heart rate (HR). HHC is the center of mass of its harmonics from 2nd to 10th expressed as consecutive integers, where mass corresponds to amplitudes of these harmonics.

Methods: From the 325-patient Cambridge TBI 2002 to 2010 database containing patients whose high resolution ICP and ABP signals were recorded with a bedside computer system, we extracted 26 patients with ICP plateau waves and calculated HFC and HHC utility in 2 steps: (1) We investigated the correlations between HFC/HHC and ICP, arterial blood pressure (ABP), cerebral perfusion pressure (CPP), HR and PRx, a cerebral autoregulation index. (2) We calculated HFC/HHC and their correlations with ICP, CPP, ABP, and HR during isolated ICP plateau waves to compare baseline values of centroids with ICP plateau wave peak values.

Results: (1) For the whole monitoring period ICP (22 ± 7 mmHg) correlates significantly with its centroids ($R=0.42$, $p=0.035$ for HFC (7.72 ± 0.45 Hz); $R=0.45$, $p=0.022$ for HHC (3.64 ± 0.46). ABP (96 ± 10 mmHg) also correlates significantly with HFC/HHC ($R=0.627$, $p=0.001$, HFC; $R=0.5$, $p=0.009$, HHC). CPP (75 ± 7 mmHg) correlates significantly with HFC ($R=0.46$, $p=0.019$) but not with HHC. PRx (0.03 ± 0.19) doesn't correlate significantly with any centroid. (2) During the ICP plateau waves we found significant HFC and HHC decreases at baseline vs. peak (ICP: 22 ± 7 mmHg vs. 55 ± 13 mmHg; HFC: 7.7 ± 0.46 Hz vs. 7.55 ± 0.6 Hz; HHC: 3.72 ± 0.54 vs. 3.17 ± 0.37).

Conclusion: This study confirms the utility of computerized ICP pulse waveform analysis. In contrast to previously reported data high frequency centroids decreases at high ICPs. Further studies are needed to identify individual ICP-HFC/HHC breakpoints and their potential clinical utility.

MO.09 Wirbelsäule – Outcome/Follow-Up

Montag Monday, 15.05.2017, 08.00 – 09.30 Uhr hrs

- MO.09.01 *Predictors of clinical outcome in cervical arthrodesis: Evaluation of physical, mental and social factors*
E. Shiban* (München, Deutschland), S. Youssef, T. Jeff, B. Florian, F. Ringel, J. Lehmberg, B. Meyer
-
- MO.09.02 *Retrospective analysis of 20 thoracic corpectomies due to neoplastic vertebral body fractures - a single centre consecutive case series*
C. Wipplinger* (Innsbruck, Austria), S. Hartmann, P. Kavakebi, A. Tschugg, S. Lener, N. Koegl, C. Thomé
-
- MO.09.03 *Long-term Follow-up in Patients undergoing Anterior Screw Fixation for Odontoid Fractures.*
A. Elnewihi* (Magdeburg, Deutschland), R. Firsching
-
- MO.09.04 *Comparison of different devices for kyphoplasty in osteoporotic spine fractures - a prospective randomized trial*
F. Schwarz* (Jena, Deutschland), A. Steinberg, A. Waschke, C. Ewald, R. Kalff
-
- MO.09.05 *Improves outcome of back surgery using a transsectoral pathway*
H. Poimann* (Würzburg, Deutschland)
-
- MO.09.06 *New craniocaudal expandable implant for the minimally invasive reconstruction of vertebral body compression fractures*
J. Assaf* (Neubrandenburg, Deutschland), M. Fritsch
-
- MO.09.07 *Clinical and radiological long-term results of anterior discectomy and fusion (ACDF) versus dynamic cervical implant in the treatment of degenerative cervical spine disease.*
S. Jadik* (Kiel, Deutschland), M. Synowitz
-
- MO.09.08 *Risk factors, clinical outcome and therapy strategies after incidental durotomy in lumbar disc herniation surgery and in decompression surgery for lumbar spinal stenosis – a retrospective analysis*
M. Schomacher* (Berlin, Deutschland), M. Cabraja, J. Leibling, S. Hammersen, D. Moskopp
-
- MO.09.09 *Painless motor radiculopathy of the cervical spine – clinical and radiological characteristics with long-term outcome after operative decompression*
S. Siller* (München, Deutschland), R. Kasem, T. Witt, J. Tonn, S. Zausinger
-

Predictors of clinical outcome in cervical arthrodesis: Evaluation of physical, mental and social factors

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Objective: The influence of psychological and social factors has only recently been acknowledged to impact clinical outcome following spine surgery. Some studies demonstrated that preoperative affective disorders predicts poor outcome after spinal surgery. We aimed to identify potential risk factor for unfavourable outcome following cervical spine surgery for degenerative disc disease.

Methods: In a prospective observational study the authors determined quantitative measurements of pain (visual analog scale [VAS]), health related quality of life (HRQL: SF-36 and EuroQOL-5D), disease-specific disability (ODI), mental status (anxiety [STAI-T, STAI-S and ASI-3] and Depression [ASD-K]) and social status (Berliner Social Support Scale [BSSS] and education level). Uni- and multivariate analyses were performed to assess associations between the various preoperative factors and the health related quality of life (HRQL) at 12 months follow up.

Results: 51 patients met all inclusion criteria. 34 patients were male (66.7%); mean age was 58.6 years. Most patients were married or in a steady relationship (78.4%). Preoperatively high values in education ($r=0.293$; $p=0.07$), SF-36 PCS ($r=0.405$; $p=0.022$) and low scores of depression (ASD-K: $r=-0.363$; $p=0.011$) and anxiety (ASI-3: $r=-0.354$; $p=0.013$) and ODI ($r=-0.343$; $p=0.038$) correlated with better HRQL at 1 year postoperatively.

Conclusion: Clinical outcome one year after surgery is influenced by pre-operative physical, mental and social status. A screening instrument allowing the identification of such patients is feasible.

Retrospective analysis of 20 thoracic corpectomies due to neoplastic vertebral body fractures – a single centre consecutive case series

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Objective: The thoracic spine is the most common site of metastatic spinal cord compression mostly due to infiltration by prostate, lung or breast cancer. Due to the palliative nature of the procedure and often reduced health status of the patients the extent of surgery in these cases is still a matter of debate. In case of spinal cord compression, we prefer a posterolateral corpectomy with posterior instrumentation over only dorsal decompression and stabilization or anterior transthoracic corpectomy. The aim of the present study was to critically assess outcome and complications of our treatment strategy to potentially optimise future interventions.

Methods: 20 patients, who were treated in our department from 2011 to 2015 and who were available for a minimum follow-up of 12 months, were included in this retrospective evaluation. The mean age was 57 (± 16) years with a female to male ratio of 8 to 12. One- to four-level corpectomies were performed via a posterolateral approach followed by dorsal transpedicular instrumentation. The intraoperative loss of blood (LOB), red cell-transfusions (rcT), the length of operation (LOO) and the length of hospitalisation (LOH) were evaluated and correlated with postoperative outcome.

Results: The majority of our patients suffered from metastatic lesions, only two patients had a primary vertebral body tumour. The mean follow-up was 3,53 years ($\pm 1,33$). An average of 1.35 (± 0.81) thoracic vertebrae were resected and as a routine the dorsal pedicle screw instrumentation involved two levels above and below the resection. All patients with metastatic lesions were admitted to radiotherapy postoperatively. The mean LOO was 307min (± 124) and the mean LOB was 1616ml (± 1611) with 2.6 ($\pm 3,38$) rcT per patient used. All participants were transferred to the intensive care unit postoperatively with a mean ICU stay of 2.3 days. The mean LOH amounted to 12 days (± 7). One patient required revision surgery due to a wound infection, which results in a postoperative complication rate of 5%. No implant-related failures or procedure-related death were observed. Four of our patients died within two years after the operation due to progression of primary disease.

Conclusion: Thoracic corpectomies in patients with metastatic or primary spine lesions are challenging procedures which are associated with a significant loss of blood, transfusion requirement and long hospitalisation time. Nevertheless, the posterolateral approach is associated with a low rate of surgery-related complications and encouraging local tumour control as suggested by satisfactory overall survival.

Long-term follow-up in patients undergoing anterior screw fixation for odontoid fractures

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Objective: Dens fractures represent roughly 10% of all cervical fractures (Winking, 2009). Little evidence can be found in the literature about the frequency of the secondary instability following ventral fixation by means of screws. In this study, the long-term follow-up of the ventrally-operated patients with dens fractures is presented to find out how often secondary instability occurs.

Methods: In the period from January 2002 to November 2016, 257 patients with dens fracture were treated in the Neurosurgery Clinic of the Magdeburg University hospital. Depending on the fracture type, 75 patients (29.2%) were conservatively treated, 11 patients (4.3%) were treated with a halo fixator, 18 patients (7%) were operated primarily from dorsal, and 153 (59.5%) were ventrally operated by means of a double-threaded screw.

The data was obtained retrospectively from patient records and follow-up examinations. Out of 153 patients, 112 (73.2%) were studied while 41 patients did not appear for postoperative control. 50 patients (44.6%) were males and 62 patients (55.4%) were females. The patients ages ranged between 15 and 101 years (a median of 80).

Results: Postoperative radiological examinations revealed a primary stable and fused dens fracture without neurological deficits in 76 patients (67.85%), out of which 32 were males (28.6%), 44 were females (39.25%). With 26 patients (23.2%) aged between 55 and 96 (a median of 79.1 years), it was necessary to perform a second dorsal operation due to secondary instability. Additional stabilization by means of dorsal Osteosynthesis was indicated for 7 patients (6.25%), but it was rejected. In 3 cases (2.7%), a revision surgery was necessary to correct the screw position.

Overall, 36 patients (32%) were with manifested secondary instability, aged between 55 and 99 years (median of 81). 18 patients were females (50%) and 18 were males (50%).

The preoperative pain symptoms improved after ventral care in 81 cases (72.3%) while said pain symptoms persisted in 31 cases (27.7%).

Conclusion: Ventral care is an effective method for dens fracture treatment with low instability incidence and high fusion rate.

Comparison of different devices for kyphoplasty in osteoporotic spine fractures – a prospective randomized trial

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Objective: Since 1998 the kyphoplasty has been an established method to treat osteoporotic vertebral body fractures. Recently, lots of new devices have been presented to optimize this procedure.

In our study we compare one device (ST - standard), which is most common in clinical use, with two new kyphoplasty devices (N1 – new one; N2 – new two). The advantage of both new devices is a reduction of intraoperative working steps.

Methods: Ninety patients were prospectively randomized and compared regarding the device, operation time, cement application, intraoperative cement dislocation, X-ray time, radiation dose, follow-up and complications.

Results: In every device group 30 patients were included. 57 patients (63.3%) were female. Median time of operation was 30 minutes with a minimal radiation dose in the standard device (853 mGy). Regarding the operation time (ST = 32 min; N1 = 29 min; N2 = 30 min) and the radiation dose (ST = 853 mGy; N1 = 907 mGy; N2 = 920 mGy) significant differences were not detected between the three different groups. On average 5 ml bone cement were applied per fractured vertebra body. In 8 cases an intraoperative cement dislocation was determined without any clinically relevance. At this moment the median follow-up is 10 months.

Conclusion: Despite a reduction of working steps and a subjective shorter operation time, there is no objective advantage for the new devices in comparison to the standard device. Reasons could be a high number of different surgeons in our study and different experiences with the new devices. Also the bone density and the level of kyphoplasty seem to influence the operation time.

Improves outcome of backsurgery using a transsectoral pathway

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Objective: Sectoral partition is a problem in spine surgery combining out-patient, in-patient and rehabilitation treatment. Waiting lists between sectors, delayed treatment and loss of information lead to longer treatment and quality gaps along the line of care. Porter/Teisberg (2006) found an effective and valuable treatment for patients only in transsectoral care at a certain medical condition level from the beginning of one defined disease till reintegration into daily life, if the responsibility lies in the hands of one team.

Methods: The pilot supported by the bavarian state department of healthcare developed an IT-tool for a transsectoral treatment path in order to allow every caregiver starting from the orthopedic doctor to the surgical hospital and rehabilitation center and back to the orthopedic doctor having permanent access to necessary data of the patient during the complete circle of care. At the beginning of the pilot study in 2014 base line data concerning randomly 30 selected patients undergoing spine surgery were gathered. By December 2015 results as shorter treatment circles, higher satisfaction of the patients, improved clinical outcome, higher satisfaction of co-workers in the different organizations, and evaluation of the organization performance will be evaluated

Results: The development and the roll out of the IT-tool was completed in November 2014. 15 organizations took part and 375 patients have been treated using the trans sectoral path. Results proof the good usability of the path attested by the care givers. Some improvement projects are already underway. Patients and caregiver's satisfaction rose ($p < .001$). treatment time has shortened between 5-20 days ($p < .001$). Medical outcome was improved ($p < .001$). Oeconomical data show that organizations with a higher number of patients gain more profit.

Conclusion: An IT-tool allowing all participants in the care of spine surgery patients to have an 24/7 data access is a real progress concerning the transsectoral treatment of degenerative spine disease: better clinical outcome, shorter treatment time, higher satisfaction of either patients or clinical staff, and smother hospital processes will supply an improved resource utilization.

New craniocaudal expandable implant for the minimally invasive reconstruction of vertebral body compression fractures

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Objective: We present surgical technique and patient data of 76 patients with one year follow up treated for osteoporotic and traumatic compression fractures of the thoracic and lumbar spine. Patient data were collected prospectively. The aim of this study is to evaluate safety of the technique and the clinical outcome for the patients.

Methods: We treated 76 patients for 84 spinal fractures with an age ranging from 26-87 years (41 female, 35 male). Fractures were osteoporotic in 14 patients and traumatic in 62 patients. Magerl classification was type A.1.1 (3), A.1.2 (19) A.1.3 (6), A.2.1 (32), A.2.3 (12), A.3.1 (15), A.3.2 (16) und A.3.3 (10). Fracture localization was 48 (63%) T11L1, 12 (15%) T4T10 and 24 (32%) L2-L5. All implants were applied percutaneous transpedicular. For augmentation PMMA or a combination of PMMA / hydroxylapatit was used. All patients received preop a clinical examination, spine x-ray, CT and MRI and postop clinical examination and x-ray after mobilization. For pain evaluation we utilized the VA-scale. For each patient we measured the height of the vertebral body as well as the kyphosis angle of the fractured vertebral body. All included patients had a 1 year follow up.

Results: Within the 1 year follow up period the reduction of pain according to VA-scale was 77%. Increase of vertebral body height was 15% after the procedure and 11% after 1 year. The kyphosis angle was -6° prior to surgery and -4° 1 year later. Cement leak was seen in 31 cases (41%), in all of them without neurologic deficit. There was no reoperation in the same segment and no implant dislocation within 1 year.

Conclusion: The presented method with an craniocaudal expandable implant is efficient, safe and is providing excellent results at 1 year follow-up. We achieved long lasting reduction of pain and pain medication in our patients. The presented technique and the results are at least comparable to kyphoplasty.

Clinical and radiological long-term results of anterior discectomy and fusion (ACDF) versus dynamic cervical implant in the treatment of degenerative cervical spine disease.

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Clinical and radiological long-term results of anterior discectomy and fusion (ACDF) versus dynamic cervical implant in the treatment of degenerative cervical spine disease.

Objective: To evaluate clinical and radiologic outcome in patients treated with a dynamic cervical implant (DCI) or anterior cervical discectomy and fusion (ACDF).

Methods: This retrospective cohort study enrolled patients with single- or two-level cervical degenerative disc disease who underwent DCI arthroplasty or ACDF between September 2008 and June 2016. Patients were followed up for more than 5 years. The study included 68 patients with one- or two-level cervical degenerative disk disease (DDD) undergoing treatment with either DCI (n=36) or ACDF (n=32). Clinical and radiologic outcomes were assessed 60 to 72 months after surgery. Clinical scoring systems included the Visual Analog Scale for Neck (VAS-N) and Arm pain (VAS-A), the Neck Disability Index (NDI), and the Quality of Life Scale (SF36).

Results: Both the DCI and ACDF group showed significant clinical improvement 60 months after surgery using the VAS-N ($p=0.034$ and $p<0.001$, respectively), VAS-A ($p<0.001$ and $p<0.001$, respectively), NPAD ($p<0.001$ and $p<0.001$, respectively), and SF36 ($p<0.001$ and $p<0.001$, respectively). There were no significant differences in clinical outcome comparing both groups at the 60-month follow-up. The fusion rate at 60 months after surgery was 90.4% and 94.0% in the DCI and ACDF groups, respectively. Heterotopic ossification was found in 90.9% in the DCI group at 60-month follow-up.

Conclusion: The clinical results for DCI treatment are equivalent to those for ACDF in the treatment of one- and two-level cervical DDD at 60 months after surgery. There is a high rate of fusion associated with DCI treatment due to heterotopic ossification.

Risk factors, clinical outcome and therapy strategies after incidental durotomy in lumbar disc herniation surgery and in decompression surgery for lumbar spinal stenosis – a retrospective analysis

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Objective: Incidental durotomy (ID) seem to be the most common complication in lumbar disc herniation- and decompression surgery. We therefore evaluate risk factors, therapy strategies and clinical outcome in patients with lumbar disc herniation surgery and in lumbar decompression surgery for spinal stenosis.

Methods: All patients in the period from 1/2013 to 12/2015 with lumbar disc herniation surgery and lumbar decompression surgery for lumbar spinal stenosis at our institution were reviewed retrospectively. Age, gender, co-morbidities, body mass index (BMI), neurostatus, surgery-time and -procedure, strategies of dural repair in case of ID (suture, fibrin glue, fat patch or lumbar drainage) and hospital-stay overall as well as patients outcome (Odom's criteria) were assessed. Two groups - patients with ID in lumbar disc herniation surgery (group 1) and patients with ID in decompression surgery for lumbar spinal stenosis (group 2) - were formed.

Results: In total 509 patients with lumbar disc herniation surgery and 438 patients with lumbar decompression surgery could identified.

In group 1 ID occurred in 35 patients (6.87%) operated on lumbar disc herniation. Mean patient age was 57 (29-77) years and 57% of the patients were male. The BMI in this group was 27 ± 6 kg/m². Operation procedure time was 121 ± 39 minutes. In 23 operations the dural lesion was covered with Tachosil™, fibrin glue or fat-patches, only in 12 cases additional sutures were necessary. No lumbar drainage was necessary. 11 patients (31%) had a previous lumbar spine surgery before. After mean hospital stay of 9 days 34 patients with improvement of complaints were discharged at home. 2 Month follow up evaluation showed in 81% a fair or better post-operative result and no signs or symptoms of dural leakage.

In group 2 ID occurred in 23 patients (5.25%) operated with decompression surgery for lumbar spinal stenosis. Mean patient age was 76 (60-84) years and 48% of the patients were male. The BMI in this group was 30 ± 5 kg/m². Operation procedure time was 158 ± 53 minutes. In 18 operations the dural lesion was closed with sutures and covered with Tachosil™, fibrin glue or fat-patches. A lumbar drainage application was not necessary. 4 patients (17%) had a previous lumbar spine surgery before. After mean hospital stay of 10 days all patients with improvement of complaints were discharged at home. 2 Month follow up evaluation showed in 87.5% a fair or better result. Signs or symptoms of dural leakage were not presented.

Conclusion: ID in lumbar disc herniation surgery and in decompression surgery for lumbar spinal stenosis can be safely performed with and without suture repair. An elevated BMI and previous lumbar spine surgery can increase the risk of incidental durotomy.

Painless motor radiculopathy of the cervical spine – clinical and radiological characteristics with long-term outcome after operative decompression

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Objective: Painless paresis/atrophy of the upper limbs are usually treated by neurologists and diagnosed e.g. as motoneuron-disease or neuralgic shoulder amyotrophy. We examined the rare clinical manifestation of compression-induced cervical radiculopathy with predominant motor deficit and muscular atrophy without pain and only minor disturbance of sensitivity. Aim of the study was to determine the incidence of the syndrome and the long-term outcome after surgical decompression.

Methods: Medical records of 788 patients undergoing decompression due to degenerative cervical radiculopathy/myelopathy were analyzed. Among those, 31 pat. (3.9%, m/f=4/1) presented with painless compressive cervical motor radiculopathy; long-term FU was available in 23 pat. with 49 symptomatic foraminal stenoses. Clinical, imaging and operative findings were retrospectively analyzed. Outcome parameters included course of MRC paresis grade and a questionnaire evaluation of QoL at the end of FU. Patients' informed consent and approval by the local ethical review board was obtained.

Results: Preop. symptoms (mean duration 13.3mos) included – besides a defining painless paresis (median grade 3/5) – atrophy (78%) and sensory changes (39%) with smoking history in 83% and diabetes in 17% of the pat. Mean age at 1st operation was 59.9yrs, mean FU 4.8yrs. Preop. imaging revealed a predominant nerve root compression from anterior at the neuroforaminal entrance (mostly due to uncarthrosis) in 98% of the stenoses; most stenoses were located in C4-5 (33%) and C5-6 (31%). 30 stenoses in 11 pat. were initially decompressed via ACDF and 19 stenoses in 12 pat. via Posterior Cervical Foraminotomy (PCF). 2/11 pat. with ACDF and 3/12 with PCF needed 2nd surgery for 5 new and 3 recurrent stenoses with time to reoperation being sign. shorter in smokers ($p=0.033$) Long-term FU revealed a stable or improved status acc. to paresis in 87% of the pat. and Odom's Grade in 91%, independent from the surgical procedure chosen. The severity of paresis was sign. improved compared to the preop. status ($p=0.046$) with a median grade of 4/5 at the end of FU. Long-term general performance was excellent with 87% having a WHO/ECOG PSS ≤ 1 , 100% a KPS ≥ 80 , and 87% a Barthel Index of 100%.

Conclusion: Painless cervical motor radiculopathy predominantly occurs in males with focal compression of the anterior nerve root and disturbance of microperfusion. After differentiation from neurological disorders, surgical decompression can provide improvement of motor function and a favourable long-term outcome.

MO.11 Joint Meeting Session 2 – Trauma 1

Montag Monday, 15.05.2017, 11.00 – 12.20 Uhr hrs

- MO.11.01 *Keynote lecture - The impact of Major Trauma Organization on Head Injury Management and Outcome. The NHS 2010 - 2016*
Paul May (Liverpool, United Kingdom)
-
- MO.11.02 *Keynote lecture - Megatrends - Head injury. Megatrends 2017*
Andreas Unterberg (Heidelberg, Deutschland)
-
- MO.11.03 *Using stem cells following TBI*
A. Ahmed* (Hampshire, United Kingdom), S. Gajavelli, B. Da Sousa, B. Coles, A. Pringle, M. Bullock
-
- MO.11.04 *Diagnosis of a subdural haemorrhage in abusive head trauma: the absent falx cerebri consideration*
A. Ali* (Manchester, United Kingdom), I. Kamaly
-
- MO.11.05 *Clinical outcome of epidural haematoma (EDH) in the era of modern resuscitation and chain of survival*
P. Gutowski* (Berlin, Deutschland), C. von der Brelie, U. Meier, V. Rohde, J. Lemcke
-
- MO.11.06 *The financial outcome of traumatic brain injury: a single centre study*
D. Fountain* (Cambridge, United Kingdom), A. Koliass, R. Laing, P. Hutchinson
-
- MO.11.07 *Intraoperative ICG-based cortical perfusion measurement in patients suffering from severe traumatic brain injury*
M. Kamp* (Duesseldorf, Deutschland), A. Petridis, J. Cornelius, B. Turowski, H. Steiger
-
- MO.11.08 *Treatment with direct oral anticoagulants does not increase in-hospital mortality in patients with acute subdural hematoma*
S. Brenner, A. Unterberg, C. Beynon* (Heidelberg, Deutschland)
-

Using stem cells following TBI

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Objectives: While no treatment strategies in Traumatic Brain Injury (TBI) are available, stem cells have emerged as putative therapeutic candidates. Endogenous stem cells can be activated following injury to provide local trophic support and exogenous stem cells can be transplanted to integrate with the host tissue. We present both functional and histological data in both stem cell transplantation and endogenous activation after TBI.

Methods: Adults rodents underwent a unilateral TBI. In the first experiments, we stereotactically injected human stem cells into the injury penumbra. In a separate study, following TBI, we modulated the Sonic Hedgehog signaling pathway to alter endogenous stem cell characteristics. In both experiments, brains were histologically assessed for cell type and cell maturation. Motor function and memory function were evaluated.

Results: In the cell transplantation experiments, transplant engraftment could be seen by 8 weeks. The transplant processes follow intact white matter tracts. Transplanted cells displayed a neuronal phenotype. Both motor performance and spatial memory were better compared to injured controls. In the endogenous cell experiments, endogenous stem cells were activated after injury, and were modulated following alteration of Sonic Hedgehog signaling. This was accompanied by improvements in motor performance compared to controls.

Conclusion: Stem cell therapy offers a potential treatment for TBI. Strategies to harness these cells include transplantation of cells into the injured site. Alternatively, there is the potential to harness the brain's own endogenous stem cells for repair by modulating regulatory pathways. Both strategies result in improved functional performance post-injury.

Diagnosis of a subdural haemorrhage in abusive head trauma: the absent falx cerebri consideration

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Objective: Head injury is common in children with an estimated annual incidence of 400 per 100,000 in the UK. Head injuries in children are typically due to falls, however a certain number can be non-accidental injuries (NAI). NAI in children is relatively common with an incidence rate of 14-40 cases per 100,000 under the age of 1 and the leading cause of death and disability in the under 1 age group (1,2).

The falx cerebri is composed of anterior and posterior parts, that join to form a single midline structure. We present a case of an anatomical variation of the falx cerebri diagnosed radiologically, that presented with subdural haemorrhage that may be confused into the category of NAI.

Methods: A literature review was conducted using pubmed. CT & MRI scans were used to aid the diagnosis.

Results: A literature review revealed two documented cases of absent anterior cerebral falx in adults. No cases were found in children. Baby A's blood test (FBC, U&E's and Coagulation) were normal. An US Scan on admission revealed prominent extra-axial spaces. A CT scan revealed bilateral hypodense frontal parietal temporal subdural collections. There was no evidence of a scalp haematoma or a skull fracture. The non-accidental injury screen was reported as negative.

An MRI scan was done to aid diagnosis. The MRI revealed the presence of bilateral subdural collections and there was T1 hyperintense linear abnormality in the posterior fossa, tent and along the falx above the cerebellum. A repeat MRI Scan six months later showed complete resolution of the subdural collections.

Conclusion: A baby presented to A&E with parents with an increasing head size (From 25th to 98th Centile) and bulging frontanelle. No associated injuries were found. The clinical examination was normal.

The initial scans indicated the presence of subdural collections. However the MRI scan revealed the absence of the anterior falx cerebri when reviewed by a consultant neurosurgeon and neuroradiologist. It was deemed that these subdural collections were resolving bleeds from minor trauma associated with the absent falx cerebri. We report the first case of subdurals associated with absent falx cerebri in a child and emphasise the importance of recognising anatomical abnormalities in children to prevent unnecessary heartache for families.

Clinical outcome of epidural haematoma (EDH) in the era of modern resuscitation and chain of survival

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Objective: Larger case series reviewing cohorts > 100 patients with EDH report data from more than 25 years ago. Outcome of EDH is thought to be depending on several clinical and radiological parameters. The aim of this study is to reevaluate if these paradigms have changed with regard to modern structures of resuscitation and chain of survival. Patients with TBI resulting from EDH in modern times might be different regarding age, co – morbidities and coagulation status. We analyzed predictors for outcome in patients with EDH treated by surgery.

Methods: A retrospective observational analysis was carried out. All included patients underwent surgery. Indication for surgery followed international guidelines. Retrospective data assessment obtained data reflecting the effectiveness of the chain of survival (arterial blood pressure on the scene, shock index and time interval between resuscitation on the scene and arrival in the emergency department), baseline characteristics (age, sex, abnormality in pupillary diameter, coagulopathy, degree of polytrauma using the injury severity score (ISS), neurological status, radiological findings and laboratory values. For the analysis we dichotomized patients into two groups with isolated EDH and the control group comprises EDH plus other intracranial traumatic injuries. The neurological outcome was measured by Glasgow Outcome Scale at discharge.

Results: 268 patients with EDH were treated from January 1997 until December 2012, 132 of which underwent surgery. The majority of patients with isolated EDH (65 % of all patients) had mild TBI (GCS 13 – 15), 19 % were comatose. The overall mortality was 6.8% (mortality for patients with GCS < 9 - 15 %). As expected, factors with a high significant ($p < 0.01$) impact on outcome were concomitant other intracranial injuries, brain midline shift and higher ISS reflecting a higher degree of polytraumatization. Alcohol intoxication was a significant ($p < 0.05$) predictor for unfavorable outcome (GOS 1-3). Interestingly, anticoagulants and GCS at admission had no significant impact on the outcome. A subgroup analysis of the patients in which the elements of the chain of survival are thought to play a crucial role (GCS < 8, patients, patients with high ISS) show that the most relevant factor for favorable outcome is the duration from the primary treatment on the scene until the arrival in the emergency room. Comparing our cohort with older published data in a matched pair fashion regarding the GCS showed that the outcome improved over the years.

Conclusion: The outcome of EDH is more favorable than decades ago most probably reflecting a well established chain of survival especially in patients with a high degree of polytraumatization and a low GCS. Anticoagulation does not play a decisive role for outcome. EDH presents a well treatable disease with a high chance for favorable outcome especially for patients with isolated EDH.

The financial outcome of traumatic brain injury: a single centre study

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Objectives: Severe traumatic brain injury (TBI) is a potentially devastating insult to the brain with high rates of fatality and neurological deficits. Evidence suggests TBI can result in substantial costs to the centre providing care, but there is an absence of data on financial outcome. We sought to present the experience of a Major Trauma Centre (MTC) in the United Kingdom and ascertain the financial implications of this healthcare provision, in particular detailed costs, reimbursement and the surplus or deficit accrued by the centre.

Methods: All cranial non-elective neurosurgical admissions with a TBI over 4.5 months (26th October 2014 to 15th March 2015) were analysed retrospectively, excluding cases of chronic subdural haematoma, at an MTC in England. Clinical and demographic data were collected alongside detailed cost and income data.

Results: Ninety-four patients were identified. The majority of patients presented with more than one diagnosis of cranial trauma. Average length of stay was 18.8±21.6 days. Total deficits as a result of treating this cohort amounted to £558,034. There was a significant association between (i) more complex presentations and (ii) a longer length of stay and the deficit accrued by the centre. The major drivers of the financial outcome were costs associated with wards, medical staffing and overheads.

Conclusion: There was a substantial deficit accrued as a result of the management of patients with TBI at an MTC. The more complex the presentation, extensive the intervention, and lengthy the stay, the greater the deficit accrued by the centre. The tariff payment system in the United Kingdom is not currently effectively reflecting the severity of injury or intensity of management of patients with TBI.

Intraoperative ICG-based cortical perfusion measurement in patients suffering from severe traumatic brain injury

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Objective: The pathophysiology of traumatic brain injury (TBI) largely involves the brains vascular structural integrity. We analyzed the value of an intraoperative cortical ICG-angiography in patients with TBI who underwent decompressive craniectomy to treat acute subdural hematoma.

Methods: ICG-derived fluorescence curves of cortex and cerebral vessels were recorded using a software integrated into a surgical microscope in 10 patients. The maximum intensity, rise time (RT), time to peak (TTP) and residual fluorescence intensity (FI) were estimated from cortical arteries, the parenchyma and veins. ICG-derived fluorescence parameters were correlated with the short-term outcome 3 months after discharge.

Results: Each five patients had a favorable and five an unfavorable outcome. Patients with a favorable outcome showed a significant longer RT in the arteries and a trend towards a significant longer RT in the veins. Overall mean residual FI was $47.5 \pm 6.8\%$ for the arteries, $45.0 \pm 7\%$ for the parenchyma and $57.6 \pm 6\%$ for the veins: The residual FI of the parenchyma and the veins was significantly higher in patients with an unfavorable clinical outcome. Patients with an unfavorable clinical outcome showed an altered shape of the ICG-derived fluorescence curve, a shorter increase of the ICG-derived fluorescence intensity in the cortical arteries and a significant higher residual fluorescence intensity. These observations are likely a correlate of an increased ICP, a capillary leak and a venous congestion.

Conclusion: Intraoperative quantification of the ICG-derived fluorescence might help to appreciate the clinical outcome in patients with severe TBI.

Treatment with direct oral anticoagulants does not increase in-hospital mortality in patients with acute subdural hematoma

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Objective: Direct oral anticoagulants (DOAC) are increasingly used for the treatment and prevention of thromboembolic events. Due to a lack of specific antidotes for the majority of DOAC, concerns exist regarding the management and outcome of respective patients presenting with intracranial haemorrhage. Here we present our experiences with patients suffering from acute subdural haematoma during DOAC treatment and compare the mortality rate to patients treated with vitamin K antagonists (VKA).

Methods: We retrospectively analysed all consecutive anticoagulated patients with acute subdural hematoma treated at our institution between 4/2015 and 6/2016. Patient characteristics as well as treatment modalities were analysed with specific focus on the rate of neurosurgical procedures, pro-haemostatic therapy and in-hospital mortality.

Results: A total of 76 patients were included in this analysis (DOAC: 37; VKA: 39). The median age was 79 years in both groups. The median GCS score on admission was 13 in VKA and 14 in DOAC. Patients treated with VKA received prothrombin complex concentrate significantly more often than patients treated with DOAC, but no significant differences regarding neurosurgical intervention were observed. A total of 34 VKA patients received prothrombin complex concentrate for anticoagulation reversal (87%) and 27 patients underwent neurosurgical intervention (69%). In patients treated with DOAC, 22 patients (59.5%) received prothrombin complex concentrate and 26 patients underwent neurosurgical intervention (70.3%). No differences were observed regarding the in-hospital mortality rates of both groups (DOAC: n=6; 16.2% / VKA: n=7; 17.9%).

Conclusion: Treatment with DOAC was not associated with higher mortality than VKA treatment in patients with acute subdural hematoma. Neurosurgical treatment is feasible and acceptable survival rates can be achieved despite the current lack of specific antidotes to factor Xa-inhibitors. In patients requiring anticoagulation therapy, treatment with DOAC should not be withheld from patients in fear of fatal bleeding complications.

MO.12 Pädiatrische Neurochirurgie 2

Montag Monday, 15.05.2017, 11.00 – 12.00 Uhr hrs

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- MO.12.01 *Accuracy of Ultrasound Guided Placement of Ventricular Catheters in First Time Pediatric VP-Shunt Surgery and Relation to Catheter Occlusion*
M. Kullmann* (Tübingen, Deutschland)
-
- MO.12.02 *The correlation of optic nerve sheath diameter (ONSD) using ultrasound and magnetic resonance imaging (MRI) in pediatric neurosurgical patients*
S. Kerscher* (Tübingen, Deutschland), K. Hockel, M. Schuhmann
-
- MO.12.03 *Assessment of intracranial pressure in pediatric neurosurgical patients using ultrasound determination of the optic nerve sheath diameter (ONSD)*
S. Kerscher* (Tübingen, Deutschland), D. Schoeni, F. Neunhöffer, M. Schuhmann
-
- MO.12.04 *Neuroendoscopy (lavage, clot reduction, septostomy) followed by surgical temporizing methods for posthemorrhagic hydrocephalus (PHH) in newborns-preliminary results*
S. Fleck* (Greifswald, Deutschland), A. El Damaty, S. Marx, K. Linnemann, E. EL Refaee, H. Schroeder, M. Heckmann
-
- MO.12.05 *Neurosurgical management in childrens and adolescents with NF2-associated vestibular schwannomas regarding growth control and hearing preservation.*
I. Gugel* (Tübingen, Deutschland), V. Mautner, M. Tatagiba, M. Schuhmann
-
- MO.12.06 *Is the concurrent installation of ventricular-peritoneal shunt and Ommaya reservoir in pediatric patients with posterior fossa tumor prone to infection?*
K. Lischka* (Essen, Deutschland), O. Müller, D. Pierscianek, U. Sure, N. El Hindy
-

Accuracy of Ultrasound Guided Placement of Ventricular Catheters in First Time Pediatric VP- Shunt Surgery and Relation to Catheter Occlusion

Marcel Kullmann¹

¹Neurosurgery University Hospital of Tübingen, Tübingen, Deutschland

Objective: Hydrocephalus (HC) is the most common surgically treatable neurological disorder in children and can be treated by the implantation of a ventricular shunt (VS). Shunt obstruction due to ventricular catheter (VC) obstruction is one of the primary causes for revisions. VC obstruction can be related to its position in the ventricle. Most VC placements are done freehand using anatomical landmarks. Previous studies showed that the use of neuronavigation and ultrasound (US) increased the accuracy of the VC location and reduced the proximal shunt failure rate in an adult and older children cohort. There was however no analysis of the long-time shunt survival in these patients. Our study evaluates the benefit of intraoperative US guidance during first time VC placement in children by postoperative verification its position and long-term proximal shunt survival. No data exist so far evaluating these parameters in an exclusive pediatric group.

Methods: This is a retrospective cohort study of children with HC treated at the University Hospital of Tuebingen in Germany between April 2009 and October 2015. 89 patients with a postoperative cranial imaging (sonography, MRI) clearly identified the location of VC were included in the final analysis. A scoring system was applied with regard to the location of the tip of the VC. Failures of the shunt system due to a VC obstruction were noted. We divided VC occlusions in *early* within the first three month and *late occlusion* between three and 9 month postoperatively.

Results: 63 ventricular catheters (71%) were implanted through a right sided burr hole versus 26 (29%) on the left. 63 patients (71%) received a frontal VC, 26 (29%) had an occipital position. In the first postoperative cranial imaging, 7 (8%) VC tips were close or touching the lateral wall of the ventricle, 20 (22%) close or touching the medial wall and 53 (59%) were positioned in the middle of the intended ventricle. In three cases, the tip of the catheter was located in the foramen of Monroe or within the third ventricle, one was in contralateral side and 5 (6%) were touching tumor tissue, choroid plexus or lying within the 4. ventricle. In 84 of 89 cases (94%), the VC tip was in the intended ventricle. Within the first 9 months 6 patients (6.7%) had a VC occlusion. 4 of these had an early, 2 a late revision. Regarding the point of entry the occlusion rates were the following: 4/26 (15%) of occipital catheters and 3/63 (3%) of frontal catheters. Regarding the initial position the occlusion rate was 2/53 (3.8%) for ideally placed catheters, and 4/35 (11.4%) in not-ideally placed catheters.

Conclusion: US guided VC placement is quick, safe, and has no extra cost. US in experienced hands is as precise as navigated procedures. The use of US seems to prolong VC longevity as optimized VC placement was associated to a much lower rate of obstruction. Therefore we strongly recommend US use as a routine tool for VC placements.

The correlation of optic nerve sheath diameter (ONSD) using ultrasound and magnetic resonance imaging (MRI) in pediatric neurosurgical patients

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Objective: Trans-orbital ultrasonographic measurement of the optic nerve sheath diameter (ONSD) is a sensitive, non-invasive and radiation-free technique to reliably identify potentially increased intracranial pressure (ICP) or, in case of a longitudinal assessment, changes of ICP over time. The spatial resolution of ultrasound is much higher than that of magnetic resonance imaging (MRI), thus ultrasound assessment is the gold standard of ONSD measurement. In uncooperative infants and small children awake determination of ONSD might be difficult or impossible. Thin slice T2-weighted MRI of the orbit, visualizing the optic nerve sheath, can serve as an alternative method to assess ONSD. MRI measurements have also their importance as previous values for comparison to a recent ultrasound assessment. This study thus investigates the accuracy and reliability of MRI versus ultrasound ONSD assessment in pediatric patients in neurosurgery.

Methods: The presented prospective study investigates 27 patients (age range 1 to 16 years) diagnosed with tumor (n=18), hydrocephalus (n=8), and other intracranial pathologies (n=1). Bilateral ONSD was quantified by ultrasound in a standardized way, i.e. 3 mm behind the optic nerve papilla using an 11MHz linear array transducer for a total of 3 measurements per eye. This was compared to simultaneously (usually within 24 hours) assessed ONSD on T2-weighted MRI of the orbit.

Results: Overall mean values for ONSD were 5.8 ± 0.9 and 5.7 ± 0.9 mm for ultrasound and MRI, respectively. There was a strong positive correlation between ONSD measured on MRI compared to ultrasound ($r= 0.938$, $p< 0.0001$). Bland and Altman analysis of the two methods showed a mean bias of -0.2 mm with limits of agreement of -0.8 and 0.4 mm. 24 out of 27 values were within the limits of agreement.

Conclusion: MRI-based determination of ONSD can serve as a reliable alternative if ultrasound assessment of ONSD is not possible for various reasons. It is of note, however, that MRI has the tendency to underestimate true ONSD. This needs to be taken into consideration when directly comparing ultrasound to MRI values in longitudinal assessment or in case MRI-based ONSD values are used to diagnose increased ICP according to thresholds. Large patients` series will be necessary to consolidate these first impressions.

Assessment of intracranial pressure in pediatric neurosurgical patients using ultrasound determination of the optic nerve sheath diameter (ONSD)

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Objective: In pediatric neurosurgery many pathologies are associated with raised intracranial pressure (ICP). Because of the need for diagnosing children non-invasively and radiation-free, ultrasonography is highly appreciated. Regarding detection of a possible ICP increase, ultrasound based measurement of the optic nerve sheath diameter (ONSD) has been proven to be a reliable method in children of any age group. This pediatric study aims to investigate a) the relationship between ONSD and invasively measured ICP and b) if ONSD values can guide the neurosurgeon in clinical situations with potentially increased ICP in pediatric neurosurgical patients.

Methods: The presented prospective study investigates 49 patients aged 1 month to 17 years (median age 6 years). Diagnoses included hydrocephalus (n=29), tumor (n=9), craniosynostosis (n=5), and other intracranial pathologies (n=6). ONSD was measured using 11 Mhz transducers, standardized 3 mm behind the globe, for a total of 3 measurements per eye. Dependent on diagnosis, the investigation was performed pre- and post-operatively or longitudinally over a period of time, respectively. In 12 patients the mean binocular ONSD was compared to invasively measured ICP.

Results: 12 patients underwent ultrasonography of the ONSD during invasive measurement of ICP. ONSD revealed dynamic changes that were directly proportional to ICP (e.g. ONSD 7.2/6.7/5.7/5.25 mm at ICP 20/14/8/4 mmHg). The correlation between ONSD and ICP was satisfactory, especially regarding the relatively small number of cases ($r = 0.61$, $p < 0.01$).

25 patients with clear symptoms of increased ICP underwent surgery to decrease ICP. All patients showed increased ONSD values before surgery (mean 5.89 ± 0.82 mm). Post treatment ONSD significantly ($p < 0.001$) decreased to a mean of 5.14 ± 0.8 mm. In 16 patients with moderate clinical signs of raised ICP, normal ONSD values (mean 4.78 ± 0.38 mm) were found. In those a wait-and-see strategy was applied and none needed a therapeutic intervention during follow-up. In four patients with mild or absent symptoms of raised ICP, increased ONSD values were found (mean 5.4 ± 0.29 mm). In those further invasive diagnostics were pursued.

The ONSD cut-off value with the highest diagnostic accuracy for detecting clinically relevant situations of increased ICP was 5.3 mm, with a sensitivity of 76%, specificity of 94% and odds ratio (OR) of 47.5.

Conclusion: In pediatric neurosurgical patients high-resolution ultrasound measurement of the ONSD appears to be a reliable, non-invasive and radiation-free technique to identify patients with potentially raised ICP. ONSD reacts quickly to changes of ICP and demonstrates a high diagnostic accuracy for detecting increased ICP. The potential role of ONSD is already promising as a first line screening tool in daily routine.

Neuroendoscopy (lavage, clot reduction, septostomy) followed by surgical temporizing methods for posthemorrhagic hydrocephalus (PHH) in newborns- preliminary results

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Objective: There is an on-going debate about the optimal treatment strategies for posthemorrhagic hydrocephalus (PHH) in premature infants. Recent studies show a reduction of shunt dependency after endoscopic lavage and clot removal.

To determine the role of endoscopic lavage, clot reduction combined with septostomy, followed by temporizing methods (ventricular reservoir, subgaleal shunting) in order to provide a lower shunt complication rate or even to reduce shunt dependency.

Methods: In 7 preterm infants (gestational week: 23-36 (mean 27), birth weight: 595-2400 g (mean 971)) and 1 term neonate (41 wks, 3155 g) suffering from intraventricular hemorrhages (grade II-III+) we performed endoscopic lavage with warmed Ringer solution (n=8), partial clot removal (n=8), septostomy (n=5) after 13-118 days after birth (mean 38.2) followed by ventricular reservoir or subgaleal shunting including intermittent punctures. The indications for operation were progressive ventricular enlargement, enlarging head circumference combined with symptoms of intracranial hypertension.

Results: Endoscopic procedures could be safely performed (Little LOTTA[®]-Ventriculoscopic System, Storz, Tuttlingen). No secondary hemorrhage or endoscopy related morbidity/mortality occurred. One premature infant died due to pulmonary insufficiency. Permanent shunting (incl. stent to fourth ventricle (n=1)) was performed after 14 -112 (mean 57) days after first operation. No avoidance of shunting was possible in this small cohort. Afterward, shunt revision was needed in one patient due to a suspected shunt obstruction during the follow-up period of 4-26 (mean 14) months. One intraventricular cyst occurred and could be endoscopically fenestrated.

Conclusion: Neuroendoscopic interventions seem to be safe treatment options for PHH in premature infants, and might reduce later shunt complications. Earlier and more complete clot removal may even reduce shunt dependency. Further prospective evaluations with larger cohorts and longer follow-up are needed.

Neurosurgical management in childrens and adolescents with NF2-associated vestibular schwannomas regarding growth control and hearing preservation

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Objective: To evaluate tumor growth rate and hearing outcome after decompression of the internal auditory canal (IAC) with or without tumor resection in NF2-associated vestibular schwannomas

Methods: In this retrospective study we reviewed twenty children and adolescent (9-18 years) with Neurofibromatosis Type 2 who had undergone decompression of the IAC with or without subtotal or total tumor resection between 2004 and 2016. The minimum follow-up was 1 year. Hearing outcome was assessed using pure-tone average, speech discrimination test, acoustic evoked potentials and was classified with known classification systems. Tumor volumetry was performed before and after surgery to control tumor growth rate using the Brainlab software. Pre- and postoperative facial grade were also recorded. 7 patients received postoperative chemotherapy.

Results: In total 30 surgeries (10 patients bilaterally and 10 unilaterally) were performed under continuous electrophysiological monitoring. All cases received decompression of the IAC. Respecting functional and anatomical preservation of the facial and acoustic nerve, total tumor removal was achieved in 18,75 % and subtotal tumor removal in 65,63% of the operated tumors. Facial palsy was postoperatively observed in 3 (30) cases. Following surgery, the majority of patients showed functional hearing preservation over several years. In all patients acoustic evoked potentials deteriorated before conventional hearing test.

Conclusion: Decompression of the IAC seems to be a useful procedure for hearing maintenance in NF2 patients, with very low morbidity. Ideal timing and association with chemotherapy can stabilize or even maintain tumor growth rate and hearing over the time.

Is the concurrent installation of ventricular-peritoneal shunt and Ommaya reservoir in pediatric patients with posterior fossa tumor prone to infection?

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Objective: Posterior fossa tumor (PF) is the most common brain tumor in children. Postoperative tumor protocol requires the application of intrathecal (ith) chemotherapy in certain cases. The installation of an Ommaya reservoir (OR) facilitates repeated ith application of chemotherapy. As many children with PF develop persistent hydrocephalus, installation of a ventricular-peritoneal shunt (VPS) device is mandatory as well. Many investigations cope with infection of either the OR, or VPS, but nothing has ever been reported about infection rate of simultaneously installed OR and VPS and repeated injection of chemotherapy. The aim of our investigation was to reveal complications with special respect to infection in this special situation.

Methods: We retrospectively reviewed the data of all children operated for PF in our department from 2011 to 2016. Inclusion criteria were simultaneously installed OR and VPS and application of ith chemotherapy. Data was analyzed with respect to age, sex, tumor entity, applied ith chemotherapy, infection and complications. Descriptive statistic was used to reveal differences.

Results: A total of 16 children (5 girls, 11 boys) with a median age of 7 years (range 4 months- 15 years) were included in the study. Predominant tumor entity was medulloblastoma in 13 (81.3%), PNET in 2 (12.5%) and ependymoma in 1 (6.2%) patient. There were no perioperative complications. In one child there was a wound dehiscence. 2 of the 16 (12.5%) children developed infections, which made VPS revision mandatory. OR remained in both cases. In one child *Acetivobacter* genomospecies 3 was found, in the other child suffering from fever, only cell count in CSF was elevated without detection of any microorganisms. Prior to OR and VPS installment, 15 of 16 children were provided with external ventricular drainage. In all cases (16/16) methotrexate was applied ith; in one child additional Etoposid was administered.

Conclusion: Despite installation of two intraventricular devices, repeated application of ith chemotherapy, adjuvant therapy with radiation and i.v. chemotherapy, infection rate is comparable to VP shunt installation.

MO.13 Vaskuläre Neurochirurgie 2

Montag Monday, 15.05.2017, 11.00 – 12.20 Uhr hrs

- MO.13.01 *Functional approach for brainstem cavernomas: surgical results in the era of electrophysiology and functional imaging.*
M. Tatagiba, G. Lepski, M. Moraes* (Natal RN, Brazil), F. Günther, M. Liebsch, U. Ernemann
-
- MO.13.02 *Endovascular treatment of Benign Intracranial Hypertension caused by venous stenosis: Indications, treatment success and analysis of the literature*
C. Roder* (Tübingen, Deutschland), K. Hockel, M. Schuhmann, J. Hempel, U. Ernemann, M. Tatagiba
-
- MO.13.03 *Intra-arterial ICG fluorescence video-angiography - a feasible method for intraoperative perfusion assessment?*
E. Suero Molina, W. Schwind, W. Stummer, M. Holling, E. Suero Molina* (Münster, Deutschland)
-
- MO.13.04 *Contrast enhancement special sequence MRI of the aneurysm wall can be a predictor to treat*
A. Petridis* (Düsseldorf, Deutschland), J. Cornelius, H. Steiger, B. Turowski, R. May
-
- MO.13.05 *AneurysmFlow; a novel angiographic tool to analyse cerebral blood flow.*
A. Tortora* (Düsseldorf, Deutschland), J. Cornelius, H. Steiger, A. Petridis, B. Turowski
-
- MO.13.06 *A scoring system for the identification of the ruptured aneurysm in patients with aneurysmal subarachnoid hemorrhage and multiple intracranial aneurysms.*
A. Hadjiathanasiou* (Bonn, Deutschland), T. Welchowski, M. Schmid, S. Brandecker, P. Schuss, H. Vatter, E. Güresir
-
- MO.13.07 *Introduction of intraoperative monitoring does not necessarily improve outcome in elective aneurysm clipping*
T. Greve* (München, Deutschland), V. Stöcklein, J. Tonn, C. Schichor
-
- MO.13.08 *Surgical treatment of innocent intracranial aneurysms - clinical outcome in a series of 128 patients*
S. Schmidt* (Greifswald, Deutschland), S. Fleck, J. Baldauf, H. Schroeder
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Functional approach for brainstem cavernomas: surgical results in the era of electrophysiology and functional imaging.

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Objective: Although cavernous malformations of the brainstem are benign vascular malformations, they can cause severe neurological deficits when bleeding. Since the introduction of magnetic resonance imaging (MRI) and the improvement of microsurgical techniques, surgical removal of superficially located lesions has been performed with low morbidity rates. Due to higher morbidity rates, surgery of deep-seated brain stem cavernomas is still a matter of controversial debate. For proper consideration of the best treatment strategy, it is essential to consider the actual surgical risks, in light of the recent advances in functional brain imaging, intra-operative imaging and electrophysiological monitoring (IOM). In this single-center retrospective study we compare the surgical results of a series of superficial and deep-seated brain stem cavernomas.

Methods: Forty-two consecutive cases of brain stem cavernomas treated surgically within a 12-years period were retrospective reviewed. Pre-operative neuroradiological examinations included T2- and T2*-weighted MRI sequences as well as diffusion tensor imaging (DTI) to visualize brainstem fiber tracts. Neuronavigation and brainstem mapping were used to custom tailor the surgical approach and to determine a safe point of entry. IOM included systematic MEPs and SEPs of the lower and upper extremities, facial EMG & MEPs, and AEPs as well as EMG of the motor brainstem cranial nerves. The clinical outcome was assessed by the Glasgow Outcome Scale at the last follow-up (mean 3.2 years, 2 months to 6.7 years).

Results: All patients suffered at least one hemorrhage before undergoing surgical treatment. Symptoms included headaches (n=22 / 50%), hypaesthesia (n=10 / 23.8%), gait disturbance (n=16 / 38.1%), diplopia (n=25 / 59.5%), facial palsy (n=11 / 26.2%), hearing loss (n=9 / 21.4) and difficulties in swallowing (n=6 / 14.2%). Fourteen deep-seated lesions were 1 to 5 mm distant from the surface of the brainstem. Using 3D tractography, neuronavigation, brainstem mapping, and blunt microsurgical dissection under continuous intra-operative monitoring, total removal of the lesion was achieved in 24 patients (85.7%) in the superficial group and in all deep-seated lesions. New cranial nerve deficits were observed in four patients (14.28%) after surgery in the superficial group and 2 (14.28%) in the deep-seated. Out of four patients with incomplete removal of the cavernoma, all superficially seated, re-bleeding was observed in one patient during follow-up. Overall, the GOS improved from 4 to 5 after surgery.

Conclusion: Our results show that a tailored approach guided by electrophysiology, navigation and sometimes tractography yields a high chance of total resection of CMBs even in deep-seated lesions, with low morbidity rates.

Endovascular treatment of Benign Intracranial Hypertension caused by venous stenosis: Indications, treatment success and analysis of the literature

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Objective: Benign intracranial hypertension (BIH), traditionally termed pseudotumor cerebri, is a challenging disease complex with diverse etiologies. Because of improved MR venography sequences and interventional angiography techniques, the focus has shifted within the last decade to an appreciation of possible venous causes, namely non-thrombotic sinus stenosis. Although not wide-spread yet, successful treatment of this pathology by interventional venous stenting has been repeatedly described. Here we report our experience of the last three years in diagnosis and treatment of BIH-patients with venous stenosis.

Methods: We analyzed our prospectively collected patient database of patients with BIH and suspected venous stenosis. The clinical files and imaging data were studied and analyzed for: Pre- and (possible) postinterventional symptoms, ophthalmology examinations, BMI of patients, grade of the stenosis in MRI and angiography, intravenous pressure proximal and distal of the stenosis, follow up and imaging results after venous stenting.

Results: We have investigated 10 patients with BIH and suspected venous stenosis in MR venography. 9/10 patients were affected by the complete clinical triad of headaches, visual disturbances and papilledema. A significant stenosis could be confirmed in conventional angiography in 8/10 patients. By retrograde venography, the pressure gradient proximal and distal to the stenosis was measured (mean values; range in mmHg): proximal (21.75; 15-28), distal (6.6; 3-9), pressure-gradient (15.2; 5-25). The stenosis was located at the sagittal sinus in 3 patients, and the transverse sinus in 5 patients. If located in the transverse sinus, the contralateral sinus was hypoplastic in four and stenotic in one patient. Venous stenting was indicated in all patients, however due to a F-V-Leiden mutation in one patient, stenting was performed in 7/8 patients only. Clinically, stenting was successful (significant improvement of the symptom-triad) in 6/7 patients (85%), one patient had continuous symptoms, which however disappeared after a significant weight loss. Radiographically, stenting was successful in all patients with a persisting significant reduction of the stenosis. In one patient a redilatation of the stent was needed twice until the result was finally satisfactory. No complications occurred during treatment or follow up (26 months (mean)). These numbers correlate with findings in the literature, where successful treatment is reported in 85-95%, the need for re-stenting in 10% and relevant complications in 5%.

Conclusion: Standardized diagnostic protocols in patients with BIH should include MR venography. In cases with suspected stenosis, angiographic confirmation and pressure gradient determination by retrograde venography is necessary, before venous stenting can be discussed as a safe and long-lasting treatment option.

Intra-arterial ICG fluorescence video-angiography – a feasible method for intraoperative perfusion assessment?

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Objective: Indocyanine green (ICG) facilitates the intraoperative visualization of blood vessels and vascular malformations after intravenous injection. ICG fluorescence video-angiography can be used as a tool before and after neurosurgical clipping of aneurysms in order to evaluate cerebral local perfusion and vascular filling. Given the long distance the intravenous ICG bolus arrives diluted, reducing the resolution of images acquired. In the present study we evaluate the usefulness of selective intra-arterial ICG injection during aneurysm surgery and compare it to conventional ICG intravenous angiography.

Methods: Six patients undergoing elective middle cerebral artery aneurysm clipping were assessed. Rise time and transit time after intravenous (5mg ICG) and selective intra-arterial (2.5mg ICG) injections after aneurysms occlusion were compared. DSA was performed intraoperatively. Rise time was defined as the interval between 10% and 90% of the maximum fluorescence signal. Transit time was measured between proximal arteries and adjacent tissue.

Results: After intravenous injections rise time 2.6 +/- 145.1 seconds in the M2-branches, whereas during the selective intra-arterial injection rise time was 418 +/- 92 milliseconds. Rise time in the M2-branches and adjacent parenchyma after intravenous and intra-arterial ICG application was statistically significant ($P < 0.0001$). Transit time between M2-branch and adjacent parenchyma between intravenous and intra-arterial injection was likewise statistically significant ($P = 0.0002$). After intra-arterial injection, pulse-synchronous peaks were recorded and a clearer and detailed vision of parent vessels could be achieved.

Conclusion: Intra-arterial ICG angiography is a feasible method with potential for assessing blood flow and cerebral perfusion during surgery of intracranial aneurysms. It provides information about circulation parameters in parent arteries and adjacent cerebral tissue, being probably more sensitive to acquire perfusion deficits. Though actual analysing tools are not designed to interpret intra-arterial ICG injection, providing the right evaluation software intra-arterial ICG angiography could play a role in the surgery of intracranial aneurysms and arterio-venous malformations.

Contrast enhancement special sequence MRI of the aneurysm wall can be a predictor to treat

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Objective: There is still controversy on when to treat a cerebral aneurysm. Size, shape etc. are factors which influence the treatment decision. However additional factors like inflammation of the aneurysm wall are still to be evaluated. With contrast enhancing MRI there is the possibility to identify such aneurysm wall inflammation and to specify if this inflammation could indicate a risk of rupture.

Methods: Eight patients with cerebral aneurysms were evaluated with a black blood sequence MRI with contrast enhancement (CE) to identify any contrast enhancing areas in the aneurysm wall. The blood signal in this MRI sequence is suppressed and the contrast enhancement in the aneurysm wall is well visualized. The patients were treated in our hospital in 2016.

Results: Of the eight patients (mean age: 53 years) one patient suffered a subarachnoid haemorrhage and received the MRI after stent and coil embolization. The rest of the patients (N=7) received the MRI imaging before treatment. Three patients were treated conservatively. One patient with a giant MCA aneurysm (3 cm) who was moribund and could not be treated (82 y.o.) is under MRI controls for 2 years and has no progression of his aneurysm nor has he a CE of the aneurysm wall. A second patient with MCA aneurysms (mirror aneurysms) did not receive treatment since the aneurysms are < 5mm. Both aneurysms show no CE in their walls and no progression in the last 12 months. The third patient has a fusiform aneurysm of the PICA and in the first MRI the wall of the aneurysm was strongly CE positive. After Aspirin (ASS 100 mg) the CE in the aneurysm wall was decreasing and the aneurysm size was regressive (in 2 months follow up). Four patients received endovascular treatment. In all four patients the aneurysms were > 8 mm and showed a CE in their walls. In two cases there was an aneurysm growth in the time of 2 months.

Conclusion: Although the data are preliminary there is a CE in the aneurysm wall in aneurysms which grow and in aneurysms > 8 mm. In aneurysms of stable size there was no CE in their walls. CE could become a predictor for aneurysm growth and a parameter for the decision to treat a cerebral aneurysm.

AneurysmFlow; a novel angiographic tool to analyse cerebral blood flow

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Objective: The evolution of endovascular therapy led to development of flow diversion. A permeable stent reduces flow near the aneurysm neck while preserving flow into the parent vessel and neighboring branches. This provides delayed thrombosis of the aneurysm and causes shrinkage of the sac as the thrombus organizes, followed by growth of new endothelium that excludes the aneurysm from the circulation. Unexpected incomplete aneurysmal occlusion and onset of late hemorrhagic complications in few patients, through mechanisms that are not fully understood, led investigators to analyze flow changes related to stent implantation. Based on optical flow algorithms (OFA), a novel angiographic tool called AneurysmFlow describes flow patterns qualitatively and quantifies relative flow changes in the aneurysm before and after stent implantation (MAFA ratio). MAFA ratio was already correlated with aneurysm occlusion after flow diversion. In this study we describe the technique and an initial experience with 15 patients with intracranial aneurysm.

Methods: The OFA is based on both 2D digital subtraction angiography (DSA) and 3D-rotational angiography (3DRA). After 3DRA scan, a DSA projection avoiding overlapping of the aneurysm with other branches is chosen to acquire flow sequences with 60 frames per second after dye injection. The contrast fluid is transported in a pulsatile fashion from heart activity. This pulsatile dye progression is analyzed for the Optic Flow calculation. The OFA is an image-processing algorithm that extracts velocity and flow data analyzing temporal and spatial variations of pulsatile dye attenuation. The 2D DSA sequence is then projected on 3DRA data to generate a 2D flow map, a representation of detector velocity fields. A monodimensional Optic Flow scheme is then applied iteratively on the contrast wave map to extract the velocity profile. Mean Aneurysm Flow Amplitude (MAFA) ratio is derived by comparing the average projected velocity of the blood flow in the aneurysm before and after flow diverter implantation.

Results: In all patients, we were able to qualitatively describe flow both into the aneurysm and in parent vessels and neighboring branches. Direction of flow was represented with a vectorial map and velocity was superimposed using a color scale. Temporal resolution during pulsatile cardiac activity produced cyclical variation of the vector's direction and color intensity.

Conclusion: AneurysmFlow is an innovative angiographic tool, with the ability to qualitatively analyze cerebral flow and quantitatively compute cerebral flow variations. Further investigations may help to optimize the use of flow diverters and flow information provided using this technique may be applied in current neurosurgical practice.

A scoring system for the identification of the ruptured aneurysm in patients with aneurysmal subarachnoid hemorrhage and multiple intracranial aneurysms

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Objective: 20% of patients suffering from aneurysmal subarachnoid hemorrhage (SAH) are harboring multiple intracranial aneurysms (MIAs). However, identifying the ruptured aneurysm in patients with MIAs can be challenging. Therefore, we developed a statistical model for the prediction of the ruptured aneurysm in patients with SAH and multiple potential bleeding sources at the time of SAH ictus.

Methods: Between 2012-2015, 424 patients harboring 791 aneurysms were admitted to the authors institution. Patients were included in a prospectively conducted database. Aneurysm and patient characteristics, as well as radiological findings were included and analyzed. A generalized, additive boosting model was used for analysis.

Results: According to the statistical prediction model the main factors used for assessing the rupture score in patients harboring multiple aneurysms were: 1) aneurysm size, 2) aneurysm localization and 3) aneurysm shape. A simplified version of the scoring system was produced for the use in the clinical setting. A score for each aneurysm is calculated according to these three factors. The aneurysm with the highest score poses the highest possibility of being the bleeding source.

Conclusion: This new and simple prediction tool might provide support for neurovascular teams for treatment decision in SAH patients harboring multiple aneurysms. However, prospective evaluation is necessary.

Introduction of intraoperative monitoring does not necessarily improve outcome in elective aneurysm clipping

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Objective: Intraoperative neuromonitoring (IOM), particularly somatosensory evoked potentials (SEP) and motor evoked potentials (MEP) evolved as standard of care in a variety of neurosurgical procedures. However, impact of IOM on outcome of elective microsurgical clipping of unruptured intracranial aneurysms (EC-UIA) is yet unknown. Our aim was to retrospectively analyze the neurological outcome before and after IOM introduction for EC-UIA at our neurovascular center and to evaluate it regarding feasibility and clinical impact.

Methods: Patients undergoing EC-UIA were included from 2007 until 2014. IOM was introduced starting 2011 and was routinely conducted in all cases by properly trained technicians. For median and tibial nerve SEP and extremity muscle MEP monitoring, cut-off criteria for abnormality were defined as amplitude diminishment of > 50%. MEP stimulation was bihemispheric and suprathreshold. Procedures before (136 procedures, NIOM-group) and after introduction of IOM (138 procedures, IOM-group) were analysed regarding SEP/MEP changes and neurological outcome.

Results: Both groups did not significantly differ in sex distribution, risk factors, aneurysm diameter and location. Median follow-up was 3 months (IOM-group) and 6 months (NIOM-group) respectively ($p < 0.001$). Age was higher in the IOM-group (57 vs. 54yrs., $p = 0.01$).

In the IOM-group, SEPs were obtained in 138 cases (100%), MEPs in 137 cases (99%). IOM showed significant changes in 18 cases, 4 of which exhibited postoperative hemisyndrome (true-positive cases). 12 patients showed no new deficits, 1 each suffered from ataxia and coma. Those 14 cases were defined as false-positives and were not included in risk stratification, since they cannot be detected by SEP/MEP monitoring. 5 patients with new hemisyndrome did not meet cut-off SEP/MEP alterations (false-negative cases). Sensitivity of SEP/MEP monitoring was 44%, specificity 89%, positive predictive value 22%, negative predictive value 89%. False-positive rate was 11%, false-negative rate was 56%.

In the IOM-group, there were 18 new postoperative deficits (13%; 4.3% permanent), 9 of which affecting pathways covered by SEP/MEP (hemisyndrome), 9 not detectable (cranial nerve deficits, seizures, ataxia, coma). In the NIOM-group there were 19 new deficits (14%; 6% permanent, including 7 hemisyndromes).

The groups neither significantly differed in count ($p = 0.093$) and nature ($p = 0.832$) of postoperative deficits nor in their recovery-rate ($p = 0.169$).

Conclusion: Introduction of SEP/MEP monitoring did not affect overall neurological outcome in EC-UIA at our department due to a low sensitivity and high false-negative rate. Considering the low risk profile in most clipping procedures and complications, principally undetectable by SEP/MEP-monitoring, future studies should address IOM-vindicating risk factors, as well as modified IOM techniques.

Surgical treatment of innocent intracranial aneurysms – clinical outcome in a series of 128 patients

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Objective: To evaluate the outcome and surgical risk after innocent intracranial aneurysm surgery.

Methods: We retrospectively evaluated data of a consecutive series of 119 patients who underwent 128 surgeries for one or more innocent intracranial aneurysms.

Results: 119 patients (83 females, 36 males, mean age at surgery 52.6 years) underwent 128 procedures including 121 clippings, 4 wrappings, one trapping, one aneurysm excision with end-to-end anastomosis and one STA to MCA EC-IC bypass additionally to clipping of a giant left sided MCA aneurysm in an awake brain surgery procedure. In 9 cases two or more aneurysms were clipped within one procedure. Most aneurysms were discovered incidentally and the patients had no (29) or unrelated (64) symptoms or diseases. 14 patients were diagnosed within a subarachnoid hemorrhage of a different ruptured aneurysm before. Three patients showed symptoms of nerve or brain compression (one at the brain stem, one in the internal acoustic meatus, mimicking a vestibular schwannoma and one via compression of the optic nerve). Aneurysm location (138 aneurysms) included MCA (75), Acom (20), ICA (21), PCA (3), SCA (3), PICA (2), AntChoroidal (2), ophthalmic (2), pericallosa (3), ACA (3), Pcom (3) and AICA (1). There was no intraoperative aneurysm rupture. 13 patients with 14 aneurysm surgeries were lost to follow-up. Postoperative angiographic control of the treated aneurysms showed a complete occlusion in 103 cases (90.4%) and minor aneurysm remnants in 4 patients. Major remnants were seen in 7 patients (6 expected as 5 of them underwent aneurysm wrapping, 1 unexpected). Two clips were revised. One patient with an Acom-aneurysm died of a remote midbrain and pons hemorrhage; two other patients (one Acom and one MCA aneurysm) had a remote cerebellar hemorrhage without permanent symptoms. One patient with an Acom aneurysm, who could not successfully be coiled before, died of a malignant bifrontal infarction after clipping. Permanent deficits included two cases with hemiparesis (one in a patient with aneurysm wrapping occurring 7 weeks after surgery). Transient complications included 5 mild hemipareses, 6 mild aphasias, one seizure with a short resuscitation episode (patient recovered completely), 3 CSF leakages (one revised, two treated with a lumbar drain) and 1 epidural hematoma due to perioperative anticoagulative treatment requiring evacuation. One patient needed evacuation of a chronic subdural hematoma at the 3 months follow-up. In 75.4 % of the cases patients presented no neurological deficits during the perioperative course, 92.1% were discharged without neurological deficits.

Conclusion: Clipping of innocent intracranial aneurysms is a safe procedure providing good neurological outcome and lasting protection from aneurysm rupture.

MO.14 Tumor 2 – gemischt A

Montag Monday, 15.05.2017, 11.00 – 12.00 Uhr hrs

- MO.14.01 *Integrative analysis of surgical, neurological and oncological outcomes of corpus callosum glioblastoma multiforme*
P. Franco Jimenez* (Freiburg, Deutschland), D. Heiland, P. Reinacher, W. Masalha, B. Mercas, O. Schnell
-
- MO.14.02 *AXL tyrosine kinase receptor is widely activated in glioblastoma tissue and is associated with a significant shorter overall survival*
J. Onken* (Berlin, Deutschland), R. Josefine, H. Claudia, V. Peter
-
- MO.14.03 *Charlston Comorbidity Index (CCI) as an additional prognostic factor for glioblastoma patients*
M. Barz* (München, Deutschland), C. Delbridge, J. Gerhardt, S. Bette, B. Meyer, J. Gempt
-
- MO.14.04 *Clinical characteristics and molecular assignment of cerebellar glioblastoma*
B. Hong* (Hannover, Deutschland), B. Rouzbeh, M. Nakamura, C. Hartmann, J. Krauss
-
- MO.14.05 *Comparison of the effect of different treatment strategies within discrepant healthcare systems on survival of glioblastoma patients*
P. Stavrinou* (Köln, Deutschland), S. Katsigiannis, C. Hamisch, G. Stranjalis, B. Krischek, R. Goldbrunner
-
- MO.14.06 *High therapy compliance in patients treated with optune does not depend on demographic data, stage of disease or treatment duration*
M. Misch* (Berlin, Deutschland), J. Onken, P. Vajkoczy
-

Integrative analysis of surgical, neurological and oncological outcomes of corpus callosum glioblastoma multiforme

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Objective: Glioblastomas are the most aggressive tumors of the central nervous system. When they appear in the Corpus callosum, the typical growth pattern extends to both cerebral hemispheres, most commonly within the frontal lobe, but an invasion of the both parietal and both occipital lobes can also be found. The involvement of the Corpus callosum usually leads to poor clinical course and a gives the patient a dismal prognosis. Until now, the surgical benefit of this subgroup of glioblastomas is still unknown and there is no consensus about the optimal therapy strategy for these patients. The purpose of this study was to analyze the overall- and progression-free survival of corpus callosum glioma (CCG) and evaluate the functional outcome of patients who underwent biopsy compared to those who received surgical resection.

Methods: In this retrospective study, 58 patients were treated at the Department of Neurosurgery, Medical Center - University of Freiburg between 2009 and 2015. Indication for either stereotactic biopsy or surgical resection was based on individual patient characteristics. Time depended variables were analyzed by Cox-regression model. Primary endpoints were overall survival (OS) and progression-free survival (PFS). Secondary endpoints were NANO score, Karnofsky Performance Scale (KPS) and clinical parameters. Binomical variables were analyzed by univariate and multivariate regression models and chi-square test. The alpha-level was determined at 5% to achieve a statistical power of 0.8.

Results: Out of 58 patients 29 were biopsied and 29 underwent surgical resection (8 gross-total resection (GTR), 21 partial resection (PR)). Age and sex were balanced in both groups. Between the biopsy and partial resection groups, no significant differences were found (HR 1.02, PR mean OS 137 days, Biopsy OS 105 days $p > 0.05$). Patients who underwent a GTR showed a significant improvement in overall and progression-free survival (OS 600 days, $p < 0.01$). In all three groups, no significant differences between postoperative neurological outcome were found (PR NANO 2.38, NANO Biopsy 1.63, NANO GTR 1.88).

Conclusion: Patients with CCG may have significantly improved OS if GTR can be achieved with a moderate risk of an additional postoperative deficit. Surgical treatment, which failed a gross-total resection, does not improve the outcome of CCG and can even produce more neurological deficits. Therefore, in the individual treatment decision, if gross total resection is feasible, it should be the first treatment option. If this is not possible, biopsy and rapid adjuvant therapy should be recommended.

AXL tyrosine kinase receptor is widely activated in glioblastoma tissue and is associated with a significant shorter overall survival

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Objective: Receptor tyrosine kinase AXL (RTK-AXL) is regarded as suitable target in glioma therapy. Here we evaluate the expression and localization of the biological active RTK-AXL (P-AXL) in human glioblastoma (GBM) tissue in order to define a suitable subgroup for future anti-AXL therapy.

Methods: We analyzed 100 tissue samples from newly diagnosed glioblastoma patients according to their P-AXL expression. The tissue was analyzed in terms of P-AXL expression by immunohistochemistry and immunofluorescence, antibody specificity has been proven with positive and negative controls. Co-staining of P-AXL and mesenchymal markers like vimentin and fibronectin was performed. Results were correlated with survival data.

Results: We stained a total of 100 patients and showed that P-AXL is expressed in each patient. We identified three main distribution patterns within the tumor. In 9% of patients P-AXL was found exclusively in perivascular/vascular regions, in 91% P-AXL was expressed in hypercellular tumor tissue, pseudopalisades or vessels. P-AXL is found in mesenchymal-like areas and is co-localized with mesenchymal markers like vimentin and fibronectin. Expression of P-AXL in tumor tissue and tumor vasculature is associated with a significant decreased overall survival (Hazard ratio 2.349, 95% confidence interval 1.069 to 5.162, *p=0.03).

Conclusion: The broad expression of P-AXL among our patient collective and impaired survival in these patients strongly suggest that P-AXL serves as a target in the majority of GBM patients. Its role in EMT (epithelial to mesenchymal transition) and (neo-) vascularization of GBMs needs to be further investigated.

Charlston Comorbidity Index (CCI) as an additional prognostic factor for glioblastoma patients

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Objective: Many established prognostic factors for glioblastoma (GB) patients like histopathological diagnosis, molecular status and extent of resection can only be assessed postoperatively. The only well-known prognostic clinical factors that can be obtained preoperatively are age and the Karnofsky performance scale (KPS). This study aimed to optimize preoperative diagnostics and to find other prognostic factors for glioblastoma patients.

Methods: We retrospectively included 223 patients (92 female, 131 male), mean age 64.0 years (+/-13.6), with surgery for a newly diagnosed GB from May 2006 to December 2015 with available Charlson comorbidity index (CCI) including data about cardiovascular diseases or other relevant comorbidities. Preoperative age, sex, comorbidity status quantified by the CCI, KPS and adjuvant treatment regimes were recorded for each patient. Pre- and postoperative tumor volume was manually segmented.

Results: The median overall survival was 9.7 months (95% confidence interval (CI) 7.1-12.3). Preoperative KPS > 70% (P<0.001), CCI <5 (P=0.001) and age <60 years (P<0.001) were associated with significantly improved survival in univariate analysis.

Including these preoperative factors only in multivariate analysis, preoperative KPS (≥ 80 / < 80) is the only significant prognostic factor (HR 2.57 [1.84-3.58], P<0.001), whereas CCI (< 5 / ≥ 5) missed statistical significance (HR 1.32 [0.89-1.95], P=0.172). Including also other well-known prognostic factors like MGMT-status and extent of resection (EOR), preoperative KPS showed statistical significance (P<0.001), whereas CCI did not reach significance (P=0.515).

Subgroup analysis for patients ≥ 60 years showed that beneath preoperative KPS, CCI (< 5 / ≥ 5) is a prognostic factor (HR 1.88 [1.11-3.19], P=0.029). Including also MGMT status and EOR in this subgroup analysis, CCI missed statistical significance (P=0.220).

Conclusion: Besides established prognostic factors like age and KPS CCI could be a valuable additional factor in preoperative estimation of individuals' prognosis especially for older patients.

Clinical characteristics and molecular assignment of cerebellar glioblastoma

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Objective: A cerebellar localization can be found in only approximately 0.4 - 3.4% of patients with glioblastomas. Therefore, tumor characteristics, survival, and the efficacy of therapies are not yet clear. The present study reports 8 patients with cerebellar glioblastoma treated in our institution over a period of 12 years.

Methods: Medical records and histology of 8 patients were analyzed retrospectively. EGFR amplification, pyrosequencing of H3F3A and BRAF, BRAF:KIAA1549 fusion and expression of IDH1(R132H) and ATRX were determined to obtain genetic characteristics of the tumors. Patients' treatment history, including surgical interventions, radio-/chemotherapy regimens, radiological images, progression-free survival (PFS), and overall survival (OS) were reviewed.

Results: Six adult and 2 children (mean age 36.3 ± 26.4 years; range 1 to 67 years) underwent tumor resection via medial or lateral suboccipital craniotomy. Both children harbored a H3F3A K27M mutation, classifying tumors as diffuse midline glioma WHO grade IV H2-positive in accordance to the WHO 2016 classification. In one of these tumors also showed a BRAF V600E mutation. Interestingly, this child had a PFS of 64 months. Both children underwent radio-/chemotherapy. Several surgeries were required due to LCS disturbance. In the 6 adult patients, mutation of IDH1 R132H is expressed in 2 glioblastomas, indicating a relation to typical supratentorial IDH-mutant gliomas. In both cases, the patients initially had presented with such lesion, which, however, were anatomically distant to the cerebellar glioblastoma. Another patient with a cerebellar glioblastoma initially had a mesencephalic pilocytic astrocytoma. The cerebellar tumor neither revealed a BRAF:KIAA1549 fusion nor a BRAF V600E mutation. The remaining 3 patients exhibited neither clinical nor molecular characteristics that would allow an assignment to a particular entity. Mean PFS was 4.83 months. Mean follow-up time was 15.3 ± 21.9 months and median OS was 12 months in all patients.

Conclusion: Glioblastomas of the cerebellum can be found in all age groups. Our results indicate that a fraction of such tumors are presumably metastatic lesions due to tumor cell migration or cerebrospinal fluid seeding. Some tumors, however, may indicate original glioblastoma of the cerebellum. Mutation of BRAF V600E may have a stronger biological significance than H3F3A K27M alterations. In comparison to patients who had supratentorial glioblastoma, the OS of patients with cerebellar glioblastoma appears to be lower.

Comparison of the effect of different treatment strategies within discrepant healthcare systems on survival of glioblastoma patients

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Objective: Whether an interdisciplinary treatment approach within a well-financed, robust healthcare system plays a significant role on the survival of glioblastoma patients remains unclear. The goal of this study was to examine survival in parallel cohorts of glioblastoma patients from two university hospitals with different treatment strategies functioning within two completely different healthcare systems.

Methods: We retrospectively analyzed two matched cohorts from a university hospital in Greece (188 patients) and Germany (189 patients). In both centers patients were treated with surgery followed by radiochemotherapy according to the Stupp protocol. In case of recurrence, Greek patients were treated rather conservatively and the further therapeutic decisions were made by the primary treating physician as German patients were treated more aggressively, with a strategy that was developed within an interdisciplinary tumorboard. The primary endpoint was progression-free and overall survival. Groups were compared using the Kaplan-Meier method for survival estimates.

Results: Both groups were comparable with respect to baseline parameters. Only 17% of Greek patients versus 88% of German patients received second line treatment. Progression-free survival was similar for both patient cohorts (PFS_{Greece} = 9,9 months vs PFS_{Germany} = 9,0 months, p=0,37). Median survival was 12 months (95% CI, 9,4-14,5) and 16,6 months (95% CI, 13,3-19,8) for Greek and German patients respectively (p=0,02).

Conclusion: Treatment steered by a neurooncological tumorboard, functioning within a well-financed-health care system and favoring second line treatment for recurrent glioblastomas was associated with significantly better overall survival.

High therapy compliance in patients treated with optune does not depend on demographic data, stage of disease or treatment duration

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Objective: Optune is a novel treatment that is approved for the treatment of patients with newly diagnosed glioblastoma (GBM) and also for patients with recurrent high grade glioma (HGG). Alternating electric fields of low intensity (1-3 V / cm) and intermediate frequency (200 kHz) are delivered to the tumor in the brain. Here we report our experience with TTFIELDS in 26 patients at Charité over the last year and the factors that could affect therapy compliance.

Methods: Since June 2015 twenty-six patients with a diagnosed HGG have been treated with Optune in our hospital. Patients were carefully introduced to the therapy. Compliance is a crucial indicator for the acceptance but also for the efficacy of the therapy. According to the EF-11 trial and PRiDe registry optune therapy should be applied at least 18 h per day (Compliance >75 %) to be efficient. Compliance reports were generated at the monthly routine check of the device.

Results: Patients had newly diagnosed GBM (n=17) or first recurrence of HGG (n=9). Mean age at therapy start was 47.9 years (range 25-70). Gender distribution female to male was 1:1.7. Mean treatment compliance was 87% in the total population (range 67-96%) independent of age, sex (female 85.3±5.8 % vs. male 87.6±7.3 % [Mean±SD], p=0.41) and stage of disease (newly diagnosed 88.5±5.4 % vs. recurrent 84.2±8.0 % [Mean±SD], p=0.12). Regression analysis reveals no negative correlation between age and compliance or inter-sex differences. Our data showed that the compliance is not negatively correlated with time on treatment and compliance in time course was stable once therapy was established..

Conclusion: Therapy compliance is not negatively influenced by age. In contrast, older patients even at the age of around 70 years showed a remarkable average compliance far above 80%. Furthermore, compliance was equal in female and male population. In the light of a female to male ratio of 1:1.7 reflecting a typical GBM patient population (1:1.64), we assume that Optune is accepted by both male and female patients without difference. In addition, there was no significant difference of compliance between patients with newly diagnosed and recurrent GBM suggesting that the stage of the disease does not play a big role in the acceptance and feasibility of the treatment. Since the therapy takes time to be fully effective, compliance should be maintained on a high level. Compliance did not correlate negatively with time on treatment nor drop substantially below 75% in time course. Once patients are on therapy they are compliant over the course of treatment, making Optune suitable for long-term therapy.

MO.15 Joint Meeting Session 3 – Cervical Spine 1

Montag Monday, 15.05.2017, 11.00 – 12.20 Uhr hrs

- MO.15.01 *Radiation dose and image quality of the cervical spine computed tomography using a 150 kVp protocol with spectral beam shaping: an intra-individual non inferiority study in patients with suspected cervical foraminal stenosis*
M. Arp* (Mannheim, Deutschland), J. Gawlitza, G. Ehrlich, T. Henzler, D. Hänggi, J. Perrin
-
- MO.15.02 *Non-navigated Posterior C1-C2 Fusion: Experience of 130 Cases*
N. Buchmann* (München, Deutschland), A. Rienmüller, J. Kirschke, J. Gempt, B. Meyer, Y. Ryang
-
- MO.15.03 *Low-grade infection in spinal instrumentation: Is this the real cause of screw loosening?*
E. Shibani* (München, Deutschland), I. Janssen, I. Mohammed, F. Ringel, J. Lehmberg, B. Meyer
-
- MO.15.04 *Do we know the outcome predictors of Cauda Equina Syndrome (CES)? A retrospective single center analysis of 60 patients and a suggestion for a new score*
J. Lemcke* (Berlin, Deutschland), A. König, M. Danne, L. Amelung, P. Bartels, U. Meier
-
- MO.15.05 *Common data elements in degenerative cervical myelopathy (CODE-DCM): Identifying the patient and carer perspective*
C. Munro* (Cambridge, United Kingdom), F. Akter, P. Hutchinson, B. Davies, M. Kotter
-
- MO.15.06 *Carer quality of life reduced in degenerative cervical myelopathy (DCM)*
O. Mowforth* (Cambridge, United Kingdom), I. Sadler, B. Davies, M. Kotter
-
- MO.15.07 *Surgery remains the research focus in degenerative cervical myelopathy (DCM) research*
S. Goh* (Cambridge, United Kingdom), C. Ota, C. O'Neil, B. Davies, M. Kotter
-
- MO.15.08 *Adjustment of axial load characteristics of polyurethane foam in a porcine spine model for spondyloplasty*
W. Polanski, H. Jiang, M. Molcanyi, J. Zivcak, D. Ruess, C. Reinshagen, G. Schackert, B. Rieger* (Dresden, Deutschland)
-

Radiation dose and image quality of the cervical spine computed tomography using a 150 kVp protocol with spectral beam shaping: an intra-individual non inferiority study in patients with suspected cervical foraminal stenosis

Mirko Arp¹, Joshua Gawlitza², Gregory Ehrlich¹, Thomas Henzler², Daniel Hänggi¹, Jason Michael Perrin¹

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²Institut für Klinische Radiologie und Nuklearmedizin, Universitätsmedizin Mannheim, Medizinische Fakultät, Universität Heidelberg, Mannheim, Deutschland

Objective: Cervical spine computed tomography (csCT) is the modality of choice for pre-surgical evaluation of osseous foraminal stenosis and central spinal stenosis as a result of ossification of the posterior longitudinal ligament (OPPL) or stenotic osteophytes. However, radiation dose of csCT is crucial especially in younger patients due to a non-negligible irradiation of the thyroid gland. With the introduction of 3rd generation dual source CT (DSCT) 150 kVp imaging with spectral beam shaping by means of a dedicated 0.6 mm Sn filter has become clinically available. High tube voltage settings are generally superior to standard CT protocols for the assessment of high contrast structures but were traditionally associated with a higher radiation dose when compared to standard 120 kVp protocols. The novel 150 kVp protocol with additional Sn filtration generates a sharper x-ray beam spectrum which filters low energy photons of the polyenergetic x-ray beam.

The aim of this prospective study was to evaluate this novel csCT protocol in patients with suspected osseous stenosis in comparison to a standard csCT protocol.

Methods: 59 patients with suspected cervical foraminal stenosis prospectively underwent csCT using a 150 Sn protocol as well as a standard 120kV protocol on a 3rd generation dual-source CT. Radiation dose parameters (DLP and CTDIvol) were recorded and compared between both protocols. Furthermore, image quality was subjectively and independently evaluated by an experienced neurosurgeon and radiologist in direct comparison using a 5 point Likert scale regarding overall image quality, foraminal stenosis and other relevant pathologies.

Results: The DLP (dose-length product) and CTDI (CT dose index) were significantly reduced using the new protocol. In 59 proceeded images we found a mean radiation dose reduction of 34,4% (DLP) and 37,5% (CTDI). The image quality overall was rated superior by the radiologist in 54 of the 59 cases and in 52 by the neurosurgeon. Foraminal stenosis analysis showed the highest subjective image quality score 5 [range 4-5] in the new protocol. The standard 120 kVp datasets image quality was rated inferior in comparison to the new protocol (120 kV: 4 [range 3-5]. Evaluation of disc herniations was also rated superior using the 150 kV protocol (mean score 4 vs 3).

Conclusion: csCT performed with 150 kV Sn filtration leads to a significant radiation dose reduction when compared with standard 120 Kv csCT. Furthermore, the image quality of the novel 150 Sn csCT protocol has shown to be superior to previous standard protocols. This new image modality could therefore aid to improve individual surgical strategies due to the superior image quality whilst simultaneously reducing the preoperative radiation exposure of patients. Additional studies are needed to determine whether soft tissue pathologies, in particular herniated discs, can be sufficiently ascertained.

Non-navigated posterior C1-C2 fusion: experience of 130 cases

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Objective: The best and safest technique for C1-C2 fusion for atlantoaxial instability is a matter of debate. Transarticular screw insertion as well as C1-C2 stabilization in a modified Goel-Harms technique using C1-lateral mass screws and C2-isthmic screws are feasible surgical options which bare specific challenges. To improve the safety of these procedures, neuronavigation is used with increasing frequency. However, even though results with regard to accuracy are promising, OR-times are significantly longer when using navigation. We present our series of 130 patients using freehand, fluoroscopy-guided C1-lateral mass and C2-isthmic screw insertion.

Methods: Clinical database of the neurosurgical department was screened for patients treated for traumatic atlantoaxial instability with posterior C1-C2 fixation. Positioning of the screws was rated using the Gertzbein & Robbins classification. Vertebral artery injuries, further treatment of this complication and/or revision surgeries for malpositioned screws were assessed.

Results: In 130 patients (median age 79 years \pm 17,4; range: 7 to 99years) a total of 589 screws were inserted. Median OR-time was 112min \pm 45min; range: 37 to 254min). Fracture type 2 according to Anderson & D'Alonso occurred in 93, type 3 in 9 and atypical C2 fractures in 8 cases, combined fractures of C1 and C2 in 19 cases and a C1 fracture in one case. Good screw position according to Gertzbein & Robbins grades A (0mm extraosseous position) and B (\leq 2mm extraosseous) was achieved in 486 (83%) and 70 (12%) screws, respectively. Grade C (\leq 4mm extraosseous) and D (\leq 6mm extraosseous) occurred in 18 (3%) and 14 (2%) screws, respectively. A complete malposition (Grade E, $>$ 6mm extraosseous) was seen in one screw (0,2%). Vertebral artery canal breaching occurred in 30 screws (5%) with a complete obliteration in only 4 screws (0,07%, three in C1 and one in C2). Endovascular treatment (Coiling) was necessary in one case. None of the patients suffered clinically apparent vascular complications. Revision surgeries due to malpositioned screws were performed in nine patients (6 in C1 and 3 in C2, Revision rate 7%).

Conclusion: Freehand, fluoroscopy-guided posterior fusion of atlantoaxial fractures by C1-lateral mass and C2-isthmic screws is a safe and feasible technique also without the use of neuronavigation. The risk of vertebral artery injury is low but not to be underestimated.

Low-grade infection in spinal instrumentation: Is this the real cause of screw loosening?

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Objective: We investigated the hypothesis that many aseptic screw-loosening revisions in spinal instrumentations are in fact low-grade infections and not due to mechanical screw overload.

Methods: A prospective observational study was performed. All patients undergoing spinal instrumentation revision surgery between August 2015 and August 2016 were screened. In the study group all patients with an indication for revision due to screw loosening on CT-scan were included. In the control group those needing revision for adjacent disc disease were included. The rate of low-grade infection using a sonification fluid culture and routine swab culture were analyzed.

Results: 48 patients met all inclusion criteria. 44 patients were enrolled; thereby 24 (55%) cases and 20 (45%) cases were in the study and control groups, respectively. Median age was 70.6 years (range 40-83). 22 patients (46%) were male.

Low-grade infections were identified in 42% and 20% of cases in the study and control group, respectively. All of those patients received postoperative antibiotic treatment.

Conclusion: Almost half of all patients presenting with symptomatic screw loosening following Instrumentation of the spine had a low-grade infection. The clinical relevance is still not clear, as 20% of the patients without screw loosening also had a low-grade infection.

Do we know the outcome predictors of Cauda Equina Syndrome (CES)? A retrospective single center analysis of 60 patients and a suggestion for a new score

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Objective: Despite the awareness and familiarity of almost every medical professional with the Cauda Equine compression Syndrome (CES), risk factors for a poor prognosis of the disease remain elusive. Even the relationship between subsequent outcome and the time elapsed from the time of appearance of symptoms to surgery taking place remain obscure.

The aim of our study, therefore, was to analyze a relatively large population of our own patients studied consecutively, in order to identify outcome predictors for CES and to propose a clinical score for CES symptoms.

Methods: We screened the hospital's electronic database retrospectively for patients admitted with CES between 2001 and 2010. Since our hospital is a superregional trauma center with standardized emergency room procedures, all patients included in the study underwent the same routine. Using baseline data, we analyzed the following parameters: duration of symptoms, length of time between diagnosis and imaging, respectively, surgery; pre- and postoperative pain, motor deficits, reflex changes, urinary and bowel dysfunctions, reduced anal wink, saddle anesthesia, genital or perianal sensations and residual urine. The semi-quantitative assessment of the neurological outcome was performed by application of the Berlin CES score.

Results: Surprisingly, we were not able to identify any single parameters that could reliably predict the outcome of the disease.

We were able to show statistically significant correlations between a high preoperatively Berlin CES score (i.e., a weighted summation of bladder dysfunction, rectal dysfunction, genital sensation, perianal sensation, rectal tone and saddle anesthesia) and a poor outcome regarding the postoperative existence of perianal ($p < 0,001$) and genital ($p = 0,001$) hypesthesia, as well as reduced rectal tone ($p = 0,0047$). There was no significant interference of bladder or bowel function.

Conclusion: Although we analyzed a relatively large cohort, we were not able to identify single parameters that were capable of reliably predicting the outcome of patients with CES. Nonetheless, we were able to show that consideration of multiple parameters of symptomatology would enable an improvement in making a prognosis. In conclusion, we propose establishing a simple semi-quantitative clinical score of the main symptoms of CES.

Common data elements in degenerative cervical myelopathy (CODE-DCM): Identifying the patient and carer perspective

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Objective: Effective inter-study comparison of treatment studies for Degenerative Cervical Myelopathy (DCM) is limited by variable outcome reporting¹. CODE-DCM is a consensus process aiming to standardise this. This sub-project aimed to identify the outcomes from a patient and carer perspective.

Methods: Using the Delphi process, DCM patients (N=5) and their carers (N=4) were interviewed about the impact of the condition on patients. Results from the systematic reviews¹ and patient research priorities² were disseminated, and further discussion recorded. The groups were merged, results shared and categorised by mutual agreement.

Results: 41 effects were reported by patients and 11 by carers. These were categorised into: arm/leg function (P 22; C 27), immobility (P 20; C 0), pain (P 17; C 9), psychosocial (P 12; C 18), sleep (P 10; C 9), genitourinary issues (P 7; C 18), sensation (P 5; C 0), symptom variability (P 5; C 18), and breathing (P 2; C 0). (P x; C y: % of effects reported by patients and carers in each domain).

Conclusion: DCM affects both patients and their carers in a variety of ways. Symptom variability, breathing and sleep are not currently measured in DCM treatment studies. This now needs to be validated in a larger cohort.

References:

1. Davies BM et al. Reported Outcome Measures in Degenerative Cervical Myelopathy: A Systematic Review. *PloS One*. 2016;11(8).
2. Davies BM et al. What are the research priorities in degenerative cervical myelopathy? In: *SBNS Autumn Meeting 2016*

Carer quality of life reduced in degenerative cervical myelopathy (DCM)

O. D. Mowforth¹, I. Sadler¹, Benjamin M. Davies¹, Mark R. N. Kotter¹

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Objectives: DCM can leave patients with permanent disability and reliant on others for support. The impact of the disease on their carers is unknown. This project used the Care Related Quality of Life (CarerQol) instrument to measure this.

Methods: An internet-based survey was conducted. Self-reported carers of patients with DCM were recruited using Social Media, Google Adwords[®] and the Myelopathy.org community. CarerQol 7D (burden) and VAS (happiness) scores, alongside patient (including Nurick disease severity and pain scores) and carer demographics were collected (N=110). Missing data analysis was performed. Full survey responses (N=49) were analysed. Correlations (Spearman's rho) and between group differences (one-way ANOVA) were performed ($p < 0.05$).

Results: Mean CarerQol-7D was 64.7 ± 20.7 . Mean CarerQol-VAS was 6.20 ± 2.30 . Carers reported financial (47%), own mental (73%) or physical health (69%) consequences. Disease characteristics correlated weakly with carer burden (Nurick $r = .26$, $p = .073$ and limb pain ($r = .13$, $p = .390$)) and carer happiness (Nurick $r = -.12$, $p = .428$). Age, gender and length of time caring did not influence CarerQol measures.

Conclusions: Carer quality of life is affected by DCM. Whilst current participant numbers hinder statistical significance and limit the strength of conclusions, patient disease characteristics may not explain the reduced CarerQol. Further study, including focus on carer characteristics is required to elucidate the widely unappreciated consequences of informal care provision.

Surgery remains the research focus in degenerative cervical myelopathy (DCM) research

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Objective: DCM is the most common cause of spinal cord dysfunction worldwide. Despite significant global research interest, many patients remain significant handicapped by this condition. Our objective was to quantify research activity and the prevailing themes in DCM research over the last 20 years.

Method: We conducted a systematic review of clinical human trials exclusively on DCM, published since 1st January 1995. EMBASE and MEDLINE were searched for "Cervical" AND "Myelopathy". Results (N=2633) were hand searched for inclusion. Initial research themes were taken from a previous review [1], and iteratively expanded. Study characteristics and research themes were recorded for shortlisted articles. Spearman's Rho was used for correlations.

Results: 1396 trials were identified, which included a total of 4040741 patients. Research originated largely from Japan (31%), North America (23%) or China (11%). Most data concerned patients undergoing surgery (59%), and the predominant research theme was the type of surgery (71%). Other common themes included imaging (18%) and prognostication (7%). Research activity has increased over time (Rho=0.94, p=0.001) and the type of surgery remains its predominant theme across all years. Over the past ten years there has been increased research focus on imaging (Rho=0.754, p=0.007) and epidemiology (Rho=0.934, p<0.001). Over the same period that has been a decreased focus on electrophysiology (Rho=0.891, p<0.001).

Conclusion: DCM research activity is increasing, yet focus remains on the type of surgery. Imaging and electrophysiology are emerging research themes.

References: [1] Davies BM et al. Reported Outcome Measures in Degenerative Cervical Myelopathy: A Systematic Review. *PLoS One*. 2016;11(8).

Adjustment of axial load characteristics of polyurethane foam in a porcine spine model for spondyloplasty

Witold Polanski¹, Hongzhen Jiang², Marek Molcanyi³, Jozef Zivcak⁴, Daniel Ruess³, Clemens Reinshagen⁵, Gabriele Schackert⁶, Bernhard Rieger⁷

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Objective: Polymethylmetacrylate (PMMA) bone cement is widely used in the vertebral body. PMMA has about seven to ten times higher elastic modulus than normal cancellous bone what increases stiffness of PMMA augmented vertebral body by 174%. While augmentation with PMMA is highly successful in stiffer bony conditions, a significantly increased risk of adjacent fractures was found in osteoporosis. New osteoporotic fractures occurred at the adjacent levels after vertebroplasty with PMMA in 82%. Therefore, biomechanical axial load characteristics of adjustable polyurethane foam (PU foam) were analyzed in a porcine model for its alternative use as cancellous bone filler in osteoporosis or as a replacement of a vertebral body together with a new expandable device, made of titanium. In preparation of an intervertebral fusion concept in osteoporosis without using any pedicle screws adjustable PU foam as filler of vertebral cancellous bone was targeted. For the treatment of fractures or vertebral body replacement biocompatible and to lysine degradable foam was generated. For its use in osteoporosis, also non-biodegradable foam is available.

Methods: The adaptability of PU foam referring to compressive strength and stiffness was tested in a porcine model by comparing biomechanical behavior of vertebrae filled with PU foam with normal and hollowed vertebrae. Porcine lumbar vertebrae of pigs slaughtered at the age of 14 months were randomly split into four groups: A, B, C, D. Group A was normal vertebral body. Group B, C and D were defined hollowed with a specially designed router: through 8mm borehole ventral to the transverse process nearly complete cancellous bone was removed. This position of the borehole was chosen because the dorsolateral approach for implantation of a two-dimension expandable container was effective. Vertebrae of group C and D were filled with adjustable PU foams of different ratios. The compressive strength and stiffness of vertebral bodies in all four groups were recorded and analyzed.

Results: The strength and stiffness in all of the hollowed groups were lower than group A. However, the difference was not statistically significant between group A and group C ($p > 0.05$), and were obviously different between group A and group B or group D ($p < 0.01$ and < 0.05). Moreover, the strength and stiffness after filling foams in group C or group D were significantly greater than in group B ($p < 0.01$ and < 0.05).

Conclusion: In developing a spinal fusion system for patients suffering from osteoporosis without the use of any pedicle screws there was a demand of an augmentation material of adjustable stiffness to avoid adjacent fractures in osteoporosis. This study compared the compressive strength and stiffness between vertebrae filled with new adjustable biocompatible PU foams and normal vertebrae in a porcine model to demonstrate its adaptability in stiffness according surgical requirements.

MO.16 Funktionelle Neurochirurgie 2

Montag *Monday*, 15.05.2017, 11.00 – 12.10 Uhr *hrs*

- MO.16.01 *Keynote Lecture - Spinale Neurostimulation zur Schmerztherapie*
Lars Büntjen (Magdeburg, Deutschland)
-
- MO.16.02 *Assessment of rechaging, satisfaction, confidence and adverse Events of rechargeable internal pulse Generators as Initial neurostimulators in patients with deep brain Stimulation for movement disorders*
M. Jakobs* (Heidelberg, Deutschland), M. Kloß, A. Unterberg, K. Kiening
-
- MO.16.03 *Burst or tonic stimulation? Results from a prospective placebo controlled, double blinded, study - 2y follow up*
J. Vesper, P. Slotty, J. Maciaczyk, S. Schu, P. Slotty* (Düsseldorf, Deutschland)
-
- MO.16.04 *Complications of deep brain stimulation for secondary dystonia in the early postoperative period (30-day morbidity): experience in 49 patients*
A. Wloch* (Hannover, Deutschland), M. Abdallat, A. Saryyeva, C. Blahak, M. Wolf, C. Schrader, J. Runge, J. Krauss
-
- MO.16.05 *DBS electrode implantation of the posterior subthalamic area for treatment of essential tremor: proposal of MRI-based anatomical landmarks*
A. Nowacki* (Bern, Switzerland), I. Debove, M. Oertel, M. Schuepbach, C. Pollo
-
- MO.16.07 *Diffusion connectivity parcellation based analysis of electrode positions in the subthalamic nucleus*
A. Zolal* (Dresden, Deutschland), W. Polanski, G. Schackert, S. Sobottka
-

Assessment of recharging, satisfaction, confidence and adverse Events of rechargeable internal pulse Generators as Initial neurostimulators in patients with deep brain Stimulation for movement disorders

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²*Neurologische Klinik, Universitätsklinikum Heidelberg, Heidelberg, Deutschland*

Objective: Rechargeable internal pulse generators (r-IPGs) for deep brain stimulation (DBS) promise a longer battery life and cost effectiveness compared to non-rechargeable IPGs. However, patients need to learn to check the battery capacity and perform the recharging process to ensure continuous therapy.

Methods: n=35 consecutive adult patients with movement disorders that underwent DBS electrode placement with implantation of a r-IPG were assessed with a standardized questionnaire. They were asked to report on their recharging routine, user confidence, satisfaction and adverse events. Patients were asked to assess the level of difficulty of the individual steps and the overall recharging process on an ordinal scale awarding 1 to 5 points.

Results: 89% (n=31) patients responded and were available for data analysis. n=21 patients received DBS for Parkinson's Disease, n=8 for essential tremor and n=2 for dystonia at a mean age of 63.3 years. The mean follow up was 21.2 months. n=7 patients have partners or nursing services check and recharge the IPG. The recharging takes an average of 57.6 minutes. 90,3% felt confident using their IPG after a mean of 2.1 weeks and 1.6 training sessions. 97% of patients prefer their r-IPG over a conventional one. n=3 patients experienced inability to recharge their IPG at some point. One patient experienced battery depletion and interruption of stimulation because of inability to recharge. The overall recharging process as well as each individual step was rated as „easy“ at a median score of 4.0 out of 5 points. Old age was not associated with more adverse events or a lower rating for the recharging process.

Conclusion: : Choosing a r-IPG during initial DBS surgery is safe and associated with a low number of adverse events even in older patients. Handling and recharging the IPG is considered as "easy" by the vast majority of patients. Most of the patients undergoing DBS for movement disorders will profit from the advantages of r-IPGs.

Burst or tonic stimulation? Results from a prospective placebo controlled, double blinded, study – 2y follow-up

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Objective: Spinal cord stimulation is an established method for treatment of chronic pain in FBSS patients. In the last decades only tonic stimulation patterns were used to modulate the pain. There were several reports that indicate that burst stimulation offers other opportunities and advantages. The goal of this study was to evaluate the pain level during placebo stimulation, burst stimulation, 500 Hz tonic stimulation with tonic 40-50 Hz stimulation as a baseline and to show long-term outcome among this population.

Methods: The study was designed as a double blind, randomized, prospective, cross over study. 20 patients were enrolled and completed the study at the investigational site. The patients were randomized to one of six treatment sequences. Twenty patients with FBSS and a pre-existing SCS system each received 3 treatment allocations in random order for a period of 1 week: Tonic 500 Hz Stimulation, Burst Stimulation, and Placebo Stimulation.

Results: The primary outcome measure was overall pain intensity measured on a numerical rating scale (NRS), 6.9 (baseline) vs. 4.2 (tonic) ($p < 0.001$), tonic vs. 2.08 (burst) ($p < 0.001$). Secondary outcome measures were pain quality measured using the Short Form McGill Pain Questionnaire (SFMPQ). Additional data were collected relating to pain related disability measured using the Oswestry Disability Index (ODI). Mean overall NRS and SFMPQ scores were not significantly different between Tonic 500 Hz Stimulation and Placebo Stimulation. Although the lowest mean ODI score was observed under Burst Stimulation, no significant differences were found between the ODI categories. No adverse events occurred, and Burst Stimulation was significantly preferred by 17 patients (80%). Positive results sustained during the long-term follow up. After two years mean VAS score under burst stimulation was three (range 0-6) ($p < 0.001$), one pat. died, one was lost for FU, one suffered from stroke and was switched off.

Conclusion: The lowest mean NRS and SFMPQ scores were observed under Burst Stimulation. For the Burst Stimulation treatment group, mean NRS and SFMPQ scores were significantly decreased compared with the other treatment groups. Overall, Burst Stimulation resulted in significantly better constant pain relief and improved pain quality during the 2y follow-up.

Complications of deep brain stimulation for secondary dystonia in the early postoperative period (30-day morbidity): experience in 49 patients

Andreas Wloch¹, Mahmoud Abdallat¹, Assel Saryyeva¹, Christian Blahak², Marc Wolf², Christoph Schrader³, Joachim Runge¹, Joachim K. Krauss⁴

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³*Medizinische Hochschule Hannover, Klinik für Neurologie, Hannover, Deutschland*

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Objective: Deep brain stimulation (DBS) has been shown to be efficacious in the treatment of primary dystonia (idiopathic and inherited dystonia). There is less experience in, however, secondary dystonia (acquired dystonia). Since patients with secondary dystonia, who are often more disabled, may be more vulnerable to postoperative complications we aimed to investigate the 30-day morbidity in a large cohort of patients with secondary dystonia operated over a period of 19 years.

Methods: From 1997 until 2016, a total of 49 patients (27 women and 22 men; mean age 43,5 years (range 13-77)) with secondary dystonia underwent DBS with electrodes implanted either in the thalamic Nucl. ventralis intermedius (Vim) or the posteroventral lateral globus pallidus internus (GPi). Most frequent cause of for dystonia was cerebral palsy in 17 patients.

Results: There were no intraoperative complications or complications in the early postoperative period related to surgery. The electrode location was corrected in 2 instances. Two patients developed a wound infection, one patient had a subdural hematoma and subcutaneous collection of cerebrospinal fluid (CSF). Three weeks after DBS the subdural hematoma and CSF resolved.

Conclusion: The 30-day morbidity rate in DBS for secondary dystonia is comparable to that in primary dystonia. DBS surgery may be offered to patients with secondary dystonia without concerns about higher morbidity.

DBS electrode implantation of the posterior subthalamic area for treatment of essential tremor: proposal of MRI-based anatomical landmarks

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Objective: Deep Brain Stimulation (DBS) is an approved treatment option for therapy of refractory essential tremor (ET). Although evidence exists about its therapeutic effect, the optimal location of stimulation to improve tremor is still a matter of debate. Apart from the Ventral Intermediate Thalamus (VIM), the posterior subthalamic area (PSA) including the Dentato-Rubro-Thalamic-Tract (DRTT) has more recently been proposed as an appropriate target. The objective of our study is to present our MRI-based targeting procedure and correlate it with the stimulation site, clinical outcome and DTI-based fiber tracking identification of the DRTT.

Methods: We present a prospective series of 9 patients with unilateral or bilateral DBS implantation in the PSA. T2-weighted MRI was used to target the PSA on axial slices 2-3 mm below midcommissural point (MCP) within the white matter between red nucleus and subthalamic nucleus using iPlan Net 3.0 (BrainLab). Fiber tracking of the DRTT was performed in each patient. Stimulation site was obtained by calculation of the position of the active contact and its corresponding Volume of Tissue Activated (VTA). Active contact positions and VTA were correlated to clinical outcome.

Results: The mean position of the active contact was LAT 10.54; AP -3.80 and VERT -1.59 mm with reference to MCP. Projection of the mean active contact position and its corresponding VTA onto the Morel stereotactic atlas revealed a stimulation site within the PSA in the proximity of the DRTT. This was correlated to DTI fibertracking. DBS resulted in 60% tremor reduction 3-6 months postoperatively on the Fahn–Tolosa–Marin Tremor Rating Scale ($p < 0.0001$, two-way-ANOVA).

Conclusion: DBS of the PSA is effective in the treatment of ET. Our MRI-based anatomical landmarks seem to be reliable to target the PSA in each individual case. Our DTI findings suggest that the DRTT is involved in the efficacy of PSA DBS, although DRTT is not clearly identifiable in each patient.

Diffusion connectivity parcellation based analysis of electrode positions in the subthalamic nucleus

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Objective: The functional specialization of various regions within the subthalamic nucleus (STN) seems to play a role in the effectivity of treatment with deep brain stimulation (DBS). Diffusion tensor based analyses have been shown to enable the parcellation of the STN into distinct subregions. We attempted to evaluate the utility of connectivity based parcellation for the evaluation of the deep brain stimulation electrode positions in the subthalamic nucleus.

Methods: The location of the DBS electrodes has been studied in relation to the connectivity based parcellation of the STN in four hemispheres. Segmentations of cortical regions corresponding to the BA 4 and 6 and the pallidum have been obtained using Freesurfer. STN was segmented manually using preoperative T2 scans. Probabilistic fiber tracking parcellation using FSL was used to create a parcellation of the subthalamic nucleus. The resulting images were fused with the postoperative CT scan in order to evaluate the position of the electrode in relationship to the individual parcellations. **Results:** Connectivity based parcellation was possible in all four hemispheres and showed a distinct pattern of STN subregions. The region with predominantly pallidal connections was the largest with approximately 74% (average 1091 mm³) of the total volume of the STN, the region connecting mostly to BA6 occupied 22% (average 323 mm³) of the total STN volume, and the region connecting predominantly to the BA4 occupied approximately 4% (average 53 mm³) of STN volume. In all four cases, the electrodes were located at the boundary between the pallidal subregion and the BA6 subregion within the STN.

Conclusion: Probabilistic diffusion based connectivity parcellation of the STN can be combined with postoperative CT scans in order to obtain information on electrode location in relationship to STN subregions. Further analysis of available data is needed to evaluate the potential utility of this technique in MRI-based targeting of the electrodes.

MO.17 Joint Meeting Session 4 – Various 1

Montag Monday, 15.05.2017, 11.00 – 12.20 Uhr hrs

- MO.17.01 *Profile of patients referred to the emergency neurosurgical service in whom intervention is deemed futile*
A. Kumaria, C. Santos, A. Dapaah* (Nottingham, United Kingdom), H. Ingale, S. Horwarth
-
- MO.17.02 *Surgical checklist the introduction of a novel neurosurgical postoperative checklist improved postoperative care*
A. Hall* (Aberdeen, United Kingdom), P. Bhatt
-
- MO.17.03 *Timing of emergency referrals to neurosurgery*
D. Fountain* (Cambridge, United Kingdom), K. Honney, W. Sage, A. Joannides
-
- MO.17.04 *Out of programme experience in UK neurosurgery trainees – optimising the transition back into clinical practice*
R. deSouza* (London, United Kingdom), M. Amarouche, B. Cheserem, J. Lam, C. Talias
-
- MO.17.05 *Neurosurgical clinical research and the EU research registry*
C. Turner* (Cambridge, United Kingdom), P. Hutchinson
-
- MO.17.06 *"I'm not afraid of death"- A survey on preferences concerning surgical measures among patients aged 75+*
C. Unterhofer* (Innsbruck, Austria), W. Ho, K. Wittlinger, M. Ortler, C. Thomé
-
- MO.17.07 *Patients with Cushing's disease need illness support apart from good neurosurgery*
A. Grzywotz* (Essen, Deutschland), B. Kleist, S. Siegel, C. Gammel, M. Buchfelder, I. Kreitschmann-Andermahr, O. Müller
-
- MO.17.08 *Considerations regarding repatriation of patients from a neurosurgical view - lessons learned?*
G. Freude* (Ulm, Deutschland), C. Schulz, U. Mauer, U. Kunz, D. Ritter
-

Profile of patients referred to the emergency neurosurgical service in whom intervention is deemed futile

Aruna Kumaria¹, C. Santos¹, Andrew Dapaah¹, Harshal Ingale¹, Simon P. S. Horwarth¹

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Objectives: To identify patient factors and disease characteristics including diagnosis, severity of neurological insult, associated injuries/illnesses, co-morbidities, pre-morbid status and quality of documentation.

Methods: Retrospective study of all patients referred to the on-call neurosurgery registrar over a 9 month period (September 2014 to April 2015) in whom neurosurgical intervention was deemed futile.

Results: 100 patients were identified, representing 2.2% of all emergency referrals, most of who were referred by emergency departments (86%). Mean age of patients was 72 (range 16-93). Diagnoses included trauma (31%), spontaneous intracerebral haemorrhage (46%), subarachnoid haemorrhage (11%) and ischaemic stroke (7%). Cardiorespiratory arrest had occurred in 9%. Mode Glasgow Coma Score on referral was 3 (range 3-9, mean 4.5). Unreactive pupils were present in 81%.

A significant proportion of patients had been taking anticoagulant (20%) and antiplatelet therapy (29%). Co-morbidities in referred patients included active cancers (10%), dementia (11%), cerebrovascular disease (12%), chronic kidney disease (4%) and ischaemic heart disease (8%). Frailty or non-independent functional status was documented in 19%.

Quality of documentation, including reasons why intervention was considered futile, was to a satisfactory standard in 80% and all cases had been discussed with a Consultant Neurosurgeon. Only in 16% was re-referral suggested should the patient improve clinically and these were mainly in patients with poor grade subarachnoid haemorrhage.

Conclusion: This study sheds light on the profile of patients in whom emergency neurosurgical procedures are deemed futile and not in the patients' best interests. An understanding of this category of patient may lead to better informed decision making by the on call neurosurgical registrar.

Surgical checklist the introduction of a novel neurosurgical postoperative checklist improved postoperative care

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Objective: Following the introduction of our Postoperative Checklist in 2015, we aimed to evaluate whether the improved performance in postoperative care reported in our initial study had been sustained, and whether we could recommend the Checklist introduction in other neurosurgical units.

The World Health Organization Surgical Safety Checklist is notable for its ubiquity and efficacy in improving safety for patients undergoing surgery. However it fails to address pitfalls occurring once the patient has left the operating department, including inadequate clinical assessment, postoperative prescriptions, and documentation of postoperative instructions. In 2015 we introduced a Postoperative Checklist to be completed by the medical team on return to the ward. We observed a dramatic improvement in postoperative care, and the Checklist has been adopted permanently in our department, and introduced in other UK units.

Method: One year following the introduction of our Postoperative Checklist we reviewed the medical records of 50 random patients between September and November 2016. We assessed performance using the original audit matrix which evaluated four principle domains: documentation of procedure; clinical assessment, documentation of postoperative instructions; medical contact details, and compared the quality scores with scores before and immediately after the Checklist was introduced. Ward staff were unaware that performance was being evaluated.

Results: Prior to introduction of the Checklist, postoperative reviews were completed for 74.0% of patients; average score was 34.3%. Following introduction of the Checklist 98.0% underwent postoperative review – the Checklist was used in 77.6% of these cases, average score was 90.6% compared to 62.1% without the Checklist. At re-audit all 50 patients had been reviewed postoperatively; the Checklist was used in all 50 cases, and average score was 95.9%. Performance remained very high across all four domains.

Conclusions: The introduction of a Neurosurgical Postoperative Checklist yielded a dramatic improvement in postoperative clinical assessment, communication of postoperative plans, and postoperative care as a whole. This effect was maintained when re-audited one year later, following the introduction of new junior medical staff. We recommend this Neurosurgical Postoperative Checklist for use in Neurosurgical units as a simple, cheap, reproducible tool to improve patient care

Timing of emergency referrals to neurosurgery

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Objectives: Given evidence of improved outcomes with management of neurosurgical patients in dedicated units, and the importance of rapid neurosurgical intervention for emergency extra-axial haematomas, we investigated the timings for emergency neurosurgical referrals from a district general hospital (DGH) to a tertiary referral hospital (TRH).

Methods: This retrospective cohort study included all emergency neurosurgery referrals made from a DGH and from other specialties within the TRH over 6 months between 28th February and 31st August 2016. Referrals were identified using an online neurosurgical referral system and patient notes reviewed to establish the timing of imaging, and neurosurgical decisions and interventions. A Wilcoxon rank sum test was performed for pairwise comparisons.

Results: Of the 427 cases, 242 were male (56.7%) with a median age of presentation of 63 years. The vast majority of referrals were made following a CT head (75%). Overall median time from scan completion to a neurosurgical decision was 3.17 hours at the DGH compared to 1.68 hours at the TRH ($p < 0.0001$). There was a significant difference in the median time from diagnostic imaging to transfer of patients either urgently to the ward (DGH 7.50 hours vs. TRH 3.60 hours, $p = 0.0010$), as an emergency to critical care (DGH 5.58 hours vs. TRH 1.25 hours, $p = 0.0036$), or as an emergency to theatre (DGH 5.14 hours vs. TRH 2.07 hours, $p = 0.0952$).

Conclusions: There is evidence of delayed neurosurgical decision making for referrals between the district general hospital and the tertiary referral hospital and disproportionate delays in admission to neuroscience wards or theatre for emergency neurosurgical procedures.

Out of programme experience in UK neurosurgery trainees – optimising the transition back into clinical practice

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Objectives: Out of programme (OOP) experience from training increases the skill pool of the neurosurgical workforce and drives innovation in the specialty. OOP approval criteria are well defined but transition back to clinical work can be challenging with little data published on perspectives of OOP neurosurgical trainees on their experience.

Methods: We undertook an online anonymised survey of neurosurgery doctors in the UK to understand factors influencing transition from OOP back to clinical work.

Results: Out of 70 respondents, 7 are currently on OOP and 26 completed OOP. OOP was most commonly taken at registrar level (28/32), used for research (27/32) and motivated by the aspiration of an academic neurosurgery career (18/32). All current OOP respondents have established funding, versus (10/25) of past OOP trainees. 2/7 of current OOP respondents have a formal return to work plan versus 5/25 of past OOP trainees. Post OOP, 10/25 reported deterioration of surgical skills. 21/25 have applied the skills learned during OOP to their clinical practice

Conclusions: Skills learned during OOP are relevant and transferable in the clinical environment but mainly limited to research with management and education OOP under-represented. Deterioration of surgical skills is a concern. Formal return to work plans are becoming more commonplace but require refinement and tailoring to individual training requirement in order to optimise an effective return to clinical work

Neurosurgical clinical research and the EU research registry

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Objective: Research is crucial for the survival, growth and expansion of neurosurgery. A survey of neurosurgical articles published between 1996 and 2009 identified that 38% of research was conducted in the US, with just 2 EU countries listed in the top 5 (Germany 6.3% and the UK 4.2%)¹. There is also a need for appropriate avenues of funding to be widely publicised and easily accessible. Our objective is to promote and encourage neurosurgical clinical research throughout Europe.

Methods: Methods employed to promote research include an EU registry of multicentre trials, directory of academic neurosurgeons with associated subspecialty interests, a dedicated section on the UK neurosurgical website and regular updates of recruitment and trials status at national and international forums.

Results: To date there are 15 multicentre national trials and 7 international trials open to recruitment, which are registered on the UK neurosurgical database.

Conclusion: We aim to increase awareness and participation in neurosurgical research throughout the EU without developing trial fatigue.

¹JS Hauptman, DS Chow, NA Martin. Research productivity in neurosurgery: trends in globalization, scientific focus, and funding A review. *J Neurosurg.* 2011. 115:1262–1272

"I'm not afraid of death" – A survey on preferences concerning surgical measures among patients aged 75+

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Objective: The treatment of elderly patients with traumatic brain injury (TBI) is mainly determined by the age of the patient and the severity of the trauma. The aim of this study was to explore personal preferences regarding life-prolonging neurosurgical interventions among ambulatory, autonomous elderly people.

Methods: 100 consecutive patients aged more than 75 years frequenting the outpatient clinic of the Department of Neurosurgery were interviewed about their personal opinion on surgical treatment, if they themselves would suffer from TBI with space-occupying acute subdural hematoma. Their position, wishes and fears were assessed by a 23 point questionnaire. Additionally, the Mini-Mental-score plus the Beck Depression score and the Barthel Index were evaluated.

Results: Fifty-one percent of autonomous elderly persons would not wish surgical measures. If treatment was expected to physical disabilities, 68% of the people wished no surgery. In case of expected cognitive impairment, 91% were against any surgical intervention. The majority of the cohort feared to be a burden to their relatives (76%) and not being able to master an independent life (75%). Four fifths of the interviewed patients were not afraid of death (82%).

Conclusion: A majority of elderly patients only consents to surgical measures if no relevant disabilities are involved and if they can return to a life comparable to before. These findings need more consideration by neurosurgeons in case of neurosurgical emergencies as well as in the surgical treatment of elderly patients in general.

Patients with Cushing's disease need illness support apart from good neurosurgery

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Objective: Patients with Cushing's disease (CD) often suffer of a long-term reduced quality of life, despite successful neurosurgery and other medical therapies. In order to obtain leverage points for improving patient care, it was the aim of the present study to obtain structured information about the needs of CD patients to successfully cope with their illness by means of a patient-reported outcome (PRO) survey.

Methods: Patients with ACTH-dependent CD, who had received pituitary surgery at two neurosurgical tertiary referral centers, completed a self-developed PRO survey, asking about the timeframe support was needed the most, current disease burden, coping strategies, as well as patients' interest in different kinds of support (e.g. support-groups, workshops and other). Descriptive data were analyzed using SPSS. Answers in free text options were categorized and counted.

Results: 71 patients answered the questionnaire. Support was mostly needed before therapy (45.1%) and within the first year after the start of therapy (42.3%). Patients suffer primarily from common CD-related symptoms (52.3%, e.g. overweight, moon face, skin issues) and reduced performance (36.9%, e.g. muscle weakness, fatigue). The care of the physician (44.4%) and the support of family/friends (31.7%) were stated as the most helpful factors in coping with CD. Patients also wished to be supported within the scope of brochures, lectures, online-forums and support-groups. When asked about a specific program, most patients preferred internet-based programs (75.4%). The most frequently requested topics were communicating with other people (52.9%), physical exercise (45.6), nutrition (45.6), and relaxation (36.8%)/stress management (33.8%). Also, 52.5% of patients answered to be willing to pay for a support program.

Conclusion: The survey clearly shows that patients with CD need long-term support in dealing with their illness apart from good neurosurgery and other medical interventions. This need should be recognized by caregivers and patients should be directed in the direction of self-help groups and other supplementary support sources. Furthermore, the development of educational resources for patients with CD and other pituitary disorders is suggested.

Considerations regarding repatriation of patients from a neurosurgical view – lessons learned?

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Objective: Repatriation of patients (military and/or civilian) with neurosurgical injuries is a corner stone in the chain of treatment. After initial treatment including stabilization and diagnostics on scene the next step is to decide on the appropriate further therapy. In our study we wanted to analyse neurosurgical repatriations

Methods: The data of a personal repatriationregister (D. Ritter, M.D.) were analysed. 116 neurosurgical cases were repatriated between 2011 and 2013. These patients were classified in subgroups. In line with a retrospective case-control-group the data of military and civilian neurosurgical patients - repatriated to the military hospital of Ulm or prepared to repatriation in missions were selected - and the cases described.

Results: Summarising the craniocerebral injuries and the spinal injuries in 83 from 116 cases (71,6 %) a trauma diagnosis was underlying. The other diagnosis (disc herniation, tumor, malformation and spontaneous bleeding) were in 33 of 116 cases (28,4 %) not associated with a trauma. From 116 patients only 10 were female (8,6%).

Conclusion: Neurosurgical cases are usually not part of daily practice of repatriation. To determine the best therapeutical procedures adequate expert opinion should be obtained. The decision on the best spectrum and timeline of neurosurgical interventions to be applied and consequently on the optimal timeframe for repatriation to Germany has to be based on a multidisciplinary risk analysis. Therefore, the results of radiological examinations have to be assessed by a neurosurgeon, possibly supported by telemedicine. The increasing risk of infections by multi-resistant bacteria has to be taken into account.

MO.18 **Bildgebung 1**

Montag *Monday*, 15.05.2017, 11.00 – 12.10 Uhr *hrs*

- MO.18.01 *Combining nTMS-tractography reveals different errors may involve different segments of the arcuate fasciculus*
D. Giampiccolo* (Verona, Italy), T. Picht, I. Bährend
-
- MO.18.02 *Contrast enhanced ultrasound perfusion imaging for recanalization therapy in acute stroke patients*
M. Oertel* (Zürich, Switzerland), R. Reitmeir, J. Eyding, R. Wiest, A. Raabe, W. Z'Graggen, J. Beck
-
- MO.18.03 *Imaging of pituitary tumours and peritumoral anatomy by dual energy computed tomography - a proof of principle study*
Bildgebung von Hypophysentumoren und umgebender Anatomie mittels Dual Energy Computertomographie - eine Machbarkeitsanwendung
M. Seiz-Rosenhagen* (Mannheim, Deutschland), J. Gawlitza, N. Vogler, H. Wenz, D. Hänggi, M. Ratliff, T. Henzler
-
- MO.18.04 *Impact of additional 18F-FET-PET imaging following immunotherapy with DC vaccination in GBM patients*
A. Schmitz* (Düsseldorf, Deutschland), R. Sorg, O. Grauer, M. Kamp, M. Sabel, K. Langen, M. Rapp
-
- MO.18.05 *Infarct volume predicts long-term outcome in malignant hemispheric stroke*
N. Hecht* (Berlin, Deutschland), H. Neugebauer, A. Pinczolits, P. Vajkoczy, E. Jüttler, J. Woitzik
-
- MO.18.06 *Intraoperative Arterial Spin Labeling - Technical Considerations and First Results*
H. Ahmeti* (Kiel, Deutschland), T. Lindner, O. Jansen, M. Synowitz, S. Ulmer
-
- MO.18.07 *Magnetic resonance imaging of collateral networks in moyamoya angiopathy at 7 Tesla*
B. Chen* (Essen, Deutschland), T. Matsushige, M. Krämer, M. Schlamann, M. Ladd, U. Sure, K. Wrede
-

Combining nTMS-tractography reveals different errors may involve different segments of the arcuate fasciculus

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Objective: Losing language function following tumour resection has considerable impact on quality of life, hence appropriate presurgical planning is needed. Navigated transcranial magnetic stimulation (nTMS) is a non-invasive method that may be effective in evaluating which cortical regions are important for different aspects of language ability. Language function requires interaction between perisylvian regions, connected by the arcuate fasciculus (AF). nTMS and diffusion imaging methods can be combined to assess the relationship between cortical stimulation and underlying white matter. The AF is subdivided into a direct long segment (LS; fronto-temporal) and two indirect segments, anterior (AS; fronto-parietal) and posterior (PS; parieto-temporal). These may contribute to different aspects of language function. We set out to identify if there were common speech errors specific to different segments of the arcuate fasciculus.

Methods: 22 patients with left hemisphere gliomas were recruited, who underwent nTMS language mapping. Trains of 5 stimuli at 5 Hz frequency were applied over the perisylvian cortex while the patient named images of different semantic categories, displayed as black and white drawings on a screen. Misnamings were categorized into motor speech errors and semantic errors. On average 80 cortical areas were targeted with nTMS three times in each subject in the left hemisphere. Diffusion imaging was performed and the three branches of the AF reconstructed using deterministic spherical deconvolution tractography. The nTMS stimulation locations were then overlaid with the images to identify overlap.

Results: All patients produced motor errors, and 17/22 produced semantic errors. Over 50% of total errors were at locations corresponding to the AF. Motor speech errors occurred at locations corresponding to the AS in 16/22 patients, the LS in 10/22 patients and the PS in 8/22 patients. Significantly more motor errors occurred at stimulation points at terminations of the AS than the PS ($p < 0.03$). Semantic errors were less common. Of the total errors overlapping with the AF more occurred in sites corresponding to the posterior segment than the other segments (AS in 3/17 patients, LS in 2/17 and PS in 7/17).

Conclusion: Our results support the idea of the AF as the major language tract. Moreover, the different types of errors elicited by nTMS may be related to stimulation of different segments of the arcuate fasciculus. This supports current theories that propose the posterior segment may be important for object recognition to verbal recall (and hence, semantic processes) and the anterior segment for verbal recall to speech production, motor aspects of speech. The results of this preliminary work may be important for evaluating risk pre-operatively, and further, the appropriate focus for speech mapping during awake surgery.

Contrast enhanced ultrasound perfusion imaging for recanalization therapy in acute stroke patients

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Objective: Transcranial contrast enhanced ultrasound perfusion imaging (tceUPI) was demonstrated to be a viable diagnostic tool for the assessment of cerebrovascular diseases, although periinterventional tceUPI data are scarce. In the present study, the authors investigated the use and ability of tceUPI to detect physiological and pathophysiological perfused brain regions before and after recanalization therapy in acute stroke patients. For the first time, its diagnostic safety and accuracy when compared to magnetic resonance and computed tomography perfusion (CTP) imaging was evaluated.

Methods: High mechanical index tceUPI, magnetic resonance perfusion (MRP) weighted, and CTP imaging data were prospectively analyzed in acute ischemic stroke patients before and after first-time intravenous or intraarterial reperfusion therapy at a single stroke center. Time-to-peak (TTP) intensities of 10 regions of interest (ROIs) in the ischemic hemisphere were compared to 4 standardized ROIs of the non-ischemic hemisphere in each patient and categorized as either normo- and hyperperfused or hypo- and non-perfused. ROIs with a TTP >3 seconds in tceUPI and >4 seconds in MRP or CTP were considered as hypoperfusion or as nonperfusion when TTP was not measurable.

Results: Twelve patients (4 men, 8 women; mean age 77 years) and a total of 120 ROIs were included for final analysis. 78/120 preinterventional and 91/120 postinterventional UPI ROIs of the ischemic hemisphere were normo- or hyperperfused, 34/120 and 16/120 hypo- or nonperfused. 8/120 and 13/120 ROIs could not be assessed because of artifacts, respectively. There was a significant correlation of UPI with MRP and CTP data. Detection of stroke demarcation or hemorrhage was feasible in all patients. tceUPI examinations did not delay therapeutic management and no tceUPI-associated complications were observed.

Conclusion: tceUPI, a flexible and mobile examination tool, enables dynamic, repeatable, fast, safe, and reliable detection and monitoring of tissue perfusion abnormalities and its changes, and of ischemic infarct demarcation or hemorrhagic transformation before and after recanalization therapy for acute stroke. The results of tceUPI compared favorably with those of the current gold standard perfusion modalities MRP and CTP. Promising further applications of tceUPI might include imaging of subarachnoid hemorrhage and vasospasm, treatment of carotid artery stenosis, and intraoperative brain perfusion.

Imaging of pituitary tumours and peritumoral anatomy by dual energy computed tomography - a proof of principle study

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Objective: The major goal of preoperative imaging in patients with pituitary tumors is to delineate tumor and to assess cavernous sinus invasion. Until now, MRI is the gold standard imaging modality. However, MRI is limited regarding sufficient information about the bony anatomy. 3D-information about the sphenoid sinus and the sella facilitates the surgical approach in selected cases. Moreover, the number of patients with cardiac pacemakers that limit their access to preoperative MRI is rising.

Standard CT of the pituitary gland provides excellent information of the bony anatomy. However, the soft tissue contrast of standard CT is inferior to MRI and patients often undergo preoperative CT and MRI diagnostic. Contrast enhanced dual-energy CT (DECT) enables the calculation of *so-called* monoenergetic (ME) images between 40-190 keV. Low keV images significantly increase contrast due to the high photon absorption. Thus, the purpose of this feasibility study was to evaluate low keV monoenergetic DECT images as a potential *one-stop-shop* preoperative modality in patients with pituitary tumours.

Methods: 14 patients with different pituitary gland lesions were prospectively enrolled in this study. All patients underwent contrast enhanced DECT imaging (FORCE, Siemens Healthineers). Imaging data was calculated from 40-190 keV in 10 keV intervals. In addition, a standard 120 kV polyenergetic CT dataset was reconstructed as a standard CT reference method. Objective image quality was evaluated by measuring pituitary gland attenuation and image noise in a standardized region of interest (ROI) on all 34 available datasets. The signal to noise ratio (SNR) was calculated for each dataset by dividing attenuation and image noise. Image quality was evaluated by a neurosurgeon and a radiologist. Both were asked to select 1. best diagnostic image dataset, 2. dataset with best delineation of the cavernous sinus and 3. best dataset for delineation of cystic tumour areas out of the 34 available datasets.

Results: The ME datasets of 50 and 40 keV showed a higher difference between tumor and sinus cavernosus attenuation (TSAD) when compared to the standard 120 keV CT protocol. The TSAD for the reference polyenergetic 120 keV protocol was 67 HU, for the 50 keV ME 106 HU and for the 40 keV ME 163 HU. Of all datasets, the 40 and 50 keV ME images were preferred regarding overall best image quality by the neurosurgeon as well as by the radiologist.

Conclusion: ME datasets at low keV between 50 and 40 keV significantly improve objective and subjective image quality when compared to standard CT. These findings are explained by the physical k-edge of iodine that leads to an increasing tissue/iodine absorption. Thus, DECT may become the CT imaging technique of choice for pituitary lesions since it allows full flexibility of keV settings and the calculation of virtually non-contrast enhanced images.

Impact of additional ¹⁸F-FET-PET imaging following immunotherapy with DC vaccination in GBM patients

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Objective: Vaccination therapy using autologous dendritic cells (DC) is a promising approach alongside standard treatment for Glioblastoma (GBM). However, large study groups with long-term surveillance are still missing and reliable best criteria regarding therapy monitoring are not established. Therefore, lately the RANO working group recommended modified observation periods and additional MRI scans according to varying MRI findings during immunotherapeutic treatment. Here, we retrospectively analysed the impact of additional ¹⁸F-FET PET imaging for the differentiation between tumor progression and therapy related changes following DC vaccination therapy.

Methods: We included in the following series (1) glioblastoma patients received additional vaccination therapy with autologous, mature, tumor- loaded dendritic cells, (2) underwent additional ¹⁸F-FET PET imaging as tumor recurrence was suspected and (3) were treated between 2003 to 2016 in our institution. Vaccination was performed weekly for six times by intradermal injections between concomitant radio/-chemotherapy and intermittent chemotherapy (weeks 6-10), or in relapse situations, before re-radiation therapy. MRI and ¹⁸F-FET PET results were compared and correlated with clinical data. Informed consent was given by the patients for these individual treatment schemes. Data are presented as mean ± standard error of mean.

Results: 7 patients were identified (2 female; mean age: 52 ± 10y). The progression-free survival was 7 ± 8 month after vaccination therapy. 4/7 patients showed congruent results of MRI and ¹⁸F-FET PET scans. Tumor progression was confirmed by neuropathological analysis or according to the RANO criteria. ¹⁸F-FET PET revealed reactive tissue in 3 patients: In one patient, histopathology identified massive necrosis with reactive changes confirming a response to vaccination therapy. In the second case, diagnosis was confirmed according to the RANO criteria and repeated MRIs. The third patient was lost of follow-up.

Conclusion: ¹⁸F-FET PET appears to be more accurate than contrast-enhanced MRI in distinguishing tumor recurrence from reactive changes following vaccination therapy in glioblastoma patients. The retrospective design, the small number of patients and the divergent diagnostic strategies limit this pilot study. However, it indicates a crucial role of ¹⁸F-FET PET for monitoring upcoming glioblastoma vaccination studies.

Infarct volume predicts long-term outcome in malignant hemispheric stroke

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Objective: Surgery is accepted as a treatment for malignant hemispheric stroke (MHS) that is lifesaving but may result in moderate to severe disability. Since survival at the cost of disability may be acceptable to some but not to others, there remains a need to identify long-term outcome measures for MHS that can assist in surgical or non-surgical decision-making. Therefore, the aim of the present study was to identify prognostic variables for long-term outcome in patients undergoing decompressive hemicraniectomy (DHC) for treatment of MHS.

Methods: The present study included 97 patients with subtotal or total middle cerebral artery infarction, who underwent standardized DHC in our institution within 48 hours after stroke onset. After surgery, patients were transferred to the intensive care unit and a routine postoperative CT or MRI was performed within 24 hours. Intracranial pressure (ICP) was monitored and patients remained intubated / sedated until ICP was within normal ranges. The primary outcome measure was clinical outcome at 12 months according to the modified Rankin Scale (mRS) based on the initial infarct volume. Secondary clinical outcome measures included the time to treatment, estimated blood loss, postoperative ICP crisis, surgical complications and the duration of intubation. Secondary neuroimaging outcome measures included the involvement of vascular territories other than the MCA territory. All clinical and neuroimaging data was retrospectively reviewed and analyzed by two independent observers.

Results: At 12 months, overall mortality was 16% (16/97), while 64% (62/97) of all patients survived with severe (mRS 4-5) and 20% (19/97) with mild to moderate (mRS 2-3) disability. The Receiver Operating Characteristic (ROC) curve of the infarct volume mortality yielded a good classification result (AUC=0.77) and multivariate logistic regression was able to confirm infarct volume (*p=0.045) as a factor with significant association to mortality. Further, logistic regression analysis revealed a significant influence of the infarct volume on 12-month mRS (*p<0.001) with an effective power of 0.56 according to the Cohen classification. Post-hoc analysis with Bonferroni correction revealed significant lower infarct volumes in patients with mild to moderate disability (mRS 2-3) versus patients with severe disability or death (mRS 5-6) at 12 months. Additional univariate predictors of outcome were identified as involvement of the anterior (*p=0.01) and posterior cerebral artery (*p=0.001) territories, thalamic involvement (p=0.02), age>60 years (p=0.002), hypothermia (p=0.03), atrial fibrillation (p=0.01), and the duration of intubation (p<0.001).

Conclusion: In MHS, the initial volume of the infarction may help to weigh the consequences of DHC against the patients' presumed individual expectation towards the benefit of surgery.

Intraoperative arterial spin labeling – Technical considerations and first results

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Objective: Intraoperative magnetic resonance imaging (MRI) is a unique tool visualizing structures for resection control during brain surgery. Not only structural imaging, but also functional information (e.g. perfusion imaging) can become important in both preoperative imaging as well as during the procedure and for evaluating the success of tumor removal. Commonly used method to enhance certain structures and visualize perfusion includes contrast agent application and is therefore limited in their application. A remedy might be Arterial Spin Labeling (ASL) as this method allows for visualizing cerebral perfusion without any external contrast injection. The goal of this study is to present and to evaluate the use of ASL in an intraoperative setting and also to compare the results to routinely performed (contrast-enhanced) structural imaging.

Methods: In a previous study, ten volunteers were scanned on different MRI machines (3T and 1.5T) in radiology and neurosurgery to ensure comparability of the obtained results. In this study the same scanners were used (all from Philips Healthcare, Best, Netherlands). Pseudo-continuous ASL (pCASL) was used and CBF quantified as ml blood/min/100g brain tissue. Data was obtained on currently six patients (3 male, 3 female, mean age = 59.2 years) suffering from glioblastoma multiforme who underwent pre-, intra- and postoperative imaging according to the local standard of care with ASL performed additionally. The results from ASL regarding the possibility to visualize residual tumor mass during and after surgery were directly compared to contrast enhanced structural imaging.

Results: In four out of six patients the same results could be obtained (two had total removal, two residual tumor mass). In one patient structural imaging data was first false-positively misinterpreted. Here, a partial-volume effect of an artery was interpreted as residual tumor mass, but the result was later changed without taking the information from ASL into consideration. On the ASL data no uncertainties occurred in this case. In a second patient no residual tumor was identified on the structural images, but ASL showed an area of elevated perfusion. The results from structural imaging were then amended and concluded that there is in fact residual tumor mass.

Conclusion: The currently obtained data appears promising to use ASL routinely for intraoperative perfusion imaging. As ASL data allows to be quantified in absolute values, a comparison between different scanners and equipment can be performed straight-forward. The presented data obtained on patients shows that ASL allows for delineation of tumors in concordance with contrast-enhanced structural imaging sequences. In one case, ASL was even superior to structural imaging alone, changing the final diagnosis of the patient.

Magnetic resonance imaging of collateral networks in moyamoya angiopathy at 7 Tesla

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Objective: Collateral networks in Moyamoya angiopathy (MMA) have a complex angioarchitecture difficult to comprehend in conventional examinations. This prospective study aimed to delineate deeply seated collateral networks (DSCNs) and evaluate their morphologic patterns by 7 Tesla (T) magnetic resonance angiography (MRA) in comparison with the current gold standard conventional digital subtraction angiography (DSA).

Methods: Ten patients suffering from MMA underwent 7T TOF MRA with $0.22 \times 0.22 \times 0.41$ mm³ resolution and MPRAGE with $0.7 \times 0.7 \times 0.7$ mm³ resolution, additional to the standard clinical workup with conventional DSA. Four experienced raters analyzed the images in consensus reading. Classification of DSCNs was according to location and connecting vessels. Presence of DSCNs and image quality for DSA, TOF MRA and MPRAGE were rated on a five-point scale. Delineation of collateral networks was analyzed by the McNemar test. Image quality was compared using Wilcoxon signed-rank tests. Statistical analysis was carried out with the STATA software package (Stata/MP 14.2 for Linux 64-bit).

Results: All examinations were successfully performed without occurrence of adverse events. The study group comprised 3 male and 7 female patients. The mean age was 34 years (range: 21 – 58 years). DSCNs were classified into 2 major categories (connection to cortical vessels and connection to major trunk vessels) with a total of 6 pathways. Seventy DSCNs were detected in DSA, 79 in TOF MRA, and 54 in MPRAGE, respectively. All collateral networks detected in DSA were excellently delineated in TOF MRA and 54 of 70 (77.1%) in MPRAGE. Nine anastomoses were identified by MRA (TOF: n = 9, MPRAGE: n = 3) not visible in DSA. Detection of DSCNs was significantly better in TOF MRA than in DSA and MPRAGE ($p < 0.01$). The mean overall image quality was 4.83 in DSA, 4.92 in TOF MRA and 4.75 in MPRAGE, respectively. Overall image quality showed comparable results for DSA and TOF MRA ($p = 1.0$); however, both were better than MPRAGE ($p < 0.0001$).

Conclusion: Delineation of submillimeter vessels in DSCNs in MMA is feasible with excellent image quality using 7T MRA. Visualization by 7T TOF MRA was superior to conventional DSA and 7T MPRAGE. The presented 7T TOF MRA protocol is very promising for further morphological and pathophysiological MMA research especially for submillimeter collateral networks.

MO.20 Vaskuläre Neurochirurgie 3

Montag Monday, 15.05.2017, 15.30 – 17.00 Uhr hrs

MO.20.01	<i>Clinical and radiological characteristics of deep lumbosacral spinal dural arteriovenous fistulae</i> F. Jablawi* (Aachen, Deutschland), O. Nikoubashman, G. Schubert, M. Dafotakis, F. Hans, M. Mull
MO.20.02	<i>Dural arteriovenous fistulas of the spine (SDAVF): Retrospective series of 51 patients.</i> M. Bayer* (Dresden, Deutschland), M. Kirsch, G. Schackert, T. Pinzer
MO.20.03	<i>Effectiveness and safety of anticoagulation therapy after treatment of spinal dural arteriovenous fistula</i> F. Jablawi* (Aachen, Deutschland), G. Schubert, F. Hans, M. Mull
MO.20.04	<i>Cavernous hemangiomas – special manifestations: from pediatric skull tumors to surgery in eloquent brain regions</i> A. Wloch* (Hannover, Deutschland), J. Lang, E. Hermann, M. Nakamura, J. Krauss
MO.20.05	<i>Back to work in 6th month after SAH- a question of gender?</i> M. Bruder* (Frankfurt, Deutschland), S. Kashefiolasl, N. Dinc, S. Won, M. Wagner, V. Seifert, J. Konczalla
MO.20.06	<i>Intraoperative neurophysiological warning criteria to guide shunt placement in carotid endarterectomy</i> K. Seidel* (Bern, Switzerland), J. Jeschko, P. Schucht, D. Bervini, A. Raabe, J. Beck
MO.20.07	<i>Resolution of cerebral inflammation following subarachnoid hemorrhage in vivo</i> V. Patsouris* (Berlin, Deutschland), K. Blecharz-Lang, U. Schneider, P. Vajkoczy
MO.20.08	<i>3 months follow-up of subarachnoid haemorrhage headaches after treatment of ruptured aneurysms in interventionally and surgically treated patients</i> A. Petridis* (Düsseldorf, Deutschland), J. Cornelius, M. Kamp, I. Fischer, S. Falahati, H. Steiger
MO.20.09	<i>The application of the unruptured intracranial aneurysm treatment score - a retrospective, single-center analysis</i> S. Hernandez Duran* (Göttingen, Deutschland), V. Malinova, D. Mielke, V. Rohde

Clinical and radiological characteristics of deep lumbosacral spinal dural arteriovenous fistulae

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Objective: Spinal dural arteriovenous fistulas (SDAVF) located below the L5 vertebral level are rare and the most difficult to diagnose and treat among SDAVFs. Specific clinical and radiological features of this particular subgroup of fistulas are still inadequately reported and are the subject of this study.

Methods: We retrospectively evaluated all data of SDAVF patients treated and/or diagnosed in our institution between 1990 and 2016. Demographic, radiological and clinical data of patients with SDAVF located in the deep lumbosacral region (lsSDAVF) were included in this study, with all but one patient (endovascular embolization) receiving microsurgical treatment.

Results: A total of 19 patients eligible for this analysis were identified. The most common neurological finding at time of admission was paraparesis (89%), followed by sensory disturbances (84%) and sphincter dysfunction (68%). Medullar T2-hyperintensity and contrast-enhancement were present in the vast majority of the cases. The filum vein (FV) and/or lumbar veins were dilated in 18/19 (95%) patients. In addition, contrast-enhanced MRA (CE-MRA) indicated a SDAVF at/ or below L5 vertebral level in 6/7 (86%) patients who received CE-MRA before DSA. All patients received at least two DSA examinations till the correct diagnosis of lsSDAVF was established. A bilateral arterial supply of the fistula zone was detected via DSA in 5 (26%) patients. The occlusion rate in our recent series was 84%. Three of 18 (17%) patients who received initial microsurgical treatment in our center presented fistula recurrences within a mean follow-up period of 12 months (median: 10, range; 1-24 months). All three patients were re-treated microsurgically in our institution with no major complications.

Conclusion: Clinical symptoms caused by lsSDAVFs are nonspecific. Our findings imply that the presence of a dilated FV and/or lumbar radicular vein(s) combined with typical congestive medullar changes should always evoke the differential diagnosis of an AV shunt in the deep lumbosacral region, even in the absence of prominent perimedullar veins. Spinal CE-MRA facilitates the detection of the drainage vein and helps to localize of the fistula with a high sensitivity even before DSA. Definite detection of these fistulas remains challenging and requires a sufficient visualization of the fistula-supplying arteries and draining veins by conventional spinal angiography.

Moreover, the low-flow characteristics and the frequent ventral course of the draining veins in these fistulas cause serious difficulties in the intraoperative localization of the fistula resulting in a higher recurrence rate compared with this of SDAVF of other locations.

Dural arteriovenous fistulas of the spine (SDAVF): Retrospective series of 51 patients.

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Objective: Retrospective analysis of spinal dural arteriovenous fistulas SDAVF after surgical and/or endovascular treatment including failure rates, recurrence rates, outcome of symptoms and quality of life.

Methods: A retrospective data analysis of all 51 patients treated for SDAVF between 1999 and 2016 including quality of life (SF-36) process of symptoms (Aminoff-Logue-Score (ALS), Janda). Patients and lesion-related factors were compiled in a database. Statistical analysis were performed using SPSS 13.

Results: The 51 pts. (3:1 male/female) had a median age of 66 years (range:45-83 years). Symptom duration before the diagnosis was established ranged from 0-60 months with a median 8 months +/- 15.5.

Surgery was performed in 86.3 % (44/51), embolization in 13.7 % (7/51) of the patients.

Complications occurred in 25.5 % (13/51) and the two most common events were epidural hemorrhage or deep venous thrombosis. Complication rates were similar but slightly less after surgery.

Most importantly, recurrence rates revealed a significant difference ($p=0.007$) in favor of surgical treatment: only 1 of 43 surgically treated patients (2%), but 3 of 7 pts. experienced failure after endovascular treatment (43 %).

Using the modified ALS, short-term outcome revealed minimal worsening (OP:+0.13,E: +0.14) (directly after treatment) and a notable long-term improvement (median: 16 months) for surgery (-0.35) and embolization (-0.2). The perception of the patients 30 days after treatment showed a better score after embolization (-0.8) compared to surgery (+0.55). However, in the long-term-follow up (median: 6 years) both treatment modalities had similar outcomes (OP: +0.68, E: +0.83).

AL-scores were significantly better, if the patients had a shorter time to diagnosis (<8 months, $p=0.05$) or if they were below 70 years of age ($p= 0.002$).

Quality of life and neurological symptoms improved initially (embolization > surgery) but deteriorated over time comparable to the preinterventional status.

Discussion: Our study demonstrates in a single-departmental retrospective cohort that a shorter time to diagnosis correlates with a significantly better ALS-Outcome and additionally decreases the risk of recurrences. Younger age correlates also with ALS-Outcome. Endovascular treatment had an unacceptable high failure rate, whereas microsurgery was extremely successful in SDAVF closure.

Nonsurprisingly, pts. had less complaints after endovascular compared to surgical closure of the SDAVF.

In the long-term-follow-up patients of both treatments had comparable results and presented a status which – on average - was comparable to the preintervention state.

In summary, pts. can be instructed that the aim of any intervention is to stop progression of neurological symptoms but not cure of existing deficits.

Effectiveness and safety of anticoagulation therapy after treatment of spinal dural arteriovenous fistula

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Objective: Anticoagulation therapy (AC) after treatment of spinal dural arteriovenous fistula (SDAVF) is well known in clinical practice but still inadequately reported in the literature. In this study, we evaluated the effectiveness and safety of postoperative AC in SDAVF patients.

Methods: We retrospectively analyzed our medical database for patients who were treated due to SDAVF in our institution between January 2006 and February 2016. Data of overall 53 patients were included in this analysis. Microsurgical treatment was performed in all patients. Follow-up informations were gathered by telephone questionnaire. We used Aminoff-Logue disability score (AL-score) to evaluate the functional outcome at time of admission, of discharge, and of telephone survey. Follow-up data were available in 40 patients with a mean follow-up period of 53.4±36 months.

We dichotomized our cohort with regard to the administration of AC as follows:

- a) Prophylactic group (n=11): UFH (n=7) aiming a PTT of 40-50sec, or high-dose weight-adjusted LMWH (n=4) (2x1mg/kg body weight)
- b) Non-prophylactic group (n=42): routine thromboembolic prophylaxis with low-dose LMWH (n=38) or therapeutic AC via UFH (n=4) aiming a PTT of 40-50 sec.

Results: In group (a) no acute deterioration was reported during the inpatient stay. In group (b) 4 of 42 patients presented an acute deterioration within the first two postoperative days (mean: 0.75, range: 0-2 days); however, the incidence of postoperative deterioration did not reach statistical significance (p=0.57). Therapeutic AC was performed in all 4 patients with acute deterioration, immediately after exclusion of hemorrhage and progressive congestive myelopathy via emergency MRI. Neurological deterioration resolved completely within few days after AC (mean 6.8±1.2 days, range: 5-8). One patient developed secondary aggravation of his paraparesis two days after termination of postoperative AC, which in turn resolved completely after re-starting AC. At time of discharge, all four patients presented an unchanged neurological status compared with the pretreatment status. No clinical AC related complications were observed in either group. Neurological status did not differ significantly between both groups at time of admission (p=0.093), of discharge (p=0.723) and of last follow-up (p=0.222).

Conclusion: Acute deterioration after treatment of SDAVF is a rare complication and was present in overall 7% of patients in our series. Even though the sample size is small to draw a definite conclusion, our findings imply that AC could be effective and safe to treat acute postoperative deterioration in SDAVF patients. In these cases, AC might reinforce the venous microcirculation and outflow of the spinal cord. Prophylactic postoperative AC may be considered to decrease the incidence of postoperative deterioration though an influence on outcome was not observed.

Cavernous hemangiomas – special manifestations: from pediatric skull tumors to surgery in eloquent brain regions

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Objective: Cavernous hemangiomas (CH) are vascular malformations that usually can be operatively removed with a justifiable risk. Here, we discuss two special situations: Cavernomas presenting as pediatric skull tumors and in eloquent regions.

Methods: We reviewed the medical records and imaging studies of 40 patients (18 women and 22 men) with CHs in eloquent regions and of two 6- and 8-month old babies with solitary and multifocal congenital CHs of the skull, who underwent surgical resection. The cerebral CHs were located in the following eloquent regions: sensorimotor system (n=13), brainstem (n=9), language areas (n=6), cerebellum (deep nuclei) and peduncles (n= 5), basal ganglia (n=5) and visual pathways (n=4). Long-term follow-up of the CHs was available in 33 patients (82,5%) with a follow-up to 80 months. Outcome was evaluated using the modified Rankin scale. Additionally, we analyzed the clinical and radiological signs, surgical approach and clinical course of the two pediatric patients.

Results: Total resection was achieved in all patients with CH in eloquent regions without surgery-related mortality. Neurological deterioration occurred immediately after surgery in 11 patients (27,5%). Thirty patients (91%) had no new deficits or experienced improvement at the last follow-up. According to the modified Rankin scale 13 patients (42%) had a slight (≥ 1 point) and 9 patients a moderate (≥ 2 points) impairment. 27 patients (81%) could live independently or recovered completely. 2 patients (6%) suffered severe permanent neurological deficit after surgery for a CM located in middle cerebellar peduncle and brainstem, respectively. Postoperative improvement was correlated with good preoperative neurological status and younger age. Adverse factors for the occurrence of surgical morbidity were pontine or brainstem location, smaller size of the CM, preoperative hemorrhage, poor neurological status and age.

Both pediatric patients suffered from painless slow- growing bone lesions in the left frontal skull involving superior sagittal sinus. An 8-month-old male infant had an additional CH arising from the right parietal skull. The skin over the skull lesions had a yellow appearance. Each tumor had a diameter of 3,0 cm and was of a tender consistency. On the T1- and T2-weighted MR images the bone lesions were hypointense involving inner and outer table of the skull with and without enhancement after contrast administration. Because of tumor progression it was decided to resect the affected bone en bloc. The diagnosis of CH was histologically confirmed. The follow-up was in both cases uneventful.

Conclusion: In our experience in most patients CHs located in eloquent regions can be removed safely. Transient impairment may occur in up to one third of patients, but permanent morbidity is rare. Removal for CHs in eloquent regions may be considered on a case-to-case basis. Patients with brainstem CHs or poor neurological status face a higher risk for postoperative morbidity.

Skull CH should be considered in the differential diagnosis of osseous tumors. We recommend complete removal of these lesions to achieve a diagnosis and a permanent cure.

Back to work in 6th month after SAH- a question of gender?

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Objective: Subarachnoid hemorrhage (SAH) is a life threatening situation. Many patients die or are severely disabled. However, due to advantages in aneurysm occlusion, intensive care treatment and rehabilitation, a reasonable number of patients can reach a favorable outcome in means of independency in daily concerns. Re-entry into working life is another important step of recovery – in personal, social and financial aspects. Re-entry to working life enables complete autonomy in those patients lives and avert depression.

Methods: Patients with non-traumatic SAH which were treated in our institution between 2007 and 2015 and aged between 20 and 60 years were analyzed. Diagnostic and treatment was performed due to standardized protocols. If an aneurysm was identified as source of the SAH, treatment decision was based on an interdisciplinary approach. Clinical data and treatment course were entered in our prospectively kept database. At 6th month follow up, work status, social recovery and outcome per modified Rankin Scale (mRS) and Glasgow Outcome Scale (GOS) was assessed in 605 patients via outpatient visits or structured telephone interview when necessary.

Results: Favorable outcome (mRS 0-2) at 6th month follow up was achieved in 66.3%, and 263 patients (43.5%) were already able to work again at this time. Prognostic factors for re-entry into working life were: younger age, good admission status, no intracerebral or subdural hemorrhage, non-aneurysmal SAH, small aneurysm size, endovascular aneurysm treatment, no early hydrocephalus or shunt dependency at follow up (each item: $p < 0.001$). Women did significantly less often re-enter working life at the time of follow up than men (40% vs. 49%; $p < 0.001$). Multivariate analysis revealed sex, good admission status, no intracerebral hemorrhage, no hydrocephalus and endovascular treatment as strongly related with re-entering working life.

Conclusion: Due to structured treatment and interdisciplinary approach, in combination with an intensive rehabilitation system, more than 40% of patients were back at work 6th month after non-traumatic SAH. Even though, sex is not associated with favorable outcome, gender is - beside the known prognostic factors in SAH patients - strongly associated with this feature of excellent recovery. Why women do less often reenter working life after SAH seems to be associated with social structures, but needs to be further investigated.

Intraoperative neurophysiological warning criteria to guide shunt placement in carotid endarterectomy

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Objective: During carotid endarterectomies (CEA) intraoperative carotid artery (ICA) cross clamping is a critical event. Yet placement of a shunt itself is associated with higher rates of micro embolism and increased rates of postoperative cognitive impairment. Various warning criteria have been discussed to decide when temporary shunt placement is necessary to avoid insufficient collateral perfusion.

Methods: A retrospective review of all in 2014 performed CEA cases in our department of neurosurgery was done. Transcranial doppler sonography (TCD) flow velocities and median nerve somatosensory evoked potentials (SEP) amplitudes at several critical intraoperative events (baseline value, start of EEG burst suppression, changes in arterial blood pressure, cross clamping and vessel suture) have been analyzed. Furthermore a correlation to postoperative clinical outcome was done.

Results: In 2014 67 CEAs were performed on 44 male (66%) and 23 female patients (34%) at mean age of 72 years (SD +/- 9.8 years).

49 (73%) of all CEA procedures were monitored with both modalities (TCD and SEP). 17 (25%) surgeries were performed under SEP monitoring only and one patient with TCD monitoring only. At the critical time of ICA clamping TCD values on the surgical side were available in 44 (66%) of all patients whereas SEP values were available in 64 (96%).

The criterion for arterio-arterial shunt was progressive reduction of the SEP amplitude or TCD flow velocity. In 4 patients (6%) an arterio-arterial shunt was placed. New permanent postoperative neurological motor or sensory deficits appeared in 3 patients (4%).

Comparing both modalities during ICA clamping, SEP demonstrated more stable signals but TCD velocity a larger fluctuation. There was no significant correlation between both modalities.

Combining patients with new postoperative neurological deficit and shunted patients the following observations could be made: The highest sensitivity (60%) was found applying a 30% relative change in TCD flow velocity as sole warning criteria. This low sensitivity was even compromised by a very low positive predictive value (27%) and a moderate specificity (79%). Contrary a 50% amplitude change in SEP as sole alarm criteria demonstrated an excellent specificity (100%), positive predictive value (100%) and negative value (92%) with the limitation of a low sensitivity.

Conclusion: The study demonstrates an excellent positive and negative predictive value, which might guide the decision whether to shunt or to proceed without shunting. Yet the number of intraoperative events was low which might have had an impact on the low sensitivity of our warning criteria. However we could demonstrate a very low rate of shunting compared to other series, with a low incidence of postoperative deficits.

Resolution of cerebral inflammation following subarachnoid hemorrhage *in vivo*

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Objective: Cerebral inflammation and neuronal cell death play an important role in the development of brain injury after SAH. In previous studies we have demonstrated an array of SAH-induced inflammatory processes in the injured brain including: microglia accumulation, release of proinflammatory cytokines and neuronal cell death. Termination of these inflammatory processes is of utmost importance, as it is required for restoring tissue homeostasis post SAH. Therefore, we evaluate the inflammatory resolution phase, while signs for a possible tertiary brain damage in case of incomplete resolution were also considered.

Methods: Experimental SAH was induced through endovascular filament perforation in mice. Animals were sacrificed on days 1, 7, 14 and after 1, 2 and 3 months post SAH. Brain cryosections were immunolabeled for Iba-1 to detect microglia, NeuN to visualize neurons and by TUNEL staining for apoptotic cells. The numbers of microglia and neurons were counted in regions of interest in all experimental groups at all time points. Additionally, the gene expression of various proinflammatory cytokines in whole brain samples was examined using qPCR, as well as the IL6 protein quantity by using ELISA. Sham-operated mice served as controls.

Results: The number of microglia cells increased from the baseline level of sham-operated mice up to 5.4 ± 1.8 -fold on day 1, up to 15.5 ± 5.3 -fold on day 7 and up to 16.4 ± 9 -fold on day 14. At the same time the amount of apoptotic neurons increased by 11.1 ± 5.2 -fold on day 1, by 28.5 ± 8.5 -fold on day 7 and by 25.4 ± 12.1 -fold on day 14 post SAH. After month 1 there were no significant differences between the investigated groups and the sham-operated mice, showing a strong decrease of microglia accumulation and neuronal apoptosis between day 14 and month 1. In contrast to these results, gene expression of the investigated cytokines IL6, IL1 β and TNF α was still on a high level after 1 month. The IL6 protein concentration was increased on day 1 to 1.7 ± 1.2 -fold and on day 14 to 2.4 ± 0.5 -fold in comparison to control levels, respectively. By passing month 1 no significant differences of the IL6 protein concentration could be shown.

Conclusion: In our study we observed restoration of tissue homeostasis regarding microglia accumulation, neuronal apoptosis and IL6 protein concentration one month post SAH. However, the gene expression of the investigated proinflammatory cytokines was still on a high level at this time point, whereby an exclusion of a possible tertiary brain damage by incomplete resolution could not be assured. Inflammatory resolution and tissue homeostasis appear to be important parts of the disease pathology and future studies should also examine later time points after the bleeding to define the impact on brain damage and outcome.

3 months follow-up of subarachnoid haemorrhage headaches after treatment of ruptured aneurysms in interventional and surgically treated patients

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Objective: We studied the difference of surgical “clipping” vs. endovascular “coiling” in concern to post-procedural headaches in patients with ruptured aneurysms.

Methods: Retrospective analysis of N=43 patients with aneurysmal subarachnoidal haemorrhage treated in our department from September 1st 2015 - September 1st 2016 with a WFNS of 1-3. N=22 were surgically treated and N=21 interventional. We compared the post-procedural headaches at the time points of 24 h, 21 days, and 3 months after treatment using the visual analog scale (VAS) for pain.

Results: After surgical treatment the headache decreased for 8.8 points in the VAS, whereas the endovascular treated population showed a decrease of headaches of only 3.3 points ($p < 0.001$). This highly statistical difference remained for 3 weeks where the pain score for the surgically treated patients was 0.68 and for the endovascular treated 1.8. After 3 months the pain was less than 1 for both groups with surgically treated patients scoring 0.1 and endovascular treated patients 0.9 (not significant).

Conclusion: Clipping relieves the patients SAH headaches faster and more effective than endovascular coiling. This effect stays significant for at least 3 weeks and plays a crucial role in stress relieve during the acute and subacute ICU care of such patients.

The application of the unruptured intracranial aneurysm treatment score - a retrospective, single-center analysis

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Objective: The unruptured intracranial aneurysm treatment score (UIATS) was published in April 2015 as a multidisciplinary consensus among cerebrovascular specialists regarding treatment of incidental intracranial aneurysms (IIA). The UIATS is based on the stratification of aneurysm-related, treatment-related, and patient-related risk factors. It should alleviate decision-making as to whether or not an IIA should be treated. As a tertiary center with focus on vascular neurosurgery, we aimed to investigate whether our decision-making in patients with IIA has been in accordance with the newly-published UIATS data.

Methods: We conducted a retrospective analysis of patients admitted to our center IIA from January 2011 to May 2016. The UIATS was applied to all IIA, and they were subsequently divided into three groups: (a) UIATS favoring treatment, (b) UIATS favoring observation, and (c) UIATS non-conclusive. The results of the UIATS were then compared to the clinical decisions made in these patients, and Spearman's rank-order correlation was run to determine the relationship between the UIATS and our clinical decisions. Discrepancies between the UIATS and the clinical decisions made were then examined for associated complications, defined as intra-operative or post-operative complications in cases where UIATS favored observation. Statistical analysis was performed using IBM® SPSS® Statistics Version 21.

Results: A total of 93 patients, 65 (70%) females and 28 (30%) males, harboring 147 IIA were included. Mean age was 57 years (36-84). In our cohort, 118/147 (80.3%) of IIA were treated. In 70/118 (59.3%) of treated IIA, the UIATS favored treatment. In 18/118 (15.3%), the UIATS was non-conclusive, while in 30/118 (25.4%), the UIATS favored observation. In 29/147 (19.7%), IIA were not treated. In 15/29 (51.7%), the UIATS favored observation, while in 9/29 (31%) the UIATS favored treatment. In 5/29 (17.2%) the UIATS was non-conclusive. Spearman's rank-order correlation coefficient was 0.366, $p < 0.01$. Discrepancies between UIATS and our clinical decisions did not correlate with complications (correlation coefficient 0.034, $p = 0.714$).

Conclusion: Our analysis shows that our clinical decision-making has been in line with the newly-established UIATS. Furthermore, it supports the use of the UIATS in clinical decision-making when treating unruptured intracranial aneurysms.

MO.21 **Bildgebung 2**

Montag *Monday*, 15.05.2017, 15.30 – 16.40 Uhr *hrs*

- MO.21.01 *Optical analysis of human brain tumor biopsies using Raman spectroscopy*
O. Uckermann* (Dresden, Deutschland), R. Galli, M. Meinhardt, G. Steiner, G. Schackert, M. Kirsch
-
- MO.21.02 *Outcome Prediction by Volume of Ischemic Brain in Malignant Middle Cerebral Artery Infarction treated by Decompressive Hemicraniectomy*
C. Freyschlag* (Innsbruck, Austria), C. Boehme, M. Bauer, J. Kerschbaumer, C. Unterhofer, C. Thomé
-
- MO.21.03 *Qualitative and quantitative assessment of arteriovenous malformation architecture at 7 Tesla MRI*
B. Chen* (Essen, Deutschland), T. Matsushige, P. Dammann, T. Schoemberg, M. Ladd, U. Sure, K. Wrede
-
- MO.21.04 *Radiofrequency-induced heating around intracranial aneurysm clips: An implant safety study at 7 Tesla MRI*
B. Chen* (Essen, Deutschland), Y. Nouredine, O. Kraff, A. Bitz, M. Ladd, U. Sure, K. Wrede
-
- MO.21.05 *Validation of Accelerometer derived response latencies in TMS guided language mapping*
F. Dreyer* (Berlin, Deutschland), H. Schneider, I. Bährend, O. Nikolenko, F. Pulvermüller, T. Picht
-
- MO.21.06 *Voxel-based morphometry in epilepsy surgery for patients with focal cortical dysplasia using neuronavigation and intraoperative MRI*
B. Sommer* (Erlangen, Deutschland), S. Rampp, H. Hamer, I. Blümcke, M. Buchfelder, K. Rössler
-
- MO.21.07 *A Novel Optical Molecular Imaging Strategy for Glioblastoma Surgery Using Dual-Modality Raman and Optoacoustic Contrast Enhancing Nanostars*
V. Neuschmelting* (Köln, Deutschland), H. Stefan, H. Charlene, B. Nicolas, H. Ruimin, N. Vasilis, K. Moritz F.
-

Optical analysis of human brain tumor biopsies using Raman spectroscopy

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Objective: Raman spectroscopy reveals the molecular composition of tissues and proved to be suitable for intraoperative in situ diagnosis of glioma. Furthermore, the technique can provide prognostic information, for instance about the *IDH1* genotype. Therefore, Raman spectroscopy is regarded as promising tool to early obtain an integrative diagnosis of brain tumors. However, studies have been performed on a small number of patients or on cryosections until now. Therefore, we investigated fresh tissue biopsies to approximate the intraoperative setting with the aim to evaluate the potential and limitations of intraoperative Raman spectroscopy.

Methods: 208 biopsies were obtained during brain tumor surgery and subjected to Raman spectroscopy without any processing. Samples from surgeries for treatment of pharmaco resistant epilepsy served as non-tumor control tissue. Spectra were obtained with a RamanRxn1™ (Kaiser Optical Systems Inc) coupled to a microscope at five positions of each sample. Data analysis was performed using MATLAB functions

Results: Raman spectra of 51 meningioma, 53 glioblastoma multiforma, 19 recurrent glioblastoma, 11 astrocytoma, 8 oligodendroglioma, 6 oligoastrocytoma, 8 neurinoma, 24 metastases, and 16 other tumors were acquired. Furthermore, three samples of necrotic tissue and nine biopsies of non-tumor human brain tissue were analyzed. Raman bands related to hemoglobin at 754 cm^{-1} and between $1540\text{-}1570\text{ cm}^{-1}$ proved to be valuable markers to detect contamination with blood. Moreover, a sharp and intense Raman band at 959 cm^{-1} indicated PO_4^{3-} groups of calcium hydroxyapatite. All tumor types showed a significant reduction in the spectral range $1050\text{-}1150\text{ cm}^{-1}$ compared to non-tumor brain tissue according to the Fisher's coefficient. Bands related to lipids ($1297, 2850, 3011\text{ cm}^{-1}$) were strongly reduced in glioblastoma. Furthermore, the band at 1660 cm^{-1} (assigned to protein) was increased. These spectral changes were less pronounced in recurrent glioblastoma or low grade glioma. Neurinoma exhibited additional bands at 1158 und 1521 cm^{-1} which are assigned to carotinoids. The band of cholesterol at 700 cm^{-1} was largely missing in brain metastases and bands assigned to collagen ($755, 856, 938, 1031, 1236, 1401\text{ cm}^{-1}$) were more intense. Raman spectra of meningioma were characterized by higher intensities of bands assigned to (phospho)lipids ($715, 1088, 1127, 1302, 1438, 1656\text{ cm}^{-1}$) and DNA (830 and 1336 cm^{-1}) compared to dura. Furthermore, Raman bands of proteins and collagen were reduced.

Conclusion: The Raman spectra of fresh biopsies measured in the operating room were in accordance to previous data obtained from tissue sections, opening the possibility of in situ tissue classification with high sensitivity and specificity. Perspectively, this will assist neuropathologists and neurosurgeons to obtain early - intraoperative - integrated diagnosis and to consecutively apply personalized local therapies.

Outcome Prediction by Volume of Ischemic Brain in Malignant Middle Cerebral Artery Infarction treated by Decompressive Hemicraniectomy

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Objective: Malignant middle cerebral artery (MCA) infarction represents a life-threatening condition due to its space-occupying character. The surgical treatment outcome was assessed in multiple well-designed trials and showed strong evidence in favor of decompressive hemicraniectomy. However, the timeframe for decompressive surgery remains debatable and no objective criteria are found to facilitate the decision. We aimed to analyze imaging characteristics of patients with MCA-infarction for outcome prediction.

Methods: A retrospective analysis of 34 consecutive patients undergoing decompressive craniectomy was carried out. We used volumetric analysis through segmentation to determine the volume of the initial infarction and subsequently volumes on the first and 3rd postoperative day (pod1 and 3). The size of craniectomy was assessed and the time between onset and surgery. Outcome was measured as modified Rankin Scale (mRS), whereas favorable outcome was set for mRS ≤ 3 .

Results: Median age of our patients was 53.5 years (25 – 72), the median time from the onset of first symptoms to surgical intervention was 38 hours (1 – 150) and the male: female ration was 2:1. The median ischemic volume was 250 cc (106 – 418) preoperatively, 315 cc (141 – 505) on pod1 and 349 cc (177 – 617) on pod3, respectively. A mRS ≤ 3 after 6 months could only be reached in 7 (20%) patients. Within the first 24 hours, the volume of infarction rose significantly ($p=0.0003$) and was associated with a worse outcome ($p<0.0001$) upon univariate analysis. In multivariate analysis, the volume on pod 3 showed a significant ($p=0.014$) correlation with outcome, so was the age upon onset ($p=0.018$).

Conclusion: A total infarct volume of >300 cc in native CT-scan in patients undergoing hemicraniectomy, reliably predicts worse outcome for malignant MCA-infarction.

Qualitative and quantitative assessment of arteriovenous malformation architecture at 7 Tesla MRI

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Objective: Identification and characterization of cerebral arteriovenous malformation (AVM) architecture is essential for treatment planning. This prospective clinical study aims to evaluate signal characteristics of arterial feeders, nidus and venous drainage in cerebral AVMs using 7 Tesla (T) MRI.

Methods: Ten adult patients suffering from cerebral AVM were examined using 7T MRI. The study was conducted according to the principles expressed in the Declaration of Helsinki and was approved by the local university institutional review board. Written informed consent was obtained before each examination. Imaging was performed on a whole-body MRI system (Magnetom 7T, Siemens Healthcare, Erlangen, Germany) utilizing a 1/32-channel transmit/receive head coil (Nova Medical, Wilmington, USA). Acquired sequences included TOF, MPRAGE (non-enhanced and enhanced), and SWI. Two experienced readers evaluated arterial feeders, AVM nidus and venous drainage in consensus. Additionally, AVMs were segmented manually for each patient by both raters. After co-registration of the 3 acquired MRI sequences, signal intensity histograms (249 bins) were calculated for the extracted feeders, AVM nidus and drainage, respectively.

Results: The patient group comprised 5 male and 5 female subjects. Mean age was 38 years (range: 22-52 years). Arterial AVM feeders were delineated excellently in TOF sequences, correlating with narrow ranges of high signal intensities in the histograms. On the contrary, MPRAGE and SWI delineated AVM feeders heterogeneously with histograms showing a variable and wide signal intensity distribution. Delineation of the AVM nidus was homogeneous in TOF, MPRAGE and SWI for the majority of patients and histograms showed homogeneous signal intensity distributions. The venous drainage appeared inhomogeneous in all acquired sequences with hyperintense as well as hypointense findings. Intensity histograms reflect these results with variable peaks at all intensity levels.

Conclusion: Vessel delineation with 7T MRI is excellent for AVMs. However, in contrast to conventional examinations that depict arterial feeders, AVM nidus and venous drainage homogeneously, identification of the AVM architecture remains challenging in 7T MRI. Due to the signal heterogeneity especially in the feeders and drainage these structures might be misinterpreted in some cases.

Radiofrequency-induced heating around intracranial aneurysm clips: An implant safety study at 7 Tesla MRI

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Objective: Ultrahigh-field (UHF) magnetic resonance imaging (MRI) at 7 Tesla (T) has been shown to excellently delineate cerebral aneurysms and other neurovascular pathologies. However, electrically conductive implants like aneurysm clips remain a contraindication for 7T MRI. The goal of this study was to examine radiofrequency (RF) induced tissue heating around intracranial aneurysm clips during a 7T head MR examination. Test methods including a conservative approach and realistic exposure scenarios in heterogeneous models are presented.

Methods: The study focused on three main topics: the first part investigated polarization effects on the specific absorption rate (SAR) using both computer simulations and in-vitro measurements; the second part investigated the effect of clip length on both electric field (E-field) and temperature; and, finally, heating in heterogeneous models using both a conservative approach in case information about the clip is missing as well as realistic exposure scenarios were studied.

Results: Worst-case orientation was found for the clip aligned parallel to the E-field polarization for both simulation and measurement. Absolute local temperature remained below the International Electrotechnical Commission (IEC) regulatory limit for 44/50 clinical scenarios presented in this study. No significant effect on heating was determined for a short clip (length = 18.8mm); worst-case heating was determined for a clip with length 51.5mm. The conservative approach led to a maximum E-field strength in the head of 72V/m corresponding to a maximum B1+ of 1.2 μ T, resulting in an accepted power for the considered RF head coil of 4.6W instead of 38.5W without clip. Most scenarios with a single aneurysm clip allow safe scanning when SAR levels are adapted. Scenarios with multiple aneurysm clips will remain challenging especially when clips are closely related but without electrical connection.

Conclusion: This study indicates that safe scanning conditions at 7 T MRI can be applied for most scenarios with single aneurysm clips regarding RF-heating. Nevertheless, further studies on force and torque as well as scenarios with multiple aneurysm clips are mandatory before in-vivo examinations can be declared completely safe.

Validation of Accelerometer derived response latencies in TMS guided language mapping

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Objective: Response latency, in addition to response accuracy, provides a very powerful measure in psycholinguistic neurostimulation approaches and could potentially also be used to identify language eloquent brain regions in TMS guided language mapping. However, objective response latency measures are rarely seen in language mapping paradigms, as so far these latencies could only be acquired post-hoc involving significant effort. A solution was presented by Vitikainen and coworkers (2015) who introduced the Accelerometer as a convenient device to automatically detect vocal response onsets on the basis of larynx vibrations in language mapping paradigms. The current approach aimed at validating the temporal precision of Accelerometer data.

Methods: A word reading paradigm was conducted on a cohort of healthy participants, while an Accelerometer was placed on their throat to measure larynx movements during speaking. Word stimuli of the reading paradigm were selected to cover a wide range of word-initial phonemes and each word was presented three times. Automatically detected Accelerometer response latencies were validated by comparison to manually determined responses from sound recordings. Effects of word-initial phonemes and repetitions were investigated with repeated measures analyses of variance.

Results: Results indicate an overall good match between manual and automatic detection of response latencies. Critically though, systematic differences in Accelerometer precision between word-initial phonemes were observed ($p < 0.001$). At the same time, word-initial phoneme specific precision of the Accelerometer was shown to not vary significantly over time ($p = 0.5$).

Conclusion: Accelerometers may very well be used to automatically detected response latencies in TMS guided language mappings. Results must however always be related to word-specific baseline performance to account for word-initial phoneme depended differences in Accelerometer precision.

Voxel-based morphometry in epilepsy surgery for patients with focal cortical dysplasia using neuronavigation and intraoperative MRI

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Objective: Voxel-based morphometry (VBM) is an important post-processing MRI technique to identify occult malformations in epilepsy patients. We investigated our surgical results in patients operated on for focal cortical dysplasia (FCD) who suffered from refractory epilepsy with the aid of VBM, neuronavigation and intraoperative 1.5T-MRI (iopMRI).

Methods: In this retrospective study, 14 patients (9 female, 4 male, median age 32.0 ± 13.1 yrs) were operated on a FCD in our department using VBM data. The VBM lesion was superimposed into neuronavigation and surgery was performed with intraoperative 1.5T-MRI resection control. Median duration of epilepsy was 20.0 ± 12.5 years. Additional functional MR imaging (motor, memory and speech areas) and diffusion tensor imaging (DTI) for tracking neuronal fibers (language and pyramidal tracts) was acquired in 11 patients. Every patient underwent invasive phase-2 monitoring before respective surgery.

Results: Complete resection of the FCDs was achieved in all of these patients. Intraoperative MRI revealed remnant pathological tissue according to our resection plan in 3/14 patients (21%), which led to further tissue removal intraoperatively. Of 14 patients (7 lesional, 7 non-lesional), VBM identified the FCD in 12 cases and missed the exact localization in 2 non-lesional patients. In 6/12 patients, the VBM lesion was resected completely according to the latest postoperative 3T MRI. Five of these six patients were seizure-free (Engel 1A), whereas only one patient of the remaining 6 patients with subtotal resection of the VBM lesion had excellent seizure control. Overall, 8/14 patients (57%) had Engel class 1A outcome. After surgery, one patient had a permanent and one patient a transient neurological deficit (7% each).

Conclusion: Especially in cases with ill-defined or non-lesional FCDs, voxel-based morphometry, neuronavigation and intraoperative MRI proved to be helpful in the resection of the epileptogenic zone. The rate of complete resections was increased, which transformed into a higher rate of seizure-free patients.

A novel optical molecular imaging strategy for glioblastoma surgery using dual-modality raman and optoacoustic contrast enhancing nanostars

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Objective: The difficulty in visualizing glioma margins intraoperatively remains a major issue in the achievement of gross total tumor resection and, thus, the better outcome of glioma patients. Fluorescence guided surgery with the use of 5-aminolevulinic acid as a contrast agent has become the standard of care in Europe, but suffers from low sensitivity, specificity as well as limited spatial resolution and imaging depth. We opted to test the potential of a new optical imaging strategy with the use of gold nanostars as a dual-modality contrast agent combining the specificity and -sensitivity of Raman spectroscopy with the complementary tissue depth multispectral optoacoustic tomography (MSOT) provides in real-time.

Methods: Four week old *Nestin-tv-a/Ink4a-arf^{-/-}/Pten^{fl/fl}* mice were stereotactically implanted with RCAS-Pdgfb and RCAS-Cre transfected DF-1 cells to induce glioblastoma in the forebrain. Four weeks later surface-enhanced resonance Raman scattering nanoparticles featuring a star-shaped gold core and a Raman reporter resonant in the near-infrared were intravenously injected. Sequential 2D MSOT imaging was performed prior and post injection *in vivo* and followed by streamline Raman imaging for image comparison. Subsequent histological examination served as a reference standard. The pharmacokinetics of the nanostars were assessed by both modalities. The *in vitro* limit of detection as well as the photostability of the nanostars were assessed in a brain tissue mimicking phantom.

Results: *In vitro* the limit of detection of the nanostars was found to be in the low picomolar (<1 pM) by MSOT as well as even up to the low femtomolar range (1.5 fM) by Raman imaging. When exposed to high energy laser light they were found to be photostable. We found the nanostars to be cleared from the blood stream within a few hours and to sufficiently accumulate in the glioblastoma tumor tissue. MSOT was able to well depict the glioblastoma up to a centimeter in tissue depth with high specificity *in vivo* and found to correspond well to the Raman images proven to be ultrasensitive and -specific in the depiction of the accumulated nanostars.

Conclusion: The surface enhanced Raman scattering nanostars reported here were shown to be suitable to serve as dual-modality contrast agent in the depiction of glioblastoma by Raman and MSOT imaging in the near-infrared in a mouse model. Far beyond the limits of fluorescence imaging this complementary novel imaging strategy allowed for the ultrasensitive and -specific detection of glioblastoma up to a centimeter in tissue depth at high resolution.

MO.22**Tumor 3 - Gliome - High-grade intraoperativ**Montag *Monday*, 15.05.2017, 15.30 – 16.50 Uhr *hrs*

- MO.22.01 *The Impact of extent of resection and MGMT-promotor methylation in newly diagnosed IDH1R non mutated glioblastoma*
F. Geßler* (Frankfurt am Main, Deutschland), P. Baumgarten, A. Braczynski, M. Mittelbronn, V. Seifert, C. Senft
-
- MO.22.02 *Awake-awake-awake with dexmedetomidine compared to asleep-awake-asleep craniotomies in glioma surgery - an analysis of 180 glioma patients*
E. Suero Molina* (Münster, Deutschland), S. Schipmann, I. Müller, J. Wölfer, C. Ewelt, M. Maas, W. Stummer
-
- MO.22.03 *Clinical outcome of patients with subtotally resected unilocular glioblastomas involving eloquent areas utilizing intraoperative MRI - a multi-center retrospective comparative analysis*
J. Segovia von Riehm* (Stuttgart, Deutschland), A. Gerber, M. Renovanz, O. Ganslandt, C. Wirtz, J. Coburger
-
- MO.22.04 *Dual-labelling with ALA and fluorescein for fluorescence-guided resection of high-grade gliomas - technical report*
E. Suero Molina* (Münster, Deutschland), J. Wölfer, C. Ewelt, A. Ehrhardt, B. Brokinkel, W. Stummer
-
- MO.22.05 *Impact of anesthetic technique on recurrence and outcome in patients with glioblastoma*
S. Kellermann* (Köln, Deutschland), V. Taurisano, M. Timmer, R. Goldbrunner, T. Annecke, S. Grau
-
- MO.22.06 *INTRAGO: Intraoperative radiotherapy in newly diagnosed glioblastoma multiforme results of an open-label dose-escalation phase 1/2 trial*
S. Brehmer* (Mannheim, Deutschland), F. Giordano, B. Mürle, M. Seiz-Rosenhagen, D. Hänggi, P. Schmiedek, F. Wenz
-
- MO.22.07 *Volumetric extent of resection in newly diagnosed Glioblastoma: Does neurosurgical innovation improve outcome?*
A. Haj* (Regensburg, Deutschland), C. doenitz, D. ehrensberger, A. brawanski, M. proescholdt
-
- MO.22.08 *Brain tumor resection with and without neuropsychological support during awake craniotomy - effects on surgery and clinical outcome*
A. Kelm* (München, Deutschland), N. Sollmann, F. Ringel, B. Meyer, S. Krieg
-

The Impact of extent of resection and MGMT-promotor methylation in newly diagnosed IDH1R non mutated glioblastoma

Florian Geßler¹, Peter Baumgarten², Anne Braczynski², Michel Mittelbronn², Volker Seifert², Christian Senft²

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Purpose: The purpose of this prospective single-center analysis was the incorporation of molecular diagnostics in the assessment of extent of resection (EOR) as a prognostic factor for patients with glioblastoma (GBM).

Patients and Methods: Histology, MGMT promoter methylation status, isocitrate dehydrogenase 1 (IDH-1) R132H-mutation status, EOR and clinical data were prospectively added to a glioma patient database. We analyzed patients with newly diagnosed WHO grade IV glioblastomas and excluded those with IDH-1 R132H mutations. Survival analyses were performed using the Kaplan-Meier method. Prognostic factors were calculated by proportional hazard models.

Results: 176 patients were included in the analysis. 104 patients (59.4%) had gross total resection (GTR), 71 patients (40.6 %) had subtotal or partial resection. 80 patients (45.7%) displayed MGMT-promoter methylation, 95 patients (54.3%) showed no MGMT-promoter methylation. In Cox regression analysis, both MGMT-promoter methylation (HR 1.55; 95% CI, 1.01-2.19; p=0.0133) and GTR (HR 1.48; 95% CI, 1.06-2.07; p=0.0206) were significantly associated with favorable progression free survival (PFS). Furthermore, both MGMT-promoter methylation (HR 2.13; 95% CI, 1.45-3.12; p=0.0001) and GTR (HR 1.81; 95% CI, 1.24-2.63; p=0.0020) were even associated with favorable overall survival (OS). Of other risk factors analyzed, only age (> 60 vs. ≤60 years) was significantly associated with PFS (HR 1.60; 95% CI, 1.14-2.24; p=0.006) and OS (HR 2.19; 95% CI, 1.51-3.19; p<0.0001). No significant difference was observed between GTR, MGMT-non-methylated and non-GTR, MGMT-methylated GBM patients (PFS p=0.726; OS p=0.477).

Conclusion: GTR and MGMT-promoter methylation are independent prognostic factors for improved OS and PFS in a homogeneous cohort of non-IDH-1 mutant, newly diagnosed glioblastomas. If achieved, GTR compensates the biological disadvantage of lacking methylation of the MGMT-promoter region in primary GBM.

Awake-awake-awake with dexmedetomidine compared to asleep-awake-asleep craniotomies in glioma surgery - an analysis of 180 glioma patients

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Objective: For over 70 years, awake craniotomies have been part of treatment of gliomas located in so called “eloquent regions”. The patients’ compliance plays an important role in the success of each surgery. Finding the optimal balance between dosage and type of sedative, analgesic and anxiolytic drugs and keeping the patient clinically and neurologically assessable remains challenging. Different techniques are applied in neurooncology centres: “Asleep-awake-asleep” and “awake-awake-awake” are both techniques which have been used at the Department of Neurosurgery, University Hospital of Münster. Since 2013, we performed solely “awake-awake-awake” surgeries using the α_2 -receptor agonist, dexmedetomidine, as sole anaesthetic drug. The aim of this study was to compare both techniques and evaluate the clinical use of dexmedetomidine in the setting of awake craniotomies for glioma surgery.

Methods: We retrospectively analysed patients that were operated in the Department of Neurosurgery, University Hospital of Muenster either under “asleep-awake-asleep” using propofol-remifentanil sedation, or under “awake-awake-awake” conditions, using dexmedetomidine infusions. In the „asleep-awake-asleep“-group patients were intubated with laryngeal mask and extubated for the assessment period. Patients in the fully awake group were sedated with dexmedetomidine beyond the test phase. A scalp block was used in both conditions.

We evaluated the electronical medical record and the digitalized anesthetic protocols from each patient. Adverse events, as well as applied drugs with doses and frequency of usage were recorded. Compliance was evaluated according to the surgeons’ perception.

Results: Two-hundred twenty-four (n=224) awake surgeries were performed in the period from october 2009 till september 2015. One-hundred eighty (n=180) of these were performed for the resection of gliomas and included into the study. In the “awake-awake-awake”- group (n=75) significantly less opiates (p<0.000), less vasoactive (p<0.000) and antihypertensive (p<0.000) drugs were used in comparison to the “asleep-awake-asleep”-group (n=105). In addition, compliance was much higher rated in the “awake-awake-awake”-group. Furthermore, the overall length of stay (p<0.000) and the surgical time (p<0.000) were significantly lower in the “awake-awake-awake” group.

Conclusion: Dexmedetomidine provides excellent setting for fully awake surgeries. Our experience shows that using dexmedetomidine as sole anaesthetic drug during awake craniotomies sedates moderately and acts anxiolytic. Thus, after ceasing infusion it enables quick and reliable clinical neurological assessment of patients. Furthermore, according to our experience, it reduces the length of hospital stay and duration of the whole surgical procedure.

Clinical outcome of patients with subtotally resected unilocular glioblastomas involving eloquent areas utilizing intraoperative MRI - a multi-center retrospective comparative analysis

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Objective: Aim of this multi-center-study is to evaluate extent of resection (EoR) in preoperatively intended subtotal resection (STR) of glioblastomas (GBs) involving eloquent areas depending on the use of intraoperative MRI (iMRI). Further, to assess clinical outcome and progression free (PFS) and overall survival (OS).

Methods: Patient data from 3 neurosurgical centers (years 2008-2013) was retrospectively reviewed including patients with primary GB (pGB) – or their recurrence (rGB). Tumors presenting unilocular growth, involving eloquent areas with intended STR were included. All patients underwent comparable adjuvant therapy. Imaging data was pseudonymized and assessed blinded by one central reviewer (neurosurgeon). Overall EoR (oEoR) was assessed based on pre- and postoperative tumor volume with iPlan 3.0 (Brainlab). In addition, a potentially resectable tumor volume (RV) was defined by the reviewer. Based on this data, a delta EoR (dEoR) achieved during the respective surgery was calculated. We calculated multivariate linear regression for oEoR and dEoR, binary regression for complications and Cox-regression for PFS and OS.

Results: Out of 101 patients, 88 presented pGBs and 13 presented rGBs. 46 patients underwent surgery without (w/o) iMRI, 38 patients with (w/) iMRI. In linear regression model controlling for age, tumor volume, neurophysiological mapping and use of iMRI no significant impact on any variable on oEoR was found. Yet, using the same model but assessing achieved dEoR, we solely found a significant influence of iMRI minimizing residual tumor ($p=0.03$). In binary regression model controlling for age, tumor volume, EoR, neurophysiological mapping and use of iMRI, none of the variables showed a significant difference concerning complications. OS was significantly higher ($p=0.01$) w/ iMRI (median OS = 10 months) compared to surgery w/o iMRI (median OS = 9 months). Minimal EoR > 70% and maximum RV < 5 cm³ independently showed a significant advantage ($p < 0.01$, $p = 0.01$) concerning OS. Both criteria were found simultaneously in 48% of patients treated w/ iMRI and 24% of patients treated w/o iMRI ($p = 0.04$).

Conclusion: Pointing out the importance of maximum safe resection in STR in order to achieve survival benefit, our data shows significant superiority in the use of iMRI.

Dual-labelling with ALA and fluorescein for fluorescence-guided resection of high-grade gliomas - technical report

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Objective: Fluorescence-guidance with 5-ALA helps improve resections of malignant gliomas. However, one limitation is the low intensity of blue light for background illumination. Fluorescein has recently been re-introduced into neurosurgery and novel microscope systems are available for visualizing this fluorochrome, which highlights all perfused tissues but has limited selectivity for tumor detection. We here investigate a combination of both fluorochromes, ALA for distinguishing tumor and fluorescein for providing tissue fluorescence of adjacent brain tissue.

Methods: We evaluated six patients with cerebral lesions suggestive of high-grade glioma. Patients received ALA (20mg/kg) orally four hours before induction of anesthesia. Low dose fluorescein (3mg/kg i.v.) was injected immediately after anesthesia induction. Zeiss Pentero microscopes (equipped either with Yellow560 or Blue400 filters) were used to visualize fluorescence. To simultaneously visualize both fluorochromes, the Yellow560 module was combined with external blue light illumination (Storz D-Light).

Results: Fluorescein-induced fluorescence created a useful background for protoporphyrin IX (PPIX) fluorescence, which appeared orange to red, surrounded by greenly fluorescent normal brain and edematous tissue. Green brain tissue fluorescence was helpful in augmenting background. Too strong levels of blue illumination obscured PPIX fluorescence. Unspecific extravasation of fluorescein was noted at resection margins, which did not interfere with PPIX fluorescence detection.

Conclusion: Dual labeling with both PPIX and fluorescein fluorescence is feasible and gives superior background information during fluorescence guided-resections. We believe this technique carries potential as a next step in fluorescence-guided resections if completely integrated into the surgical microscope.

Impact of anesthetic technique on recurrence and outcome in patients with glioblastoma

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Objective: Perioperative administration of volatile anesthetics or opioids is known to impair humoral and cellular immune function and latest studies suggest an influence on recurrence rates in patients with solid tumors. We investigated the potential influence of the anesthetic method on progression-free (PFS) and overall survival (OS) in patients with glioblastoma.

Methods: In a retrospective single-center analysis we identified all adult patients undergoing complete resection of contrast enhancing glioblastoma under general anesthesia followed by standard radio-chemotherapy. We then formed two matched groups differing in anesthetic technique only, including volatile anesthetics (VA) versus total-intravenous anesthesia (TIVA). Outcome measures were PFS and OS. Groups were compared using chi square, Mann-Whitney U-test and Kaplan-Meier method for survival estimates.

Results: A total of 120 patients were included, balanced with 60 patients in each anesthesia-method group. There was no significant difference regarding age, preoperative KPS, MGMT promotor methylation, IDH mutation status and extent of resection. Choice of the anesthetic drug did not influence time to progression ($p=0.879$) nor OS ($p=0.324$).

Conclusion: There appears to be no impact of the choice of the anesthetic drug on recurrence and overall survival in patients with glioblastoma.

INTRAGO: Intraoperative radiotherapy in newly diagnosed glioblastoma multiforme results of an open-label dose-escalation phase 1/2 trial

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Objective: Patients diagnosed with glioblastoma (GBM) have despite aggressive treatment with surgery and adjuvant radiochemotherapy a poor prognosis with a progression-free survival (PFS) of about 7 month. As almost every progress is seen at the resection cavity an augmentation of local treatments may improve outcome. We here present the results of a dose finding trial testing intraoperative radiotherapy (IORT) with low-energy x-rays to the resection cavity.

Methods: In a single-center, open-label, phase 1/2 dose-escalation trial for adult patients with newly diagnosed GBM (INTRAGO) patients received (IORT) at three dose levels starting at 20Gy prescribed to the surface of the resection cavity and escalated in 10Gy steps up to 40Gy. Afterwards patients received standard adjuvant therapy consisting of classic radiotherapy (60Gy) in combination with temozolomide followed by maintenance temozolomide. The primary endpoint was safety respectively the occurrence of dose-limiting toxicities within the first 3 months following IORT defined as wound healing disorders, cerebral hemorrhage/ ischemia, radionecrosis and early termination of radiochemotherapy). Secondary endpoints were PFS and overall survival (OS). Additionally the local PFS, defined as tumor recurrence within 1 cm of the treated resection cavity was analyzed. The trial is registered at ClinicalTrials.gov (NCT02104882).

Results: Between 8/2013 and 8/2015 15 patients with GBM were treated at three dose levels (7 at 20Gy, 4 at 30Gy, 4 at 40Gy). Of these 13 underwent incomplete resection; 6 had unresected multifocal tumors; and 3 did not receive per-protocol treatment (PPT). The MGMT promoter was not methylated in 10 patients. The median follow-up was 13.8 months. The majority of grade 3-5 adverse events (25 of 30) were deemed related to external-beam radiotherapy, chemotherapy, or tumor progression. 5 patients developed suspected or confirmed radionecrosis. No IORT-related deaths occurred. The median PFS was 11.2 months (95%CI 5.4-17.0) for all patients and 11.3 months (95%CI 10.9-11.6) for those receiving PPT. The median local PFS was 14.3 month (95%CI 8.4-20.2) for all patients and 17.8 month (95%CI: 9.7-25.9) for those receiving PPT. The median OS was 16.2 month (95%CI 11.1-21.4) for all patients and 17.8 month (95%CI 13.9-21.7) for those receiving PPT.

Conclusion: IORT caused a highly relevant increase of local progression-free survival with manageable side effects in a cohort with predominantly incompletely resected GBM and unfavorable prognostic factors.

Volumetric extent of resection in newly diagnosed Glioblastoma: Does neurosurgical innovation improve outcome?

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Objective: Glioblastoma (GBM) is the most common brain tumor of the adult population. Standard management consists of microsurgical resection, concomitant radio chemotherapy followed by adjuvant chemotherapy. Maximal resection has been demonstrated to provide the best outcome. The foundation of a specialized neuro-oncology care center following the paradigm maximal resection with minimal morbidity requires the implementation of a large technical portfolio including functional imaging, awake craniotomy with direct cortical and subcortical stimulation, intraoperative neuromonitoring and fluorescence supported resection. We wanted to address the question whether the innovation in the neurosurgical management have resulted in a larger extent of resection and ultimately improved patients outcome.

Methods: A cohort of 149 patients (mean age 61.8 years; female male ratio 67/82) treated surgically for newly diagnosed GBM were included. Neurological and functional independence status were measured by the medical research neurological performance status (NPS) and the Karnofsky performance score (KPS) respectively. Extent of resection was volumetrically quantified utilizing Brain Lab iPlan Cranial software version 3 BrainLAB AG Germany. Based on the treatment timepoint, patients were stratified into a subcohort before and after implementation of the above mentioned technical improvements. Subsequently, the surgical treatment pattern and the resulting progression free (PFS) and overall survival (OS) was evaluated.

Results: Both KPS and NPS had significantly improved postsurgically. Relevant confounding factors for PFS and OS in the entire patient population were age beyond 65 years ($p = 0.001$) and the MGMT promoter methylation status ($p = 0.005$). Patients with a volumetrically determined complete resection had a significantly better PFS (8.7 vs 7.8 months $p = 0.041$) and OS (18.4 vs 14.5 months $p = 0.005$) compared to incompletely resected patients. The frequency of transient or permanent postoperative neurological deficits was not higher after complete resection compared to subtotal resection. The frequency of complete resection significantly improved in the timespan after the implementation of technical improvements (34.8% to 68.2% $p = 0.007$). Accordingly the patient cohort being treated utilizing the improved technical potential showed a significantly better PFS (8.9 vs 7.6 months $p = 0.002$) and OS (16.8 vs 13.1 months $p = 0.032$). Multivariate Cox regression analysis revealed age, MGMT promoter status, complete resection and treatment time span as independent prognostic factors for PFS and OS.

Conclusion: Our data demonstrate that the frequency of complete resection in GBM patients is improved upon a series of technical developments in the neurosurgical management. This results in a significantly better outcome without the risk of increased surgery related morbidity.

Brain tumor resection with and without neuropsychological support during awake craniotomy - effects on surgery and clinical outcome

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Objective: During awake craniotomy, a neuropsychologist is regarded as a highly valuable partner for us neurosurgeons. Yet, there are some centers who do not involve neuropsychologists during awake surgery. The aim of this study was to investigate whether there is a difference in clinical outcome measures between patients that underwent awake craniotomy for tumor removal with and without the attendance of a neuropsychologist.

Methods: 68 patients that underwent awake craniotomy for resection of presumably language-eloquent tumors were included in our analysis. 54 awake craniotomies were done under condition of neuropsychological support (NP). 14 awake surgeries were performed without a neuropsychologist (non-NP) due to language barrier between the neuropsychologist and the patient. In these patients, neuropsychological evaluation was provided by a bilingual resident speaking the mother tongue of the respective patient.

Results: Both groups were highly comparable regarding age, gender, and tumor entity. However, gross total resection (GTR) rate was significantly higher in the NP group (NP vs. non-NP: 63.0% vs. 28.6%, $p=0.02$) whilst duration of surgery was shorter (235.6 vs. 286.6 min, $p<0.01$). Furthermore, the rate of unexpected residual tumor (estimation of the intraoperative extent of resection vs. postoperative imaging) was lower within the NP group (16.7% vs. 42.9%, $p=0.04$), but no statistically significant difference in terms of permanent surgery-related language deterioration was observed when comparing the NP and non-NP group (5.6% vs. 14.3%, $p=0.26$).

Conclusion: Although our non-NP cohort is small, our data emphasize the need for professional neuropsychological evaluation during awake craniotomy.

MO.23 Tumor 4 – Metastasen B

Montag Monday, 15.05.2017, 15.30 – 16.30 Uhr hrs

- MO.23.01 *Endothelial EphrinB2 mediates metastatic homing of tumor cells and angiogenesis in spinal bone metastasis formation*
T. Broggini, A. Piffko, C. Harms, P. Vajkoczy, M. Czabanka* (Berlin, Deutschland)
-
- MO.23.02 *A single center series of 16 pituitary metastases and their surgical management*
T. Burkhardt* (Hamburg, Deutschland), M. Henze, L. Kluth, M. Westphal, N. Schmidt, J. Flitsch
-
- MO.23.03 *Do size or multiplicity of cerebral metastases predict Infiltration into brain parenchyma ?*
I. Fiss* (Göttingen, Deutschland), V. Rohde, C. Wolfert, S. Hernandez Duran, A. Bleckmann, T. Pukrop, C. Stadelmann, S. Sperling, A. Barrantes-Freer, B. Schatlo
-
- MO.23.04 *Impact of the use of 5-ALA on overall survival in patients undergoing surgery for metastatic brain disease – a matched cohort study*
A. Hussein* (Göttingen, Deutschland), I. Fiss, C. Wolfert, S. Hernandez-Duran, A. Bleckmann, V. Rohde, B. Schatlo
-
- MO.23.05 *Incidence and impact of postoperative complications on the clinical course of patients with brain metastases – an analysis based on the metastasys study data*
A. Hussein* (Göttingen, Deutschland), I. Fiss, C. Wolfert, S. Hernandez-Duran, A. Bleckmann, V. Rohde, B. Schatlo
-
- MO.23.06 *Pre-operative Karnofsky Performance Scale score is the best prognostic factor in patients with multiple brain metastases*
S. Silva* (Sao Paulo, Brazil), M. Skardelly, C. Petitto, L. Lage, G. Lepski, O. Feher, M. Teixeira
-

Endothelial EphrinB2 mediates metastatic homing of tumor cells and angiogenesis in spinal bone metastasis formation

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Objective: The EphrinB2 system has been linked to organ specific metastasis formation by mediating both tumor cell - endothelial cell interactions and angiogenesis. It was the aim to determine the influence of endothelial EphrinB2 depletion on tumor cell – endothelial cell interactions in osseous tissue and to characterize the effects on spinal metastasis angiogenesis.

Methods: Luciferin expressing B16 melanoma cell ($1 \cdot 10^5$ cells) were injected retrograde into the left CCA in control (*efnb2*^{lox/lox}) and endothelial EphrinB2 knock-out mice (*efnb2*^{iΔEC}, N≥5). Spinal bone histology was performed in *efnb2*^{lox/lox} and *efnb2*^{iΔEC} animals using endomucin and CD31 staining. Cell dissemination (3 hours after injection) experiments and calvae fluorescence intravital microscopy (IVM) were performed to identify *efnb2* related endothelial - tumor cell interactions during tumor cell dissemination.

Results: In non-tumor bearing *efnb2*^{iΔEC} animals endomucin positive spinal sinusoids were significantly reduced compared to controls (65±14% vs. 39±20%) whereas CD31 positive sinusoids were comparable between groups. In spinal metastasis bearing *efnb2*^{iΔEC} animals, this vascular phenotype changed to a significant increase of CD31 pos. spinal sinusoids (21±19% vs. 41±21%), whereas no difference was observed in Endomucin pos. vessels. IVM demonstrated a significantly increased number of trapped tumor cells in bone microvessels after intraarterial tumor cell injection in *efnb2*^{iΔEC} animals (31±28 cells/ROI vs 69±18 cells/ROI; 3 hours after injection)

Conclusion: Endothelial EphrinB2 depletion leads to increased tumor cell – endothelial cell interactions during hematogenous metastatic dissemination to the spine and supports a proangiogenic response in spinal metastasis angiogenesis.

A single center series of 16 pituitary metastases and their surgical management

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Objective: Pituitary Metastases are rare, therefore this entity is not subject to standardized guidelines. There is debate about typical initial symptoms that may lead to the correct diagnosis and information about the clinical course is sparse.

Methods: A retrospective analysis of patients with pituitary metastases, surgically treated via a transsphenoidal procedure between 2006 through 2014. Primary disease, clinical and surgical course as well as adjuvant radiotherapy and follow-up data are presented.

Results: 14 patients (8 female, 6 male). Mean age 61.5 years. Most patients became symptomatic with visual symptoms -visual deterioration and diplopia (n=13)- and anterior lobe insufficiency (n=8). Diabetes insipidus was seen in 3 patients. All underwent transsphenoidal surgery, 4 patients had to undergo surgery for residual tumor or recurrence, two via a transcranial route. Breast cancer was the most common entity (n=6), followed by prostate cancer (n=3), non-small cell lung cancer (n=2) and melanoma, thyroid cancer and renal cancer in one case each. Postoperative MRI showed gross total resection in 4 cases and residual disease in 8 cases, 2 patients files were incomplete regarding MRI-results. All patients underwent adjuvant radiotherapy. Survival after the initial diagnosis of cancer was 36 months and 16 months after diagnosis of pituitary metastases.

Conclusion: Transsphenoidal surgery is a safe method to resect pituitary metastases, the extent of resection does not influence survival time. Diabetes insipidus may not be the most common initial symptom of pituitary metastases and lack thereof should not lead to making a wrong diagnosis and delaying appropriate therapy.

Do size or multiplicity of cerebral metastases predict Infiltration into brain parenchyma ?

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Objective: Cerebral metastases are known to exhibit infiltrative behavior beyond macroscopic tumor boundaries. We hypothesized that the size of a cerebral metastasis and the presence of multiple filiae are predictors of cellular invasion beyond the conventional limits of a tumor as determined by macroscopic appearance. This could have implications on the surgical treatment of larger metastases which might warrant more aggressive – i.e. supratotal – resection strategies.

Methods: Patients with suspected cerebral metastases were enrolled in a prospective protocol and underwent resection of a cerebral lesion. Based on the Metastasis-trial protocol, biopsies were obtained at the margins of resection and analyzed for histological evidence of tumor cells. The size and number of cerebral lesions were correlated with the dichotomized invasion pattern using Chi²-tests with a 2-sided significance level of p<0.05. Statistical workup was performed using SPSS 18.0 (IBM).

Results: Sixty-one patients were operated with a mean age of 63±8 years. 26/61 patients (43%) had evidence of more than one metastasis. Average tumor size was 31±13mm. Infiltration was found in 49/61 (80%) with similar degrees across primary tumor type. In cases with infiltration, multiple cerebral metastases were present in 21/49 cases (43%). In cases without infiltration, the rate of multiple lesions was similar (5/12; 42%, p=0.94). In 27 patients, tumor size exceeded 30mm (47%) while 31 had smaller tumors (53%). Histological evidence of tumor infiltration was found in 25/31 in smaller lesions (81%) and 22/27 in larger lesions (82%, p=0.94).

Conclusion: Based on our prospective series, we could not confirm the hypothesis that infiltration of a metastatic tumor is associated with tumor size. Our data do not warrant altering the surgical strategy towards more aggressive transmarginal resection in larger lesions.

Impact of the use of 5-ALA on overall survival in patients undergoing surgery for metastatic brain disease – a matched cohort study

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Objective: Recent studies suggested a reduced incidence of local recurrence after supramarginal resection of brain metastases employing either 5-aminolaevulinic acid (ALA) fluorescence or an additional 5mm margin in non-eloquent regions. We analyzed whether overall survival differed after resection of metastases with or without the use of 5-ALA.

Methods: We included consecutive patients who underwent surgical resection of brain metastases at our institution since June 2013 up until 11/2015 in the present analysis. A minimum follow-up of 1 year was required for inclusion in this study. We routinely employ 5-ALA in the resection of brain metastases as part of the prospective Metastasis-trial-protocol. Age- and sex-matched cohorts were extracted for analysis of overall survival after resection with and without 5-ALA.

Results: A total of 125 patients were included in the present analysis (50% male, mean age 63yrs (CI95%: 45-79yrs)). The primary tumor originated from the lung in 57 cases (47%) in the conventional and in 25 cases (52%) in the 5-ALA-group ($p>0.05$). N=89 patients were operated without addition of 5-ALA fluorescence, while 36 patients underwent fluorescence-assisted tumor resection. Overall survival was 35.5 (26-45) weeks in the conventional group and 28.8 (21-35) weeks in the 5-ALA group. Kaplan-Meier Log rank testing revealed no difference between groups ($p=0.39$).

Conclusion: This matched cohort study revealed no significant difference in overall survival between patients operated with and without the use of 5-ALA. Despite cohort matching, differences in the extracerebral burden which were not taken into account may explain the discrepancy between our findings and previous reports.

Incidence and impact of postoperative complications on the clinical course of patients with brain metastases – an analysis based on the metastasys study data

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Objective: Surgical resection of brain metastases is carried out with the aim of prolonging survival or preventing impending neurological deficits. There is an inherent difficulty in deciding to perform brain surgery on an often fragile and comorbid patient. The aim of this analysis, based on prospectively collected data, is to assess the risks of complications, identify their predictors and evaluate their effect on outcome.

Methods: We included consecutive patients who underwent surgical resection of brain metastases at our institution since June 2013 up until 2016 in the present analysis. The definition of postoperative complications included new neurological deficits, hemorrhage, ischemia or the need for wound revision. Systemic Infections requiring therapy were equally included. We employed univariate and multivariate analyses where applicable as well as survival (Kaplan Meier log-rank) to assess predictors and effects of postoperative surgical complications.

Results: A total of 168 patients were included in the present analysis (53.6% male, mean age 63yrs (CI95%: 47-80yrs)). The primary tumor originated from the lung in 81 cases (48%). Complications were recorded in 36 patients (21.4%). Postoperative hemorrhage or ischemia occurred in 11/168 cases (6.5%), while infections (local and systemic) occurred in 22/168 patients (13.1%). New neurological deficits were present after surgery in 8.9% (15/168). Among the analyzed predictive factors, duration of surgery was associated with postoperative infections ($p=0.005$), but not with hemorrhage or neurological impairment. Kaplan-Meier Log rank testing demonstrated a marked difference between patients with (median 6 weeks (CI95%: 0.1-17.9)) and without complications (median 27.0 weeks (CI95%: 22.4-31.6); $p<0.001$). Patients with new neurological deficits had a median survival of 2 weeks (CI95%: 0.1-4.2) vs. 25 weeks without new neurological deficit (25 weeks; (CI95% 21.1-28.9); $p<0.001$). Patients with postoperative hemorrhage had a median survival of 2 weeks (CI95%: 0.1-4.1) compared to 24 weeks (CI95%: 20.1-27.9; $p<0.001$) without hemorrhage. Postoperative infections were not associated with lower survival rates (21 weeks (CI95%: 4.6-37.4)) compared to patients without infections (23 weeks (CI95%: 19.7-26.3; $p=0.23$)).

Conclusion: Based on data from a prospective study on metastatic disease we found that one in five patients undergoing brain surgery suffer from complications which may dramatically reduce survival. We advocate including this data in discussing expected outcomes with patients and their families. While potentially serious, infections did not significantly affect survival in our cohort.

Pre-operative Karnofsky Performance Scale score is the best prognostic factor in patients with multiple brain metastases

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Objective: Brain metastases represent the most critical neurological complication in cancer patients. Recent evidence suggests that the incidence of brain metastases is on the rise, which may be explained by the availability of more efficient cancer treatment regimens. Very often, the treating team faces the challenge of deciding whether a patient harboring brain metastases should be operated on or not. This decision would clearly benefit from individual patients' predicted survival. Although numerous prognostic factors have been described for these patients, there is little consensus regarding which works best. Identifying the most efficient way to determine prognosis could help professionals make a more confident and well-informed decision regarding the choice to operate patients on a case-by-case basis.

With the aim of identifying the best prognostic factors, we assessed the correlation between 16 patient-specific criteria and survival length in a group of 85 patients with multiple brain metastases who were submitted to surgical lesion resection at our institution.

Methods: A group of 85 patients harboring brain metastases and submitted to neurosurgical treatment at our institution from 2008 to 2012 were enrolled in this retrospective analysis. We identified subgroups with short (death < 2 months after surgery) versus longer (>1 year) survival and assessed their correlation with the following 16 variables: age, sex, body mass index (BMI), histological type, pre-operative Karnofsky Performance Scale (KPS) score, platelet number, lactate dehydrogenase level, time between cancer diagnosis and brain surgery, presence of extra-cranial disease, number of intracranial lesions, Graded Prognostic Assessment (GPA), post-operative radiation, radiological pattern, presence of a lesion in the posterior fossa, volume of the larger intracranial lesion, and presence of neurological symptoms at the time of diagnosis.

Results: Pre-operative KPS score was significantly associated with both short (< 2 months; $p < 0.001$) and longer (> 1 year; $p < 0.05$) survival, as was post-operative (whole brain) irradiation ($p < 0.001$ for the <2 month group and $p < 0.05$ for the >1 year group). Furthermore, the multiple logistic regression model revealed that both KPS score and symptom duration were protective factors in the <2 months group (OR 0.93; 95%CI 0.90-0.97, and 0.19; 95%CI 0.05-0.68, respectively).

Conclusion: Among the various clinical, oncological and radiological criteria we assessed, the two factors most significantly associated with both short and longer survival rates after surgery were the patient's pre-operative functional status (based on the KPS score) and the use of post-operative whole brain radiotherapy. We conclude that KPS is the best prognostic factor for patients with multiple brain metastases and should therefore be used to determine the need for surgical resection.

MO.24 Joint Meeting Session 5 –Tumors (High-grade)

Montag Monday, 15.05.2017, 15.30 – 17.00 Uhr hrs

- MO.24.01 *Keynote lecture - Metabolic consequences of mutation of IDH 1*
Tom Cadoux-Hudson (Oxford, United Kingdom)
-
- MO.24.02 *Keynote lecture - Additional molecular diagnostics in neurooncology. Necessary and beneficial?*
Christian Mawrin (Magdeburg, Deutschland)
-
- MO.24.03 *IDH-1 status in glioblastoma patients correlates with rates of clinical venous thromboembolism and pro-coagulant expression levels*
A. Aly* (Nottingham, United Kingdom), L. Glancz, F. Smith, S. Smith
-
- MO.24.04 *Is preoperative geometry and texture of glioblastomas prognostically relevant?*
P. Stavrinou* (Köln, Deutschland), S. Katsigiannis, C. Hamisch, B. Krischek, A. Mpotsaris, R. Goldbrunner
-
- MO.24.05 *Location-dependent prognostic factors and recurrence patterns in IDH wildtype glioblastoma*
C. Jungk* (Heidelberg, Deutschland), R. Warta, B. Hug, M. Bendszus, A. von Deimling, C. Herold-Mende, A. Unterberg
-
- MO.24.06 *Long-term survivors of glioblastoma - which factors influence survival in those who have crossed the three-year mark?*
A. Sachkova* (Göttingen, Deutschland), M. Goldberg, S. Goraynov, A. Potapov, V. Rohde, L. Shishkina, H. Bock, B. Schatlo
-
- MO.24.07 *Platelet activation and heterotypic platelet-leucocyte conjugate formation in the blood of glioblastoma patients*
S. Marx* (Greifswald, Deutschland), M. Splittstöhser, H. Paland, A. Boehm, C. Ritter, S. Bien-Möller, H. Schroeder, B. Rauch
-
- MO.24.08 *Residual enhancing disease after surgery for glioblastoma multiforme: National service evaluation of practice in the United Kingdom*
R. Ma* (Oxford, United Kingdom), A. Chari, P. Brennan, B. Collaboration, C. Watts
-
- MO.24.09 *Characterising tumour boundary with intraoperative shear wave elastography*
H. Chan* (Nottingham, United Kingdom), C. Uff, A. Chakraborty, J. Bamber, N. Dorward
-

IDH-1 status in glioblastoma patients correlates with rates of clinical venous thromboembolism and pro-coagulant expression levels

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Objectives: Venous thromboembolic events (VTE) are common causes of morbidity and mortality in glioblastoma patients. Mutation in the isocitrate dehydrogenase-1 gene (IDH1) is frequent in secondary glioblastoma and results in altered metabolomics. This study evaluates whether IDH-1 status correlates with incidence of VTE in glioblastoma patients.

Methods: We retrospectively analyzed case notes and histology of 398 cases of patients with glioblastoma, who all underwent surgery in a regional Neurosurgical centre between April 2012 and December 2014. Mutated IDH was assessed by immunohistochemistry for the most common R132H mutant. Tissue factor expression was detected by immunohistochemistry. DVT and pulmonary embolism were diagnosed by Doppler ultrasound and pulmonary CT angiogram respectively in clinically relevant cases (no routine screening). We examined the Cancer Genome Atlas dataset for gene expression levels in GBM patients. Comparison was made of the expression level of the pro-coagulant thromboplastin (F3) gene between patients with WT and mutant IDH1.

Results: 336 cases were wild type (WT) IDH-1 (94.1%) and 21 cases were IDH-1 mutated (R132H) (5.9%). 51 patients had a thromboembolic event (15.3%), with all cases of VTE in WT IDH-1 tumours, a rate of 21.8% within this group. IDH-1 status had a significant correlation with VTE ($p=0.033$ Fisher exact test). WT IDH GBM patients express significantly higher levels of thromboplastin, a potential mechanism for the clinical observation.

As expected, mutant IDH was associated with prolonged patient survival ($p=0.024$ Log rank). There was no difference in survival or age in patients with / without VTE ($p=0.185$ Log rank and $p=0.733$ T-test respectively).

Conclusion: A significant association exists between IDH1 status in glioblastoma patients and the risk of VTE. Patients with wild type IDH-1 appear at high risk of VTE and appropriate precautions should be considered in this at risk group.

Is preoperative geometry and texture of glioblastomas prognostically relevant?

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Objective: The importance of preoperative MRI based geometric features in glioblastoma patients is currently debated in a controversial way. The goal of this study was to identify the value of distinct preoperative tumor related volumes as well as postoperative residual tumor volume and clinical and molecular parameters in predicting patient survival.

Methods: We retrospective analysed 189 patients with glioblastoma who underwent radiochemotherapy according to the stupp protocol. The MR T1-weighted post contrast and FLAIR images were segmented so as to describe the three major tumor textures: active tumor, necrosis and edema/infiltration. Preoperative and postoperative tumor volumes were calculated using the iPlan software and the methodology was verified with the Discovery software. Age, sex, performance status (KPS), duration of symptoms, infiltration of midline structures and MGMT promotor methylation status were also included in the multivariate analysis.

Results: Preoperative volumes of contrast enhancing tumor, necrosis and edema as well as the various volume ratios failed to attain any statistical significance regarding survival prognosis. In the multivariate analysis, age, infiltration of the midline structures as well as MGMT promotor methylation status were significant prognostic factors for progression-free (PFS) and overall survival (OS). Postoperative residual tumor volume and the percentage of resection was an important prognostic factor both for OS (OR=0,98, $p=0,03$) and for PFS (OR=0,96, $p=0,02$).

Conclusion: Our findings implicate that preoperative volumetric parameters lack significant role in the prognosis of glioblastoma patients. We confirmed that the extent of resection is an independent significant prognostic factor that affects both PFS and OS irrespective of the tumor volume or geometry prior to operation.

Location-dependent prognostic factors and recurrence patterns in IDH wildtype glioblastoma

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Objective: Recent studies suggest that glioblastomas (GBM) contacting the subventricular zone (SVZ) confer a dismal prognosis and may be linked to a distinct cell of origin compared to their cortical counterparts. However, existing analyses have disregarded the unique molecular and prognostic phenotype associated with isocitrate dehydrogenase (IDH) mutant GBM. We therefore sought to examine location-dependent prognostic factors and recurrence patterns exclusively in IDH wildtype GBMs.

Methods: Out of a consecutive cohort of 302 GBM patients treated at our department from 2004 until 2011 for whom clinical, molecular and imaging data were available, 288 patients (95%) did not harbor IDH mutations as ruled out by immunohistochemistry or direct sequencing. Based on preoperative contrast-enhancing MR images, patients were allotted to GBM with (SVZ+) and without (SVZ-) SVZ involvement or with (cortex+) and without (cortex-) cortical involvement, respectively, and compared for demographic, treatment-related, imaging and survival data at first diagnosis and recurrence. Multivariate survival analysis was performed employing a Cox proportional hazards model with stepwise forward selection of covariates.

Results: IDH mutations were more common in SVZ- GBMs (7% vs. 2% in SVZ+ GBMs; $p=0.04$). Consequently, only IDH wildtype GBM were analyzed. Demographic (age, sex) and treatment-related factors (Karnofsky performance status, completion of Stupp regimen, treatment within clinical trials) were balanced between groups with two exceptions: SVZ+ GBMs were found to have a lower frequency of complete resections at first diagnosis ($p<0.0001$) and lower non-surgical treatment intensity at recurrence ($p=0.0009$). Regarding growth and recurrence patterns, multifocal disease both at first diagnosis ($p=0.031$) and at recurrence ($p=0.0006$) was more common in cortex+ GBMs, together with a higher frequency of distant recurrences (28% vs. 2% in cortex- GBMs; $p<0.0001$). Besides established clinical prognostic factors (higher age, subtotal resection, lower treatment intensity at first diagnosis and recurrence), multivariate survival analysis identified SVZ involvement as the only independent prognosticator of inferior overall survival ($p=0.018$; HR=1.58) and survival after relapse ($p=0.015$; HR=1.58).

Conclusion: In this large-scale analysis of IDH wildtype GBMs, SVZ involvement significantly contributed to their dismal prognosis. In contrast, cortical involvement determined growth and recurrence patterns. This holds out the prospect for location-tailored prognostication and treatment planning. Interestingly, IDH mutations were enriched in non-SVZ GBM that, together with distinct clinical features, supports the hypothesis of location-dependent cells of origin.

Long-term survivors of glioblastoma - which factors influence survival in those who have crossed the three-year mark?

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Objective: Long time survivors (LTS) of glioblastoma (GBM) are defined as patients surviving longer than 36 months. It is known that LTS are set apart from other patients by a combination of 1) positive clinical and 2) molecular factors such as IDH1 and MGMT. We herein present data from a large cohort of LTS based on a collaborative database of two large oncology centers. This large database enabled us to identify characteristics of prognostic relevance within the group of LTS.

Methods: Patients treated for GBM between 1998 and 2012 were included in this study. We extracted records of patients surviving > 36 months after first diagnosis. We evaluated patient-related (age, sex, KPS), surgical (extent of resection, number of surgeries), treatment-related parameters and molecular markers (IDH1 mutation, MGMT methylation). Progression was defined according to RANO criteria. P-values below 0.05 were considered significant.

Results: We identified 125 LTS (63 female, 50.4%) with a mean overall survival (OS) of 55.7 months (CI 95%=50.7; 60.8) and a PFS of 34.5 months (CI 95%= 28.7; 40.4). 32% of patients survived 4 years after initial diagnosis, while 26.4% survived 3 years and 22.4% survived 5 years. The use of alkylating agents as first line therapy was associated with higher survival (94.3 months (CI 95%=42.2; 146.4) vs. 48.8 months (CI 95%=44.3; 53.3; p<0.001). Patients who underwent multiple surgeries did not have better survival (56.2 months (CI 95%=44.5; 67.8)) than those with single surgery (49.6 months (CI 95%=43.9; 55.2; p>0.05). Additional treatment regimen (subgroups of chemotherapy) for recurrent GBM did not result in differences in outcome (data not shown). A limited number of IDH-1 and MGMT status data was available. Within this smaller sample, patients with IDH-1 mutation (N=14/49, 28.6%, p=0.53) or MGMT promoter methylation (N=10/14, 71.4%, p=0.89) did not have different in progression-free survival and OS compared to their negative counterparts.

Conclusion: In this cohort of LTS, the use of alkylating agents appeared to be associated with longer survival. IDH-1 mutation and MGMT promoter methylation are known to positively affect outcome. However, once patients have passed into the LTS category, these prognostic markers potentially only play a secondary role. Our data prompts the need to identify further prognostic markers in LTS.

Platelet activation and heterotypic platelet-leucocyte conjugate formation in the blood of glioblastoma patients

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Objective: Glioblastoma patients (GBM) suffer from an increased incidence of cardiovascular events. Platelets are well known as main player of the primary haemostasis, but have a broad range of additional functions. The formation of heterotypic conjugates between platelets and leucocytes (PLC) represents a pro-inflammatory surrogate marker and is usually increased after platelet activation. The aim of the present study was to evaluate the platelet activation status and the rate of circulating PLC in GBM.

Methods: Blood samples were drawn of consecutive patients before surgery for a suspected glioblastoma. The formation of PLC and several parameters of platelet activation were determined by flow cytometry before and after stimulation with either ADP or the thrombin receptor-activating peptide (TRAP) *in vitro*: expression of P-Selectin, CD63, CD40L and fibrinogen-binding to the activated GPIIb/ IIIa. Blood samples from age and gender matched healthy volunteers were used as controls. Statistical analysis was done with the Mann-Whitney-Test.

Results: Final analysis included 22 patients with histopathological proven virgin glioblastoma (9f, 13m, mean age 67.5 years, range from 55 to 86 years) and their respective controls. Basal platelet activation and *in vitro* platelet reactivity was increased in GBM. The difference got significant in the basal expression of CD63 (2.8% versus 1.9%, $p=0.008$), the Fibrinogen-binding after ADP-stimulation (110.3 MFI versus 63.1 MFI, $p=0.04$) and the CD63 expression after TRAP-stimulation (38.4% versus 33.3%, $p=0.04$). Furthermore, a reduced number of circulating PLC and *in vitro* PLC formation was seen in GBM without getting statistically significant.

Conclusion: In this preliminary report, we show for the first time an increased level of platelet activation and agonist-induced platelet reactivity in GBM. Both could be a reflection of the pro-thrombotic status in these patients. Interestingly, the formation of PLC was not increased, but in tendency decreased. Whether this observation potentially mirrors the intra-tumoral, anti-inflammatory microenvironment in GBM remains unclear.

Residual enhancing disease after surgery for glioblastoma multiforme: National service evaluation of practice in the United Kingdom

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Objectives: Despite extensive clinical research the prognosis for patients with glioblastoma (GBM) remains poor. Surgical management of GBM patients has improved significantly with the introduction of new technologies and clinical sub-specialisation. A growing body of clinical data highlights the prognostic importance of post-operative residual enhancing disease (RED) following resection. Recent clinical trial data has started to emphasise the importance of gross total resection (GTR), defined by the absence of RED on early post-operative MRI, compared to sub-total resection (STR). Here we report the results of a service evaluation of practice in the United Kingdom.

Methods: Multicentre prospective observation study to evaluate current neuro-oncological practice in the United Kingdom. Data was collected between 01/05/2016 and 31/07/2016 through the British Neurosurgery Trainees Research Collaborative. Patients were included if they had suspected GBM and were scheduled to undergo GTR at their first surgery. Inclusion criteria included adult patients (age >18) with suspected GBM on presenting magnetic resonance imaging (MRI) scan and multi-disciplinary meeting (MDT) decision that the tumour was suitable for GTR. Exclusion criteria included children (age <18) with subsequent histology that confirmed an alternative diagnosis.

Results: A total of 113 patients from 15 neurosurgical units who were deemed suitable for gross total resection for treatment of glioblastoma were recruited. There was varying use of surgical adjuncts between differing neurosurgical units. Most patients (70.8%) had a postoperative MRI scan within 72hours of surgery. GTR was deemed to be achieved at time of surgery in 82% (91/111) of cases, compared to only 45% (36/80) on postoperative MRI. RED was deemed operable in 16.3% (13/80) of cases, however, no patient underwent early repeat surgery for RED. The most commonly cited reason (38.5%, 5/13) was perceived lack of clinical benefit.

Conclusion: Despite advances in surgical technique there is a subset of patients in which GTR is thought possible, but not achieved at primary surgery. Thus residual disease may be amenable to early reintervention. Further prospective surgical research is required to better define the prognostic implications of RED/GTR and explore the options for converting STR to GTR before starting definitive treatment.

Characterising tumour boundary with intraoperative shear wave elastography

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Introduction: Neurosurgeons have always tried to identify the potential surgical plane of cleavage (slip boundary) to initiate safe resection. However, this may not be immediately obvious. Shear wave elastography (SWE) images soft tissue stiffness but the potential usefulness of detecting slippery boundary has not been shown. We report the laboratory experiment with gelatine phantoms, mimicking the presence and absence of slippery boundary, and clinical application during brain tumour resection.

Methods: Twelve cuboidal gelatine phantoms with a central cylindrical inclusion (3 of each configuration – slip stiff and soft inclusions, and adhered stiff and soft inclusions) were imaged with SWE.

Thirty five patients (aged 1-62 years, 15 males and 20 females) were recruited and scanned with SuperSonic Aixplorer® using the SWE function before resection. The presence or absence of surgical cleavage plane was noted by the surgeon during resection.

Results: A characteristic soft 'bracket' sign was present in both stiff- and soft-inclusion phantoms with slip boundary (n=6). This was absent in those with adhered boundary (n=6). Of 35 patients, only 4 demonstrated a surgical cleavage plane. The soft 'bracket' sign was demonstrated in 3 of 4 patients. The patient that did not have the sign had a small craniotomy precluding direct contact of the transducer with the dura, and insufficient water standoff due the location of the tumour.

Conclusion: These preliminary results showed that SWE was able to characterise slip boundary with a novel soft 'bracket' sign *in vitro* and *in vivo*, thereby suggesting the potential of SWE to be a useful tool during brain tumour resection.

MO.25 Periphere Nerven

Montag *Monday*, 15.05.2017, 15.30 – 16.30 Uhr *hrs*

- MO.25.01 *Intraneural ganglion cysts of the peroneal nerve: clinical outcome and recurrence rate in long-term follow-up*
A. Knoll* (Günzburg, Deutschland), A. Pala, U. Bätzner, M. Pedro, R. König, C. Wirtz, G. Antoniadis
-
- MO.25.02 *12 Months Follow Up Comparing Outcomes of Retractor- Endoscopic vs. Open Release of Carpal Tunnel and Ulnar Sulcus Syndrom in a Prospective Randomized Study*
F. Schwarm* (Gießen, Deutschland), K. Krishnan, K. Graf, M. Reinges, E. Uhl, M. Kolodziej
-
- MO.25.03 *Interdisciplinary treatment regime in patients with large retroperitoneal neurinomas*
A. Uerschels* (Essen, Deutschland), O. Gembruch, L. Podleska, N. El Hindy, J. Treckmann, U. Sure, K. Wrede
-
- MO.25.04 *Surgical management of isolated traumatic and iatrogenic axillary and radial nerve lesions – surgical technique and clinical outcomes*
C. Heinen* (Oldenburg, Deutschland), T. Schmidt, T. Kretschmer
-
- MO.25.05 *Cross sectional area of the median nerve before revision carpal tunnel release – a cross sectional study*
S. Dützmann* (Frankfurt, Deutschland), S. Tas, V. Seifert, G. Marquardt, T. Dombert, F. Staub
-
- MO.25.06 *Analysis of axonal regeneration, remyelination and guidance in human neuroma*
P. Dömer* (Oldenburg, Deutschland), B. Kewitz, C. Heinen, U. Janssen-Bienhold, T. Kretschmer
-

Intraneural ganglion cysts of the peroneal nerve: clinical outcome and recurrence rate in long-term follow-up

Andreas Knoll¹, Andrej Pala², Ute Marlies Bätzner³, Maria Teresa Pedro⁴, Ralph W. König⁵, Christian Rainer Wirtz⁶, Gregor Antoniadis⁷

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Objective: Intraneural ganglion cysts are rare, benign and nonneoplastic lesions that spread within the epineurium. Mostly, the peroneal nerve is affected causing weakness of the anterior tibial muscle (ATM) by compression of the peroneal deep branch. We report on a large series of patients undergoing surgical treatment at our department on clinical outcome and investigated recurrence rate in correlation to knee pathology.

Methods: Clinical outcome of 29 patients treated with symptomatic intraneural ganglion cysts at our between Nov. 2002 and July 2016 were analyzed retrospectively. Standard surgical therapy was ligating and severing the articular branch and decompressing the cyst. We evaluated function of the peroneal nerve in all patients pre- and postoperatively using Janda motor function grading system. Additionally, sensory deficits and pain within innervation zone were analyzed. Mean follow-up were 57 months (Range 3-156 months).

Recurrent cysts and knee pathology were determined based on MRI-follow up images or ultrasound examination. Furthermore surgical complications and role of an external muscle stimulation after surgery were evaluated.

Results: Mean-time of weakness before surgery were 11 weeks. Muscle strength just before surgery was in mean M 1.5 for ATM, M 1 for extensor hallucis longus muscle (EHL) and M 3 for peroneal muscle (PM). After surgery, weakness improved to the mean of M 4 for ATM, M 3.5 for EHL and M 5 for PM. Only in two cases no improvement of ATM has been achieved. Two patients treated at our department developed symptomatic recurrent cysts and needed additional surgery. Asymptomatic recurrent cysts were detected in three patients, whereas extraneural ganglion cysts were found in three patients.

One patient developed new high-grade pareses of ATM, EHL and PM after surgery and needed additional surgery, which resulted in complete muscle functional restoration. We could not find significant correlation between the functional improvement and using of an external muscle stimulation after surgery. Knee pathology had furthermore no influence on breeding recurrent cysts.

Conclusion: Clinical outcome after ligation and sectioning of the joint and decompression of intraneural ganglion cyst is excellent even after weeks of weakness before surgery. The recurrent rate is very low after ligation of the articular branch independent of knee pathology, whereas surgery had no influence on formation of extraneural ganglion cysts in accordance to progressive osteoarthritis.

12 months follow-up comparing outcomes of retractor- endoscopic vs. open release of carpal tunnel and ulnar sulcus syndrom in a prospective randomized study

Frank Patrick Schwarm¹, Kartik G. Krishnan¹, Katharina Graf¹, Marcus H.T. Reinges¹, Eberhard Uhl¹, Malgorzata Kolodziej¹

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Objective: The goal of this study was to evaluate and compare the neurological and neurophysiological outcomes of retractor-endoscopic versus open release of the carpal tunnel (rCTS and oCTS) and ulnar sulcus (rCUS and oCUS) after 3 and 12 months follow up.

Methods: Between May 2013 and November 2016, 64 patients were prospectively blinded randomized to retractor-endoscopic or open decompression of the median or ulnar nerve. Patients were analyzed in four cohorts, open vs. endoscopic CTS and CUS. Standard clinical, neurophysiological examination, and subjective assessment using a patient questionnaire were conducted preoperatively as well as 3 and 12 months after surgery. All patients presented with typical clinical signs, symptoms and pathologic neurophysiological examinations. Outcome measures included the time until return to full activity, duration of postoperative pain and the classification of disease severity according to McGowan. Surgical outcome was assessed using the Bishop Rating System (BRS). Statistical significance was calculated using the Mann-Whitney U and the Wilcoxon rank-sum test.

Results: 64 patients (median age, 52.5 years; range, 24-90 years) underwent retractor-endoscopic (n=37) or open (n=27) decompression of the median (n=37) or ulnar nerve (n=27). The rCTS group (n=21) showed better outcomes with a shorter time of postoperative pain (median: 2 weeks, range 0-15 weeks), less actual discomfort and better results in the BRS compared to oCTS (n=16) release after 3 and 12 months postoperatively. Excellent results in the BRS were obtained in 68% of the whole study population for all procedures after 12 months. The rCTS group showed excellent and good results in 100% of the cases. An improvement of the McGowan Score was seen from a median value of 2 to 1 in the rCTS, oCTS and rCUS cohort and from 1,5 to 1 in the oCUS cohort, respectively. Nerve conduction velocity was improved postoperatively in 78% of the patients with no statistical significance between the cohorts. After 12 months follow up patients' subjective assessment for symptom improvement was 95% and 81% in rCTS and oCTS release and 69% and 91% in rCUS and oCUS release, respectively. Statistical significant results were achieved in rCTS for less postoperative pain after 3 and 12 months ($p=0.02$), subjective assessment after 3 months ($p=0.04$), and in BRS after 3 and 12 months ($p=0.02$) in comparison to the oCTS cohort. The rCUS and oCUS cohorts showed no significant differences. There were postoperative complications in the series.

Conclusion: Our study shows significant better results in the retractor-endoscopic procedure for CTS release both in short and long term follow up. Less postoperative pain, improvement in the subjective assessment of symptoms, and higher BRS in rCTS after 3 months indicate a shorter recovery from surgery. There were no significant differences between rCUS and oCUS.

Interdisciplinary treatment regime in patients with large retroperitoneal neurinomas

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Objective: Deep-seated retroperitoneal neurinomas are very rare lesions causing a variety of symptoms. Because of their slow growth and deep-seated location with soft surrounding structures some can gain large size before initial diagnosis. This report presents an interdisciplinary treatment regime needed for successful surgery of these complex lesions.

Methods: In 2016, three patients with large retroperitoneal neurinomas were treated interdisciplinarily in our institution. Two patients with deeply located neurinomas of the lumbosacral plexus and one patient with a small intraspinal and a large extraspinal neurinoma of the L2/L3 segment are included in this report. All patients underwent preoperative enhanced and non-enhanced magnetic resonance imaging (MRI). The surgical approach and operative strategy was decided in an interdisciplinary case discussion (neurosurgery/general surgery) and the surgical procedure was scheduled accordingly. All patients underwent clinical and MRI follow-up three months after the treatment.

Results: A general surgeon performed the retroperitoneal approach in all three cases and microsurgical tumor resection was carried out by a neurosurgeon under permanent electrophysiological monitoring. Both deep seated intrapelvine neurinomas were microsurgically resected over a lateral retroperitoneal approach in supine position in an interdisciplinary procedure. Both patients were mobilized one day after surgery and could be discharged home on the fifth and sixth postoperative day, respectively. Both patients had no early or late postoperative deficit and 3 months MRI follow-up showed complete tumor removal without tumor recurrence. They could fully return back to work as an IT-specialist and a ballet teacher, respectively. The intra- and extraspinal neurinoma was treated in a two-portal-technique over a hemi-laminectomy of L3 and a retroperitoneal approach in lateral position. The patient could be mobilized on the first postoperative day and was discharged home five days after the procedure without deficits. At three months follow-up she was without deficits and fully back to work as a teacher. MRI showed complete tumor removal without signs for tumor recurrence.

Conclusion: An interdisciplinary team of neurosurgeons and general surgeons allows treatment of large deep-seated neurinomas with complete tumor removal and excellent clinical outcome. An interdisciplinary surgical team is mandatory for treatment of these complex lesions.

Surgical management of isolated traumatic and iatrogenic axillary and radial nerve lesions – surgical technique and clinical outcomes

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Objective: Traumatic or iatrogenic nerve lesions have a deep impact on patient's activities. Depending on the involved nerve movement and joint stability as well as chains of movement in the three-dimensional space are impaired. Recovery crucially depends on depth of lesion. In addition, different nerves display different regeneration capacity. Radial nerve is considered to have a good prognosis for spontaneous recovery. In contrast, axillary nerve lesions have a bad reputation. We therefore present our patient collective with isolated axillary and radial nerve lesions, decision making, pre- and intraoperative assessment, choice of strategy and the clinical outcome.

Methods: We retrospectively analyzed our collective of over n= 170 patients (2012-2016) with traumatic nerve lesions. N=23 showed an isolated axillary and n=37 an isolated radial nerve affection. Pre- and postoperative assessment included clinical features, electrophysiology, MRI and ultrasound. Intraoperatively, a microsurgical setting was used, enhanced by intraoperative electrophysiology and ultrasound. The individual lesion influenced on surgical techniques and approaches applied.

Results: For axillary nerve n= 13/24 patients were grafted (n=3 infraclavicular only, n=9 from infraclavicular to dorsal, n=1 dorsal only). In n=11 decompression and external/ internal microsurgical neurolysis was performed. N= 1 patient required direct muscular neurotisation. N= 1 patient with a long interval from trauma to nerve surgery and significant shoulder joint lesion received a free muscle transfer. In n=13/ 15 patients with a follow-up >9 months a MRC \geq 3 for deltoid muscle could be achieved. For radial nerve n=19 required autologous transplantation, n=2 could be coaptated end-to-end. In n=8 patients an extraneural decompression only sufficed, n=8 needed epineuriotomy with n=1 bearing an intraneural hematoma. In n=18/20 patients with a minimum follow-up of 9 months MRC \geq 3 could be achieved for wrist and finger extension. No persistent new neurological deficit was observed, no complication occurred.

Conclusion: In our series, results after treatment of axillary nerve lesions are promising and better than its reputation. In contrast, most radial nerve patients showed significant lesions with no chance for spontaneous recovery. We could prove the feasibility of pluriportal access. Results seem to depend on joint function. Timing is of essence, therefore meticulous preoperative evaluation including all modalities is mandatory to assess the depth of nerve lesion and thus choose the appropriate treatment.

Cross sectional area of the median nerve before revision carpal tunnel release – a cross sectional study

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Objective: High- resolution ultrasound can be used for diagnosis of CTS with an accuracy that is on par to electrodiagnostic studies. Up to date there has been no investigation published that examined on a large patient cohort the median nerve in patients with recurrent or persistent symptoms. Reference and cutoff values are lacking. This study was done to provide reference values for detection of ongoing or recurrent compression in patients with recurring or persisting symptoms in carpal tunnel syndrome.

Methods: One hundred sixteen patients undergoing revision decompression of the median nerve at the carpal tunnel between January 2010 and October 2015 were studied retrospectively to determine the cross-sectional area of the median nerve at the wrist by the technique of neurosonography.

Results: In cases of insufficient primary release the mean cross-sectional area was 20.0 mm² pre-op. In cases of scar or synovialitis the mean cross sectional area was 17.0 mm² (significantly less, p=0.008). Compared to successfully operated patients with de-novo carpal tunnel syndrome (n=74), a cutoff value of 14.5mm² yielded a sensitivity of 78% and a specificity of 97% to diagnose ongoing or recurrent compression in case of a typical clinical presentation.

Conclusion: For the first time we provide reference values in patients with recurring or persisting symptoms in carpal tunnel syndrome based on a large patient population. Ultrasound can aid in the evaluation of patients with entrapment neuropathy of the median nerve and recurring or persisting symptoms.

Analysis of axonal regeneration, remyelination and guidance in human neuroma

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Objective: Neuromas are pathologic nerve distensions caused by a nerve's response to trauma. Sprouting axons attempt to cross the injury site, as long as scar tissue, a gap or lacking axonal guidance do not counteract sprouting. If target-oriented sprouting is prevented a neuroma in-continuity or discontinuity will form. So far, rat models have shown that regeneration associated genes play an important role for axonal regeneration. Furthermore, endoneurial tubes providing axonal guidance are crucial for successful regeneration. On a molecular scale, however the precise sequence has not been resolved for human nerve. Therefore, human neuroma formation, its influencing factors and the neuroma composition are of interest.

Methods: Axonal sprouting, the formation of endoneurial tubes and the status of myelination was analyzed in six human neuromas. Neuroma tissue was obtained from nerve grafted patients during surgery. Tissue samples were prepared directly in the OR for fixation (2% PFA, over night) or frozen at -80°C immediately after resection. For immunochemistry, cryosections (20 µm) were blocked (10% NGS, 1h) and incubated with primary antibodies (ABs) over night (4°C). Corresponding fluorochrome conjugated ABs were applied at RT for 2h. Analysis of the axon count was carried out using ImageJ (paired t-test).

Results: NF-immunoreactivity patterns indicate a significant reduction of axons from the proximal to the distal segment of each neuroma (neuroma in-continuity: $p=0.0007$, stump neuroma: $p=0.0001$). Beside NF-containing nerve fibers, axons expressing large amounts of Gap43 were detected. Axonal growth cones labeled with Gap43 antibodies sprout along NF-positive fibers in a piggyback-like manner. Double labeling of Gap43 immunoreactive axons and the myelin-sheath (MBP) indicate a remyelination of sprouting axons by Schwann cells in the neuromatous tissue. Mini-fascicles of regenerating axons were ensheathed by NG2 positive endoneurial tube like structures in the neuromatous tissue, whereas NG2-immunoreactivity was absent proximal and distal to the neuroma. There seem to be no differences in the molecular and cellular architecture between stump neuroma and neuroma in-continuity.

Conclusion: The extensive expression of Gap43 underlines the remaining regenerative potential and axonal plasticity of regenerating axons within the neuroma. Furthermore, myelination of Gap43-positive axons suggests that the capability of Schwann cells to remyelinate regenerating axons is preserved in neuroma tissue. Therefore, unsuccessful regeneration may be more likely related to the lack of and failure to connect to persistent endoneurial tubes distal to the neuroma and thus, disruption of axonal guidance to the target organ. Correlation of results to corresponding clinical findings (e.g. age, latency, functional outcome) will help to improve surgical strategy including timing.

Modified motor threshold criterion for intraoperative corticobulbar MEPs for prediction of postoperative facial nerve outcome

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²Department of Neurosurgery, Beijing Tiantan Hospital, Capital Medical University, Beijing, China

³Klinikum Grosshadern, Klinikum Grosshadern, Neurochirurgische Klinik und Poliklinik, München, Deutschland

⁴University of Munich, Neurochirurgische Klinik und Poliklinik, Dept. of Neurosurgery, München, Deutschland

Objective: Intraoperatively, facial nerve (FN) function is assessed with direct electrical stimulation, observation of spontaneous activity and corticobulbar Motor Evoked Potentials (FN-coMEP). MEP-amplitude decrement and increase in motor threshold (MT) serve as warning criteria. A novel threshold criterion for extremity MEP additionally compared MT-increments to the non-operated side (bilateral final-to-baseline motor threshold level, BFB-MT). We applied BFB-MT for FN-coMEP with regard to postoperative FN-function.

Methods: 47 patients (26f; 46 ± 18yrs., 28 vestibular schwannoma (VS), 12 meningioma, 2 metastasis, 1 medulloblastoma, 1 lipoma, 1 chordoma, 1 epidermoid cyst, 1 teratoma) undergoing posterior fossa tumor surgery were analysed. FN-function was assessed as per House-Brackmann score (HB) pre- and postoperatively at day 1 (1d), 7 (7d), 3 months (3m) and grouped in mild (HB score increase ≤1) or marked deterioration (HB score increase ≥2). FN-coMEP were elicited with anodal transcranial electric stimulation at C4; C3 referenced to Cz, and recorded from bilateral orbicularis oris and mentalis muscles. A BFB-MT difference of >20% (operated vs. non-operated side) was regarded as significant. Increase of MT on the operated side of ≥20mA served as reference criterion (RefC). Risk factor analysis for postoperative FN deterioration was performed (patient characteristics, tumor size, extent of resection, BFB-MT and RefC)

Results: At 1d, 15% of the patients (7/47) showed mild HB deterioration, 36% (17/47) marked. At 7d, 12 patients showed mild deterioration (25%), 10 marked (19%). 3m follow-up in 40 patients (85%) showed recovery in 31 patients (78%). 5 patients (13%) showed mild and 4 (10%) marked deterioration (HB 3 (1), HB 4 (2); HB 6 (1)), the latter suffered from giant VS (2), recurrent tumor (1) or NF II (1).

FN-coMEP changes according to RefC occurred in 10 patients (39.5±17.2mA) and BFB-MT in 11 patients (35.2±20.6mA), whereas mean threshold increase being 6±7.8mA on the unaffected side. 3/4 patients with FN-coMEP loss showed signs of recovery in their HB score at 3m, but didn't reach preoperative status.

BFB-MT and RefC correlated significantly with FN function at 1d,7d and 3m(p < 0.001). The correlation was stronger using the BFB-MT (spearman correlation: 1d: p = 0.683; 7d: p = 0.741; 3m: p = 0.616) compared to the RefC (spearman correlation: 1d: p = 0.620; 7d: p = 0.564; 3m: p = 0.684). The multivariate analysis revealed BFB-MT to be an independent predictor of postoperative FN deterioration at all 3 time points (1d: p = 0.017; 7d: p < 0.001; 3m: p = 0.002) - despite the low incidence of FN deterioration at 3m.

Conclusion: An increase of BFB-MT of more than >20% between the affected vs. unaffected side serves as a better predictive indicator for postoperative FN function than the RefC. Further, it was identified as an independent variable for postoperative FN-function at 1d, 7d and 3m.

MO.26 OP-Techniken 1

Montag *Monday*, 15.05.2017, 15.30 – 16.50 Uhr *hrs*

- MO.26.01 *Modified motor threshold criterion for intraoperative corticobulbar MEPs for prediction of postoperative facial nerve outcome*
T. Greve* (München, Deutschland), L. Wang, J. Tonn, W. Rachinger, C. Schichor, A. Szelényi
-
- MO.26.02 *Neuroendoscopic approach to ependymal cysts*
A. El Damaty* (Heidelberg, Deutschland), S. Marx, S. Fleck, H. Schroeder
-
- MO.26.03 *The surgical management of primary cerebellopontine angle melanocytoma*
S. Adib* (Tübingen, Deutschland), M. Tatagiba
-
- MO.26.04 *The benefit of iMRI assisted endoscopic transsphenoidal approach compared to microsurgical technique in pituitary surgery*
A. Pala* (Oberelchingen, Deutschland), A. Knoll, G. Etzrodt-Walter, J. Coburger, C. Wirtz, M. Hlavac
-
- MO.26.05 *Frontolateral approach or endonasal approach in case of anterior skull base meningiomas: which approach should be preferred?*
S. Linsler* (Homburg, Deutschland), G. Fischer, A. Stadie, J. Oertel
-
- MO.26.06 *nasal complications after endoscopic endonasal procedures*
B. Prokein, J. Oertel, S. Linsler, B. Prokein* (Homburg, Deutschland)
-
- MO.26.07 *The use of intraoperative CT neuronavigation for dorsal cervical spine procedures promises a better intraoperative orientation in special cases*
S. Linsler* (Homburg, Deutschland), S. Antes, J. Oertel
-
- MO.26.08 *Double balloon kyphoplasty (DBK) – a new technique for vertebral fracture treatment*
F. Hertel* (Luxemburg, Luxembourg), H. Böcher-Schwarz, J. Koy, H. Standhardt, M. Raket, N. Gunness, C. Berthold, L. Schröder
-

Modified motor threshold criterion for intraoperative corticobulbar MEPs for prediction of postoperative facial nerve outcome

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Objective: Intraoperatively, facial nerve (FN) function is assessed with direct electrical stimulation, observation of spontaneous activity and corticobulbar Motor Evoked Potentials (FN-coMEP). MEP-amplitude decrement and increase in motor threshold (MT) serve as warning criteria. A novel threshold criterion for extremity MEP additionally compared MT-increments to the non-operated side (bilateral final-to-baseline motor threshold level, BFB-MT). We applied BFB-MT for FN-coMEP with regard to postoperative FN-function.

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Results: At 1d, 15% of the patients (7/47) showed mild HB deterioration, 36% (17/47) marked. At 7d, 12 patients showed mild deterioration (25%), 10 marked (19%). 3m follow-up in 40 patients (85%) showed recovery in 31 patients (78%). 5 patients (13%) showed mild and 4 (10%) marked deterioration (HB 3 (1), HB 4 (2); HB 6 (1)), the latter suffered from giant VS (2), recurrent tumor (1) or NF II (1).

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BFB-MT and RefC correlated significantly with FN function at 1d,7d and 3m(p < 0.001). The correlation was stronger using the BFB-MT (spearman correlation: 1d: p = 0.683; 7d: p = 0.741; 3m: p = 0.616) compared to the RefC (spearman correlation: 1d: p = 0.620; 7d: p = 0.564; 3m: p = 0.684). The multivariate analysis revealed BFB-MT to be an independent predictor of postoperative FN deterioration at all 3 time points (1d: p = 0.017; 7d: p < 0.001; 3m: p = 0.002) - despite the low incidence of FN deterioration at 3m.

Conclusion: An increase of BFB-MT of more than >20% between the affected vs. unaffected side serves as a better predictive indicator for postoperative FN function than the RefC. Further, it was identified as an independent variable for postoperative FN-function at 1d, 7d and 3m.

Neuroendoscopic approach to ependymal cysts

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Objective: We aimed in our study to evaluate the success rate of endoscopic fenestration of intracranial ependymal cysts.

Methods: Our prospectively maintained endoscopy database was screened for all cases of ependymal cysts. The charts were retrospectively reviewed regarding symptoms, surgery, postoperative course, and complications. The MR images prior to and after surgery were analyzed.

Results: Seven patients harboring an intracranial ependymal cyst were identified. The cyst location was frontoparietal, parietal, occipital or mesencephalic. Patients presented with several symptoms according to the location of the cyst, i.e. epilepsy, hemiparesis, diplopia, and hemianopsia. All patients were treated by navigation-guided endoscopic fenestration of the cyst to the ventricular system. Two complications occurred; a CSF leakage which was managed surgically by wound revision without the need for CSF shunting and a chronic subdural hematoma occurred six weeks after surgery and required burr hole evacuation. The follow-up period ranged from 6 months to 9 years. MR imaging revealed that all cysts decreased in size. The symptoms improved in all patients.

Conclusion: Endoscopic fenestration of ependymal cysts to an adjacent ventricular cavity is a very successful treatment option with excellent long-term results and minimal morbidity. It should be considered as the therapy of choice to avoid craniotomy and shunt dependence.

The surgical management of primary cerebellopontine angle melanocytoma

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Objective: The most common lesions in the cerebellopontine angle (CPA) are vestibular schwannoma (70-80%) and meningioma (5-10%) followed by epidermoid cysts (6-7%). The goal of this study is to analyze the surgical management of an extremely rare lesion of the CPA - the meningeal melanocytoma. The annual incidence of meningeal melanocytoma of the CNS has been estimated as 1 per 10 million persons.

We present three cases of primary CPA melanocytoma (PCPAM), which have been treated, in our department. Particular attention was paid to their clinical presentation, surgical treatment, early and late treatment outcomes, and recurrence rates.

Methods: Patients who received surgical treatment for PCPAM from January 2004 to October 2016 were identified by a computer search of their files from the Department of Neurosurgery, Tübingen. We identified three patients with PCPAM, which were surgically treated in our Department in the last 12 years. Two were male and one was a female patient, aging 33, 45 and 54 years (mean age: 44 years). The 45-year-old male patient had two previous surgeries elsewhere. Patients were evaluated for initial symptoms, pre- and postoperative facial nerve function, pre- and postoperative cochlear function, complications and recurrence rate by reviewing surgical reports, patient documents, neuroradiological data, and follow-up data. In all cases the PCPAM was confirmed histologically. In one patient it was a melanocytoma with intermediate grade.

Results: There was no mortality in this series. Anatomical facial and cochlear nerve preservation were achieved in all 3 cases. One patient had a new moderate facial palsy after surgery (H+B II). The cochlear nerve function was not significantly affected by surgery.

Two patients had adjuvant radiotherapy (50,4 Gy and 54 Gy) and one patient had ion beam therapy for tumor recurrence (six years after surgery). All patients presented tumor recurrence at 2 years, at 3 years and at 6 years follow up respectively.

Conclusion: Our case series include a very heterogenous patient collective (one case of intermediate grade melanocytoma, one case of multifocal recurrence after two previous surgeries in other hospitals), however preservation of the facial and cochlear function was achieved in all cases. At long-term follow-up all patients had recurrence. Treatment must include besides surgery radiotherapy in order to avoid early recurrence.

The benefit of iMRI assisted endoscopic transsphenoidal approach compared to microsurgical technique in pituitary surgery

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Objective: The routine use of intraoperative MRI (iMRI) helps to achieve gross total resection (GTR) in transnasal transsphenoidal pituitary surgery. We have analyzed the added value of iMRI on extent of resection in endoscopic compared to microsurgical transsphenoidal approach and evaluated the endocrine outcome between both techniques.

Methods: A total of 96 patients with pituitary adenoma were included. A number of 28 consecutive patients underwent endoscopic transnasal transsphenoidal tumor resection. Historic cohort of 68 patients who underwent microsurgical transsphenoidal adenomectomy have been used for the analysis. We evaluated the residual tumor volume after conducting iMRI using intraoperative and late postoperative volumetric analysis 3 months after surgery. Knosp classification was used to stratify the invasive growth pattern of adenomas in cavernous sinus. Pituitary function was evaluated. Mann-Whitney-U, Fisher exact test and binary logistic regression were used for analysis.

Results: The most common histological subtype was non-functioning adenoma (N=65, 67.7%). There were significantly less additional resections after conducting iMRI in the endoscopic group ($p=0.042$) especially in Knosp 0-2 adenomas ($p=0.029$). We found no significant difference in Knosp 3-4 adenomas ($p=0.520$). The use of endoscopic approach was associated with smaller intraoperative tumor volume ($p=0.023$). There was no significant difference with regard to postoperative tumor volume between both techniques ($p=0.228$). No significant difference was noted with regard to surgical complications between both cohorts. Satisfactory results of pituitary function were significantly associated with an endoscopic approach ($p=0.001$).

Conclusion: With endoscopic approach, significantly better endocrine outcome has been achieved especially in Knosp 0-2 pituitary adenomas. Furthermore, iMRI assisted transsphenoidal endoscopic technique was associated with less intraoperative tumor volume and in less invasive adenomas with Knosp 0-2 additional resection was barely needed. In the case of extensive and invasive adenomas (Knosp 3-4) additional tumor resection and increase in the extent of resection (EoR) has been achieved by using iMRI in both groups.

Frontolateral approach or endonasal approach in case of anterior skull base meningiomas: which approach should be preferred?

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Objective: Keyhole approaches and endonasal endoscopic approaches for the skull base are currently under investigation for tumor surgery. A lower complication rate is to be expected with the same successful resection rate in comparison to endoscopic extended endonasal procedures, which promise to avoid retraction of neurovascular structures. However, the reported results with these techniques are diverging.

Here, the authors compare their current series in case of anterior skull base meningiomas resected via an endoscopic endonasal or microsurgical frontolateral keyhole approach.

Methods: Between January 2011 and December 2016 18 patients received microsurgical frontolateral keyhole procedures for tuberculum sellae meningiomas and 11 patients for olfactorius meningiomas. In the same time period 6 patients received endoscopic endonasal procedure for tuberculum sellae meningiomas and 3 patients for olfactorius meningiomas.

The cases were prospectively followed (4 months – 4.7 years). The surgical technique was carefully analysed and the endoscopic endonasal technique was compared to microsurgical supraorbital technique. Special attention was paid to necessity to switch the operation strategy, complications, surgical radicality, and recurrences.

Results: In all cases a sufficient visualization of the tumor was possible. In 24 of 29 microsurgical cases an endoscope was used for final additional control of tumor resection. Remnant tumour was visualized with angled optics in 28% of the endoscopic endonasal cases and in 56% of the microsurgical cases. Gross-total-resection was achieved in 77% of endonasal and 89% of transcranial cases. There were one recurrence in follow up.

In one case of microsurgical procedure an ischemia occurred in the frontal lobe without any neurological deficit.

In endoscopic cases all patients received a lumbar drainage intraoperatively. No persistent CSF fistula occurred with this treatment.

Conclusion: Resection of skull base meningiomas via frontolateral keyhole approach has been shown to be safe and successful with a high radicality and only minor complications. Especially the high risk of CSF fistulas and the more sophisticated endonasal approach can be avoided.

Thus, for most anterior skull base meningiomas, we usually prefer microsurgical transcranial approach. Thereby, the application of angled endoscopes is an essential step of surgery resulting in a higher radicality of tumor resection. The use of lumbar drainage and autologous fat graft for skull base closure minimize the risk of CSF fistula.

Nasal complications after endoscopic endonasal procedures

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Objective: The microsurgical and endoscopic endonasal approach is well established for endonasal skull base surgery. However, there are only few studies pointing out the nasal complaints after surgery. In this study, the authors evaluated postoperative nasal complications after mononostril endoscopic procedures.

Methods: In order to evaluate complications, a retrospective questioning of 144 patients operated in our department was performed. Applicable data of 81 patients could be included in this study. Endpoints were the quantitative evaluation of complications and correlation of these data. In addition to this, in some cases olfactometry data were generated and compared to these data.

Results: Nasal pain (12.3%), reduced nasal breathing (30.9%), reduced olfaction (24.7%), reduced gustatory sense (16.0%) and dry nose (48.1%) were the most frequent reported complaints. In 18% synechia and in 11% septum perforation was detected. Further treatment by ENT physician was necessary in 29.6% of all cases. Thereby, 12.3% of patients required resurgery of the nose by ENT physician.

Reoperation of sellar lesions had a significant increase of nasal complications and complaints. The use of a tamponades reduced significantly the risk of nasal complaints and ENT treatment for sinusitis or synechia.

The results of olfactometry did not show any statistically significant reduction of olfaction after surgery.

Conclusion: Endoscopic endonasal procedures to skull base lesions induce nasal complaints in some patients. Reoperations increase the risk of nasal complaints and complications significantly. The use of nasal tamponades reduces the risk of complications in postsurgical follow-up.

Further prospective studies are necessary to objectify the evaluation of postsurgical nasal complications and to compare the outcome of different surgical approaches and techniques.

The use of intraoperative CT neuronavigation for dorsal cervical spine procedures promises a better intraoperative orientation in special cases

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Objective: The safety and efficiency of cervical spine surgery can be enhanced by accurate navigation in preoperative CT and MRI. Here we report our initial experience of real-time intraoperative computed tomography-guided navigation for cervical spine surgery via dorsal approach.

Methods: We report about 10 cases with dorsal cervical spine procedures. In 4 of these cases we performed an endoscopic Frykholm procedure of C6/7 or C7/Th1. In 6 cases were performed a laminectomy and dorsal fusion with massae lateralis screws.

In all these cases we used Medtronic Stealth Air System which was registered via intraoperative CT scan (Siemens CT Somatom suite) to enable 3D navigation based on MR and CT imaging data.

Results: Three-dimensional (3D)-based computer navigation prolonged the duration of preoperative setting but helped to reduce the radiation emitted and led to significantly increased accuracy of identification of the surgical target at the cervical spine. In 4 of 4 cases the neuroforamen could be identified correctly with neuronavigation. In all cases of instrumentation the anatomical landmarks of the massae lateralis were excellent. There was an adjustment of less than 1 mm in all cases. In all cases the identification of neuroforamen was possible from level C5 to Th2 which was not possible with lateral fluoroscopy in these cases.

Conclusion: The use of intraoperative CT/MR imaging-guided neuronavigation for cervical spine surgery is a time-effective, safe, and technically beneficial technique. Especially the identification of levels C6 to Th2 is more safely possible than in lateral fluoroscopy.

Double balloon kyphoplasty (DBK) – a new technique for vertebral fracture treatment

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Objective: Balloon Kyphoplasty (BKP) has become an established therapy of vertebral fractures (especially of type A) within the last 2 decades. The goal of BKP is to remodel and to stabilize the fracture. Especially in higher grade fractures or in those with a loss of more than 70 % of the anterior vertebral body height, conventional BKP is not possible.

Methods: In double balloon kyphoplasty (DBKP), 2 balloons are mounted on each catheter and a separate inflation of each one is possible. The available system is CE marked and therefore applicable. Within the recent years, we applied this technique in a series of patients with different types of fractures. We report retrospectively our experience in 57 patients treated with DBKP within the last 3,5 years.

Results: 57 patients with a mean age of 59,8 y (18 – 89) were treated with DBKP. 37 with osteoporotic (OF) and 20 with traumatic (TF) fractures of types A 1-3 and B. DBKP was used in 40 patients as stand alone and in 17 patients in combination with posterior transpedicular fixation. There were no problems due to the double balloon technique. Some patients were treatable with DBKP, which had probably not been manageable by conventional BKP. Due to the alternating inflation technique, remodelling with DBKP seems to be more effective as in conventional BKP.

Conclusion: DBKP is a new technique for kyphoplasty. DBKP is safe. Vertebral body remodelling seems to be more effective, as in conventional BKP. DBKP opens up more possibilities for the catheter placement in low grade (type A1) fractures. Even fractures with a high loss of anterior height may be treatable by DBKP. In combination with posterior fixation / decompression, it opens new treatment possibilities for augmentative minimal invasive techniques.

MO.27 Tumor – Meningeome A

Montag *Monday*, 15.05.2017, 15.30 – 16.30 Uhr *hrs*

- MO.27.01 *Surgery Versus Radiosurgery for Small Petroclival Meningiomas*
G. Montibeller* (Curitiba, Brazil), M. Coelho Neto, R. Ramina
-
- MO.27.02 *Stereotactic radiosurgery for the treatment of meningiomas eligible for complete resection*
J. Tutunji* (Köln, Deutschland), S. Grau, D. Ruess, M. Kocher, R. Goldbrunner, M. Ruge
-
- MO.27.03 *Recurrence in WHO °II meningioma: Are there any prognostic factors?*
M. Unteroberdörster* (Essen, Deutschland), O. Müller, M. Hadamitzky, B. Kleist, U. Sure, N. El Hindy
-
- MO.27.04 *Mortality and recurrence after surgery for meningioma in the elderly: Long-term prognosis, comparative analyses and a case-control study.*
B. Brokinkel* (Münster, Deutschland), D. Spille, K. Hess, C. Sauerland, C. Bleimüller, W. Paulus, W. Stummer
-
- MO.27.05 *Long term follow-up of cavernous sinus meningiomas after stereotactic radiosurgery*
D. Ruess* (Köln, Deutschland), F. Fritsche, S. Grau, H. Treuer, M. Kocher, M. Ruge
-
- MO.27.06 *Atypical meningioma: Progression-free survival of 161 cases with surgery only versus surgery and radiotherapy*
W. Masalha* (Freiburg, Deutschland), D. Heiland, P. Franco Jimenez, D. Delev, J. Haaker, O. Schnell, C. Scheiwe, J. Grauvogel
-

Surgery versus radiosurgery for small petroclival meningiomas

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Objective: Treatment of large petroclival meningiomas (PCM) causing brain stem compression is surgical removal followed by radiotherapy or radiosurgery if the lesion was partially resected. The management of patients with small, often asymptomatic PCM is controversial and includes observation, microsurgery and radiosurgery. The natural history of these tumors is not well known. The purpose of this retrospective study was to compare the outcome and extent of removal of small PCMs (< or =3 cm) with series of PCMs treated with radiosurgery.

Methods: This study comprised 29 patients with small (< or =3 cm) tumors from a total series of 107 consecutive patients with PCMs who underwent surgical removal. The mean age of patients was 56.8 years. Tumor removal was classified as radical (Simpson's grade I/II) and non-radical (Simpson's grade III/IV). The most frequent symptoms at presentation were: headaches (n = 20), tinnitus (n = 11), diplopia (n = 9) and facial hypoesthesia (n = 7). The surgical approaches were: retrosigmoid (n = 24), fronto lateral (n = 3) and presigmoid (n = 2). The postoperative follow-up ranged from 4 to 130 months. A review of outcome of PCMs series treated by radiosurgery was performed and compared with our surgical results.

Results: Radical tumor resection was achieved in 28 patients (96%). In one case a Simpson's grade III resection was achieved due to trigeminal nerve infiltration and encasement of the superior cerebellar artery. Postoperative transient abducens nerve palsy occurred in five cases and two patients presented transient facial palsy. These deficits recovered completely in a short follow-up period. There was no mortality. The preoperative cranial nerves deficits improved after surgery. Only one patient remained with diplopia.

Conclusion: Larger PCMs present poorer outcomes after surgical removal than small ones. Radiosurgery is indicated to treat small PCMs. Results of patients treated by radiosurgery should be compared with surgical series that include only small tumors. Radical removal of small PCMs can be achieved with minimal morbidity and may result in cure of patient. The results achieved in this surgical series are superior than with radiosurgery.

Stereotactic radiosurgery for the treatment of meningiomas eligible for complete resection

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Objective: Microsurgical resection is the first recommended treatment for meningiomas especially if sufficient resection can be achieved (Simpson Grade I&II). Stereotactic radiosurgery (SRS) is established as treatment option for meningiomas considered inoperable due to critical localisation or involvement of vulnerable structures. In this study, we evaluated the efficacy and safety of SRS in cases where a Simpson Grade I or II resection could be achieved but either patient's wish or condition excluded surgery.

Methods: In this retrospective single-center analysis (1995-2014) we included all patients who underwent single fraction LINAC based SRS for microsurgically resectable (Simpson Grade I&II) cranial meningiomas with clinical follow-up of ≥ 6 months. Histologically confirmed WHO II&III tumors were excluded. We analyzed local tumor control by magnetic resonance imaging, early (first 6 month after SRS) and late treatment related complications, including symptomatic peritumoral edema requiring steroids (rated by the Common Terminology Criteria for Adverse Events; CTCAEv4.03). Local control was estimated by Kaplan-Meier method.

Results: 85 patients (f:m=65:20, mean age 60 years) were treated with LINAC-SRS for 92 supra- (67.4%) or infratentorial (32.6%) meningiomas localized in skull base (63.0%), convexity (20.7%), parafalcine (14.1%) or other areas (2.2%). Treatment indication was based on documented tumor growth in 71.7 % or recurrence after surgery in 28.3%. Mean follow-up was 68.7 ± 48.8 months. Mean tumor volume was 4.1 ± 3.6 ml, mean radiation parameters were 13.2 ± 2.2 Gy surface dose at $65.8 \pm 13.9\%$ isodose level. The estimated 2-,5-, and 10-year tumor control rate was 99%, 93% and 93%, respectively. Local recurrence was observed in one case after 180.4 months (1.2%) and loco-regional (out of dose) recurrence in five patients after 17.7–155.7 months (5.9%). Minor early complications (headache, dizziness) occurred in 4.7%; one patient suffered from seizures. Late complications encompassed permanent deterioration of cranial nerve function in two cases (CTCAE:1;2) and transient seizures in one patient. Temporary steroid use due to symptomatic peritumoral edema was observed in 7.1%.

Conclusion: SRS can be considered as treatment alternative for patients with meningiomas eligible for Simpson Grade (I&II) resection either refusing or harboring contraindications to microsurgery. SRS treatment provides reasonable long term tumor control with low morbidity rates.

Recurrence in WHO °II meningioma: Are there any prognostic factors?

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Objective: Meningiomas account for 30-40% of all primary brain tumors. Mostly, meningiomas are slow growing, graded histologically as WHO°I. A small portion of meningiomas reveal a faster growths-pattern, prone to recurrence, graded as WHO°II. The course of WHO°II meningioma is variable. Although there is the possibility of postoperative radiotherapy to prevent recurrent disease, the value of prognostic factors remains hitherto unclear. The present study aims to evaluate the clinical course and histopathological pattern of WHO°II meningiomas treated in our institution to detect prognostic factors for recurrent disease.

Methods: We retrospectively reviewed the data of 64 consecutive patients who underwent surgical resection of an intracranial meningioma WHO°II between 01/2006-12/2014 in our department. Patient and tumor characteristics (sex, age, clinical symptoms, tumor localization, grade of resection), histopathological features (mitotic index, brain invasion, chordoid or clear cell subtype) and adjunctive treatment, were analyzed in sight of recurrence. Continuous data was compared by t-test for independent samples and categorical variables were analyzed using the χ^2 -test or Fisher's exact test if expected frequencies were below five. The recurrence-free rate was assessed by Kaplan-Meier estimates.

Results: A total of 55 patients (35 female, 20 male) with a mean age of 62.4 ± 13.5 years were included in the study. Headache (23.6%), seizure (21.8%) and dysarthria (14.5%) were the most common presenting signs; radiological data identified the convexity (38.2%) as the main tumor localization. Gross total tumor resection (GTR) was performed in 44 of 55 patients (80%) and histopathological examination revealed an increased mitotic index (>4 per 10 high-power fields) in 27 of 55 patients (49%). Ten of 55 patients (18.1%) received immediate, adjunctive radiotherapy. Nine patients were lost to follow-up and mean follow-up of the residual 46 patients was 44.37 ± 26.34 months. Among them, tumor recurrence was observed in 17 patients (37%) after 30.9 months (± 28.1 months). Fourteen of them (82.4%) underwent repeated surgery, which was performed 31.5 (± 29.3) months after the first surgery. The 5-year recurrence-free rate for the irradiated patients was 70% and 73.3% for the non-irradiated patients, respectively. Interestingly, during our follow-up period, statistical analysis revealed no significant association between tumor recurrence and sex, localization, GTR, adjuvant radiotherapy and histopathological features..

Conclusion: A follow-up of 4 to 5 years is insufficient to reveal the risk of recurrence of meningioma WHO°II on the basis of routinely assessed parameters. Longer follow-up periods and larger sample sizes are necessary to detect prognostic factors. The identification of biomolecular, predictive markers could be a useful approach for short-term follow-up.

Mortality and recurrence after surgery for meningioma in the elderly: Long-term prognosis, comparative analyses and a case-control study.

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Objective: To analyze recurrence and mortality after meningioma surgery in the elderly (≥ 65 years) and to compare survival with case-control studies including elderlies without meningiomas.

Methods: Prognostic value of clinical and histopathological data in 500 patients (162 elderly and 338 younger, median follow-up: 90 months) who underwent surgery for primary diagnosed meningioma between 1994 and 2009 were analyzed in uni- and multivariate analyses. Mortality was compared with average life expectancy in Germany in each case.

Results: Percentage of surgeries in individuals of 65 years and elder raised from 27% in the first to 30% in the second and up to 38% in the last five years of the inclusion period. Median age at diagnosis among the elderly and younger patients was 71 and 51 years, respectively. Female-male ratio, intracranial tumor location, grade of resection, radiotherapy and histopathological subtypes were similar comparing younger and elderly patients. High grade (WHO °II and III) and spinal tumors were more common in elderly as compared to younger patients (15% vs. 8%, $p=.017$ and 12% vs. 4%, $p=.001$, respectively). Although progression free interval (PFI) was similar in both groups, mortality at 3 months and at 5 and 10 years after surgery was higher and median OS was shorter in elder (7, 14 and 19%; 191 month) than in younger patients (1, 3 and 5%, median not reached; HR: 4.9, 95%CI 2.75-8.74; $p<.001$). However, median OS in elderly patients did not differ from the anticipated average life expectancy of age- and sex-matched controls. In elderly patients, rate of recurrence was 3-times higher in male (21%; $N=10/74$) than in female patients (6%; $N=6/96$; $p=.011$) and mean PFI was correspondingly lower in males ($p=.014$, medians not reached). Grade II and III meningiomas were found to be more common in males (24%, $N=12/50$) than in females (11%, $12/112$, $p=.034$). Moreover, PFI was lower in high grade meningiomas (HR: 24.74, 95%CI 4.23-144.66; $p<.001$) and after subtotal resection (HR: 10.57, 95%CI 2.23-50.05; $p=.003$) but grade of resection was not correlated with mortality. PFI was shorter in elderly patients suffering from recurrent meningioma relapse (HR: 5.78, 95%CI 1.28-25.24; $p=.023$).

Conclusion: Mortality after surgery for meningioma in the elderly is higher than in younger patients but comparable to average LE. Maximum achievable resection should be strived as it prolongs PFI and does not impact mortality..

Long term follow-up of cavernous sinus meningiomas after stereotactic radiosurgery

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Objective: Microsurgical resection of cavernous sinus meningiomas (CSM) is challenging with a high percentage of recurrence due to incomplete resection (>10% reported recurrence rate after Simpson Grade II and >20% after Grade III resections) and/or permanent, partly severe cranial nerve deficits. Stereotactic radiosurgery (SRS) has evolved as alternative first-line treatment for SCM. Here, we report about the long term clinical and radiological follow-up of an unique cohort of patients with CSM treated with LINAC based SRS.

Methods: In this single center retrospective analysis we included all patients with SCM who underwent single fraction LINAC SRS between 1993 and 2012 and had a minimum follow-up of 3 months. We evaluated tumor control (no further intervention needed) by the Kaplan-Meier method. Additionally, patient data were analyzed in terms of clinical symptom control and incidence of complications or unexpected side effects rated by Common Terminology Criteria for Adverse Events (CTCAE; v4.03).

Results: 82 patients with 83 tumors (f/m =62/20, median age 53 ± 11 , range 33-81 years) were identified. Mean tumor volume was $5.8 \pm 3.5 \text{ cm}^3$ (range, 0.6-16 cm^3), the mean marginal dose was $12 \pm 2 \text{ Gy}$ (range, 7.0-18.75 Gy) at isodose levels of $64 \pm 17\%$ (range, 30-85%). Median follow-up (FU) was 57 months (range, 3-226 months).

Tumor control was 100% after 6 and 12 months, 97% after 5-years and 94% after 10 years. Symptoms prior to SRS remained stable in 88% (n=73), improved in 3.6% (n=3) and deteriorated in 2.4% (n=2) at last follow-up. Four patients (4.8%) report about adverse events CTCAE grade 1 (headache n=2, somnolence n=1, trigeminal disorder n=1).

Conclusion: SRS for SCM provides reliable long-term tumor control without considerable permanent side effects. Thus, SRS should be taken into account when counselling patients harbouring CSM.

Atypical meningioma: Progression-free survival of 161 cases with surgery only versus surgery and radiotherapy

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Objective: Meningiomas are the most common primary tumors of the central nervous system in adults, they account for 13-26% of all intracranial tumors. The majority of meningiomas are histologically classified as benign (World Health Organisation (WHO) grade I). However, 4.7-7.2% are defined as atypical meningioma, which recur frequently after total resection (Simpson grade I-II) and/or radiotherapy. Until now, the optimal adjuvant management is still unclear and controversially discussed. Recent retrospective studies analyzed the additional adjuvant radiotherapy with conflicting results. The purpose of this study was to evaluate whether the extent of surgery and receiving adjuvant radiotherapy after an initial operation along with other factors influenced the recurrence and survival rates of atypical meningioma.

Methods: Between February 2001 and March 2015, 161 cases of WHO grade II meningioma were operated in our Department of Neurosurgery. Among this population, 128 cases underwent surgical treatment alone and 33 cases underwent surgery and radiotherapy. Kaplan Meier analysis was used to provide median points estimates and time-specific rates. The ANOVA model was used in univariate and multivariate settings to identify significant factors associated with treatment. The hazard-ratio was calculated by Cox-regression model with a determined alpha-level of 5% and a statistical power of 80% ($\beta < 0.2$).

Results: The average age at the time of initial operation was 69 years, and the sex ratio (male/female) was 85/76. The mean follow-up period was 7.89 years. In a multivariate Cox-regression analysis, only Simpson grading was predictive of recurrence (hazard ratio = 1.8, p-value = 0.0004), Simpson grade I and II was associated with a longer progression-free survival compared to Simpson grade III and IV. Patients treated with surgery alone had a progression-free survival rate of 80% (3 years) and 72% (5 years), respectively, compared with 75% (3 years) and 63% (5 years) in patients treated with surgery and adjuvant radiotherapy. There was no statistically significant correlation between recurrence and subjecting patients to postoperative radiotherapy. Apart from Simpson grade I to II patients, the localization of meningioma in the anterior and posterior fossa was significantly associated with a longer progression-free survival ($p < 0.001$).

Conclusion: The most important prognostic factor in determining recurrence was Simpson grading and the localization in the anterior and posterior fossa. Radiotherapy may not increase the progression-free survival after complete or incomplete resection.

MO.28 Joint Meeting Session 6 –Tumors (Various)

Montag Monday, 15.05.2017, 15.30 – 16.60 Uhr hrs

MO.28.01	<i>Neurosurgical management of clinically silent but GH-producing pituitary adenomas</i> M. Giordano* (Hannover, Deutschland), A. Samii, H. Metwali, R. Fahlbusch
MO.28.02	<i>Ectopic pituitary adenoma presenting as a clival tumor - a case report</i> S. Ridwan* (Bielefeld, Deutschland), A. Bohrer, A. Grote, M. Simon
MO.28.03	<i>Pituitary adenoma – clinical importance of residuum</i> S. Alavi* (Leeds , United Kingdom), J. Robins, A. Tyagi, P. Nix, N. Phillips
MO.28.04	<i>Surgical Treatment and outcome of TSH-producing pituitary adenoma</i> T. Burkhardt, R. Rotermund, N. Sauer, J. Matschke, N. Schmidt, J. Flitsch, R. Rotermund* (Hamburg, Deutschland)
MO.28.05	<i>Impact of ischemic preconditioning on surgical treatment of brain tumors: a single-center randomized, double-blind, controlled trial</i> M. Barz* (München, Deutschland), A. Sales, S. Bette, B. Meyer, F. Ringel, Y. Ryang, M. Brettschneider, J. Gempt
MO.28.06	<i>Differentiation therapy in glioma – screening for modulators of differentiation commitment</i> H. Bulstrode* (Cambridge, United Kingdom), S. Pollard
MO.28.07	<i>Resection of pineal cysts – to do or not to do</i> A. El Damaty* (Heidelberg, Deutschland), S. Fleck, H. Schroeder
MO.28.08	<i>Systematic analysis of anti-estrogen effects in pituitary adenoma cells</i> M. Steffani, B. Voellger* (Marburg, Deutschland), J. Wang, J. Bartsch, C. Nimsky

Neurosurgical management of clinically silent but GH-producing pituitary adenomas

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Objective: A subtype of functional lesions called “silent adenomas” has been identified in the 1970s. This entity consists classically in adenomas showing hormone production at the histopathological examination however without clinical signs and symptoms. We report our experience about clinically silent pituitary adenomas with invasion of the cavernous sinus describing the neurosurgical treatment strategy and follow-up.

Methods: Within a series of 142 pituitary adenomas operated consecutively with the aid of intraoperative magnetic resonance imaging (MRI) (Brainsuite 1.5T), three patients were identified that were suffering from invasive but clinically silent somatotrophinomas. Tumor size, invasion pattern and hormonal features were studied preoperatively and at long-term follow-up.

Results: In two of the three cases total tumor removal was possible based on intraoperative MRI, the patients show normal hormonal status and no recurrence at three years follow-up. In the third case due to the different features of the tumor, complete resection was not possible due to invasion of the cavernous sinus and a multimodal treatment, including radiosurgery, was performed that allowed regularization of the hormonal status and control of the residual tumor.

Conclusion: Silent somatotrophinomas are uncommon. Every case should be evaluated singularly taking into consideration patient’s symptoms, MRI and immunohistochemical features. Total microsurgical excision can be curative, in case of partial removal a tailored adjuvant treatment should be considered. In objectively not resectable tumors preoperative medical treatment with somatostatine analogue remains always an option.

Ectopic pituitary adenoma presenting as a clival tumor – a case report

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Objective: To describe a case of a rare pituitary adenoma of ectopic origin presenting as a clival lesion. The majority of ectopic pituitary adenomas are located in the sphenoid sinus. Adenomas located in the clivus are rare and data are scarce in the literature. Depending on the hormonal activity of their tumors, patients present with symptoms of pituitary dysfunction, e.g. or may remain asymptomatic for a long period of time.

Methods: We describe the clinical symptoms, neuroimaging and pituitary hormone studies, and treatment of an 86-year-old female patient who primarily presented with sleep apnea and was later referred to our department for diagnostic work-up and treatment of a suspected clival tumor.

Results: The patient was transferred to our neurosurgical department after computed tomography (CT) and magnetic resonance imaging (MRI) studies were obtained by a general practitioner. Clinically, the patient presented with symptoms and complaints due to suspected sleep apnea. The initial CT scan of the paranasal sinuses revealed a clival lesion of 4x3x3 cm, which was verified by MR imaging. A CT angiogram revealed no obstruction of the carotid arteries. Pituitary hormone levels were within normal limits. The differential diagnosis included chordoma and metastatic cancer amongst other histologies. Because of advanced age the patient was scheduled for a navigation assisted transsphenoidal microsurgical biopsy rather than a tumor resection. Intraoperative frozen section pathology unexpectedly revealed the diagnosis of pituitary adenoma. In light of these results a gross total resection of the lesion was performed limited by suspected tumor infiltration of the right cavernous sinus and an abnormally medial course of the right carotid artery. The sella was never opened. The patient quickly recovered from surgery. After surgery, pituitary hormone levels remained within normal limits and no electrolyte disorders were detected. Postoperative MR imaging revealed only minimal residual tumor in the right cavernous sinus.

Conclusion: Ectopic pituitary adenomas are rare but can present as clival lesions.

Pituitary adenoma – clinical importance of residuum

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Objective: Report the characteristic and long-term outcome of subtotal resection in pituitary adenoma.

Design: Retrospective cohort study of a single institute experience.

Subjects: 149 patients who underwent endoscopic trans-sphenoidal resection of pituitary adenoma between August 2009 and August 2016.

Methods: Analysis of patient's demographics, location and volume of tumour residuum on post-operative MR imaging were performed to investigate the clinical importance of tumour residuum.

Results: A total number of 149 patients (92 Male, 57 Female) with mean age of 56 were included in the study. Tumour residuum location and volume were identified in 3-month and subsequent post-op MR. Tumour residuum was found in 135 patients (90%) with mean residuum volume of 1.8 cm³. Residuum in Cavernous sinus, supra Sellar and Para Sellar/Sellar regions were found in 7,10 and 118 cases respectively. Residuum located bilaterally, centrally, on the right and left side in 5,53,46 and 31 respectively. In Follow-up (mean 20.6 months), residuum volume decreased, increased or remained unchanged in 22,18 and 109 respectively. 39 patients (26.1%) with mean residuum volume of 1.7 cm³ had further treatment: 15 Gamma Knife, 17 Radiotherapy and 10 redo surgery. Of those who had redo surgery 2 had adjuvant Gamma knife radiosurgery and one radiotherapy. Mean time from first surgery to redo-surgery was 23 months and to Gamma knife/Radiotherapy was 22 months.

Conclusion: We have investigated multiple risk factors with possible correlation with long-term outcome in sub-total resection of pituitary adenoma. Significant predictors have not been identified. Although residuum was reported in large number of patients, only small proportion needed further treatment within this follow-up period.

Surgical Treatment and outcome of TSH-producing pituitary adenoma

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Objective:

TSH-producing pituitary adenomas account for 1-2% of all pituitary tumors and there is debate whether transsphenoidal surgery or medical treatment should be recommended as first-line treatment. This study summarizes the authors surgical experience and puts it into context of literature concerning non-surgical treatment of TSHomas.

Methods: A retrospective analysis of 12 patients including imaging, laboratory testing, short-term and long-term parameters of remission and overall pituitary function.

Results: 12 patients are presented, 3 are male, 9 are female, mean age is 40 years (16-56). Time from first symptoms to diagnosis was 92.5 months (12-180months).

Preoperative blood draws revealed mean TSH-levels of 8.07mU/l (range 0.95-43.65, SD 11.5), mean fT3 of 8.5pmol/l (range 4.2 - 17.3, SD 3.2) and mean levels of fT4 of 25.7pmol/l (range 18.7 - 33.1 SD 4.7). TSH-levels decreased to a mean of 0.69mU/l (range 0.03 - 3.018, SD 1) on postoperative day one and to 0.64mU/l (range 0.01 - 3.5, SD 1.1) between postoperative days 2 and 5 (table). Postoperative day 1 levels of fT3 and fT4 were measured at a mean of 3.68pmol/l (range 2.3 - 5.7, SD 1.2) and 21.6pmol/l (range 15.5 - 28.5, SD 4.1). A further decrease in fT3 and fT4 levels were observed during days 2 and 5 with fT3 reducing to a mean of 3.1 pmol/l (range 2-5.3, SD 0.98) and fT4 levels of 15.3 pmol/l (range 12.3 - 19.2, SD 2) Data on long term development of TSH, fT3 and fT4 were available for 9 out of 12 patients, showing levels of mean TSH of 1.8 mU/l (0.39 - 4.45, SD 1.16), mean levels of fT3 of 2.6 pmol/l (0.32 - 5, SD 2.0) and mean levels of fT4 of 16.07 pmol/l (1.7 - 19.5, SD 2). ACTH and cortisol levels were available in 10 out of 12 patients showing mean ACTH-levels of 6.6 pmol/l (2.8 - 12.1, SD 3.4) and mean cortisol levels of 356.8 nmol/l (158 - 893, SD 216.8)

Conclusion: We argue that transsphenoidal surgery for TSH-producing adenoma of the pituitary should always be considered as the treatment of choice. Even in patients harboring invasive tumors or giant adenomas remission following surgery is highly probable. Postoperative hypopituitarism is very unlikely if patients are referred to centers with high case load of pituitary surgery.

Impact of ischemic preconditioning on surgical treatment of brain tumors: a single-center randomized, double-blind, controlled trial

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Objective: Postoperative ischemia is a frequent phenomenon in patients with brain tumors and is also responsible for many cases of postoperative neurological deficits. Particularly in the field of cardiac surgery, but also in other fields, it has been shown that the application of a brief ischemic stimulus not only in the target organ but also in a remote tissue can prevent ischemia in some patients. We hypothesized that remote ischemic preconditioning (rIPC) in patients with glioma and metastasis undergoing surgical resection reduces the incidence of postoperative ischemic events and its consequences.

Methods: Randomization of 60 patients in two study arms (ratio 1:1) stratified to previous treatment with radiotherapy. Induction of ischemic preconditioning: A blood pressure cuff was placed on the upper arm and inflated three times for 5 minutes at 200 mmHg in the treatment group after induction of anesthesia. Between the cycles, the blood pressure cuff was released to allow reperfusion. In the placebo group no intervention has been performed. Early postoperative MRI images were evaluated for the presence of ischemia and its volume.

Results: Fifty-eight patients were evaluated for occurrence of postoperative ischemia. Early postoperative MRI was not performed in 2 patients in the rIPC group. One patient died within 48 hours after surgery due to clinical complications and comorbidities. In an additional patient, there were technical problems during images acquisition. Of these 58 patients, 44 (75,9%) had new postoperative ischemic lesions. The incidence of new postoperative ischemic lesions was significantly higher in the control group (87,1%) (27 of 31 patients) than in the rIPC group (63%) (17 of 27 patients) ($p=0,03$). The median infarct volume was 1,24 cm³ (IR: 0,59-3,74) in the rIPC group compared with 1,58 cm³ (IR: 0,43- 3,73) in the control group ($p=0,87$).

Conclusion: rIPC reduced the incidence of postoperative ischemic events in patients with brain tumors. We have not found a significant association between ischemic preconditioning and infarct volume. Further randomized trials with a larger sample size are necessary to evaluate the influence of rIPC on reduction of infarct volume.

Differentiation therapy in glioma – screening for modulators of differentiation commitment

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Objectives: It is now clear that neural stem cell identity in a subset of tumour cells is key to malignancy in high grade glioma, and probably also in lower grade lesions. Inducing stable therapeutic differentiation commitment in the glioma NS cells which persist after surgical resection offers the promise of effective treatment with very low toxicity. BMP4 is a potent driver of astrocyte differentiation, but differentiation therapies based on BMP4 have failed to deliver on their early promise, reflecting the capacity of glioma neural stem cells to escape differentiation commitment. We set out to develop an *in vitro* model of BMP4-induced differentiation commitment suitable for application to automated medium and high-throughput drug screening approaches.

Methods: We developed an *in vitro* model of BMP4-induced differentiation commitment. Mouse neural stem cells are first plated at low density in medium supplemented with BMP4. This drives uniform cell cycle exit and adoption of astrocyte morphology and marker expression. After 24 hours, BMP4 is replaced with the growth factors EGF and FGF in order to test astrocyte differentiation commitment. Escape from commitment in any individual cell results in reacquisition of NS cell marker expression and rapid cell cycle, resulting in formation of a colony. Neural stem cells and model glioma neural stem cells (EGFRvIII; INK4ARF^{-/-}) were tested, and forced expression of the neural stem cell master regulator FOXG1 was used as a positive control to drive dedifferentiation to a neural stem cell state. As proof of principle for screening, the StemSelect Small Molecule Library 1 (Merck Millipore) was applied together with growth factors to BMP-treated NS cells in 96 well plates. After 7 days the plates were fixed and DAPI-treated, then automated counting of cell and colony numbers was performed using the Operetta High Content Imaging System (Perkin Elmer).

Results: We demonstrate stable differentiation commitment in BMP-treated normal NS cells on restoration of the growth factors EGF and FGF. As predicted, however, glioma NS model cells exhibit incomplete differentiation commitment, resulting in sporadic colony formation in this assay. Automated drug screening using a compound library of 303 compounds with known stem cell regulatory activity identified 3 hits with very marked propensity to induce dedifferentiation in committed astrocytes. These hits are each known to regulate the same key intracellular second messenger, lending validity to the approach and prompting further investigation of the role of this cascade in differentiation commitment.

Conclusion: Stem cells are key to the development and recurrence of glioma. We present an assay which allows for *in vitro* automated screening, to identify drugs which can modulate the escape from differentiation commitment which is the basis for glioma initiation and recurrence after treatment.

Resection of pineal cysts – to do or not to do

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Objective: Surgical indications for patients with pineal cysts are controversial. There are absolute indications for resection as hydrocephalus or tectal compression symptoms but there are some relative indications that are difficult to decide whether a surgical treatment would be beneficial or not. We tried to clarify the indications of resection in cases of pineal cysts in the shadow of our experience.

Methods: We reviewed retrospectively our database for all patients who underwent a surgical resection for a pineal cyst from 2003 to 2016. We studied the presenting symptoms, the size of the cyst, the used surgical approach and the extent of resection, the clinical and radiological follow-up. The follow up period ranged from 6 months to 11 years.

Results: We found 30 patients that have been operated for a pineal cyst. The presenting symptoms were headache in 28 patients, nausea and vomiting (18), visual disturbances (10), dizziness (9) and gait unsteadiness (1). In three patients, only an endoscopic fenestration was done, two of them were re-operated two and five years later with a recurrence due to occlusion of the fenestration, the third patient was completely free during follow-up without evidence of closure of the fenestration. All other patients underwent a microsurgical total resection through a supracerebellar infratentorial approach. Nineteen patients were free of symptoms after surgery. Preoperative symptoms improved in 9 patients. Two patients reported whether development of new symptoms after surgery in the form of behavioral changes or memory disturbance or no improvement of pre-existing symptoms. Only 5 patients have ventriculomegaly before surgery including the 3 patients operated through endoscopic fenestration.

Conclusion: We suppose that the indication for pineal cyst resection should be widened to include patients with small ventricles when the pattern of the headache suggests a temporary increase in intracranial pressure, i.e. headache as a symptom rather than those of hydrocephalus and tectal compression. Obviously, some cysts may cause slight aqueductal compression which leads to temporary increased intracranial pressure due to a valve mechanism.

Systematic analysis of anti-estrogen effects in pituitary adenoma cells

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Objective: Interfering with the estrogen receptor alpha pathway appears an attractive way to eliminate tumor cells in pituitary adenomas. Here we attempted to assess the potency of several anti-estrogens on cell viability in rodent pituitary adenoma cells.

Methods: TtT-GF and GH3 cells were incubated with Bazedoxifene, Clomiphene, Fulvestrant, Raloxifene, and Tamoxifen in a submicromolar to high micromolar concentration range for up to five days. Cell viability was assessed using either a water soluble tetrazolium (WST)-1 assay or 4',6-diamidino-2-phenylindole (DAPI) staining. Half-maximal inhibitory concentrations (IC_{50}) of anti-estrogens were calculated based on three independent experiments performed in triplicates.

Results: After five days, viability of TtT-GF cells was significantly decreased by Bazedoxifene ($IC_{50}=35\mu M$, $p=0.0044$), Clomiphene ($IC_{50}=5\mu M$, $p<0.0001$), and Raloxifene ($IC_{50}=20\mu M$, $p=0.013$), while Fulvestrant did not show a significant effect on TtT-GF cell viability even at high micromolar concentrations. Similarly, after five days, viability of GH3 cells was significantly decreased by Bazedoxifene ($IC_{50}=20\mu M$, $p=0.013$), Clomiphene ($IC_{50}=15\mu M$, $p=0.038$), Fulvestrant ($IC_{50}=1\mu M$, $p<0.022$), and Raloxifene ($IC_{50}=35\mu M$, $p=0.031$).

Conclusion: Viability of TtT-GF and GH3 cells was selectively decreased by anti-estrogens, of which Clomiphene had the highest potency in both cell lines. Further investigation of anti-estrogens in human cell lines is warranted to evaluate the clinical potential of anti-estrogens in pituitary adenomas.

DI.01 **Wirbelsäule – Lumbal**

Dienstag *Tuesday*, 16.05.2017, 08.00 – 09.10 Uhr *hrs*

- DI.01.01 *Efficacy of intraoperative epidural triamcinolone (Kenacort) application in lumbar microdiscectomy: a matched-control study*
M. Stienen* (Zürich, Switzerland), M. Neidert, D. Bellut, T. Waelchli, H. Joswig, K. Schaller, O. Gautschi
-
- DI.01.02 *Influence of the mental health status on a new measure of objective functional impairment in lumbar degenerative disc disease*
M. Stienen* (Zürich, Switzerland), N. Smoll, H. Joswig, J. Snagowski, K. Schaller, G. Hildebrandt, O. Gautschi
-
- DI.01.03 *First experience with the topping off technique using semi-rigid stabilisation of the lumbar spine*
S. Krieg* (München, Deutschland), A. Rienmüller, B. Nele, H. Pape, B. Meyer
-
- DI.01.04 *Predictors of clinical outcome in lumbar surgery: Evaluation of physical, mental and social factors*
E. Shiban* (München, Deutschland), S. Youssef, T. Jeff, B. Florian, F. Ringel, J. Lehmberg, B. Meyer
-
- DI.01.05 *Early Readmission, Delayed Discharge, Reoperation After Lumbar Discectomy: An Analysis from a Multicenter, Prospective, Randomized Study*
A. Kuršumovic* (Deggendorf, Deutschland), G. Bouma, P. Klassen, C. Thome, F. Martens
-
- DI.01.06 *Is there a difference in early readmission and delayed discharge after lumbar discectomy in subjects with or without a bone anchored anular closure - gerrman subanalysis from a multicenter, prospective, randomised study*
R. Bostelmann* (Düsseldorf, Deutschland), A. Kuršumovic, V. Heidecke, S. Fröhlich, M. Berth, J. Perrin, S. Jadik, P. Vajkoczy, E. von Saldern, P. Köassen
-
- DI.01.07 *Validation of the baseline severity stratification of objective functional impairment in lumbar degenerative disc disease*
M. Stienen* (Zürich, Switzerland), N. Smoll, H. Joswig, M. Corniola, K. Schaller, G. Hildebrandt, O. Gautschi
-

Efficacy of intraoperative epidural triamcinolone (Kenacort) application in lumbar microdiscectomy: a matched-control study

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Objective: To investigate whether the intraoperative application of epidural steroids (ES) on the decompressed nerve root improves short- and mid-term subjective and objective clinical outcome after lumbar microdiscectomy.

Methods: Retrospective analysis of a prospective IRB-approved two-center database including consecutive patients undergoing lumbar microdiscectomy. All patients who have received ES (40mg triamcinolone (Kenacort®); intervention group) were matched by age and sex to patients who had not received ES (control group). Objective functional impairment (OFI) was determined using age- and sex-adjusted T-scores. Back and leg pain (visual analogue scale), functional impairment (Oswestry (ODI) and Roland-Morris disability index (RMDI), and health-related quality of life (hrQoL; Short-Form (SF)-12 physical component score (PCS) and Euro-QoL index) were measured at baseline, postoperative day three (D3) and week six (W6).

Results: N=53 patients with ES were matched with n=101 control subjects. There were no baseline demographic or disease-specific differences between the study groups, and preoperative pain, functional impairment and hrQoL were similar. On D3, the intervention group had less disability on the RMDI (7.4 vs. 10.3, p=0.003) and higher hrQoL on the SF-12 PCS (36.5 vs. 32.7, p=0.004). At W6, the intervention group had less disability on the RMDI (3.6 vs. 5.7, p=0.050) and on the ODI by trend (17.0 vs. 24.4, p=0.056); better hrQoL, determined by the SF-12 PCS (44.3 vs. 39.9, p=0.018), and lower OFI (T-score 100.5 vs. 110.2, p=0.005). The W6 responder status based on the minimum clinically important difference (MCID) was similar between the intervention and control group on each metric. Rates and severity of complications were similar, with a 3.8% and 4.0% re-operation rate in the intervention and control group, respectively (p=0.272). There was a tendency for shorter hospitalization in the intervention group (5.0 vs. 5.8 days, p=0.066).

Conclusion: Intraoperative application of ES on the decompressed nerve root is an effective adjunct treatment to lower subjective and objective functional disability and increase hrQoL in the short- and mid-term after lumbar microdiscectomy. However, group differences were lower than the commonly accepted MCIDs of each metric, indicating that the effect size of the benefit is limited.

Influence of the mental health status on a new measure of objective functional impairment in lumbar degenerative disc disease

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Objective: The Timed Up and Go (TUG) test has recently been proposed as a simple and standardized measure for objective functional impairment (OFI) in patients with lumbar degenerative disc disease (DDD). It was the objective to explore the relationship between a patient's mental health status and both patient-reported outcome measures (PROMs) and TUG test results.

Methods: Prospective IRB-approved two-center study. N=375 consecutive patients scheduled for lumbar spine surgery and a healthy cohort of n=110 control subjects. Patients and control subjects were assessed with the TUG test and a comprehensive panel of subjective PROMs of pain intensity (visual analogue scale (VAS)), functional impairment (Roland-Morris disability index (RMDI), Oswestry disability index (ODI)), as well as health-related quality of life (hrQoL; EuroQol (EQ)-5D). Standardized age- and sex-adjusted TUG test T-scores were calculated. The dependent variable was the short form (SF)-12 mental component summary (MCS) quartiles and the independent variables were the TUG T-scores and PROMs. Direct and adjusted analysis of covariance (ANCOVA) was performed to estimate the interaction between the SF-12 MCS quartiles and the independent variables.

Results: In patients, there was a significant decrease in the subjective PROMs, notably the VAS back pain ($p=0.001$) and VAS leg pain (0.035), as well as significant increase on the RMDI ($p<0.001$), ODI ($p<0.001$) and the EQ-5D index ($p<0.001$) with every increase in the quartile of the SF-12 MCS. There were no significant group differences of OFI as measured by the TUG T-scores across the SF-12 MCS quartiles ($p=0.462$). In the healthy control group, a significant decrease in VAS leg pain ($p=0.028$), RMDI ($p=0.013$) and ODI ($p<0.001$) as well as a significant increase in the EQ-5D index ($p<0.001$) was seen across the SF-12 MCS quartiles, whereas TUG T-scores remained stable ($p=0.897$).

Conclusion: There are significant influences of mental hrQoL on subjective measures of pain, functional impairment and hrQoL that might lead to bias when evaluating patients with lumbar DDD that suffer from reduced mental hrQoL. The TUG test appears to be a stable instrument and especially helpful in the evaluation of patients with lumbar DDD and mental health problems.

First experience with the topping off technique using semi-rigid stabilisation of the lumbar spine

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Objective: Semi-rigid stabilization was introduced due to the concept of load sharing. We propose a topping-off technique leaving the most upper motion segment without anterior cage in order to reduce adjacent segment disease (ASD) by creating a smooth transition from stabilized to free motion segments. The objective of this study was to evaluate the influence of these angles on reoperations to investigate potential impacts.

Methods: We report on the first 203 patients enrolled from 2009 to 2013. Reoperation rate, VAS, ODI, RMDI, and subjective patient rating were used as outcome measures. All patients underwent pedicle screw-based semi-rigid stabilization of the lumbar spine with the Medtronic Horizon PEEK Rod®-system. All patients underwent computed tomography or x-ray after surgery. Outcome measures were evaluated 3 and 12 months after surgery.

Results: For 46.9% of patients, implantation of the PEEK rod was the first lumbar surgery while 53.1% received a PEEK rod system as revision surgery after decompression or following ASD after dynamic or rigid stabilization. A mean of 2.8 ± 0.7 (median 3) motion segments were included while 1.3 ± 0.6 (median 1) motion segments were fused. 80.6% of patients underwent TLIF in the same surgery. 78.4% of patients also received decompression.

General satisfaction with the surgical result 12 months after surgery was 91.8%. Mean pain score using VAS was 7.9 ± 1.0 before and 3.4 ± 1.1 at 3 months after surgery ($p < 0.05$), while RMDI was 15.8 ± 2.7 before and 9.8 ± 2.2 at 3 months after surgery ($p < 0.05$). ODI was 46.0 ± 6.8 before and 28.9 ± 6.2 at 3 months after surgery ($p < 0.05$).

Concerning screw loosening, we observed a rate of 3.6% loosened screw of all screws which caused revision surgery in 8.2% of all patients 1.5 ± 1.3 years after PEEK rod surgery. Screw loosening mainly occurred in L5 (12.2%) and S1 (14.3% of all patients).

Conclusion: The PEEK rod concept including the topping of principle seems safe with high satisfaction at least in short-term follow up. Concerning future steps, longer follow up examinations are mandatory.

Predictors of clinical outcome in lumbar surgery: Evaluation of physical, mental and social factors

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Objective: We aimed to identify potential risk factor for unfavourable outcome following lumbar spine surgery for degenerative disc disease.

Methods: Study design: Prospective cohort study

Patients were asked preoperatively to complete a series of questionnaires, including the Oswestry Disability Index (ODI), the anxiety sensitivity index (ASI-3), the SF-36, the visual analogue scale for pain (VAS), the Berliner Social Support Scale, the PTSS-10 for PTSD symptoms and indicate demographic variables concerning education or partnership for example. The evaluation was based on the ODI filled out 1 year postoperatively. The univariate and multivariate association between risk factors and outcome parameter (ODI) was assessed with correlation coefficients and multivariate logistic regression.

Results: 99 patients met all inclusion criteria. 50 patients were male (50.5%); mean age was 60 years. Most patients were married or in a steady relationship (74.8%). Preoperatively age ($r=0.230$; $p=0.025$), pain (VAS) ($r=0.380$; $p<0,001$), trait anxiety ($r=0.244$; $p=0.019$), PTSS ($r=0.222$; $p=0.034$), ODI ($r=0.404$; $p<0,001$), depression score ADS-K ($r=0.258$; $p=0.013$) and low education ($r=-0.281$; $p=0.009$) and lower SF-36 Physical Composite Score ($r=-0,487$; $p<0,001$) correlated with worse ODI scores at 1 year.

Conclusion: Clinical outcome one year after surgery is influenced by age and physical status before surgery. Mental comorbidities and social status are also influential on clinical outcome. A preoperative screening tool seems feasible.

Early Readmission, Delayed Discharge, Reoperation After Lumbar Discectomy: An Analysis from a Multicenter, Prospective, Randomized Study

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Objective: Readmissions and reoperations within the first few months of surgery are major factors driving negative clinical and financial outcomes. We evaluated the rates of delayed discharge and readmission after primary lumbar discectomy within the first 30, 60 and 90 days after surgery in patients treated with a bone-anchored ACD (treatment group) compared with discectomy alone (control group).

Methods: The study population consists of 545 subjects (278 control and 267 treatment group) from an RCT to demonstrate superiority of discectomy with ACD relative to discectomy alone. Key inclusion criteria include 6 weeks of failed conservative treatment, posterior disc height of ≥ 5 mm, minimum defect width and height, and baseline ODI and VAS leg pain $\geq 40/100$. This report presents cost, safety, and early readmission results within the first 30, 60 and 90 days after surgery based on an analyses of site reported adverse events and reoperations of the index level.

Results: Statistically significant differences in the incidence of procedure- or device-related readmissions, delayed discharges, and index-level reoperations were observed within the first 30, 60, and 90 days ($p < 0.045$), with a substantially lower rate being observed in implanted subjects compared with the control group (3.7% vs. 7.9% ≤ 90 days). Within the first 90 days, Control subjects underwent 2.5 times more reoperations.

Subsequent Surgical Intervention	0-30 days		0-60 days		0-90 days	
	Control Group N = 278	Treatment Group N = 267	Control Group N = 278	Treatment Group N = 267	Control Group N = 278	Treatment Group N = 267
Discectomy	3 events 3 (1.1%) subjects	2 events 2 (0.7%) subjects	9 events 9 (3.2%) subjects	3 events 3 (1.1%) subjects	9 events 9 (3.2%) subjects	3 events 3 (1.1%) subjects
Decompression	--	1 event 1 (0.4%) subject	--	1 event 1 (0.4%) subject		1 event 1 (0.4%) subject
Hematoma	3 events 3 (1.1%) subjects	--	3 events 3 (1.1%) subjects	--	3 events 3 (1.1%) subjects	--
Wound Revision	2 events 2 (0.7%) subjects	--	2 events 2 (0.7%) subjects	--	3 events 2 (0.7%) subjects†	--
Device Removal	--	1 event 1 (0.4%) subject*		2 events 2 (0.7%) subjects*		2 events 2 (0.7%) subjects*
Total	8 events 8 (2.9%) subjects	4 events 3 (1.1%) subjects	14 events 14 (5.0%) subjects	6 events 5 (1.9%) subjects‡	15 events 14 (5.0%) subjects	6 events 5 (1.9%) subjects‡

*Surgery followed an earlier decompression reflected above for one subject

†Repeat wound revision was performed for one subject.

‡Trend for lower rate of reoperations and subsequent surgical interventions ($p = 0.06$, Fisher's Exact Test).

Conclusion: Discectomy with bone-anchored ACD was associated with lower rates of device- or procedure-related reoperations, early readmissions or delayed discharges and associated costs compared to discectomy alone. These results suggest that bone-anchored ACD could play an important role in reducing short-term clinical and financial burdens following lumbar discectomy.

Is there a difference in early readmission and delayed discharge after lumbar discectomy in subjects with or without a bone anchored anular closure - german subanalysis from a multicenter, prospective, randomised study

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Objective: Readmissions and reoperations within the first few months of surgery are major factors driving negative clinical and financial outcomes. Providers are increasingly being asked to bear the financial burden of hospital admissions that occur within a certain time period after the index surgery, typically 30-90 days. Reherniation and progressive degeneration with are the main causes of poor outcome after lumbar discectomy and may necessitate early readmission and reoperation. An anular closure device (ACD) has been developed to address these causes, and a multicenter, prospective, post-market randomized clinical trial (RCT) is ongoing. This report evaluates the early safety of discectomy augmented with a bone-anchored ACD (treatment group) compared with discectomy alone (control group) at German centers in terms of delayed discharge and hospital readmission within the first 30, 60 and 90 days after surgery.

Methods: The study population for this interim analysis consisted of all enrolled patients at German centers (10/21 sites) with 243/554 (115/278 control, 128/276 treatment) from an ongoing RCT to demonstrate superiority of discectomy with anular closure relative to discectomy alone. Key inclusion criteria include 6 weeks of failed conservative treatment, posterior disc height of ≥ 5 mm, minimum defect width and height, and baseline Oswestry and visual analog scale leg pain scores $\geq 40/100$. Key exclusion criteria include prior surgery at the index level. This report, which comports with the study statistical analysis plan, presents safety and early readmission results within the first 30, 60 and 90 days after surgery by examining serious adverse events that were reviewed by a data safety monitoring board..

Results: Implanted patients in the treatment group had significant lower incidences of readmissions or delayed discharges that were device or procedure related and index-level reoperations, compared with the control group.

Conclusion: Discectomy augmented with bone-anchored anular closure has a similar safety profile compared with discectomy alone, with similar adverse event rates and minimal device-related complications reported. Furthermore, anular closure was associated with substantially lower rates of reoperations and early readmissions or delayed discharges, compared to discectomy alone. These results suggest that bone-anchored anular closure could play an important role in reducing short-term clinical and financial burdens following lumbar discectomy..

Validation of the baseline severity stratification of objective functional impairment in lumbar degenerative disc disease

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Objective: The Timed Up and Go (TUG) test is a simple, objective and standardized measure for objective functional impairment (OFI) in patients with lumbar degenerative disc disease (DDD). The objective of the current work was to validate the OFI baseline severity stratification (BSS).

Methods: Data was collected in a prospective IRB-approved two-center study. Patients were assessed with a comprehensive panel of pain (Visual analogue scale (VAS) for back and leg pain), functional impairment (Roland-Morris (RMDI) and Oswestry Disability Index (ODI)) and health-related quality of life (hrQoL; Euro-QoL (EQ-5D), Short Form (SF)-12) measures. OFI BSS was determined using age- and sex-adjusted cut-off values.

Results: N=375 consecutive patients scheduled for lumbar spine surgery were included. Each 1-step increase on the OFI BSS corresponded to an increase of VAS back pain of 0.53, VAS leg pain of 0.69, 1.81 and 5.93 points on the RMDI and ODI, as well as to a decrease of hrQoL of -0.073 on the EQ-5D, -1.99 on the SF-12 physical component summary (PCS) and -1.62 on the SF-12 mental component summary (MCS; all $p < 0.001$). Patients with mild, moderate and severe OFI had increased leg pain by 0.90 ($p = 0.044$), 1.54 and 1.94 ($p < 0.001$), increased ODI by 7.99 ($p = 0.004$), 12.64 and 17.13 ($p < 0.001$) and decreased SF-12 PCS by -2.57 ($p = 0.049$), -3.63 ($p = 0.003$) and -6.23 ($p < 0.001$), respectively.

Conclusion: The OFI BSS is a valid measure of functional impairment for use in daily clinical practice. The presence of OFI indicates the presence of significant functional impairment on subjective outcome measures.

DI.02 Vaskuläre Neurochirurgie 4

Dienstag *Tuesday*, 16.05.2017, 08.00 – 09.10 Uhr *hrs*

- DI.02.01 *Predicting functional outcome after aneurysmal subarachnoid hemorrhage using machine learning*
R. Christian, K. Beseoglu* (Düsseldorf, Deutschland), M. Christian, M. Rebecca, S. Benjamin, T. Bernd, C. Julian
-
- DI.02.02 *Sex- and age- dependent value of cerebral vasospasm in subarachnoid hemorrhage: The "weaker sex" is at risk!*
M. Darkwah Oppong* (Essen, Deutschland), A. Hertzen, R. Frantsev, P. Dammann, K. Wrede, U. Sure, R. Jabbarli
-
- DI.02.03 *Predictors of the severity of aneurysmal subarachnoid hemorrhage*
R. Jabbarli* (Essen, Deutschland), M. Darkwah Oppong, A. Hertzen, R. Frantsev, P. Dammann, K. Wrede, U. Sure
-
- DI.02.04 *Subarachnoid hemorrhage from a single-center series with 27 blood blister like aneurysms: outcome depends on age and aneurysm morphology.*
J. Konczalla* (Frankfurt, Deutschland), F. Gessler, J. Berkefeld, G. Marquardt, V. Seifert
-
- DI.02.05 *Did aneurysm side influence patients´ outcome from subarachnoid hemorrhage?*
N. Brawanski* (Frankfurt , Deutschland), S. Won, S. Tritt, S. Kashefiolasl, C. Senft, V. Seifert, J. Konczalla
-
- DI.02.06 *Scarred for life? Long-term quality of life after treatment of unruptured intracranial aneurysms: differences between clipping and coiling*
P. Dammann* (Essen, Deutschland), K. Wrede, B. Hütter, J. Ramazan, O. Müller, M. Forsting, U. Sure
-
- DI.02.07 *Time trends in the incidence of subarachnoid hemorrhage - a systematic review with emphasis on region, age and sex*
N. Etminan, K. Hackenberg* (Mannheim, Deutschland), H. Chang, N. de Rooij, M. Vergouwen, G. Rinkel, A. Algra
-

Predicting functional outcome after aneurysmal subarachnoid hemorrhage using machine learning

Rubbert Christian¹, Kerim Beseoglu², Mathys Christian¹, May Rebecca¹, Sigl Benjamin¹, Turowski Bernd¹, Caspers Julian¹

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Objective: The pathogenesis leading to poor functional outcome after aneurysmal subarachnoid hemorrhage (aSAH) is multifactorial and not fully understood. Microcirculatory dysfunction, assumed to play a key role, can be indirectly quantified with CT perfusion (CTP) imaging. We evaluated a machine learning approach, based on easily determinable features on admission, including CTP, to predict functional outcome.

Methods: Out of 614 consecutive subarachnoid hemorrhage patients (2009-2015), 351 were included (aSAH, ≥ 1 CTP within 72h of ictus and documented modified Rankin scale (mRS) scores after 6 months; n=5 excluded due to corrupt CTP datasets). The dataset was split in a training (n=264) and test dataset (n=87). A Random Forest model was trained on age, sex, WFNS and modified Fisher scores on admission, bihemispheric MTT and rCBF maximum, mean, maximum-mean and standard deviation (sd) to predict dichotomized mRS (≤ 2 ; >2). Feature importance was derived from the trained model. The model performance was evaluated on the test dataset and Receiver-Operator-Characteristic (ROC) analysis was performed.

Results: Sensitivity and specificity when predicting a mRS score >2 in the test dataset were 68.8% and 81.8%, respectively. Accuracy was 77.0%. Positive and negative predictive value was 68.8% and 81.8%, respectively. The area under the ROC curve was 0.83. MTTSD, WFNS and age were found to be most important.

Conclusion: A Random Forest model trained on easily determinable features on admission can predict functional outcome after aSAH with good accuracy, sensitivity and specificity. Our results underline the role of CTP. A novel finding is the importance of MTTSD.

Sex- and age- dependent value of cerebral vasospasm in subarachnoid hemorrhage: The "weaker sex" is at risk!

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Objective: Proper management of patients with subarachnoid hemorrhage (SAH) includes the consideration of relevant risk factors for cerebral vasospasm (CV). Among them, young age is a generally accepted vasospasm predictor. However, the impact of patients' sex on CV is still the point at issue. Here, we analyze the value of sex on post-SAH CV with the special focus on the patients' age.

Methods: All consecutive patients with aneurysmal SAH treated at our institution between January 2003 and December 2015 were eligible for this study. Along with demographic parameters, the following data were also collected: clinical and radiographic severity of SAH, occurrence of symptomatic CV and cerebral infarctions (on computed tomography follow-up scans). Sex-specific differences in the incidence of CV were analyzed both in the whole cohort, and in different age groups.

Results: This study included 955 patients of which 640 (67%) were female. The median age of the cohort was 55 years. Female patients were at higher risk for symptomatic CV ($p=0.0264$, odds ratio (OR) = 1.49). As expected, both genders showed a decrease in CV incidence with increasing age. However, male patients showed an earlier decline of CV incidence after reaching the median age of the cohort. By contrast, CV persisted in the sub-group of females aged between 55 and 70, showing the strongest difference to the male counterpart ($p<0.0001$). In addition, the occurrence of cerebral infarction in these age groups showed also a sex-dependent inverse pattern: females between 55 and 70 years old had the highest infarct rates (50.3% versus 43.3% for younger/older females). Inversely, 55-70-aged males had lower rates of infarction, than other male SAH patients (41.3% and 48.7% respectively). In the multivariate analysis, female sex predicted symptomatic CV independently from age and clinical/radiographic severity of SAH ($p=0.006$, OR=1.68).

Conclusion: Our data confirm the role of female sex for CV after SAH. Especially post-menopausal females are at particular risk for CV and the ischemic complications. Possibly, the reason is hormonal (decline of estrogen levels and increase of plasma-renin activity) or later onset of atherosclerosis, or both.

Predictors of the severity of aneurysmal subarachnoid hemorrhage

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Objective: Treatment decision regarding unruptured intracranial aneurysms (UIA) depends on the presence of certain risk factors for aneurysm rupture. Due to the dramatic impact on the further course and functional outcome, the predictability of the initial severity of aneurysmal subarachnoid hemorrhage (SAH) is also of clinical importance. We aimed at analyzing the risk factors for the severity of SAH upon the parameters available prior to aneurysm rupture.

Methods: 955 patients with acute SAH treated at our center between January 2003 and December 2015 were included in this study. Various demographic and radiographic parameters of the patients were recorded as potential predictors. Severe SAH was defined as a poor initial clinical condition (according to the World Federation of Neurosurgical Societies Grade 4 or 5) and thick basal clot with intraventricular and/or intracerebral bleeding on computed tomography scan.

Results: The median age of the cohort was 55 years. 363 patients (38%) presented with severe SAH. Univariate analysis of demographic parameters showed that only the patients' age significantly correlated with SAH severity ($p=0.0006$), whereas the sex ($p=0.5708$) and the race did not ($p=0.8711$). Larger size of the aneurysmal sack strongly predicted the severe SAH ($p<0.0001$), where the cutoff was set at 5 mm according to the receiver operating characteristic curve. Then, the aneurysms located at the skull base (internal carotid artery and vertebro-basilar system) were less likely to cause severe SAH, than more distally located aneurysms of the anterior circulation ($p=0.0027$, odds ratio (OR) =0.66). Finally, multivariate analysis confirmed independent correlation between the severity of SAH with higher age (>55 years old, $p<0.0001$, OR=1.76), larger size ($p<0.0001$, OR=1.11 per-mm-increase) and the location pattern of the aneurysm ($p=0.003$, OR=0.65) mentioned above.

Conclusions: The severity of SAH can be predicted prior to the bleeding event. Interestingly, common candidates for conservative management – elderly patients with UIA in the anterior circulation are at higher risk for severe SAH in case of aneurysm rupture. The size of the aneurysm remains the only parameter linking both to the rupture risk and the severity of SAH after aneurysm rupture.

Subarachnoid hemorrhage from a single-center series with 27 blood blister like aneurysms: outcome depends on age and aneurysm morphology.

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Objective: Blood blister-like aneurysms (BBLA) are rare and challenging. Whereas in the past outcome was fatal, recent retrospective studies reported excellent outcomes. We report our critically analyzed results of these challenging aneurysms. Additionally, risk factors for unfavorable outcome were identified.

Methods: Patient and aneurysm characteristics, clinical course and treatment results were collected prospectively and analyzed retrospectively including data from patient records and review of imaging findings. Aneurysm configuration was analyzed in detail and categorized to the four different subtypes of BBLA (Bojanowski et al. JNS 2015). In BBLA type I only a part of the artery's wall is affected by the blister without a sac in the angiography, whereas in BBLA type II a sac (neck not longer than diameter) can be identified. In BBLA type III a long portion is involved, which is longer than the diameter of the vessel. In BBLA type IV the artery is affected circumferential.

Results: Between 1999 and 2014 a total of 27 patients had subarachnoid hemorrhage (SAH) from BBLA. Mean age (\pm SD) was 56 ± 15 years. 12 patients (44%) had poor admission status (WFNS 4+5) and 24 (89%) a Fisher 3 or 4 SAH. 13 patients (48%) had a BBLA of the internal carotid artery, 6 of the anterior cerebral artery (22%), 5 of the middle cerebral artery (19%) and 3 of the basilar artery (11%). The majority of the patients ($n=12$) had a type IV BBLA (44%). 13 patients (48%) were treated by clip-reinforced wrapping only, 8 patients by clipping alone (30%) and 3 received no treatment (11%). The other patients were treated endovascularly ($n=1$), combined ($n=1$) or by fenestration tube technique ($n=1$). 13 patients (48%) had vasospasm-associated cerebral infarction and 6 patients (22%) developed a shunt-dependent hydrocephalus. Rerupture after treatment occurred in five patients (19%), any of them type IV BBLA. Outcome was unfavorable (modified Rankin scale score 3-6) in 52% ($n=14$) and 33% ($n=9$) of the patients died. The highest rate of elderly patients (≥ 60 y; 67%), rerupture (33%), delayed infarctions (67%), unfavorable outcome (75%) and deaths (50%) was identified in type IV BBLA, whereas type I-III had a better course: delayed infarctions (33%), unfavorable outcome (27%), deaths (13%). Due to two intraoperative ruptures we would not recommend a direct clipping of BBLA type IV.

Conclusion: Treatment of BBLA is still challenging. However, especially patients with type IV BBLA were prone to rerupture, to have delayed infarctions, unfavorable outcome and death. Interestingly, patients with BBLA type IV were older than the other subgroups, so this could indicate a chronic process underlying BBLA.

In multivariate analysis independent risk factors for unfavorable outcome of BBLA were advanced age (≥ 60 years) and BBLA type IV.

Did aneurysm side influence patients' outcome from subarachnoid hemorrhage?

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Objective: There seem to be differences in prognostic factors and outcome dependent on different aneurysm locations. Additionally factors like an existing concomitant intracerebral hemorrhage or probable infarctions due to surgical approach or endovascular catheterization are known as factors influencing patients' outcome. Therefore we compared left- and right-sided aneurysms in patients with aneurysmal SAH in our department relating to differences in outcome and prognostic factors. Additionally we question, if infarctions in dominant hemisphere may significantly convert patients' outcome after aneurysmal SAH.

Methods: Patients with SAH were entered into a prospectively collected database (since 1999). A total of 506 patients with aneurysmal subarachnoid hemorrhage were retrospectively selected and divided in two groups depending on side of ruptured aneurysm (right n = 284 vs. left n=222). Outcome was assessed using the modified Rankin Scale (mRS; favorable (mRS 0-2) vs. unfavorable (mRS 3-6)) six months after SAH.

Results: Comparing outcome in patients with left- and right-sided ruptured aneurysms showed no significant statistical difference. Also mortality rate in our patients in both groups was similar (14.4% vs. 15.8%). In both examined patient groups statistically significant prognostic factors for a later favorable outcome were clinical admission status (WFNS I-III), Fisher 3- bleeding pattern in CT, the occurrence of severe CVS, an existing early hydrocephalus and later shunt- dependence. Side of ruptured aneurysm itself had no influence of patients' outcome. Comparing patients with aneurysms of right and left side also showed no statistical significant differences concerning outcome and prognostic factors (favorable outcome right 61% vs. left 56%, death right 14% vs. left 16%).

Conclusion: Comparing outcome in patients with left- and right-sided ruptured aneurysms showed no significant statistical difference. Therefore, aneurysm side and possible complications seems not to affect patients' outcome. In both examined patient groups statistically significant prognostic factors for a later favorable outcome were clinical admission status (WFNS I-III), Fisher 3- bleeding pattern in CT, the occurrence of severe CVS, an existing early hydrocephalus and later shunt- dependence.

Scarred for life? Long-term quality of life after treatment of unruptured intracranial aneurysms: differences between clipping and coiling

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Objective: In an increasing number of patients intracranial aneurysms (IA) are detected incidentally. In this regard, endovascular coiling as a treatment option of IA increased rapidly in the last two decades as compared to microsurgical clipping. Effectivity of both methods in terms of occlusion completeness and morbidity is still a matter of debate. However, besides the direct impact of functional sequelae, the treatment impact on health related quality of life (QOL) in both treatment options remains unclear. Therefore, we analyzed a representative and comparable consecutive cohort of patients undergoing either surgical or endovascular occlusion of IA regarding QOL.

Methods: A consecutive series of 125 patients was available for a standardized telephone interview being treated by endovascular coiling or surgery for an IA at the University Hospital of Essen (mean time post-treatment 57.75 ± 13.56 months). Of these, 96 (77%) agreed to take part in the study. Both groups were statistically comparable in a wide range of sociodemographical and clinical parameters ($p > .05$, respectively). The interviews were performed in a strictly standardized manner by a specially trained interviewer who was neither neurosurgeon nor neuroradiologist. The phone calls covered the standardized SF-36 interview.

Results: Of the 96 participants 59 (61%) were treated by coiling and 37 (39%) were operated upon an IA. Both groups were comparable in terms of age, gender, delay treatment follow-up, functional outcome, radiological outcome aneurysm location and further clinical variables ($p > .05$, respectively).

Compared to healthy population controls, patients after clipping or coiling procedure showed significantly decreased health related QOL in most summary scores and sub scores (except general health perceptions, vitality, mental health ($p > .05$, respectively)).

In addition, summary scores and sub scores showed overall a tendency to be inferior in the coiling cohort compared to the clipping cohort, however showing no statistical significance (e.g. physical component summary score: 47.72 ± 11.23 vs. 45.23 ± 12.33 and mental component summary score: 50.40 ± 15.11 vs. 44.97 ± 17.08). The tendency was much stronger in the mental summary scores and sub scores.

Conclusion: Treatment of an IA seems to have a strong impact on a person's health related QOL. Although regarded as a less invasive and presumably less mentally stressful procedure, surprisingly, mental component scores of health related QOL in a cohort of patients that underwent coiling for IA were inferior when compared to a clipping cohort.

Time trends in the incidence of subarachnoid hemorrhage – a systematic review with emphasis on region, age and sex

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Objective: To investigate the time trends in the incidence of aneurysmal subarachnoid hemorrhage (SAH) with emphasis on region, age and sex by performing a systematic review and meta-analysis of population-based studies.

Methods: We updated our previously reported meta-analyses on SAH incidence published in 1996 and 2007 by performing a systematic review of the MEDLINE database until February 2015 using the key words (“subarachnoid hemorrhage” OR “subarachnoid haemorrhage”) AND (“incidence” OR “epidemiology” OR “population”). Main inclusion criteria were: 1) prospective study design, 2) reported study population was representative of the specific population, with respect to age and sex distribution, 3) for studies on stroke incidence in general, SAH was reported as a separate entity, 4) reported data included or enabled the calculation of the crude SAH incidence, 5) case finding methods included all hospitals in the region and either involvement of general practitioners or review of death certificates during the study period. For region analysis 4 populations were defined: A) Reference (all regions except B-D), B) Finland, C) Japan, D) Middle/South America. Poisson regression analyses were performed to calculate crude and region specific SAH incidences with 95% confidence intervals (CI). Moreover we assessed temporal incidence trends with year of study as determinant and stratified these analyses by sex and adjusted for age.

Results: We included 101 studies (58 old, 43 new), describing 9,408 SAH patients in 71,511,325 patient-years from 32 countries. Between 1955 and 2011 the crude SAH incidence declined by 1.3% (95% CI: 1.0-1.6) per year in the reference population. The crude SAH incidence per 100,000 person-years was 9.4 (95% CI: 9.2-9.7) in the reference population; 24.2 (22.7-25.7) in Finland, 22.8 (20.1-23.5) in Japan, 4.3 (3.7-5.1) in Middle/South America. For studies which reported incidence data stratified by age and sex (21 studies; 1381 patients) the overall crude annual decrease was 1.4% (0.6-2.1), after adjustment for age 2.0% (1.2-2.8). In these 21 studies the annual decreases stratified by sex were: men crude 2.0% (0.8-3.2), men age adjusted 2.6% (1.3-3.8), women crude 0.8% (-0.2-1.9), women age adjusted 1.5% (0.4-2.5). Mean age in the new studies was 40.5 years versus 36.9 in the old ones, with an age-specific risk ratio per year of 1.07 (95% CI: 1.07-1.08) in the new studies versus 1.07 (95% CI: 1.06-1.08) in the old ones.

Conclusion: The overall incidence of SAH in populations excluding Finland, Japan and Middle/South America has annually declined by 1.4% over the past 7 decades and now constitutes 9.5 per 100,000 person-years; the SAH incidence in Finland and Japan continues to be distinctly higher, whereas in Middle/South America it remains distinctly lower than in the reference population. The overall crude decrease in SAH incidence is more pronounced in men than in women.

DI.03 Tumor 6 - Rezidivglioblastom

Dienstag *Tuesday*, 16.05.2017, 08.00 – 09.10 Uhr *hrs*

- DI.03.01 *Identification of predictive markers for the differentiation between pseudo- and tumorprogression*
H. Sadat* (Düsseldorf, Deutschland), M. Rapp, M. Sabel, M. Kamp, H. Steiger
-
- DI.03.02 *Controlled clinical trial to evaluate the safety and efficacy of stereotactical photodynamic therapy with 5 Aminolevulinic Acid (Gliolan) in recurrent glioblastoma an introduction*
J. Schroeteler* (Münster, Deutschland), O. Grauer, C. Ewelt, J. Wölfer, S. Schipmann, M. Schwake, W. Stummer
-
- DI.03.03 *Fluorescein sodium guided resection of recurrent glioblastoma multiforme*
J. Höhne* (Regensburg, Deutschland), M. Broggin, M. Riemenschneider, P. Ferroli, A. Brawanski, F. Acerbi, K. Schebesch
-
- DI.03.04 *Impact of Pre- and Postoperative Tumor Volume in recurrent Glioblastoma*
J. Gerhardt* (München, Deutschland), S. Bette, T. Huber, M. Barz, N. Buchmann, Y. Ryang, B. Meyer, J. Gempt
-
- DI.03.05 *Radiologic patterns of first tumor recurrence of glioblastoma: Prognostic value and association to postoperative infarct volume*
S. Bette, M. Barz* (München, Deutschland), T. Huber, J. Gerhardt, C. Straube, F. Schmidt-Graf, C. Zimmer, B. Meyer, J. Kirschke, T. Boeck-Behrens, B. Wiestler, J. Gempt
-
- DI.03.06 *Is there a role for reoperation in the management of Glioblastoma?*
S. Wayhs, G. Lepski* (Sao Paulo, Brazil), L. Abaurre, C. Almeida, O. Feher, M. Jacobsen
-
- DI.03.07 *Recurrent glioblastomas show increased microvascular transit time heterogeneity and decreased mitochondrial oxygen tension*
K. Rössler* (Erlangen, Deutschland), K. Mouridsen, A. Dörfler, M. Zimmermann, S. Oberndorfer, M. Buchfelder, G. Heinz, A. Stadlbauer
-

Identification of predictive markers for the differentiation between pseudo- and tumorprogression

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Objective: Despite therapeutic improvements, the median overall survival after glioblastoma (GBM) diagnosis remains 14.6 months. Overall survival can be improved by early recognition of tumor progression. Yet, one of the major challenges is to differentiate between true and pseudoprogression, which is a reversible reaction that can occur following radiochemotherapy with radiologic changes mimicking tumor recurrence, with or without neurological deterioration. The aim of this study was to define predictive clinical and molecular markers to identify pseudoprogression.

Methods: Diagnosis of tumorprogression vs. pseudoprogression was confirmed either by histopathological findings or by re-approved assessment according to the RANO criteria on follow-up MRIs. Age, molecular markers (IDH (Isocitrate dehydrogenase) mutation, MGMT (O-6-methylguanine-DNA methyltransferase) promotor methylation), Karnofsky performance status scale (KPS) extent of resection, timing following radiation and number of operations were correlated with occurrence of pseudoprogression. For statistical analysis, chi-square values, independent t-test, Kaplan-Meier survival analysis and boxplots were used. Results with $p < .05$ were considered to be significant.

Results: From 2002 to 2015 in 151 glioblastoma patients (135 primary GBM, 16 secondary GBM, $f=49$, $m=102$, mean age=55 years, IDH mutation positive $n=13$, MGMT positive $n=42$) initial MRI findings were suspicious for tumor progression. Complete resection was achieved in 116, while 35 were incomplete resected. In 85 patients (56.3%) a pseudoprogression was diagnosed histopathologically ($n=30$) or via follow-up MRI ($n=55$) in a median timeframe of 4 months (range 1-23 months) following radiochemotherapy. There was a significant correlation between the diagnosis of pseudoprogression and patients < 50 years ($p=0.024$) and positive MGMT ($p = 0.001$). IDH mutation ($p=0.17$), KPS ($p=0.394$), number of previous resections ($p=0.09$) and extent of resection ($p=0.338$) did not reveal a significant impact. Overall survival (OAS) as well as progression-free survival (PFS) were significantly increased in patients with diagnosed pseudoprogression (14 vs 35 months OAS ($p=0.002$), 6 vs 23 PFS ($p=0.007$), respectively).

Conclusion: Pseudoprogression is associated with MGMT status and older age. There is no correlation with IDH mutation, KPS, number of resections and extent of resection. OAS and PFS were increased in patients with a diagnosed pseudoprogression. Following this first analysis, identifying important markers, we intend to develop a score system to predict pseudoprogression and to avoid unnecessary surgeries.

Controlled clinical trial to evaluate the safety and efficacy of stereotactical photodynamic therapy with 5 Aminolevulinic Acid (Gliolan) in recurrent glioblastoma an introduction

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Objective Glioblastoma is an orphan disease with a grave prognosis. Despite recent advances in the therapy, median survival is still restricted to about 15 months. Novel therapies in the recurrent situation have so far failed phase III evaluations. Therefore, new treatment concepts are needed. One concept may be interstitial photodynamic therapy (iPDT), using the endogenous heme precursor 5-aminolevulinic acid (ALA) which causes mitochondrial and nuclear DNA damage, as well as an immunological effect. This combination between immunologic targeting and local therapy is singular in the treatment of GBM. To evaluate early effectiveness of this therapy, MRI may be a useful tool. We therefore analyzed early MRI findings of patients with recurrent malignant glioma treated by iPDT in a compassionate use setting

Methods: The clinical implementation of iPDT has been shown to be feasible, accurate, and safe even for treatment of deep seated tumors. Therefore we have initiated a phase II b clinical, multicentric, randomized controlled trial (sponsored by Deutsche Krebshilfe, EudraCT-Nr: 2015-002727-25). The ethic commission vote was positive. Patients will be randomized 1:1 and treated in two arms. The treatment arm will receive 5-ALA HCl (20 mg/kg bw) orally 3.5 – 4.5 hours prior to induction anesthesia. A stereotactic biopsy will be performed in order to verify recurrence. If the result is positive, and if the patient is randomized to the PDT arm, iPDT is performed. All patients will receive further treatment of recurrent glioblastoma at the investigator's discretion (best possible care). A retrospective databank analysis was performed of our compassionate series, treated by iPDT, as well. MRI was performed within 48h post surgery. The MRI was analyzed in the context of routine diagnostics.

Results: With our planned trial we want to investigate the efficacy and safety of iPDT with 5-ALA in recurrent glioblastoma regarding progression free survival (PFS), measured as time from the day of randomization until diagnosis of progressive disease. Secondary endpoints, among others, will be the OAS and the quality of life. As pilot seven patients with diagnosis of recurrent malignant Glioma, treated by PDT in a compassionate setting between 02/2011-05/2014 were analyzed. A median OAS from first diagnosis of 24 months was reached. Early postoperative MRI showed a restriction of diffusion as well as subsidence in ADC value which could be well correlated to treatment volume planned ex ante. The SWI demonstrated the products of heme decomposition.

Conclusion: We hope to prove iPDT with this multicenter randomized trial to be a valid additional treatment option in the therapy of recurrent malignant glioma. We already saw an effect of ALA PDT in the targeted tissue in the retrospective analyzes. Especially ADC subsidence appears to be a useful indicator of early therapy effects and will be useful to monitor correct planning of the treatment volume. The reasons for ADC subsidence are unclear to date but may be related to tumor cell swelling, necrosis or early apoptosis.

Fluorescein sodium guided resection of recurrent glioblastoma multiforme

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Objective: Glioblastoma multiforme (GBM) is the most common primary brain tumor with a high recurrence rate. Maximizing the extent of resection (EOR) in recurrent GBM (rGBM) has proved to be the cornerstone of neurosurgical re-treatment. The emergence of surgical microscopes, fitted with fluorescein-specific filters have facilitated fluorescein-guided microsurgery and identification of tumor tissue. As shown before Fluorescein Sodium (FL) provides a high sensitivity and specificity for high grade glioma tissue. Here, we present our experience with FL and the dedicated surgical microscope filter YELLOW 560 nm in 81 patients with glioblastoma recurrence.

Methods: 81 patients with recurrent glioblastoma at different stages of the disease were included (41 women, 40 men, mean age 52 years). 5 mg/kg bodyweight of FL was intravenously injected approximately 45 min. before craniotomy. A YELLOW 560 nm filter (Pentero 900, ZEISS Meditec, Germany) was used for microsurgical tumor resection and resection control. Surgical reports were reviewed regarding the degree of fluorescent staining, postoperative MRIs within 48 hours regarding extent of resection and postoperative courses regarding neurological outcome, complications and any adverse events.

Results: Bright fluorescent staining was reported in all patients, which markedly enhanced tumor visibility and was deemed helpful for tumor resection. 14 patients (17 %) showed residual tumor tissue on postoperative MRI (n=9; 6 % near-total resection (NTR, >95 % volume), n=5; 6 % subtotal resection (STR, <90 % volume). Thus, gross-total resection (GTR, residual enhancement <0.175 cm³) was achieved in 67 (83 %) of patients. No adverse events were registered during.

Conclusion: FL and YE560 is a readily available method for fluorescence-guided tumor resection similar to contrast enhancement in T1-weighted MRI. FL may improve resection with minimal risk, and tumor margins are clearly visualized. FL and the YELLOW 560 nm filter are safe and feasible tools for safe maximal resection of recurrent disease in glioblastoma.

Impact of Pre- and Postoperative Tumor Volume in recurrent Glioblastoma

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Objective: Treatment standards for newly diagnosed glioblastomas are well established and extent of resection is a significant prognostic factor on overall survival. Complete tumor resection is also for recurrent glioblastoma an important prognostic factor. To date however only few studies addressed the role of pre- and postoperative tumor volume in recurrent glioblastomas. Aim of this study therefore was to assess the influence of preoperative and postoperative tumor volume in recurrent glioblastoma on overall survival.

Methods: Patients treated between January 2007 and April 2016 were retrospectively assessed. Inclusion criteria comprised surgery for 1st recurrence of glioblastoma and available received pre- and postoperative MRI. Age, sex, pre- and postoperative tumor volume, survival after recurrent surgery (post-progression survival (PPS)), pre- and postoperative Karnofsky-Performance-Status-Scale (KPS) and molecular status were recorded.

Results: 102 (39 female, 63 male) consecutive patients with a mean age of 58.411.3 years (range 21-79) received surgical therapy for first recurrent glioblastoma between May 2006 and June 2015 in our department. Median preoperative tumor volume was 11.9cm³ (IR 3.2-27.4cm³) and median postoperative tumor volume 0.2cm³ (IR 0-1.3cm³). Complete resection was achieved in 43/102 cases (42.2%) and is an important prognostic factor for PPS in univariate analysis (P<0.001; 11.0 months (95% CI 8.3-13.7) vs. 7.0 months (5.0-9.0)). Complete tumor resection (HR 2.176 [1.280-3.699], P=0.004) did also remain significant in multivariate analysis including age (<60/>=60years, HR 1.541 [0.943-2.519], P=0.084), postoperative KPS (<80/>=80, HR 1.642 [0.977-2.760], P=0.061) and preoperative tumor volume (cm³, HR 1.008 [0.999-1.017], P=0.067). Postoperative tumor volume (cm³, HR 1.051 [0.962-1.147], P=0.270) missed statistical significance in multivariate analysis.

Conclusion: Complete tumor resection at first recurrence is an important prognostic factor for PPS in glioblastoma patients. A trend towards improved survival with less residual tumor burden at first recurrence was observed. Preoperative tumor volume at first recurrence was not shown as significant prognostic factor.

Radiologic patterns of first tumor recurrence of glioblastoma: Prognostic value and association to postoperative infarct volume

Stefanie Bette¹, Melanie Barz², Thomas Huber¹, Julia Gerhardt², Christoph Straube³, Friedericke Schmidt-Graf⁴, Claus Zimmer¹, Bernhard Meyer², Jan Kirschke⁵, Tobias Boeck-Behrens¹, Benedikt Wiestler¹, Jens Gempt²

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Objective: Postoperative infarct volume is a prognostic factor for glioblastoma (GB) patients, postoperative hypoxia is suggested as potential mediator for invasive tumor growth, resulting in diffuse/multifocal recurrence patterns. Aim of this study was to analyze distinct recurrence patterns and its association to overall survival (OS)/post-progression survival (PPS) and postoperative infarct volume.

Methods: 526 consecutive GB patients were retrospectively analyzed, 129 patients met the inclusion criteria: surgery for initial tumor diagnosis, postoperative diffusion-weighted imaging and tumor recurrence during follow-up. The following imaging patterns were recorded: multifocal recurrence, contact to dura and/or ventricle, ependymal spread, circular/garland like or extensive/solid enhancement, homogenous/inhomogenous enhancement, invasive/displacing growth, with/without sharp demarcation and the local or distant recurrence. Binary logistic regression analysis as well as multivariate (Cox regression) survival analyses were performed.

Results: Patients with larger postoperative infarct volume significantly more often developed multifocal recurrence (Odds Ratio (OR) 1.10 per cm³ infarct volume, P=0.040), recurrence with contact to ventricle (OR 1.14, P=0.012) and contact to dura (OR 1.07, P=0.029). Multivariate survival analysis showed that patients with multifocal recurrence (Hazard Ratio (HR) 1.99 [1.18-3.35], P=0.009) and recurrence with contact to ventricle (HR 1.71 [1.03-2.85], P=0.038) had significantly shorter OS including other known prognostic factors like age, Karnofsky Performance Score (KPS), therapy and extent of resection. Also PPS was significantly reduced in patients with tumor recurrence with contact to ventricle (HR 1.80 [1.11-2.93], P=0.017), distant recurrence (HR 1.74 [1.09-2.77], P=0.020) and ependymal spread (HR 3.03 [1.48-6.23] P=0.003) in multivariate analysis.

Conclusion: Multifocal tumor recurrence and recurrence with contact to ventricle are associated with postoperative infarct volume and were shown as independent predictors for OS and PPS. Hypoxia-mediated aggressive tumor growth might be the trigger for multifocal and diffuse recurrence patterns.

Is there a role for reoperation in the management of Glioblastoma?

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Introduction: The standard treatment for Glioblastoma (GBM) is currently maximal safe surgical resection followed by radiation therapy and concomitant chemotherapy. Unfortunately, the disease will invariably recur even with the best treatment available; therapy goals must be to prolong survival at the best quality of life. Although literature suggests some advantage in reoperating patients harboring HGG, controversy still remains, specially regarding the most suitable candidates for reoperation.

Objective: We asked whether reoperation is an efficacious treatment strategy for GBM, and under which circumstances it can be indicated.

Methods: To address this issue, we retrospectively reviewed 286 consecutive cases of newly diagnosed GBM in a single University Hospital from 2008 to 2015. First, we evaluated clinical and epidemiological parameters possibly influencing overall survival (OS) by multivariate analysis. Second, overall survival from the diagnosis was calculated using the Kaplan-Meier method in patients submitted to one or two surgical procedures. Finally, the survival curves were fitted with the Weibull model, and survival at 12 and 24 months were estimated.

Results: Two or more surgeries were done after May 2009. The multivariate analysis revealed a positive correlation between survival and number of surgeries, initial KPS, and initial Ecog (all $p < 0.001$). The Kaplan-Meier curves differed consistently between groups submitted to one or more surgical procedures ($p < 0.05$, Wilcoxon). A mathematical regression for survival estimates was performed according to Weibull. Indeed, OS at 12 and 24 months was significantly greater for 2 surgeries.

Conclusion: Our data indicate that reoperation for GBM is especially indicated for patients with good initial functional status (Ecog and KPS), and doubles survival estimates at 12 and 24 months.

Recurrent glioblastomas show increased microvascular transit time heterogeneity and decreased mitochondrial oxygen tension

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Objective: Dynamic susceptibility contrast (DSC) perfusion MRI provide information about differences in macro- and microvasculature when executed with gradient-echo (GE; more sensitive to macrovasculature) and spin-echo (SE; sensitive to microvasculature) contrast. Our aim was to investigate whether there are differences between macro- and microvascular transit time heterogeneity (MVTH and μ VTH) and oxygen tension in tissue surrounding mitochondria ($PO_{2_{mit}}$) in untreated and recurrent glioblastoma.

Methods: Fifty-seven patients with glioblastoma (25 untreated/ 32 recurrent) were examined with a physiological MRI protocol including GE- and SE-DSC perfusion sequences, and a multiparametric quantitative blood-oxygen-level-dependent (qBOLD) approach. Maps of MVTH and μ VTH as well as coefficient of variation (MCOV and μ COV) were calculated from GE- and SE-DSC data, respectively, using an extended flow-diffusion equation. This approach was termed VTH mapping. $PO_{2_{mit}}$ maps were calculated from qBOLD data using custom-made software.

Results: The values for μ COV in both untreated and recurrent glioblastoma were significantly lower ($P \leq 0.001$) than in normal brain and in the macrovasculature (MCOV) of the lesions. Recurrent glioblastoma showed significant increased μ VTH ($P=0.014$) and μ COV ($P=0.039$) compared to untreated glioblastoma. This was associated with a significant decreased $PO_{2_{mit}}$ ($P=0.008$) in recurrent glioblastoma. VTH mapping in the macrovasculature revealed no significant differences between untreated and recurrent glioblastoma.

Conclusion: VTH mapping of the microvasculature using SE-DSC perfusion MRI and mapping of $PO_{2_{mit}}$ using qBOLD provide potential imaging biomarker for investigation of physiological and metabolic alterations responsible for recurrence of glioblastoma. VTH mapping of the macrovasculature using conventional GE-DSC perfusion MRI seems to be less useful.

DI.04 Fortschritte in der Neurochirurgie

Dienstag *Tuesday*, 16.05.2017, 08.00 – 09.10 Uhr *hrs*

- DI.04.01 *Otfrid Foerster's School: The influence of surgical neurology on the development of neurosurgery in Germany*
U. Eisenberg* (Eberswalde, Deutschland)
-
- DI.04.02 *The Nervus intermedius in vestibular schwannoma surgery*
C. Strauss* (Halle/Saale, Deutschland), J. Prell, C. Scheller, J. Illert
-
- DI.04.03 *The history of neurosurgical intensive care*
D. Jaster* (Plau am See, Deutschland)
-
- DI.04.04 *Evolution of the modern neuroendoscopy*
P. Grunert* (Homburg, Deutschland), J. Oertel
-
- DI.04.05 *Evolution of Therapeutic Strategies for Syringomyelia*
J. Klekamp* (Quakenbrück, Deutschland)
-
- DI.04.06 *Hemispherotomy - operative technique and seizure outcome 1991 to 2014*
T. Kalbhenn* (Bielefeld, Deutschland), T. Polster, H. Pannek, M. Simon, C. Bien
-
- DI.04.07 *Vestibular schwannoma surgery during the last 80 years - Technological advancements and the pioneers*
M. Tatagiba* (Tübingen, Deutschland), F. Ebner
-

Otfried Foerster's School: The influence of surgical neurology on the development of neurosurgery in Germany

Ulrike Eisenberg¹

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Objective: Historical analysis of the influence of Otfried Foerster's (1873-1941) school on the establishment of (post-war) German neurosurgery.

Methods: Research and review of documents of several archives as well as of the literature on the history of the neurosciences and of Foerster's and his students' publications, with the analysis of their main topics of research and their way of combining neurology, neuroanatomy, neuroradiology and neurosurgery.

Results: Otfried Foerster was the first German neurologist who in 1921 got a 'personal' chair for neurology in Breslau. A master of clinical and pathophysiological correlation, he founded a school of clinical, but also surgical neurology. He maintained a wide international network, was visited by neurosurgeons and neurologists from all over the world, and in 1937, he became "Member Emeritus" of the British Association of Neurological Surgeons. In this year, Wilhelm Tönnis (1898-1978) in Berlin and Foerster in Breslau hosted the 22nd meeting of the Society of the British Neurological Surgeons. The German Foerster School, mainly represented by Arist Stender (1903-1975, Berlin), Helmut Penzholz (1913-1985, Berlin and Heidelberg), Ernst Klar (1909-1967, Heidelberg), Hans Kuhlendahl (1910-1992, Düsseldorf), and Friedrich Wilhelm Kroll (1903-?, Detmold), played an important role in the establishment of neurosurgery in post-war Germany. Almost all of them were among the first German full professors for neurosurgery. And several of Foerster's 'grandchildren' got leading positions in neurology, as Hans Schliack (1919-2008, Berlin), in neuroradiology, as Sigurd Wende (1924-1991), or in neurosurgery, as Arno Schulze (1919-2012, Siegen), Volker Sturm (*1943, Köln), Kurt Pisco (*1932, Bremen) and Thomas Grumme (1938-2007, Augsburg), to name just a few of them. However, German neurology and neurosurgery lost some of Foerster's gifted students who were expelled by Nazi Germany. Among them were Ludwig Guttmann (1899-1980) who became famous for his revolutionary therapy of paraplegic patients and as founder of the Paralympics, Carl Felix List (1902-1968) who was one of the first who introduced angiography to the United States, or Alice Rosenstein (1898-1991) who emigrated to New York, as the first woman worldwide working in neurosurgery.

Conclusion: Meanwhile, the influence of Foerster's school is decreasing, but we still find its traces in modern German neurosurgery, neurology, and neuroradiology.

The Nervus intermedius in vestibular schwannoma surgery

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Objective: The Nervus intermedius is the parasympathetic portion of the facial nerve, exiting the brainstem with the fibers of the VIIth and VIIIth nerve, crossing the CPA adjacent to the superior vestibular nerve and rejoining the facial nerve at the level of the porus of the internal auditory canal. This area is considered most difficult for complete tumor resection and facial nerve preservation. From electrophysiological and anatomical studies the nerve is known to carry motor fibers to facial muscles. The nerve is seldom addressed in vestibular schwannoma surgery and its impact to surgery and outcome has not been evaluated.

Methods: A consecutive series of 203 patients undergoing vestibular schwannoma surgery has been evaluated with respect to presence or absence of a Nervus intermedius, based on operative records and EMG data. Tumor size, tumor origin, extent of resection, and facial nerve function were evaluated.

Results: A separate nerve was identified in more than 50%. There was no statistical significance for presence or absence of the nerve in various Koos size categories, except for Koos I tumors in which the nerve was identified in only 2 of 19 cases.

Presence of the nerve had no impact on extent of tumor resection ($p=0.626$) and on short ($p=0.441$) and long term facial nerve function ($p=0.749$). Tumor origin was irrelevant for presence or absence of a separate nerve ($p=0.183$). The predictability of postoperative severe facial nerve paresis (House-Brackmann >4) based on intraoperative EMG monitoring was significantly lower (Spearman's rho 0.43) when a nervus intermedius was identified during surgery as compared to those cases in whom no separate nerve was seen (Spearman's rho 0.73).

Conclusion: The Nervus intermedius poses a substantial challenge for intraoperative EMG monitoring in vestibular schwannoma surgery since at presence it is difficult to reliably distinguish pathological EMG activity arising from the nervus intermedius, which does not imply functional consequences as compared to trains from the facial nerve.

The history of neurosurgical intensive care

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Objective: The development of Neurosurgical intensive care units from the beginning until the 9th decade of 20th century will be presented under the topic "Fortschritte in der Neurochirurgie der letzten 80 Jahre" in a free speech.

Methods: The historical aspect of neurosurgical intensive care unit based on secondary literature even as the history of neurosurgery and the history of particular neurosurgical departments. In the neurosurgical archive at Würzburg there are only a few sources, so the data have to be collected.

Results: The brain death concept extended the specialty, the knowledge and skills of others subspecialties of medicine were needed to treat patients in the neurosurgical ICU. The reforms of the health system based on business administration lead to interdisciplinary intensive care units, even a few mostly at university hospitals remain in neurosurgical departments. The pros and cons will be discussed under the focus of making life worth living.

Conclusion: Which kind of ethical standards in the past and in the future give distinction to the neurosurgeon at the intensive care unit? The ethical standards will be discussed related to the new economic health system.

Evolution of the modern neuroendoscopy

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We can distinguish an early and an advanced period of neuroendoscopy depending on the technical development of the endoscopes. The early period comprised the first two decades of the 20th century. Nitze type cystoscopes were tested for neurosurgical application at several American universities. Among others Kanavel with the urologist Lespinasse fulgurated the choroid plexus in 1910 and Mixter 1923 performed the first ETV with the same method as is performed today. However after few operations this endoscopic method due to mechanical and optical limitations of this first generation of endoscopes was given up.

The advanced period of neuroendoscopy with broad field of applications became possible by means of the technical improvements made in the 50th by the British physicist Harold Horaz Hopkins(1918-1994). He had the idea for flexible endoscopes and made successful basic research for light transmission through flexible glass fibers by means of total reflection. However Hopkins name is mainly associated with the improvement of optical quality of rigid endoscopes. He replaced the relay lenses with long interspaces of air by rod lenses with higher refraction which reversed in the shaft the proportion of air and glass and together with better isolation improved the light transmission by a factor of 80 in relation to the standard Nitze endoscopes.

In the 60th and 70th neuroendoscopic procedures were rediscovered by Griffith, Fukushima and Guiot. In the 80th ETV were performed with the Hopkins system by Kelly and Manwaring in US, Sainte Rose in Paris and Jones and Teo in Australia. In the 90th systematic application in the ventricles and subarachnoidal space with anatomic basic research within the scope of minimally invasive neurosurgery with common ideas and common education courses was established by Perneczky, Gaab, Bauer/Hellwig at three universities in Germany together with Grotenhuis in Netherland and by Caemaert in Belgium. Since the 1st decade of 20th century many new indications for neuroendoscopic treatment were elaborated such as transsphenoidal pituitary, skull base, decompression of periferal nerves and spinal surgery. Most of these techniques became meanwhile standard procedures in neurosurgery.

Evolution of Therapeutic Strategies for Syringomyelia

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Objective: Treatment of syringomyelia began at the end of the 19th century with surgical opening of the syrinx. In the first half of the 20th century different types of shunts were used to drain syrinx fluid to the subarachnoid space, peritoneal or pleural cavity. The introduction of decompression for Chiari I malformations in the 1960s marked the beginning of causative treatment for syringomyelia. With the advent of magnetic resonance imaging and recognition of an increasing number of pathologies leading to syringomyelia further strategies to treat the cause of syringomyelia were developed in the 1990s.

Methods: Since 1991 all patients with spinal cord pathologies were entered into a spinal cord data base. Between 1991 and 2015 a total of 1535 patients with syringomyelia were encountered (follow up 47.1±55 months). Patients were examined on admission, after surgery, 3 months after discharge and yearly thereafter. Clinical data were analyzed with a scoring system for individual symptoms. Long-term results were determined by Kaplan-Meier statistics to calculate rates for progression-free survival.

Results: Syringomyelia was found to be caused by pathologies at the craniocervical junction in 604 patients (Chiari I malformations n = 543, foramen magnum arachnoiditis n = 32, Chiari II malformations n = 27, Chiari III malformations n = 2). For 931 patients pathologies of the spinal canal were responsible (nontraumatic arachnopathies n = 370, posttraumatic arachnopathies n = 163, intramedullary tumors n = 152, extramedullary intradural tumors n = 92, cervical disc diseases n = 70, tethered cord syndromes n = 69, extradural tumors n = 15). A total of 747 patients underwent surgery attempting to treat the cause of the syrinx without using syrinx shunts. For 83.7% causative treatment strategies resulted in progression-free survival rates of 70 – 90% for 10 years depending on the underlying pathology. Significantly worse long-term outcomes were achieved for patients with extensive arachnopathies related to subarachnoid hemorrhages or infections and for patients with posttraumatic syringomyelia related to an incomplete cord lesion. For this subgroup of 16.3%, an alternative strategy to treat syringomyelia has been employed draining cerebrospinal fluid from the subarachnoid space to the peritoneal cavity in 8 patients. For 15 patients with a complete cord lesion and ascending syringomyelia cordectomies were performed.

Conclusion: Syringomyelia may be caused by intramedullary tumors and pathologies either leading to disturbances of cerebrospinal fluid flow or cord tethering. For the great majority causative treatment strategies are available with good long-term results. Syrinx drainage procedures can be considered obsolete for first line treatment. For symptomatic therapy of syringomyelia drainage of cerebrospinal fluid from the subarachnoid space to the peritoneal cavity may be employed.

Hemispherotomy - operative technique and seizure outcome 1991 to 2014

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Objective: Surgery for treating hemispherical epilepsy was started by Krynauw in 1950. Initially, surgery aimed at removing the lesional hemisphere. More recently almost purely disconnective operative procedures have been adopted by most epilepsy surgeons. We hypothesize that the complete disconnection of the insula as well as the complete resection of the fronto-orbito-dorso-mesial cortical tissue are essential for a good postoperative seizure outcome.

Methods: We retrospectively identified all patients treated at our institution who underwent hemispherotomy from 1991 to 2014 with an epileptological follow-up > 2 years after surgery. In 2013 we changed our operative technique from a periinsular hemispherical disconnection to a keyhole approach with separate disconnection of the insula and additional wide resection of the fronto-orbito-dorso-mesial cortical tissue. The completeness of the disconnection as well as the extent of any tissue resection was documented by MRI. We attempted to correlate the respective operative techniques with the postoperative seizure outcomes (Engel classification)

Results: Between 1991 and December 2014 144 patients (129 children and 15 adults) underwent hemispherotomy. Etiologies did not change significantly over the years. Mean age at hemispherotomy was 7.2 years (median: 4.5 years). 20 patients underwent reoperation for completion of the hemispherical disconnection. Epileptological follow-up data were available in 144 cases with Engel Ia outcomes (freedom of any seizures) in 59.7% of patients at 2 years following surgery. Only 66/120 (55%) patients undergoing surgery before 2013, but 20/24 (83.3%) of cases operated upon after 2013 became seizure-free ($p=0.012$ Fisher exact test). **Conclusion:** Our data coming from one of the largest institutional hemispherotomy series imply that careful and thorough disconnection of the insula and resection of the fronto-orbito-dorso-mesial cortical tissue are crucial surgical steps during hemispherotomy. Our modified technique may significantly improve postoperative seizure outcomes.

Vestibular schwannoma surgery during the last 80 years - Technological advancements and the pioneers

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Objective: To report about the technological development and the pioneers who sustainably influenced vestibular schwannoma surgery over the last 80 years.

Methods: Literature review with the key words "vestibular schwannoma", "history", "technological advancement"

Results: Going 80 years back the analysis starts in AD 1937- the year of death of Fedor Krause. In the post Fedor Krause era, Walter E. Dandy further improved the technique performing a capsular dissection via an unilateral suboccipital approach. Thus he achieved complete tumor resection with a markedly reduced mortality rate both in the perioperative and follow-up period.

Murray et al. proved in 1944 the Schwann cell being the origin of the nerve sheath tumor. Steward and Schuknecht identified the neurilemmal-glia junction as site of origin in 1975.

In 1957 Theodor Kurze first operated a VS under microscopic visualization using the retrosigmoid route. Further development and refinement of the microsurgical technique led to the concept of facial and thereafter hearing preservation. William House applied microsurgical techniques to the translabyrinthine approach achieving excellent results in terms of facial nerve preservation rates. Introduction of ultrasonic aspirator for tumor debulking and intraoperative monitoring for continuous surveillance of cranial nerve function represent essential steps towards a new era in VS surgery. Sugita and Kobayashi reported in 1982 about the usefulness of the bipolar forceps for stimulating the facial nerve and thus facial nerve monitoring. Thereafter monitoring of brain stem evoked potentials was introduced. House and Hitselberger were pioneers in the development of auditory brainstem implants. Cochlear implants and auditory brainstem implants opened up the era of hearing restoration, a field in continuous development.

A further milestone was the understanding of the microsurgical anatomy. Prof. Johannes Lang rendered outstanding services to the knowledge of microsurgical anatomy of the cerebellopontine angle as well as A.L. Rhoton in the following years. Professor Madjid Samii contribution to the field of vestibular schwannoma surgery is outstanding. He brought operative strategy and microsurgical technique as well as perioperative management to perfection. In large patient series with excellent results he gave proof of the revolution in VS microsurgery that took place over the last 80 years.

Conclusion: Great success has been achieved - and still a lot has to be done. Advances in medical engineering, molecular biology and regenerative research will open new horizons in the microsurgical treatment of patients with VS.

DI.05 Freie Themen – gemischt

Dienstag *Tuesday*, 16.05.2017, 08.00 – 08.50 Uhr *hrs*

- DI.05.01 *First clinical results of Minimally Invasive Vector Lumbar Interbody Fusion (MIS-VLIF) in spondylodiscitis and concomitant osteoporosis. Development of the K-template to facilitate the use of MIS-VLIF in degenerative lithesis: implants and biomechanical behavior*
W. Polanski, H. Jiang, D. Ruess, C. Reinshagen, M. Molcanyi, J. Zivcak, H. Tong, G. Schackert, B. Rieger* (Dresden, Deutschland)
-
- DI.05.03 *Preoperative simulation software reduces surgical time, decreases Radiation exposure and improves 6 months back pain in minimally invasive Hybrid Lumbar Interbody Fusion (MIS-HLIF)*
W. Polanski, H. Jiang, M. Molcanyi, J. Zivcak, D. Ruess, C. Reinshagen, G. Schackert, B. Rieger* (Dresden, Deutschland)
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- DI.05.04 *Missed diagnosis of acute aneurysmal subarachnoid haemorrhage in the era of modern chain of survival, interdisciplinary treatment and multimodal diagnostic options*
A. Doukas* (Kiel, Deutschland), H. Barth, A. Petridis, M. Mehdorn, C. von der Brelie
-
- DI.05.05 *Predictors of in-hospital death following aneurysmal subarachnoid hemorrhage - analysis of a nationwide database (Swiss SOS)*
M. Stienen* (Zürich, Switzerland), J. Burkhardt, M. Neidert, C. Fung, B. Schatlo, P. Bijlenga, K. Schaller, E. Keller, O. Bozinov, L. Regli
-

First clinical results of Minimally Invasive Vector Lumbar Interbody Fusion (MIS-VLIF) in spondylodiscitis and concomitant osteoporosis. Development of the K-template to facilitate the use of MIS-VLIF in degenerative listhesis: implants and biomechanical behavior

Witold Polanski¹, Hongzhen Jiang², Daniel Ruess³, Clemens Reinshagen⁴, Marek Molcanyi³, Jozef Zivcak⁵, Huaiyu Tong⁶, Gabriele Schackert⁷, Bernhard Rieger⁸

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Objective: Dorsal stabilization is used worldwide since 1970. Although there were advancements in detail, the basic principle of the fixateur interne together with transpedicular screw connection is still in exclusive use, but minimal access spinal technologies promoted a diversification of surgical procedures according to the pathology. To benefit seriously ill patients by minimizing the surgical approach, MIS-VLIF was introduced. This technical requirement of combining screws from different directions within a small unilateral approach was solved by the development of a K-shaped template together with screws of special designed multi-axial heads and special thread.

Methods: After informed consent, 11 patients suffering from lumbar spondylodiscitis underwent a single level MIS-VLIF. Pre- and postoperative clinical status was documented using numeric rating scale (NRS) for leg and back pain. In all cases, the optimal height for the cage was preoperatively determined using software-based range of motion and sagittal balance analysis. CT scans were obtained to evaluate correct placement of the construct and to verify fusion after six months. Observing good outcome in weak bony conditions the method should be able to be used in degenerative listhesis, also, therefore a special stabilization system was built and its biomechanical behavior was studied.

Results: Since 2013, 11 seriously ill patients with spondylodiscitis - eight of them with concomitant osteoporosis - underwent MIS-VLIF. Mean surgery time was 159min and average blood loss was less than 400ml. Postoperative CT scans showed correct placement of the implants. Six months follow-up CT-scan showed remaining sagittal balance. All patients had postoperative improvement in clinical scores (NRS back<0.001; NRS leg<0.004). For surgical treatment of listhesis a K-shaped template together with specially designed screws was created with excellent biomechanical behavior.

Conclusion: The load-bearing trajectories (vectors) of MIS-VLIF are different from those of conventional pedicle screw implantation. The dorsally converging construct combines the heads of dorsoventral pedicle screws with laminar pedicle screws following cortical bone structures within a small approach. MIS-VLIF relies on cortical bony structures for all screw vectors and the construct does not depend on conventional coaxial pedicle screws in the presence of inflamed, weak, cancellous or osteoporotic bone. MIS-VLIF allows full 360° lumbar fusion including cage implantation via a small, unilateral dorsal midline approach. At present, MIS VLIF is not suggested in degenerative listhesis, because after required repositioning in listhesis, it is a challenge to combine the screws with only one rod. All efforts must be made to improve this promising surgical procedure and make it fit for common clinical use.

Preoperative simulation software reduces surgical time, decreases Radiation exposure and improves 6 months back pain in minimally invasive Hybrid Lumbar Interbody Fusion (MIS-HLIF)

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Objective: MIS-HLIF was established as the standard lumbar interbody fusion in degenerative listhesis. It combines different screw trajectories (cortical bone trajectory and common pedicle screw placement) and the advantages of the PLIF and the TLIF within one surgical procedure. Due to the cortical bone trajectory, the surgical approach could be minimized and the tightness of the screws could be optimized, especially in osteoporosis and spondylodiscitis. Spinal navigation was introduced, to increase the safety with the unfamiliar cortical bone trajectory and led to an additional radiation exposure for the patient. Without any navigation guidance, percutaneous lumbar stabilization leads to an increased intraoperative radiation exposure in comparison with open procedures. Due to the implementation of the spinal navigation system and preoperative simulation software, the radiation exposure of the staff could be reduced.

Methods: 124 patients with a follow-up of one year were enrolled in this inter cohort comparison. All patients underwent MIS-HLIF according to the standard operative procedure by one surgeon. Additionally to general surgery data, the radiation exposure in the OR was measured with the area dose product [$\text{cGy}\cdot\text{cm}^2$]. Outcome control of patients undergoing MIS-HLIF due to single level degenerative listhesis was done according the questionnaires of the European Spine Tango register. After establishing a preoperative simulation, 66 cases were evaluated (SIM group) and compared with 66 patients previously undergoing MIS-HLIF without preoperative simulation (NO-SIM group). Additionally, to observe the safety and efficacy of MIS-HLIF the outcome of all patients was considered in its entirety.

Results: The area dose product was reduced in our trained staff significantly for the SIM group ($320\text{cGy}\cdot\text{cm}^2$) in comparison with the NO-SIM group ($470\text{cGy}\cdot\text{cm}^2$) in navigation guided MIS-HLIF. The average surgical time was shorter for the SIM group (155min) than for the NO-SIM group (182min). In outcome register data there was less back pain (NRS back) after 6 months in the SIM group $p=0.48$. This trend disappeared after one year $p=0.56$. In overall consideration there was highly significant improvement in NRS back and leg, COMI and ODI in six weeks, three months, six months and one year follow-up ($p<0.01$).

Conclusion: MIS-HLIF combines advantages of the PLIF and TLIF procedure and its neurological outcome is equal to other lumbar stabilization procedures according the current literature. The implementation of preoperative simulation software reduced radiation exposure in our trained staff significantly and may lead to a better outcome due to its special algorithm which takes the individual degeneration into consideration. Based on preoperative imaging data, the simulation software suggests the optimal height of the device so it has not to be defined radiographically during the procedure.

Missed diagnosis of acute aneurysmal subarachnoid haemorrhage in the era of modern chain of survival, interdisciplinary treatment and multimodal diagnostic options

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Objective: Patients suffering from subarachnoid Hemorrhage (SAH) may present with a variety of symptoms and different severity of the primary neurological decline reflecting the intensity of early brain injury. The first treating physician might misinterpret these symptoms resulting in a delay of the diagnosis. The aim of this study is to evaluate the spectrum of misdiagnoses and to analyze which medical specialties are involved, as well as the significance of a delay in correct diagnosis on the clinical course and outcome

Methods: The data was collected prospectively from 2003 to 2013. Patients diagnosed with disease different from aneurysmal SAH by the initially treating physician, and admitted to our department with a delay of at least 24 hours after the beginning of the symptoms, were included in this study. The various diagnoses that were ascertained instead of SAH were analyzed and which medical specialty had provided them. The delay between the onset of symptoms and the correct diagnosis was analyzed as were clinical course and neurological outcome. No data were available of patient who had died from a potential re – rupture second following misdiagnosis.

Results: Overall, 704 patients were treated with acute SAH. The inclusion criteria were matched in 76 patients (13.7%). Eleven specialties were involved in the initial patients' treatment (28.9 % internist, 23% general practitioners, 18.7% emergency physicians, neurologists 15%). Unspecific headache – syndrome was diagnosed in the majority of cases (39.4% tension headaches or migraine attacks, especially in patients with a history of migraines (34.6%)). Fourteen percent of the patients were initially treated for cardiac pathologies. The time interval between initial symptoms and neurosurgical admission varied enormously (median 11 days). Forty-two percent of the patients had high grade SAH (Hunt & Hess 3-5). Statistically, higher Hunt & Hess score did not lead to an earlier diagnosis ($p = 0.56$) nor did localisation of the aneurysm ($p = .75$). Lower Fisher score was led to delayed diagnosis ($p = 0.02$). Interestingly, the absolute delay of diagnosis was not significantly associated with the outcome ($p = 0.08$) whereas Hunt & Hess grade on admission was a strong predictor for bad outcome ($p = 0.00001$) as was cerebral vasospasm on the first angiogram ($p < 0.05$). A matched-pair subgroup analysis for patients with high grade SAH (Hunt & Hess 3 – 5) showed that admittance on the first day after SAH lead to better outcome compared to misdiagnosed and delayed patients.

Conclusion: A straightforward diagnosis of SAH despite diffuse and unspecific symptoms is crucial for the successful treatment of these patients, especially with high grade SAH. This data should sensitize all physicians.

Predictors of in-hospital death following aneurysmal subarachnoid hemorrhage - analysis of a nationwide database (Swiss SOS)

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Objective: To identify predictors of in-hospital mortality in patients with aneurysmal subarachnoid hemorrhage (aSAH).

Methods: Retrospective analysis of prospective nationwide data from a multicenter registry on all aSAH cases admitted to a tertiary neurosurgical department in Switzerland between 2009 – 2014 (Swiss SOS). Patients admitted alive but dead at discharge (in-hospital mortality) were identified and both clinical and radiological predictors of death (adjusted odds ratios (aOR)) were identified using multivariate logistic regression analysis.

Results: Of n=1866 patients admitted alive with aSAH, in-hospital mortality was 20.0% (n=373) with death occurring within 48h of ictus in 35.7% (n=133). Independent predictors of in-hospital mortality at admission were uni- or bilateral pupil dilatation (aOR 3.68, 95%CI 2.33-5.83, p<0.001), followed by high WFNS grade (4 and 5; aOR 3.02, 95%CI 1.99-4.58, p<0.001), presence of intraventricular hemorrhage (aOR 2.66, 95%CI 1.73-4.09, p<0.001), age ≥ 60 years (aOR 95%CI 1.99, 1.36-2.89, p<0.001), and midline shift (aOR 1.61, 95%CI 1.03-2.53, p=0.039). Male patients were as likely as female patients to die (aOR 1.34, 95%CI 0.90-1.98, p=0.149). Patients not receiving curative therapy were more likely to die (aOR 14.11, 95%CI 9.16-21.73, p<0.001), as were patients with aneurysm re-bleeding (aOR 8.21, 95%CI 4.25-15.86, p<0.001), and those experiencing delayed cerebral ischemia (aOR 2.93, 95%CI 1.91-4.50, p<0.001). The rates of in-hospital mortality were 11.02% after a clipping and 12.55% after a coiling procedure. Finally, infarction on post-treatment CT scan was a predictor of death (OR 2.09, 95%CI 1.51-2.89, p<0.001).

Conclusion: The unselected nationwide database allows for accurate determination of the effect size of important predictors of in-hospital mortality. The highest independent risk factors were re-bleeding (aOR 8.21), pupil dilatation at admission (aOR 3.68) and high WFNS grade (aOR 3.02).

DI.06 OP-Techniken 2

Dienstag *Tuesday*, 16.05.2017, 08.00 – 09.10 Uhr *hrs*

- DI.06.01 *Early reoperation after surgical treatment of chronical subdural hematomas. A comparison of different surgical approaches.*
M. Boroumand* (Gießen, Deutschland), E. Uhl, M. Kolodziej, M. Reinges, K. Schöller, M. Stein
-
- DI.06.02 *Interdisciplinary extended approaches to skull base lesions – a single center experience*
A. Herten* (Essen, Deutschland), S. Mattheis, K. Wrede, B. Stuck, U. Sure, N. El Hindy, O. Müller
-
- DI.06.03 *Transforaminal lumbar sequestrectomy: Where do we stand 3 years after implementation of the technique in a university hospital setting?*
M. Bender, L. Herrmann, C. Gramsch, E. Uhl, K. Schoeller, M. Bender* (Gießen, Deutschland)
-
- DI.06.04 *Double-room CT scanner with sliding gantry for intraoperative imaging in neurosurgical interventions*
M. Lenski* (München, Deutschland), J. Hofereiter, N. Terpolilli, S. Zausinger, J. Tonn, F. Kreth, C. Schichor
-
- DI.06.05 *Endoscopic Intralaminar Approach for the Treatment of Migrated Lumbar Disc Herniation*
B. Burkhardt* (Homburg, Deutschland), J. Oertel
-
- DI.06.06 *Intraoperative intermittent pneumatic compression reduces incidence of venous thromboembolism in patients undergoing craniotomy: A randomized prospective study*
J. Prell* (Halle (Saale), Deutschland), G. Schenk, B. Taute, C. Scheller, C. Strauss, S. Rampp
-
- DI.06.07 *Easy minimalinvasive retractor system for the extrem lateral transthoracal approach - technical note.*
C. Ewelt* (Münster, Deutschland), N. Warneke, M. Schwake, E. Suero Molina, T. Fortmann, W. Stummer, M. Klingenhöfer
-

Early reoperation after surgical treatment of chronic subdural hematomas. A comparison of different surgical approaches.

Mehran Boroumand¹, Eberhard Uhl¹, Malgorzata Kolodziej¹, Marcus Reinges¹, Karsten Schöller¹, Marco Stein¹

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Objective: Despite several publications on the treatment of chronic subdural hematoma (CSDH), the optimal surgical approach is still controversial, and a standard therapy does not exist. The purpose of this study is to compare three different surgical approaches for the treatment of CSDH.

Methods: In this retrospective study the data of 198 patients with 224 CSDH were analyzed. The patients were analyzed by the type of surgical hematoma evacuation: 86 patients (43.4%) with one burr hole (1 BH), 41 patients (20.7%) with two burr holes (2 BH), and 71 patients (35.9%) with craniotomy. The maximum hematoma diameter (MHD) was measured pre-operatively and postoperatively. The relation between clinical data and early reoperation was evaluated by univariate and multivariate statistical analysis.

Results: The rate of reoperation during the acute stay in the group with 1 BH, 2 BH, and in the craniotomy group was 36%, 14.6%, and 15.5%, respectively. In patients with anticoagulation or antiplatelet therapy an increased rate of reoperations was observed (33.7% vs. 17.4%; $P=0.008$). Patients with reoperations were older compared to patients without reoperations (77.3 ± 6.4 years vs 71.5 ± 15.2 years; $P=0.034$). Postoperative seizures were detected in 8.6-14.6% without significant statistical differences between all groups. The median decrease in MHD for 1 BH, 2 BH, and craniotomy was 10mm (IQR: 5-16mm), 10mm (IQR: 5-18.5mm), and 11,5mm (IQR: 6-16mm), respectively. Patients with 1 BH and 2 BH were more often treated with a closed-system *drainage* (95.3% vs. 78.9%; $P < 0.001$). The median length of stay (LOS) for 1 BH, 2 BH, and craniotomy was 13 days (IQR: 7.5-17days), 13 days (IQR: 7.25-19.5 days), and 15 days (9-20 days), respectively. Patients with 1 and 2 BH had a higher Glasgow outcome scale (GOS) at discharge compared to the craniotomy group (4; IQR: 3-4 vs. 3; IQR: 1.5-3.75; $P=0.020$).

Conclusion: The reduction of the CSDH was comparable for the three analyzed methods. The recurrence rate during the acute hospital stay was increased in the 1 BH group. However, patients with less invasive approaches like 1 or 2 BH had a better outcome and had a decreased LOS compared to the craniotomy group.

Interdisciplinary extended approaches to skull base lesions – a single center experience

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Objective: Interdisciplinary extended (near total) resections of skull base tumors in a complete endoscopic transnasal or in a combined endoscopic / microscopic approach in cooperation with the Department of Otorhinolaryngology (ORL) were evaluated with regard to postoperative complications, extend of resection and progression free survival (PFS).

Methods: Intraoperative macroscopic and postoperative imaging based extend of resection, postoperative complications and PFS were assessed in 12 consecutive patients admitted to the neurosurgical clinic and treated in cooperation with the Department of ORL since 2013. Operations were performed in an isolated endoscopic transnasal approach or with microscopic support. The spectrum of skull base lesions included meningioma, carcinoma, sarcoma and cystic lesions.

Results: The cohort consisted of 5 female and 7 male patients with a mean age of 38.75 years (range 6-62y). Histology revealed meningioma (n=2), carcinoma (n=3), sarcoma (n=4) and cystic lesions (n=3). Seven cases were exclusively managed endoscopically, in 5 cases a combined endoscopic and microscopic approach was performed. Frontobasal reconstruction was achieved with fascia lata, galea-periostium flap, haddad-flap, and calvarian split transposition depending on the size of the defect and the surgical approach. Liquorrhea was not observed, 2 patients developed a pneumocephalus. In 2 patients thromboembolic events led to neurological sequelae. One infection with concomitant meningitis and pneumocephalus was observed in a patient with recurrent disease.

Gross total resection was achieved in 7 and a subtotal tumor removal could be achieved in 5 patients. 11 patients are in PFS after combined adjuvant therapy, while 1 patient suffering from undifferentiated sarcoma shows progressive disease despite multimodal treatment.

Conclusion: Interdisciplinary management of complex lesions of the skull base with a predominant endoscopic approach can be done with limited morbidity and good disease control in trained hands. Extended tumor resection and a diligent reconstruction of the skull base are essential for a successful management of the disease.

Transforaminal lumbar sequestrectomy: Where do we stand 3 years after implementation of the technique in a university hospital setting?

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Objective: Microsurgical discectomy/sequestrectomy is the standard procedure for the surgical treatment of lumbar disc herniations. The transforaminal endoscopic sequestrectomy technique with the TESSYS system is a minimally invasive alternative with potential advantages like minimal blood loss and tissue damage, as well as early mobilization of the patient. We report our experiences from the first 3 years after implementation of the technique in a university hospital setting.

Methods: From February 2013 to July 2016 we used TESSYS for lumbar sequestrectomy in 44 patients. A retrospective analysis was conducted in 33 patients, 11 additional patients were included in a prospective manner. Demographic as well as perioperative clinical and radiological data were extracted from electronic records. Intraoperative change of the procedure to microsurgery, complications, and reoperations were meticulously investigated. Analysis of the postoperative course using the Macnab criteria was supplemented by a questionnaire (last follow-up, LFU). Pre- and postoperative magnetic resonance imaging (MRI) volumetry was carried out in the prospective cohort to assess radiological efficacy of the technique.

Results: The median age of our total cohort was 53 years, and the median follow-up was 19 months. The median length of hospital stay was 5 days. Duration of surgery (median) was 102 minutes (no significant change during the course of the study) with a median blood loss of 50 ml. Surgery was most commonly performed at the level L 4/5 (63% of total cohort) and in caudally migrated disc herniations (46% of total cohort); in 6 patients surgery was performed for recurrent disc herniations. The procedure had to be changed to conventional microsurgery in 4 patients. There were no major complications. Minor complications occurred in 5 patients; in 4 patients a reoperation had to be carried out. At discharge and at LFU 84% and 78% of the patients had an excellent or good clinical outcome according to the Macnab criteria, respectively. In the MRI volumetry we detected a median postoperative volume reduction of the disc herniation of 57%.

Conclusion: The TESSYS technique can be safely established in a university hospital setting in selected patients with primary and recurrent lumbar disc herniations. The learning curve is flat, however, the first clinical and radiological results are promising. Potential advantages are low blood loss and short length of hospital stay.

Double-room CT scanner with sliding gantry for intraoperative imaging in neurosurgical interventions

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Objective: The growing demand for short turnaround time and cost effectiveness in operating room management also affects intraoperative imaging and the management of its complex and expensive devices. Aim of this study was to examine our experience with a series of patients, treated with aid of a new double room CT scanner (DR-CT), which was used by several operative disciplines simultaneously.

Methods: A multislice CT scanner was installed in between two operating rooms, connected to a neuronavigation system with direct transfer of imaging data. Several neurosurgical teams (skull base, spine, vascular neurosurgery, stereotactic surgery) used the DR-CT simultaneously. In addition it was used by the Department of Surgery. For image acquisition, the sliding gantry moved into one operating room, whereas a moving wall was closed to the other one. Image quality, workflow, utilization rate, intraoperative CT (iCT) related complications and surgical procedures were analyzed retrospectively. Non-parametric data were compared by using the Mann-Whitney-U-Test.

Results: Intraoperative CT-imaging in the DR-CT was undertaken 347 times between 01/09/2014 and 31/07/2016. Neurosurgical procedures included 23 skull base surgeries, 38 spine fusions, 8 vascular surgeries and 265 stereotactic procedures since 01/02/16. The iCT was used 11 times by the Department of Traumatology and once by the Department of Thoracic Surgery. Workflow analysis showed similar patient turnover times with (n=69) and without iCT (n=333) (Operating room-cutting time: 41 ± 13 minutes vs 33 ± 9 minutes, $p=0.53$; suture-cutting time: 95 ± 18 minutes vs 100 ± 44 minutes, $p=0.97$; time from the end of surgical measures to release of the next patient 25 ± 16 minutes vs 40 ± 44 minutes, $p=0.43$). The hygienic cleaning of the gantry took 27 ± 11 seconds (n=43). The iCT utilization rate increased from 2.6 ± 1.4 per month during the introduction phase (09/14-06/15) to 24.8 ± 25.3 per month during the routine use phase since 07/15, but did not differ significantly ($p=0.09$). There were no iCT related complications and no operative procedure was hampered by ongoing iCT imaging in the neighboring OR.

Conclusion: The concept of DR-CT in two operating rooms facilitates a broader and multidisciplinary use, increases the utilization rate and does not prolong patient turnover times. Substantial changes of the surgical workflow or surgical instruments are not necessary. The DR-CT may facilitate the availability of iCT for stereotactic procedures, intraoperative resection control, perfusion imaging and angiography, and implant control.

Endoscopic Intralaminar Approach for the Treatment of Migrated Lumbar Disc Herniation

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Objective: Almost every surgical approach carries the risk to cause some degree of spinal instability, especially in case of excessive resection of the lamina and facet joint. This study describes the endoscopic intralaminar approach (ILA) for the treatment of cranially and caudally migrated lumbar disc herniation.

Methods: Thirty-one patients who underwent endoscopic ILA for 26 caudally and 5 cranially migrated lumbar disc herniation were identified from a prospectively database. At final follow-up a personal examination and a standardized questionnaire was conducted including Oswestry Disability Index (ODI), functional outcome according to modified MacNab Criteria. Additionally particular reference was given to back-pain, leg-pain and repeat procedure.

Results: The mean final follow-up was 37.0 month (range 5-57 month) at which 29 patients attended (93.5%). No leg pain was noted in 95.0%, no back pain in 85.0%, full motor strength in 95.0%, and no sensory deficit in 95.0% of patients with ILA. Clinical success was reported by 95.0% of patients and the mean ODI was 9% in patients with ILA. Ten patients had an enlargement of ILA to conventional laminotomy (32.3%). By comparison of clinical outcome and repeat procedure rate in patients with ILA to patients with enlargement to laminotomy no significant differences were identified except for higher ODI (i.e.16%) in patients with enlargement of ILA.

Conclusion: Endoscopic ILA is a safe technique for the treatment of cranially and caudally migrated lumbar disc herniations. Careful procedure planning is recommended to protection of soft tissue and osseous structures and to achieve excellent clinical outcome.

Intraoperative intermittent pneumatic compression reduces incidence of venous thromboembolism in patients undergoing craniotomy: A randomized prospective study

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Objective: The term venous thromboembolism (VTE) subsumes deep venous thrombosis (DVT) and pulmonary embolism. The incidence of deep venous thrombosis (DVT) after craniotomy is reported to be as high as 50%. Even clinically silent DVT may lead to potentially fatal pulmonary embolism. The risk for VTE is correlated with duration of surgery, and it appears likely that it develops during surgery. The present study aims to evaluate intraoperative use of intermittent compression of the lower extremity (IPC) for prevention of VTE in patients undergoing craniotomy.

Methods: 108 patients undergoing elective craniotomy for intracranial pathology were included into a monocentric controlled randomized prospective study. In the control group, routine compression stockings were worn during surgery. In the treatment group, IPC of the calves was used in addition. The presence of DVT was evaluated by Doppler-sonography pre- and postoperatively. In addition, D-dimer plasma levels, which are known to be correlated with the incidence of VTE, were measured on the third day after surgery.

Results: Intraoperative use of IPC led to a significant reduction of VTE ($p = 0.029$); when both legs were accounted for separately, high significance was reached ($p < 0.001$). In logistic regression analysis, the risk for VTE was approximately quartered by use of IPC. Duration of surgery was confirmed to be correlated with VTE-incidence ($p < 0.01$); every hour of surgery increased the risk by a factor of 1.56. The ability of postoperative D-dimer plasma levels to predict VTE was influenced by IPC, which led to a poor positive predictive value in the treatment group (16.7%). Nevertheless, VTE was still ruled out by D-dimer $< 2.0 \text{ mg/l}$ in both groups with $> 93\%$.

Conclusion: Intraoperative use of IPC significantly lowers the incidence for potentially fatal VTE in patients undergoing craniotomy. The method is easy to use and carries no additional risks.

Easy minimalinvasive retractor system for the extrem lateral transthoracal approach - technical note.

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Objective: Anterior approaches to the thoracic spine enable corpectomy for different pathologies and vertebral replacement. However, this approach has previously required a thoracotomy incision, which is associated with significant perioperative morbidity, pain, and the potential for compromised ventilation and subsequent respiratory sequelae. The extreme lateral approach to the anterior spine has been used to treat degenerative disorders of the lower thoracic and lumbar spine, and reduces the potential complications compared with the anterior transpleural approach. We describe the first use of a new fixed, easily used retractor system for transthoracal corpectomy via a minimally invasive extreme lateral approach.

Methods: We used this new retractor system for different indications, such as pathological fractures because of osteoporosis or vertebral metastasis and spondylitis/spondylodiscitis with consecutive vertebral instability. The procedure was combined with dorsal stabilization, partly combined with cement screw augmentation.

Results: 12 patients were treated by extreme lateral transthoracal corpectomy and vertebral replacement. This new way of retractor system was easily and X-ray guided fixed into the adjacent vertebral levels via a small thoracotomy incision (4-7cm) depending on corpectomy levels. It could be used from spinal vertebra TH4 to L1 from both sides without significant compromised ventilation, severe thoracic pain and with decreased morbidity.

Conclusion: This new fixed retractor system for transthoracal, extreme lateral approach to the spine is feasible and safe for degenerative discectomy or corpectomy combined with vertebral replacement by any cages. Further, even young residents less experienced in transthoracal approaches are able to perform this surgery without long lasting learn curves.

DI.07 Pädiatrische Neurochirurgie 3

Dienstag *Tuesday*, 16.05.2017, 08.00 – 09.10 Uhr *hrs*

- DI.07.01 *Neuroblastoma in neurosurgery - a single center experience of 14 pediatric patients*
S. Marx, S. Kietz, A. El Damaty, N. Siebert, H. Lode, H. Schroeder, S. Fleck, S. Fleck*
(Greifswald, Deutschland)
-
- DI.07.02 *Distinct clinical courses in pediatric ependymoma: Evaluation of a single institution cohort.*
D. Pierscianek* (Essen, Deutschland), E. Lemonas, K. Lischka, O. Müller, U. Sure, N. El Hindy
-
- DI.07.03 *Brain tumors in children: long term follow up into adulthood*
D. Class* (Magdeburg, Deutschland), Ö. Yildiz, R. Firsching
-
- DI.07.04 *Feasibility and safety of open microsurgical approach in pediatric diffuse intrinsic glioma*
N. El Hindy* (Essen, Deutschland), T. Dinger, E. Lemonas, K. Wrede, D. Pierscianek, U. Sure,
O. Müller
-
- DI.07.05 *Implications of Notch signaling in pediatric high grade glioma.*
D. Pierscianek* (Essen, Deutschland), O. Müller, Y. Ahmadipour, Y. Zhu, U. Sure, N. El Hindy
-
- DI.07.06 *Patient with Gorlin syndrome and tanycytic ependymoma*
S. Anetsberger, A. Unterberg, H. Bächli, S. Anetsberger* (Heidelberg, Deutschland)
-

Neuroblastoma in neurosurgery - a single center experience of 14 pediatric patients

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Objective: Neurosurgical experience with neuroblastoma (NB) is limited. Especially cranial metastases (met.) are reported on anecdotal basis only and occur in advanced stage disease. Due to a high prevalence of stage 4 NB patients (P) at our department of pediatric oncology, we report our experience in P requiring neurosurgical interventions.

Methods: We report a single center experience with regard to neurosurgical procedures related to NB.

Results: Over 150 pediatric P with stage 4 NB were treated at the pediatric oncology unit since 2009. 14 of them (8f, 6m, mean age 5.2 years, ranging from 0 to 14 years, n=13 stage 4, n=1 stage 1) needed neurosurgical therapy. 8/14 P had intracranial and 6/14 intraspinal met.

In the group of 8 P with intracranial NB met. there were 3/8 P with tumor growth originating from the skull with infiltration into the adjacent soft tissue, but without penetrating the dura (occipital, frontal, presellar region in one patient, respectively). Gross total resection (GTR) was done. Carcinomatous meningiosis did occur one year later in one of them. Of the 4/8 P with intradural, intraaxial met. there were 2 located in the occipital and temporal lobe and GTR was done, respectively. In one P, tumor growth was combined intradural and extradural. GTR of the intradural and subtotal resection of the extradural tumor part was done in a staged resection, respectively. This P suffered from a central nervous lymphoma during follow-up. In one P, the tumor location was around the trigeminal nerve and subtotal resection was done. One P presented with multiple supratentorial and spinal met. and Rickham reservoir has been inserted for chemotherapy only. 6/8 P (75%) of this group died after a mean follow-up of 13 mths (range from 2 to 28 months) after their neurosurgical procedure from progressive disease.

In the group of 6 P with intraspinal, extradural tumor occurred from continuous growth through the neuroforamen. Tumor growth did respect the dura mater, but was always infiltrative to the adjacent soft tissue and bones. Tumor related spinal cord compression occurred between Th₅ and S₂, but was usually restricted to 1 to 3 levels. GTR of the intraspinal tumor part was done in all 6/6 P. In one patient, a relapse with intradural, intramedullary tumor growth did occur. 2 P died 5 and 10 mths after the neurosurgical procedure and 2 P were lost to follow-up, respectively. Two P present a stable disease 24 and 60 mths after the neurosurgical disease, respectively (the latter with stage 1 NB). Local radiation therapy after the neurosurgical procedure was done in some patients.

Conclusion: Neuroblastoma is a rare entity in neurosurgery and seems to be a characteristic manifestation in advanced stage disease. Cranial met. predominantly occur in the skull and grow infiltrative to the soft tissue or intraaxial and have a dismal prognosis. Therefore, surgical goals need to be clearly defined with respect to palliation.

Distinct clinical courses in pediatric ependymoma: Evaluation of a single institution cohort.

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Objective: Ependymoma are the third most common brain tumor in pediatrics. The majority of tumors (60-70%) arise in the posterior fossa with a higher fraction of grade III tumors. Despite similar histopathological features the prognosis is strikingly heterogeneous ranging from early recurrences, multiple tumor operations and distant metastasis to completely progression-free clinical courses. In this study, we sought to assess the clinical course of supra- and infratentorial tumors and define factors associated with outcome parameters, as recurrence or metastasis.

Methods: Thirty-seven children with the diagnosis of Ependymoma were included between 1990 and 2016. Demographic parameters, treatment modalities (resection, chemo-, radiotherapy) and the clinical course (no. of operations, recurrences, distant metastasis) were assessed retrospectively using medical records. Fisher's exact test and the two-sided t-test were applied for statistical analysis.

Results: In our patient cohort, tumor location was infratentorial in 73% of patients (N =27). In 64.9% of cases (N=24) an anaplastic ependymoma (grade III) was diagnosed. In 52.9 % of patients (N=18) a recurrence was diagnosed and 23.5% of patients had spinal or distant metastasis. The mortality was 36.7% until the time of data collection. Children with grade III tumors were significantly younger than children with grade II tumors ($p=0.006$). In our cohort, supra- and infratentorial tumors showed no differences concerning recurrence, death, no. of operations and spinal or distant metastasis. But for supratentorial tumors, there was an association between tumor grade and recurrence ($p=0.012$) and also between tumor grade and no. of operations ($p=0.033$). All children with supratentorial tumors grade III (N=6) experienced recurrence. Infratentorial tumors showed no association between tumor grade and recurrence. Time to progression was significantly shorter for infratentorial tumors compared to supratentorial tumors, independently of tumor grade ($p=0.01$). We did not detect an association between the extent of resection and recurrence or metastasis ($p>0,5$).

Conclusion: Supra- and infratentorial ependymoma show distinct clinical courses in pediatric patients. Especially for supratentorial tumors, histological tumor grading is associated with clinical outcome factors. In infratentorial tumors, factors other than tumor grading seem to influence clinical outcome. Further studies are necessary to assess prognostic factors, particularly in infratentorial tumors to stratify the risk profile.

Brain tumors in children: long term follow up into adulthood

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Objective: Recent advances in the treatment of children with brain tumors resulted in better chances for longer survival. Still open questions refer to possible late sequelae and also to the care for the patients after their transition into the adult age. We present the course of four meanwhile adult patients where different kinds of impairment are noted.

Methods: Courses of treatment and disease in three girls and one boy with brain tumors treated in childhood who are now above 18 years of age are reviewed. All patients are still in the care of our department and were examined only recently so follow-up is complete. Clinical, radiological and treatment data were collected.

Results: One boy had a chorioid plexus carcinoma in the right ventricle operated first in 1997 at the age of 4 months. The patient has no recurrence of the tumor now at the age of 19 years. Severe psychological impairment requiring psychological treatment started in 2013 and makes follow-up examinations nearly impossible at present. One girl was operated for a cerebellar medulloblastoma at the age of 2 years in 1985. She now developed a glioblastoma in the posterior fossa at the age of 33 years. Severe physical retardation is noted, too. Another girl was treated for a cerebellar medulloblastoma at the age of 4 years in 1987. No recurrence of the tumor is seen. Severe retardation is noted as well as ischemic neurological deficits due to vascular fibrosis possibly after radiation. A huge myoma in the uterus was noted, too. One girl was operated for an ependymoma of the posterior fossa at the age of 3 years in 1996. No recurrence is seen but now a tumor in the left frontal lobe is developing which may turn out to be a meningioma. All patients received chemotherapy and three patients had radiation at different ages.

Conclusion: The mean prognosis for long-term survival longer than 10 years is observed in 71 % of children with a brain tumor. Late complications and secondary tumors may occur. They may cause a new and progressive physical and psychological impairment. This may occur even late in life (in one patient of our group a secondary tumor was seen at the age of 33 years). So a life-long care and a close clinical, radiological and neurological follow up seem necessary. These findings underline the importance of the neurosurgeon in this network: he is still caring and responsible for the patient even after the pediatrician is no longer involved.

Feasibility and safety of open microsurgical approach in pediatric diffuse intrinsic glioma

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Objective: Diffuse intrinsic pontine glioma (DIPG) is the most common brainstem tumor of childhood. As the opportunity of molecular diagnostics revealed intense histopathological heterogeneity of DIPGs and their different response to adjuvant therapy, biopsy is of rising interest. Biopsy is often performed by means of stereotactic procedures. Whenever suitable, we perform open, microsurgical procedures. Hence, our aim was to evaluate the feasibility and complications of this approach.

Methods: All children operated for DIPG from 2001-2016 were included. Clinical data were analyzed with special respect to age, sex, and tumor location. Operative records were evaluated, regarding positioning, intra-/postoperative complications, onset of new neurological deficits, operative approach, neurophysiological monitoring and histopathological results. Descriptive statistics were used, to reveal differences.

Results: 10 patients could be included in this study. Median age at diagnosis was 7.5 years (range 2 – 16). All children, except one operated by stereotactic biopsy, were operated by an open, microsurgical procedure (n=9) in the semi-sitting position. Electrophysiological monitoring was utilized in all cases. 6 children were operated by a retrosigmoid, 3 by a median suboccipital, telo-velo-medullary approach. There were no intraoperative complications. One child developed a CSF fistula with mastoiditis, which had to be re-operated. There was no onset of new neurological deficits. Tumor material for pathohistological workup and reference evaluation could be collected in all nine patients. DIPG proved to be heterogeneous with 3 children suffering from WHO°IV, 3 children WHO°III and 3 children WHO°II tumor.

Conclusion: Open, microsurgical approach to DIPG in the semisitting position with electrophysiological monitoring is safe and warrants collection of sufficient tumor material for differential histological workup. Histology results reveal DIPG as heterogeneous tumors varying in WHO degree.

Implications of Notch signaling in pediatric high grade glioma.

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Objective: Malignant glioma (MG) are highly aggressive brain tumors, characterized by massive neovascularization, necrosis and therapy resistance. Many investigations report marked differences between adult and pediatric MG. Deregulated Notch signaling has been associated to different malignancies, comprising primary adult glioblastoma (GBM). Hitherto pediatric MG have not been investigated for deregulated Notch signaling. Hence our investigation aimed to reveal implications of Notch signaling in pediatric HG.

Methods: All children (age ≤ 16 years) operated for MG in our department from 2008 to 2015 were included. Basic clinical parameters like age, gender, infra- and supratentorial location were assessed. Major components of Notch signaling (receptor: *Notch1*, *Notch4*; ligand: *Dll4*, *Jagged1*; effector: *Hey1*, *Hey2*) were examined by real-time reverse-transcription-polymerase chain reaction (PCR) and Western blotting (WB) in these children and compared to adult GBM (n=26) and control (n=11) brain tissue. Vascular pattern (VP) was analyzed after vessel staining with laminin.

Results: 12 children (5 boys, 7 girls) with a median age of 9.7 years were included. 4 (33%) children had a MG °III and 8 (67%) a MG °IV. The mRNA levels of *Dll4*, *Jagged1*, *Notch1*, *Notch4*, *Hey1* and *Hey2* were 55.7-, 13.3-, 2.2-, 138.6-, 7.9-, and 24.7-fold elevated, respectively, in pediatric MG, compared to control. Interestingly, the comparison of pediatric and adult MG revealed significant differences only for *Dll4* (p=0.016) and *Notch4* (p=0.015), implicated in angiogenesis. WB confirmed marked protein expression of Dll4 in pediatric cases (4.5 fold, p=0.002) and no significant difference between Notch1 protein expression compared to adult cases. There was no difference in mRNA expression between MG°III/°IV, as well as infra-/supratentorial location. Laminin staining revealed predominantly classic, effective vascularization pattern in pediatric MG.

Conclusion: According to our results, pediatric MG are different in comparison to adult MG. Major Notch signaling components are extremely upregulated in pediatric cases. Main differences in comparison to adult MG are upregulation of *DLL4* and *Notch4*, which affect vascularization pattern. Further investigations are necessary to correlate our finding with clinical parameters, especially survival.

Patient with Gorlin syndrome and tanycytic ependymoma

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Objective: Gorlin syndrome, also called nevoid basal cell carcinoma syndrome is an autosomal dominant neurocutaneous disease characterized by developmental defects including bifid ribs, plantar pits and a predisposition to various tumours including basal cell carcinoma, medulloblastoma, ovaroma, cardiac fibroma and keratocystic odontogenic tumor. The genetic basis of Gorlin syndrome is a germline mutation of the human homolog of the *Drosophila* patched gene (PTCH) located on the long arm of chromosome 9.

Methods: 16-year old girl with known Gorlin syndrome (2 major and 2 minor criteria). She presented with macrocephaly (head circumference 58 cm, 97. percentil), jaw cyst, multiple basal cell carcinomas, strabismus, she had no neurological deficits. MRI was performed because of headache and known association of Gorlin syndrome with brain tumours. It showed a T1 and T2 hyper intense right cerebellar lesion in the IVth Ventricle with low contrast enhancement, without any sign of CSF disturbance. Because of slow growth of the lesion in follow up MRI, the girl underwent surgical resection. The lesion was uneventfully completely resected via suboccipital craniotomy.

Results: The result of histopathological examination was a tanycytic ependymoma WHO II° with PTCH mutation, which could not be classified by molecular diagnostics. No spinal metastasis. The girl had no headaches during the follow up but sometimes a slight dizziness.

Conclusion: Gorlin syndrome predisposes to tumours. Medulloblastoma from the desmoplastic subtype is the characteristic brain tumour in Gorlin syndrome. It usually occurs between 2 and 3 years of age with prevalence from 1 to 4%. To our knowledge there is no report in the literature about Gorlin syndrome associated with tanycytic ependymoma. Tanycytic ependymomas are the rarest variant of ependymoma and occur primarily in the spinal cord. Intracranial cases are even more rare.

DI.08 Wirbelsäule – Alter

Dienstag *Tuesday*, 16.05.2017, 08.00 – 08.50 Uhr *hrs*

- DI.08.01 *Elective spine surgery for patients older than 90-years old: Is 90 the new 80?*
E. Shiban* (München, Deutschland), B. Meyer, J. Lehmborg
-
- DI.08.02 *Synovial cysts of the spine in the elderly*
M. Bruder* (Frankfurt, Deutschland), F. Gessler, A. Cattani, C. Droste, M. Setzer, V. Seifert,
G. Marquardt
-
- DI.08.03 *Comparison of geriatric and non-geriatric old aged patients with lumbar spinal stenosis (LSS) after decompression surgery*
D. Shalamberidze* (Arnsberg, Deutschland), M. Hanxleden, L. Benes
-
- DI.08.04 *The anterior transarticular fixation of C1/C2 in the elderly: a feasibility study with respect to "safe entry" zones of the articular process of C2*
R. Leyrer* (Essen, Deutschland), N. El Hindy, C. Mönninghoff, O. Gembruch, K. Wrede,
U. Sure, O. Müller
-
- DI.08.05 *Surgical impact and benefit of spondylodesis in elderly patients*
J. Schroeteler* (Münster, Deutschland), R. Schroer, M. Schwake, S. Schipmann, N. Warneke,
W. Stummer, M. Klingenhöfer, C. Ewelt
-

Elective spine surgery for patients older than 90-years old: Is 90 the new 80?

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²Klinikum rechts der Isar, Technische Universität München, Neurochirurgische Klinik und Poliklinik, München, Deutschland

Objective: Demographic trends make it incumbent on spine surgeons to recognize the special challenges involved in caring for older patients. Aim of this study was to identify variables that may predict early mortality in geriatric patients over the age of 90.

Methods: Retrospective analyses of all patients over the age of 90-years, which were treated between 2006 and 2014 at our department for degenerative spine disease, were performed. Patient characteristics, type of treatment and comorbidities were analyzed with regards to the 30-day mortality rate.

Results: 25 patients were identified. Mean age was 92.8 years (range 91-101), 21 (84%) patients were female. 16 (64%) patients were on anticoagulation therapy. 17 (68%) patients were treated operatively. Mean Hospital stay was 14 days (range 2-40). Mean Charlson comorbidity index was 5.5 (range 0-12) and mean diagnosis count was 12 (range 2-24). The 30-days mortality rate was 17% in the surgically treated group compared to 0% in the conservatively treated group, this difference was however not statistically significant ($p=0.2$). Gender ($p=0.42$), diagnosis count ($p=0.65$), Charlson index ($p=0.65$) and anticoagulation therapy ($p=0.9$) did not correlate with the 30-day mortality rate. Cause of death was pulmonary embolism in two cases and unknown in one case.

Conclusion: 30-day mortality rate in patients over 90-years-old following elective spine surgery is extremely high. Standard geriatric prognostic scores seem less reliable for these patients. Prospective validation studies are needed in order to establish treatment recommendations for such patients.

Synovial cysts of the spine in the elderly

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Objective: The ongoing aging of the society leads to a rising number of patients with degeneration of the spine. Synovial cysts of the spine are strongly associated with degenerative changes, and treatment decision can be challenging especially in the elderly due comorbidities.

Methods: Patients treated between 1999 and 2014 due to spinal synovial cysts in our department were screened. 28 patients were ≥ 75 years and classified as "the elderly". Those were compared to 96 patients which were between 50 and 74 years of age. Medical reports regarding signs and symptoms, operative findings, complications, and postoperative status were reviewed. None patient was fused within cyst resecting procedure. Outcome was assessed according to Oswestry Disability Index (ODI) and Macnab classification. Mean follow up period in the elderly was 67 ± 59 month and 79 ± 54 month in the control group.

Results: Despite a significant lower frequency of muscle reflex changes in the elderly ($p < 0.05$), lumbago, radicular pain and sensory deficits were less often - motoric deficits were more often present at initial presentation in the elderly than in the control group but not on a significant level. Cyst levels, rate of complications and surgical method did not differ between both groups. The cyst was more often adherent to the dura in the elderly and significantly more often parts of the cyst were left behind (16% vs. 2%; $p < 0.05$). Postoperative examination revealed dramatic improvement of lumbago and radicular pain, and significant improvement of sensory and motor deficits and motor reflex changes in both groups. Outcome according to Macnab was "excellent or good" slightly less often in the elderly than in the control group (82% vs. 89%; $p = 0.3$). Based on ODI, outcome in the elderly group (vs. control group) was classified as "no disability" in 39% (vs. 51%), "minimal disability" in 46% (vs. 31%), "moderate disability" 11% (vs. 14%) and "severe disability" in 4% (vs. 4%). None of the patients was classified as crippled or bed bound. Recurrent cyst and delayed fusion rates in the elderly were low (4% and 4%), and lower compared to the control group with a recurrence rate of 7% and delayed fusion rate of 8% respectively.

Conclusion: Clinical course of elderly patients with spinal synovial cysts does not differ compared to younger patients. Good or excellent results can be achieved and persisted for a long time in more than 80% with microsurgical resection without initial fusion. The higher rate of subtotal cyst removal due to dural adherence, enables low CSF fistula rates without increasing the rate of recurrent cysts.

Comparison of geriatric and non-geriatric old aged patients with lumbar spinal stenosis (LSS) after decompression surgery

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²Klinik für Geriatrie, Klinikum Arnsberg, Arnberg, Deutschland

Objective: The lumbar spinal stenosis (LSS) is a common disease of the older population. The progressive ageing and accessibility of medical diagnostics/care result in an increased number of geriatric patients, who undergo a surgery for LSS. Most of the studies about postoperative results in geriatric patients with LSS define a geriatric patient only using his/her calendrical age (older than 65 or 70 years). According to German section of geriatrics (DGG) not every older patient is a geriatric one. Therefore biological age has to be prioritized instead of the calendrical age. The aim of this study was to compare the perioperative complication rate after LSS-surgery in geriatric and non-geriatric old aged patients.

Methods: In cooperation with geriatric department of our hospital we retrospectively studied 93 patients with the age of over 70 years who underwent the decompression surgery due to LSS in our department between January 2013 and April 2015. The geriatric group consisted of patients with typical geriatric multimorbidity and polypharmacy (n=47, average age=76.6 years). The non-geriatric group consisted of patients without the above-mentioned signs (n=46, average age=76.9 years). In each patient a bilateral decompression via unilateral approach (undercutting) was performed. One segment pathologies were treated with partial hemilaminectomy and contralateral undercutting. In case of two or more stenotic segments a hemilaminectomy with contralateral undercutting was performed. We analyzed the period of hospitalization (including: ASA-score, BMI, operated segments, anticoagulants, gender etc.) in both groups, respectively. Complications were classified according to *The Clavien-Dindo Classification of Surgical Complications*. Categorical variables were compared using chi-square test. P Value was generated from chi-square score.

Results: The rate of complications in the geriatric group was 32% (n=15). 73% of them were ranked grade 1 and 27% grade 2 according to Clavien-Dindo Classification. In the non-geriatric group the rate of complications was 9% (n=4). 75% of them were ranked as grade 1, and only 1 patient had an intraoperative complication grade 2. The difference of complication rates between two groups was significant (p<0.001). There was no significant correlation between ASA-score, BMI, anticoagulants etc. and rate of complications in our study. Significantly more analgetics and corticosteroids postoperatively were applied in the geriatric group (p<0,01).

Conclusion: Patients with geriatric multimorbidity and polypharmacy who undergo surgery of lumbar stenosis have a significantly higher rate of complications. The absolute majority of these complications are minor complications (grade 1 and 2).

The anterior transarticular fixation of C1/C2 in the elderly: a feasibility study with respect to "safe entry" zones of the articular process of C2

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Objective: To evaluate the feasibility of an anterior C1/C2 fixation in elderly patients with instable atlanto-axial fractures.

Methods: Between January 2015 and October 2016 a consecutive cohort of 10 patients were operated with transarticular fixation of C1/C2 from anteriorly. All patients were operated using cannulated small-fragment screws (DePuy Synthes; 22-26mm, 3.4-4.5mm) that were laterally of the corpus of C2 passed through the joints. If necessary, an additional screw was placed in the odontoid process. Placement was radiographically checked using the 3D Arcadis Orbic (Siemens, Erlangen, GER). The course of the vertebral artery was analyzed in a CT morphometric study.

Results: In all patients (6 female, 4 men; mean age 80years), the screws could be placed finally. Two screws had to be corrected intraoperatively for initial mal-placement. No neurological deficit occurred, neither was an injury of the vertebral artery observed. Yet, all patients suffered from swallowing difficulties in the postoperative course without any injury to the neck organs occurring. In two patients, an additional posterior fixation had to be carried after six and 9 months due to loosening of the screws. Operation time was significantly shorter for the anterior approach compared to dorsal stabilization. Intraoperative X-ray doses were comparatively higher with the anterior approach, which is explained by the intraoperative 3D scan that is otherwise skipped in the posterior procedures. The mean "safety zone" for the screw entry comprised 9.5mm*9.5mm (range 7.5-11.5mm).

Conclusion: The anterior approach for fixation of C1/C2 can be a valuable option in the treatment of instable C1/C2 fractures especially in the elderly. Yet, the biomechanical properties of the anterior approach are inferior to a dorsal fixation. The operation time in our collective was significantly shorter.

Surgical impact and benefit of spondylodesis in elderly patients

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Objective: The elderly population is poorly studied and constitutes a rapidly expanding surgical demographic. Although neurological deficits could be present, senior citizens are often surgically undertreated because of age and comorbidities. Due to this demographic change, we have to deal increasingly with old and severely diseased patients. Hence the question arises, if elderly patients do really profit from aggressive surgical treatment.

Methods: We performed a retrospective, single center, data base analysis. Data were extracted out of clinical data base due to search terms "patients with code spondylodesis". The data were stratified by age and patients older than 68 years were chosen. Clinical outcome was extracted out of patients` file and the Oswestry Disability Index was calculated retrospectively, as well. Surgical technical outcome represented screw placement, spine alignment and cage placement

Results: Data of 109 patients treated between 2011 and 2015 were analyzed. In the group, 61 patients were between 68-75 years old and 41 Patients were between 75 and 87 years old at time of surgery. Gender was distributed equally with 55 women and 49 men. 83% (n=91) of the patients had a cardiac history recorded. Indication of surgery was spondylodiscitis in 12, spondylosisthesis in 40 and fracture in 24 patients. In 53 patients 1 to 3 segments, in 24 patients 4 segments and in 24 cases 5 segments and more were operated. Preoperatively, the patients suffered from pain in 90.8% (n=99), sensory deficit in 35.8% (n= 39) and motor deficit in 33.9% (n= 37), as well as symptoms of spinal claudication in 52.3% (n= 57) of cases. Surgical adverse events were in 9.2% (n=10) wound infections, in 19.3% (n=21) screw dislocations, deep vein thrombosis in 0.9% (n=1) and pulmonary artery embolism in 8.3% (n=9) of the patients. Clinical neurological outcome was good in 27.5% (n=30) of all patients, worse in 6.4% (n=7), improved in 22.9% (n=25) and the same as without surgery in 15.6% (n=17). There was a significant correlation between number of segments treated and blood loss. The patients with preoperative Oswestry Disability Index between 80 to 100% (n=30) could be reduced by surgery completely (n=0). Surgical technical outcome was without displacement or needed revision surgery in 90 patients (82.6%).

Conclusion: The Oswestry Disability Index was reduced due to surgery in 30 patients. There were no severe adverse events despite this compromised patient collective. 55 Patients (50.4%) showed an improvement in clinical outcome. Surgical technical outcome was good in the majority of patients. Spondylodesis in elderly patients is feasible and most of the patients seem to benefit from spinal surgery.

DI.09 Trauma 1

Dienstag *Tuesday*, 16.05.2017, 08.00 – 09.10 Uhr *hrs*

- DI.09.01 *The role of Hypocalcaemia in Traumatic Brain Injury*
J. Vinas Rios* (Oldenburg, Deutschland), T. Kretschmer, Y. Roeller, V. Kuhna, C. Heinen
-
- DI.09.02 *Cerebral Physiology after Traumatic Brain Injury: Entropy of Monitoring Indices*
E. Lang* (Kassel, Deutschland), M. Placek, M. Kasprowicz, P. Lewis, A. Ercole, P. Smielewski, M. Czosnyka
-
- DI.09.03 *The anatomical reduction of vertebral body compression fracture of traumatic origin with underlying pathology affecting the bone quality such as osteoporosis with the Spine Jack System.*
S. Jadik* (Kiel, Deutschland), M. Synowitz
-
- DI.09.04 *Association of preoperative CT evaluation in frontobasal fractures with intraoperative findings during early frontobasal revision surgery and its clinical significance*
A. Alaid* (Göttingen, Deutschland), K. von Eckardstein, V. Rohde
-
- DI.09.05 *Is there an optimal coding for cranial imaging at the Abbreviated Injury Score?*
V. Hagel* (Ulm), C. Lisson, C. Wirtz, T. Kapapa, D. Woischneck
-
- DI.09.06 *Intensive Insulin therapy in patients with severe head injury; role and possible effects*
C. Renner* (Dessau-Roßlau, Deutschland), M. Boetel, S. Bercker, F. Hokema, J. Meixensberger
-
- DI.09.07 *Trauma of the really old: 30-day mortality of patients older than 90 years old*
E. Shiban* (München, Deutschland), R. Paulina, B. Meyer, J. Lehmborg
-

The role of Hypocalcaemia in Traumatic Brain Injury

Juan Manuel Vinas Rios¹, Thomas Kretschmer¹, Yvonne Roeller¹, Victoria Kuhna¹, Christian Heinen¹

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Objective: Annually, approximately 10 million people are affected by traumatic brain injury (TBI) worldwide. As a leading cause of death and disability worldwide, there is an increasing interest in the use of predictive markers to estimate the outcome in adult TBI. We therefore investigated the effects of hypocalcaemia in early phases after moderate to severe TBI and postulated a pathophysiological (Fig. 1) pattern leading to posttraumatic hypocalcaemia which we subsequently compared to present literature.

Methods: Data from 282 patients (180 retrospective and 102 prospective) suffering from moderate to severe TBI were collected and analyzed. Patients between the age of 16 to 87 were included. Additional inclusion criteria were: A Glasgow Coma Scale (GCS) from 3 to 13 points, Cranial Computed Tomography (CCT) upon admission and Calcium and/or ionized calcium measurements taken on the day of TBI, as well as on days 3 and 7.

Results: Contrary to our expectations and previous experience with 122 patients from Mexico, values of non-ionized serum calcium did not show any significant outcome correlation in our cohort of German patients, though ionized serum calcium did show a significant correlation predicting mortality and morbidity in patients suffering from TBI.

Conclusion: Hypocalcaemia is a reliable marker for the depth of brain damage as a result of a cascade of various pathologic mechanisms such as direct mechanical trauma, neuro-inflammation, altered vessel-autoregulation and hypoxia and therefore should be considered in TBI.

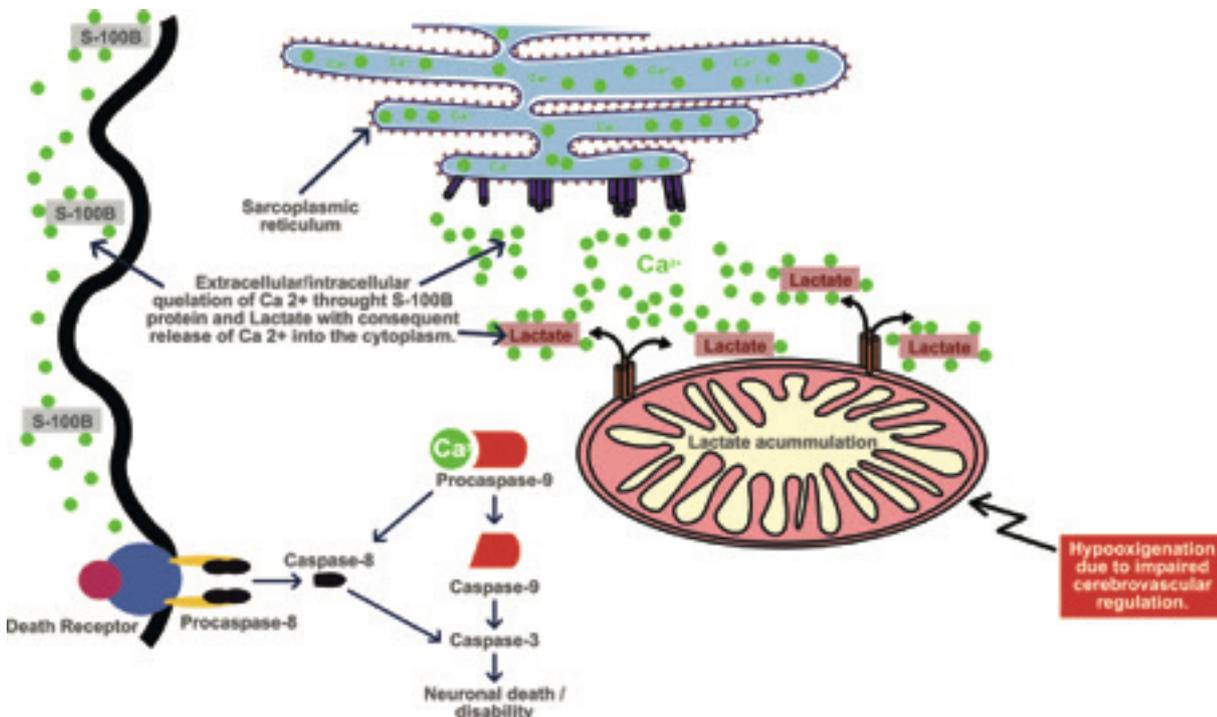


Fig.1 Proposed pathophysiological mechanism in hypocalcaemia after Traumatic Brain Injury with subsequent neuronal death.

Cerebral Physiology after Traumatic Brain Injury: Entropy of Monitoring Indices

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Objective: Depleted entropy of mean intracranial pressure (ICP), measured by a grading tool titled "complexity index" (CI), calculated with multiscale entropy analysis, correlates with worse outcome after traumatic brain injury (TBI). We went on to study whether entropy of indices, describing ICP fluctuations, cerebral perfusion pressure (CPP), cerebral compensatory reserve, and cerebral autoregulation (CA) correlates with outcome?

Methods: We analyzed continuous high resolution recordings from the Addenbrooke's Hospital, Cambridge, UK, TBI-single center database in 313 patients. Arterial blood pressure (ABP) and ICP recordings were converted to 60-second averages of (a) ICP pulse amplitude (AMP); (b) cerebral perfusion pressure (CPP); (c) RAP, an index of cerebral compensatory reserve, measured as a correlation coefficient (R) between ICP amplitude (A) and mean ICP pressure (P); and (d) PRx, an index of cerebral autoregulation, measured as a moving correlation coefficient between MAP and ICP. These time series were subjected to multiscale entropy analysis, resulting in complexity indices: CI-AMP, CI-CPP; CI-RAP, and CI-PRx calculated as the sum of the first 20 scales of entropy. CIs were then compared to outcome at 6 months post injury, measured by the 5-point Glasgow Outcome Scale (GOS 1-good; GOS 5-dead).

Results: There was a 24% mortality in our series with a 43% favorable outcome (good & moderate recovery). Twenty-two patients (7%) had an average ICP>25mmHg. Both CI-AMP and CI-CPP decreased with worsening outcome (R= -0.18, p= 0.0018; and R= -0.16, p=0.0058, resp.). CI-RAP increased with worsening outcome (R=0.15, p=0.01). The CI-PRx outcome correlation was not significant. CI-RAP and CI-AMP were useful for distinction between favorable and unfavorable outcome (Kruskal Wallis test: p=00002, and p=0.001, resp.), while CI-PRx and CI-CPP were not. AMP, but not RAP was significantly higher in patients with ICP>25mmHg (p=0.023 vs. p=0.78, resp.)

Conclusion: Entropy of secondary cerebral monitoring parameters varies. Preservation of the complexity of ICP amplitude fluctuations and CPP entropy are positive prognostic TBI markers. Entropy of cerebral compensatory reserve, however, is a negative prognostic marker. Entropy of CA is unrelated to outcome. Further studies should investigate if these findings may yield early monitoring signs of deterioration for individual patients, which may lead to targeted therapy adjustments, and eventually better outcomes.

The anatomical reduction of vertebral body compression fracture of traumatic origin with underlying pathology affecting the bone quality such as osteoporosis with the Spine Jack System.

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Objective: The intravertebral SpineJack[®] implant is developed for a specific purpose: for the anatomical restoration of vertebral compression fractures caused by an excessive craniocaudal unidirectional compression force. To reduce these VCFs, the SpineJack[®] initially deploys a controlled opposing craniocaudal unidirectional distraction force while preserving the surrounding bone trabeculae as much as possible. Once the fracture has been reduced, the SpineJack[®] maintains the restoration of the fracture before cement injection.

Methods: 29 patients with osteoporotic vertebral compression fracture between T6 and L5 were treated with the new implant and were retrospectively examined. A visual analogue scale and radiological analysis (i.e., X-ray and CT scan) were used to assess back pain, quality of life and complications and height restoration of the vertebral body

Results: Significant reductions in anterior and central vertebral body heights were observed.

Conclusion: The above mentioned technique provides a controlled craniocaudal expansion in vertebral compression fractures and maintains the restoration before the injection of cement and preserves bone trabeculae

Association of preoperative CT evaluation in frontobasal fractures with intraoperative findings during early frontobasal revision surgery and its clinical significance

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Objective: Frontobasal fractures occur in 24% of head injuries. These fractures often are associated with cerebrospinal fluid (CSF) leakage and possible meningitis as well as mucocele development. While some surgeons only will operate in case of persistent CSF rhinorrhea, we tend to surgically explore for possible dural laceration in cases of frontobasal fractures involving the posterior wall of frontal sinus, the cribiforme plate, or the sphenoid sinus to minimize the risk of meningitis or mucocele development. We aim to retrospectively evaluate intraoperative findings and clinical course in relation to preoperative imaging to assess the significance of early revision surgery.

Methods: We conducted a retrospective analysis of 49 consecutive patients undergoing early revision surgery for frontobasal fractures. Preoperative computed tomography scans (CT) were reviewed to define the extent of fracture and were correlated to findings described in the operative notes. Furthermore, we evaluated the postoperative course and specifically noted development of rhinorrhea, bacterial meningitis, and mucocele. Typically, surgeries were performed together with colleagues from the craniofacial surgery team; a trans-frontal sinus route was preferred.

Results: Forty-nine patients were included in the study (92% males). The majority of patients suffered from falls (47%) or motor vehicle accidents (43%). The indication for surgery were fractures of the posterior wall of the frontal sinus (89.8%, displaced in 55.1%) or of the cribiform plate (49.0%, displaced in 10.2%), partially associated with intradural air inclusions in 81.6%. Concomitant mid facial fractures were found in 71% and orbital fractures in 69% of the patients. Of all patients, 24.5% patients suffered from CSF rhinorrhea preoperatively. Intraoperatively, a dural laceration accompanying the fracture identified by preoperative imaging was found in 92% of patients and was microscopically sutured; this included all patients with a preoperative rhinorrhea. Correlation between intraoperative findings and air inclusions on the trauma scan could not be established, suggesting that CT scan criteria for dural laceration are non-predictive.

Conclusion: Early frontobasal revision surgery via the trans-frontal sinus route for frontobasal fractures of the posterior wall of the frontal sinus or of the cribiform plate will demonstrate dural lacerations in nine out of ten patients and offer the possibility for surgical repair. With a sufficient surgical dural repair, typical severe complications of frontobasal fracture are minimized.

Is there an optimal coding for cranial imaging at the Abbreviated Injury Score?

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³Landshut, Deutschland

Objective: The cranial Abbreviated Injury Score (AIS) is coded by results of initial computed tomography (CT). The AIS is influential to the therapy and part of the score for the overall prognosis: Injury Severity Score. MRI may also be used for coding of cranial injuries but this is only seldom performed. We examined the impact of MRI on the prognostic potency of different scores: Injury Severity Score (ISS), New Injury Severity Score (NISS), Trauma and Injury Severity Score (TRISS) and Revised Injury Severity Classification (RISC)

Methods: We identified 63 patients with a cranial AIS ≥ 1 out of our trauma database from a period of four years. All patients had cranial MRI and were rated by the Glasgow Outcome Scale (GOS). All values for AIS, ISS, NISS, TRISS, RISC and GOS were statistically used as ordinal variables. For statistical hypothesis testing, the Fisher-Exact-Test was used for dichotomous variables. Mann-Whitney-U-Test and Wilcoxon Tests were also used for specific samples. The level of significance was set as $p \leq 0.05$. The Receiver-Operating-Characteristic (ROC) accompanied by associated Area Under the Curve (AUC) served as cut-off independent instrument to quantify the predictive potency. The correlation-coefficient after Spearman (r_s) was calculated for correlation between the scores and the GOS. Sensitivity, specificity and accuracy (correct-classification rate) were also calculated for each Score.

Results: We found favourable outcome (GOS 4-5) in 31 patients and unfavourable outcome (GOS 1-3) in 31 patients. The prediction of outcome was poor by CT data: ISS (ROC 0.553; $r_s = -0.14$; $p = 0.465$), NISS (ROC 0.643; $r_s = -0.34$; $p = 0.051$), TRISS (ROC 0.731; $r_s = 0.37$; $p = 0.002$), RISC (ROC 0.781; $r_s = 0.55$; $p < 0.001$). 35% of the patients had brain stem injury in MR. However, those injuries were detected by CT only in 5%. The prognostic potency of the AIS could be improved after each brain stem lesion was coded by the score of 5: ISS (ROC 0.614; $r_s = -0.25$; $p = 0.118$), NISS (ROC 0.686; $r_s = -0.42$; $p = 0.011$), TRISS (ROC 0.768; $r_s = 0.45$; $p < 0,001$), RISC (ROC 0.831; $r_s = 0.64$; $p < 0,001$). The predictive potency could furthermore be improved after adjusting the AIS coding by matching the score to the specific mortality risks of brain stem injuries: ISS (ROC 0.639; $r_s = -0.32$, $p = 0,058$), NISS (ROC 0.752; $r_s = -0.56$; $p = 0.001$), TRISS (ROC 0.831; $r_s = 0.61$; $p < 0.001$), RISC (ROC 0.837; $r_s = 0.69$; $p < 0.001$). The RISC Score had the best predictive potency in all of the three calculating variants.

Conclusion: The best predictive potency was achieved by matching the AIS coding to the predictive impact of brain stem injuries. MRI data are preferable to CT data to improve the prognostic potency of trauma-scores after brain injury. The RISC Score should be used. Nevertheless, calculating efforts are increased due to this measure but not using MRI data, if they are available, means missing the possibility to improve the prognostic potency.

Intensive Insulin therapy in patients with severe head injury; role and possible effects

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²*Rosenheim, Deutschland*

³*Leipzig, Deutschland*

Objective: The role of Intensive Insulin Therapy (IIT) in patients with neurotrauma is unclear. Purpose of this study was to evaluate the effects of intensive insulin therapy in patients with severe head injury especially possible effects of intracranial pressure.

Methods: It was a single center non randomized study. Patients with intensive insulin therapy were prospective evaluated (IITG) und compared with patients of a historical controlgroup where only strong hyperglycemia (>10 mmol/l) was treated (CTG). Patients of both groups were matched for statistical analysis. Blood glucose levels and ICP-levels were registered over the time and shown as an Area under the Curve (AUC). SAPS II-Score, number of decompressive craniectomies, duration of ventilation, duration until oral feeding, duration on ICU, rates of infection, GOS and mRS were analyzed and compared.

Results: 130 patients were included, thus 65 patients of each group were matched. Rates of infection and duration until oral feeding were significant better in the IITG. The ICP-courses, number of decompressive craniectomies and GOS / mRS showed a positive trend in the IITG. Furthermore patients with an initial better neurologic score showed significant worse ICU-courses in case of hyperglycemia.

Conclusion: Intensive insulin therapy might have positiv effects in patients with severe head injury. Especially the ICP-courses and patients with an initial better neurologic state seem to profit from intensive insulin therapy. Further evaluation should be initiated.

Trauma of the really old: 30-day mortality of patients older than 90 years old

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Objective: Aim was to identify variables that may predict early mortality in geriatric trauma patients over the age of 90.

Methods: A retrospective analysis of all patients over the age of 90, that were treated between 2006 and 2014 at our department was performed. Patient characteristics, type of injury and comorbidities were analyzed with regards to the 30-day mortality rate.

Results: 113 patients were identified. Mean age 93 (range 91-102), 60 (53.1%) patients were female. 83 (73.5%) and 30 (26.5%) of patients presented with head and spinal trauma, respectively. 75 (66.4%) patients were on anticoagulation therapy. 53 (46.9%) patients were treated operatively. Mean Hospital stay was 10 days (range 1-31). Mean Charlson comorbidity index was 4.6 (range 0-16) and mean diagnosis count was 10.5 (range 2-23). The 30-day mortality rate was 25.7% and was significantly affected by the diagnosis ($p=0.001$). The highest mortality rate was seen in patients with acute subdural hematoma (50% surgery group, 33% conservative group), followed by patients with cervical spine fractures (40% surgery group, 37.5% conservative group). Gender ($p=0.37$), diagnosis count ($p=0.97$), Charlson index ($p=0.76$) and anticoagulation therapy ($p=0.936$) did not correlate with the 30-day mortality rate.

Conclusion: 30-day mortality rate in patients over 90-year-old following head or spine trauma is very high regardless of the treatment modality. Standard geriatric prognostic scores seem less reliable for those patients..

DI.11 Vaskuläre Neurochirurgie 5

Dienstag *Tuesday*, 16.05.2017, 10.40 – 11.40 Uhr *hrs*

- DI.11.01 *Increased rate of ventriculostomy-related hemorrhage in patients following coiling of acutely ruptured aneurysms compared to clipping*
C. Scheller* (Halle (Saale), Deutschland), S. Brandt, C. Strauss, S. Simmermacher
-
- DI.11.02 *Impacting treatment of brain AVMs by rTMS*
S. Ille* (München, Deutschland), T. Picht, B. Meyer, P. Vajkoczy, S. Krieg
-
- DI.11.03 *Radiosurgical options for large arteriovenous malformations*
K. Hamm* (Erfurt, Deutschland), S. Fichte, G. Surber, J. Boström
-
- DI.11.04 *Impact of the number of draining veins on hemorrhagic presentation in AVMs*
N. Dinc* (Frankfurt, Deutschland), M. Eibach, S. Tritt, J. Quick-Weller, J. Konczalla, V. Seifert, G. Marquardt
-
- DI.11.05 *International Multicenter Validation of the Arteriovenous Malformation Related Intracerebral Hemorrhage (AVICH) Score*
M. Neidert* (Zürich, Switzerland), M. Lawton, L. Regli, J. Burkhardt, O. Bozinov
-
- DI.11.06 *Intramedullary spinal cavernomas: Assessment of pre-operative clinical and radiographic parameters and neurological outcome in a single-center case series of 27 patients*
K. Hockel* (Tübingen, Deutschland), M. Moraes, M. Skardelly, F. Ebner, G. Lepski, M. Tatagiba
-

Increased rate of ventriculostomy-related hemorrhage in patients following coiling of acutely ruptured aneurysms compared to clipping

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Objective: Acutely ruptured aneurysms can be treated by coiling or clipping. After coiling the risk of thrombotic complications is reduced by the use of anticoagulative agents, which is not necessary after clipping. The aim of the study is to investigate the rate of ventriculostomy-related hemorrhage after coiling and clipping.

Methods: Between 2009 and 2016 101 patients with aneurysmal subarachnoid hemorrhage were treated with ventriculostomy and clipping (n=55) or coiling (n=46). Their CT scans were investigated retrospectively for ventriculostomy-related hemorrhage. Furthermore the rates of revision surgeries and bacterial ventriculitis were documented.

Results: Ventriculostomy-related hemorrhage was observed in 20 of 46 patients after coiling compared to 7 of 55 patients after clipping (ChiSquare test, $p < 0.001$). Revision surgery was indicated in 75% and in 50% of these patients revision surgery was required more than once. In nearly 50% of the patients with ventriculostomy-related hemorrhage an additional bacterial ventriculitis was observed.

Conclusion: Ventriculostomy-related hemorrhage is an underestimated complication following coiling of acutely ruptured aneurysms. It is possible that the clinical course of patients with subarachnoid hemorrhage is negatively influenced by dysfunction of the ventriculostomy, revision surgeries and bacterial infection.

Impacting treatment of brain AVMs by nTMS

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Objective: The treatment of brain arteriovenous malformations (BAVM) is still contrarily discussed. Despite the debatable results of the ARUBA trial, most BAVMs still require treatment depending on the Spetzler-Martin (SM) grading. Since size is measurable and venous drainage is visible, the determination of eloquence is crucial. In the present study the influence of data from navigated transcranial magnetic stimulation (nTMS) on decision-making for or against treatment of BAVMs was examined by confirming / falsifying presumed eloquence.

Methods: We pooled a consecutive bicentric series of 34 patients (20 male) with BAVMs (cases/SM grade: 5/I, 12/II, 14/III, 2/IV, 1/V). In all cases we performed nTMS mappings (20 motor, 16 repetitive nTMS language mappings) before the treatment decision.

Results: The results of nTMS changed the SM grading in 6 cases (1/I, 4/II, 1/III). In 2 cases the SM grading changed to a lower grade, in 4 cases the SM grading changed to a higher grade due to nTMS mappings. Out of all 34 cases, indication for surgery was based on nTMS mappings in 13 cases (38%; 2/I, 4/II, 6/III, 1/IV; 6 motor, 7 language mappings). In 6 cases (18%; 3/II, 3/III) the decision against surgery was made based on nTMS mappings (3 motor, 3 language). Six patients (24%) suffered from transient, and 3 patients (12%) suffered new surgery-related permanent motor or language deficits.

Conclusion: In 19 of 34 cases nTMS was the decisive argument. We could show that nTMS motor and language data can be used for decision-making regarding the treatment of BAVMs and for a more detailed SM grading regarding the rating of eloquence. However, the reliability of the present results has to be confirmed by a larger series and a randomized trial.

radiosurgical options for large arteriovenous malformations

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⁴Neurochirurgische Universitätsklinik, Bonn, Deutschland

Objective: Large arteriovenous malformations (AVM) of the brain pose a challenge for all treatment options - microsurgical resection, embolization and radiosurgery. Some may be treated using multimodal management. Radiosurgical volume staging and hypofractionated radiotherapy options are further published treatment modalities. The purpose of this work was to evaluate the efficacy of radiosurgery (RS) and hypofractionated stereotactic radiotherapy (hfSRT) in the treatment of large AVMs.

Methods: 20 patients (pts) with large brain AVMs (volume > 10 cm³), treated from 2001 to 2012 with RS (n=13) or hfSRT (n=7), were retrospectively evaluated. 9 pts were male, and 11 were female. Patient age ranged from 14 to 65 years (mean, 39 years). 6 pts (30%) were initially symptomatic with an AVM bleeding, 5 pts (25%) with seizures, 7 pts with headaches or a mild focal neurological deficit (35%), only in 2 pts (10%) the AVM was an accidental diagnosis. 11 pts (55 %) had previously undergone partial embolization and 2 pts (10%) prior microsurgery. Clinical outcome was measured using the modified Rankin Scale (mRS). Adverse events were evaluated with the Common Terminology Criteria (CTC) scale 3.0.

Results: One patient was lost for follow-up (FU). The mean FU was 47 months (range, 5–108 months). The nidus volume (= target volume = TV) ranged from 10 to 26 cm³ (median, 15.4 cm³). The mean radiosurgical dose was 18.75 Gy (range, 16-20 Gy) at the isocenter of the TV encompassing the 80 % isodose. For hfSRT, the median total dose was 35 Gy (range, 35-55 Gy) at the isocenter of the TV encompassing the 90-95 % isodose. In 10 (50%) of these pts there was complete AVM obliteration proven by magnetic resonance angiography (MRA), in 6 cases additionally confirmed by conventional angiography. In the other 9 pts so far a reduced flow could be demonstrated by MRI/MRA. Only one patient experienced a worsening of the mRS (0 > 2), 4 pts were improved at FU (mRS 2 > 0, mRS 2 > 1, 2 x mRS 1 > 0). The rare complications included one temporary radionecrosis with transient visual field disorder after hfSRT and one deteriorated hemiparesis after RS. There was no AVM bleeding in the study period.

Conclusion: RS and hfSRT alone or combined with embolization or surgery provide a good treatment option with an acceptable rate of obliteration and side effects in those otherwise difficult to treat large brain AVMs. In some cases, hfSRT opens up the possibility of a definitive re-treatment with radiosurgery.

Impact of the number of draining veins on hemorrhagic presentation in AVMs

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Objective: Arteriovenous malformations are currently classified by their size, location (eloquent/non-eloquent) and depth of venous drainage to estimate the risk of bleeding and treatment choice. We hypothesized that in addition to the so far used classification of Spetzler Martin the number of draining veins implies a significant predicting risk factor, too.

Methods: 238 patients harboring AVMs admitted to our department between 2006 and 2016 were analyzed with regard to the angioarchitecture. Size and quantity of draining veins, hemorrhage status, Spetzler & Martin grade, and supra- and infratentorial location were taken into account.

Results: Hemorrhage was found in 99 patients (41.6%), mostly in AVMs Spetzler-Martin grade 3. At admission, 70 (70.7%) patients of these showed a good state (WFNS I-III) and 30 patients (30.3%) a poor state (WFNS IV-V). AVMs with less than 3 draining veins into the sinus were more frequently associated with hemorrhage (56.4% vs. 22.9%, $p < 0.0001$, OR 4.36). Bleeding had occurred in 62.8% of patients with an infratentorial AVM whereas this was the case in only 36.9% of patients with a supratentorial AVM (62.8% vs. 36.9%, $p=0.003$; OR 0.35). Location and associated aneurysms were not significantly ($p > 0.05$) related to the number of draining veins. Favorable outcome (mRs 0-2) was achieved in 78 (78.8%) of the patients with hemorrhage.

Conclusion: AVMs with less than three draining veins show a hemorrhage significantly more frequently than AVMs with a higher number of draining veins. In addition to the classification criteria used so far, number of draining veins should be included into the AVM grading system to assess the hazardousness and treatment option for preventing bleeding.

International Multicenter Validation of the Arteriovenous Malformation Related Intracerebral Hemorrhage (AVICH) Score

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Objective: The recently published AVICH score showed a better outcome prediction for patients with arteriovenous malformation (AVM) related intracerebral hemorrhage (ICH) than other AVM or ICH scores. Here we present the results of a multicenter, external validation of the AVICH score.

Methods: All participating centers from the USA (n=3), Europe (n=4) and Japan (n=3) provided anonymous data sets to validate the AVICH score. Besides parameters needed to form the Spetzler-Martin (SM) grade, the supplemented SM (sSM) grade, the ICH score and the AVICH score, modified Rankin score (mRS) at last follow-up (mean 25.6 months) were retrospectively collected and analyzed. Patient outcome was dichotomized into favorable (mRS 0-2) and unfavorable (mRS 3-6). Univariate analysis and AUROC analysis were performed to validate the AVICH score.

Results: A total of 385 patients with AVM related ICH were included. Except nidus structure and AVM size, all single parameters forming the SM, sSM, ICH and AVICH score and the scores itself were significantly different between both outcome groups in the univariate analysis. The AVICH score was confirmed to be the highest predictive outcome score with an AUROC of 0.732 compared to 0.616 for the sSM grade, 0.665 for the ICH score and 0.581 for the SM grade.

Conclusion: We were able to confirm that the AVICH score predicts clinical outcome of patients with ruptured AVM and associated ICH and is far superior compared to the other scores. We suggest the routine use of this score for clinical outcome prediction and for usage in clinical research.

Intramedullary spinal cavernomas: Assessment of pre-operative clinical and radiographic parameters and neurological outcome in a single-center case series of 27 patients

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Objective: Due to repetitive hemorrhage into the spinal cord the spontaneous course of intramedullary spinal cavernomas often leads to progressive neurological deterioration. On the other hand, surgical removal of an intramedullary lesion, despite modern techniques of microsurgery and neuromonitoring, bears considerable risks. Aim of the study was to identify critical preoperative factors that help to predict long-term neurological outcome.

Methods: A series of 27 consecutive patients with intramedullary spinal cavernomas over the past 12 years was retrospectively evaluated. Preoperative demographic and clinical variables (history of hemorrhage, previous treatments, neurological status) were assessed. In addition to radiographic properties (cavernoma location, central vs. superficial, lesion size) the surgical strategy (timing of surgery, approach, myelotomy vs. superficial evacuation) were evaluated. Pre- and postoperative neurological status was graded according to ASIA classification and rate of improvement (for motor and bladder function) was assessed separately.

Results: Within the cohort mean age was 46 + 12 years and female to male ratio 2.5:1. In the majority of cases (78%) a clear history of previous hemorrhage was present with multiple events in 33%. Cavernoma location was cervical (n=10), thoracic (n=16) and at the conus level in 1 case. Central or ventral location within the myelon was identified in 7 cases. In 45% of the cases surgical therapy was initiated within 6 months of the symptom onset. Complete removal was intended in all cases, although 2 patients had recurrent cavernomas (7%). Overall 12 patients showed significant clinical improvement and none exhibited worsening of symptoms at follow-up (6-12 months). Postoperative high-grade neurological deficit (ASIA A-C) without any improvement was identified in 3 cases; all of them had long-term, pre-existing severe neurological deficits ($p < 0.005$ Chi²).

Conclusion: The presented data support our strategy of early surgical intervention in intramedullary spinal cavernomas. Neither timing of surgery (e.g. early after symptom onset), cavernoma size, location within the myelon, nor the necessity for myelotomy seem to be associated with unfavorable neurological outcome after surgery, whereas chances for neurological improvement in patients with long-term, high-grade myelopathy are little.

DI.12 Vaskuläre Neurochirurgie 6

Dienstag *Tuesday*, 16.05.2017, 10.40 – 11.40 Uhr *hrs*

- DI.12.01 *Multicenter experience in the endovascular treatment of ruptured and unruptured intracranial aneurysms using the WEB (Woven Endobridge) device*
S. Fischer* (Bochum, Deutschland), J. Popielski, W. Weber, A. Berlis
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- DI.12.02 *Nimodipine but not Nifedipine promotes expression of Fatty Acid 2-Hydroxylase in a Surgical Stress Model based on Neuro2a cells*
E. Herzfeld* (Halle (Saale), Deutschland), L. Speh, C. Strauss, C. Scheller
-
- DI.12.03 *Visualization and validation of CFD during aneurysm surgery*
C. Doenitz* (Regensburg, Deutschland), D. Deuter, A. Brawanski
-
- DI.12.04 *A novel CT-angiography scanner and algorithm for non-invasive assessment of patients undergoing surgical intracranial aneurysm repair*
A. Abdulazim* (Mannheim, Deutschland), N. Vogler, T. Henzler, S. Schönberg, D. Hänggi, N. Etminan
-
- DI.12.05 *Early plasma creatinine levels after aneurysmal subarachnoid hemorrhage correlate with functional neurological outcome – a single center series*
T. Kern* (Bonn, Deutschland), P. Schuss, A. Hadjiathanasiou, F. Lehmann, Á. Güresir, H. Vatter, E. Güresir
-
- DI.12.06 *Association of cystathionine beta synthase polymorphisms and functional outcome following aneurysmal subarachnoid hemorrhage*
P. Hendrix* (Homburg/Saar, Deutschland), P. Foreman, M. Harrigan, J. Pittet, M. Mathru, C. Griessenauer
-

Multicenter experience in the endovascular treatment of ruptured and unruptured intracranial aneurysms using the WEB (Woven Endobridge) device

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Objective: The safety and efficacy of the Woven EndoBridge (WEB) device for the treatment of cerebral aneurysms has been investigated in several studies. Our objective was to report the experience of two neurovascular centers with the WEB device in the treatment of broad based intracranial aneurysms, including technical feasibility, safety, as well as short and mid-term angiographic and clinical follow-up-results.

Methods: We performed a retrospective analysis of all ruptured and unruptured aneurysms that were treated with a WEB device (WEB Single-Layer and Single-Layer Sphere) delivered through VIA 21, 27 and 33 catheters between August 2014 and November 2016. Primary outcome measures included the feasibility of the implantation and the angiographic outcome at 3- and 12-month follow-up. Secondary outcome measures included the clinical outcome at discharge and procedural complications.

Results: 96 aneurysms in 95 patients, including 35 ruptured aneurysms, were planned for treatment with the WEB device. The median age of patients was 57 years (range, 28-89 years). Implantation of the WEB was successful in 92. Procedural complications occurred in 6/96 (6.3%) of those 5 were thromboembolic events compared to one intraprocedural rupture. Angiographic follow-up at 3 months was available for 56/96 (58.3 %) aneurysms to date showing a sufficient aneurysm occlusion in 40/56 (71.4%) cases. At the second follow-up carried out 12 months post treatment the rate of sufficient aneurysmal occlusion improved to 88.9% (24/27 aneurysms). Retreatment was necessary in 13 aneurysms to date.

Conclusion: The WEB device offers a safe and effective treatment option for otherwise difficult to treat broad based intracranial aneurysms without the need of a dual antiplatelet therapy.

Nimodipine but not Nifedipine promotes expression of Fatty Acid 2-Hydroxylase in a Surgical Stress Model based on Neuro2a cells

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Objective: Nimodipine is recommended for the management of aneurysmal subarachnoid hemorrhage and reduces poor outcomes and delayed ischemic neurological deficits. In skull base, laryngeal and maxillofacial surgery and basic research it shows a beneficial effect for cranial nerve preservation and regeneration. Nifedipine is used in the treatment of hypertension, the vasospastic form of angina pectoris, Raynaud`s disease, and premature labor. Neuroprotection by nimodipine but not by nifedipine was shown in NGF-differentiated PC12 neuronal cells . We showed, that the survival of Neuro2a cells was significantly higher when cells were pre-treated with nimodipine prior to oxidative, mechanical and heat-induced stress.

(Differentiated) Neuro2a cells were analysed for nimodipine-mediated survival considering stress treatment in comparison to nifedipine-treatment. Neuro2a cell culture was analysed for changes in fa2h expression, which is a component of myelin synthesis, induced by nimodipine or nifedipine in surgery-like stress conditions.

Methods: Cell survival after stress treatment following nimodipine or nifedipine non- and pre-treatment, respectively, was determined by measurement of LDH activity in the culture supernatant. We analysed expression levels of fa2h by qPCR using fa2h specific primers in nimodipine or nifedipine non- and pre-treated Neuro2a cell culture, respectively.

Results: Nimodipine decreased surgery-like stress-induced cell death of Neuro2a cells. This was not observed for nifedipine. Nifedipine itself rather induces cells death of Neuro2a cells in a dosage dependent manner. Nimodipine but not nifedipine significantly increases mRNA levels of fa2h in both undifferentiated and differentiated Neuro2a cells.

Conclusion: The lethal effect on Neuro2a cells consists with findings, that a neuroprotective effect of nifedipine could not be shown. In contrast to that, the clinically observed neuroprotective effect of nimodipine was verified in our surgery-like stress model.

Our findings in qPCR indicate that higher expression of fa2h induced by nimodipine may cause higher survival of Neuro2a cells stressed with surgery-like stressors. This could be possibly linked with higher (re-) myelination of nerve tissue after surgery.

Visualization and validation of CFD during aneurysm surgery

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Objective: Computational fluid dynamics (CFD) is a powerful tool to simulate flow and related forces like wall shear stress, pressure and impingement forces in cerebral aneurysms. This allows to predict regions of thin wall and high pressure prone to rupture within the aneurysm. We used intraoperative indocyanine green video angiography (ICG) in aneurysm surgery to validate CFD results and proofed the value of intraoperative visualization of these information to the surgeon during aneurysm surgery potentially changing the way of approach and aneurysm dissection.

Methods: In patients with incidental aneurysms preoperative 3D mesh-models were built using 3D rotational angiography slices. Amira (Visualization Sciences Group, USA) software package v. 5.6. and 'ANSYS' software was used for CFD. We investigated flow velocity, wall pressure, impingement point (IP) and wall shear stress (WSS). Information were transferred it into our navigation system (Kolibri, Brainlab, München). Intraoperative Indocyanine green (ICG) video angiography during surgery were screened for visible flow patterns. To visualize the flow patterns we used color-coded point of time of maximum gradient using the HSV color model. For post-processing visualization of the results and comparison to the ICG video analyses we used Avizo Wind 3D analysis software v 7.1.1 (Visualization Sciences Group SAS, USA).

Results: ICG video angiography revealed meaningful flow patterns in 8 of 12 cases. The streamline patterns of the CFD simulations correlated well with the flow seen in the ICG video angiography in all cases. The main streamlines, vortices and impingement points could be identified depending on the intraoperative angle of view. Intraoperative visualization of CFD revealed to be a useful tool in aneurysm clipping of incidental aneurysms. As previously reported, regions of low wall shear stress were confirmed to show a thin and delicate wall. Surgeons tried to avoid the regions of low wall shear stress and high pressure during the initial part of dissection appreciating the information of the CFD.

Conclusion: We present a novel assistance tool for aneurysm surgery. Visualization of CFD during operation helps the surgeon to recognize regions of low wall shear stress and high pressure prone to rupture. Validation of CFD was done by ICG video angiography and revealed good correlation to the CFD results. An CFD-adjusted approach and dissection of the aneurysm can potentially help to prevent intraoperative rupture.

A novel CT-angiography scanner and algorithm for non-invasive assessment of patients undergoing surgical intracranial aneurysm repair

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Objective: We previously reported on the beneficial value of 2nd generation dual energy CT-angiography (DE-CTA) imaging as a non-invasive and safe imaging alternative for patients undergoing surgical or endovascular intracranial aneurysm (IA) repair. Dual-energy CTA (DE-CTA) imaging is derived from simultaneous use of two x-ray tubes, which run at different energies. In contrast to single-energy CTA (SE-CTA), this allows for calculation and image reconstruction at different tube voltages (monoenergetic images). Thus, beam hardening artifact reduction (high tube voltages) while maintaining diagnostic vessel contrast (low tube voltages) may be achieved. We here investigate the potential of virtual monoenergetic images, derived from the most recent 3rd generation DE-CTA scanner to improve evaluation of the degree of IA occlusion and parent vessel patency.

Methods: 15 patients prospectively underwent DE-CTA imaging following surgical IA repair. Virtual monoenergetic datasets from 40-190keV and mixed 80/150keV images were calculated and compared to the respective 80keV dataset, comprising the standard SE-CTA 120kV tube voltage setting, as the reference standard. Signal to noise (SNR), contrast to noise (CNR), and signal to background (SBR) ratios were calculated in 10keV intervals ranging from 40-190keV as objective markers of image quality. Diagnostic image quality was independently rated by a radiologist and a vascular neurosurgeon with respect to IA neck and parent vessel using a 4-point likert scale from 4 (excellent) to 1 (poor). A score of 2 or higher was considered diagnostic.

Results: 15 patients surgically treated for 5 ruptured and 10 unruptured IA received DE-CTA imaging. Aneurysm sites were anterior (n=4) or posterior communicating (n=4) and middle cerebral artery (n=7), with a mean aneurysm size of 8.4 mm. All calculated ratios significantly decreased with increasing keV levels from 23.0 to 11.4 (SNR), 22.1 to 10.4 (CNR), and 26.8 to 11.4 (SBR) at 40keV to 190keV. Compared to the standard SE-CTA setting (80keV), evaluation of parent vessel patency was rated superior based on the virtual monoenergetic datasets (4 [range 2-4] vs. 3 [range 1-4]) and assessment of IA occlusion was rated superior based on the mixed 80/150keV dataset (4 [range 2-4] vs. 3 [range 1-4]). Based on the virtual monoenergetic datasets image quality was rated diagnostic in all patients, whereas image quality was rated not diagnostic in 3 patients on the standard SE-CTA (80keV) dataset.

Conclusion: Our data highlight that calculation of virtual monoenergetic datasets from DE-CTA, without additional radiation exposure, allows for case tailored tuning of the best possible vessel contrast to beam hardening artifact ratio. This may result in diagnostic imaging in patients where otherwise catheter angiography would be necessary for further evaluation.

Early plasma creatinine levels after aneurysmal subarachnoid hemorrhage correlate with functional neurological outcome – a single center series

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Objective: Acute kidney injury is common in critically ill patients and may contribute to poor outcome. However, data on the potential influence of early plasma creatinine (pCr) in patients suffering from aneurysmal subarachnoid hemorrhage (SAH) on neurological outcome is scarce. We therefore analyzed our neurovascular database in order to study the association between early pCr and functional outcome after SAH.

Methods: From 2011 to April 2016, 330 patients suffering from aneurysmal SAH were treated at the authors institution and included in this retrospective cohort study. Information, including patient characteristics, treatment modality, aneurysm size and location, laboratory values, radiological features, and functional neurological outcome were assessed and further analyzed. Patients suffering from SAH were divided into good-grade (WFNS I-III) versus poor-grade (WFNS IV-V) on admission. Outcome was assessed according to the modified Rankin Scale (mRS) at 6 months and stratified into favourable (mRS 0-2) versus unfavourable (mRS 3-6).

Results: Overall 163 of 330 patients suffering from aneurysmal SAH achieved favourable outcome (49%). Patients with SAH and initial pCr levels ≤ 0.8 mg/dl achieved significantly more often favourable outcome compared to patients with SAH and initial pCr levels > 0.8 mg/dl ($p=0.01$). Patients suffering from poor-grade SAH had significantly higher levels of initial pCr, when compared to patients with good-grade SAH ($p=0.02$).

Conclusion: We demonstrated that increased initial plasma creatinine levels are associated with unfavourable functional outcome after SAH. The present study highlights the necessity of close surveillance of renal function in the aneurysmal subarachnoid hemorrhage population.

Association of cystathionine beta synthase polymorphisms and functional outcome following aneurysmal subarachnoid hemorrhage

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Objective: Cystathionine β -synthase (CBS) is an enzyme of the transsulfuration pathway and is involved in homocysteine metabolism and hydrogen sulfide (H₂S) formation. Polymorphism of CBS may alter CBS activity and subsequently homocysteine and H₂S levels. CBS genostatus with decreased CBS activity has been associated with delayed cerebral ischemia following aneurysmal subarachnoid hemorrhage (aSAH) (Grobelny BT, J Neurosurg 115:101–107, 2011). The impact of CBS polymorphisms on functional outcome needs to be determined.

Methods: Blood samples from all patients enrolled in the CARAS (Cerebral Aneurysm Renin Angiotensin System) study were used for genetic evaluation. The CARAS study prospectively enrolled aSAH patients at two academic institutions in the United States from 2012 to 2015. Common CBS polymorphisms [844ins68 CBS insertion polymorphism W \rightarrow I, CBS 699 G \rightarrow A (C \rightarrow T) single nucleotide polymorphism (SNP) (rs234706), and CBS 1080 C \rightarrow T SNP (rs1801181)] were detected using 5' exonuclease (Taqman) genotyping assays. Analysis of associations between CBS polymorphisms and aSAH was performed. A modified Rankin scale (mRS) score of 3 – 6 were considered as unfavorable outcome.

Results: Samples from 149 aSAH patients were available for analysis. Multivariate analysis included Hunt and Hess grade, modified Fisher grade, Hijdra grade, location, time to treatment and complications. The GG genotype of rs234706 was associated with an unfavorable outcome at discharge (16 ± 11 days; odds ratio = 5.295, $p = 0.007$) and last follow-up (250 ± 188 days; odds ratio = 3.008, $p = 0.015$).

Conclusions: The wildtyp GG genotype of rs234706 was independently associated with a poor outcome following. This wildtyp had also been associated to an increased risk for delayed cerebral ischemia in another clinical study. A potential explanation is that the wildtyp genotype results into a decreased CBS activity compared to patients harboring the SNP.

DI.13 Tumor 7 – Ependyom/Schwannom

Dienstag *Tuesday*, 16.05.2017, 10.40 – 11.40 Uhr *hrs*

- DI.13.01 *Quality of life in patients with unilateral vestibular schwannoma*
F. Arlt* (Leipzig, Deutschland)
-
- DI.13.02 *Gross total resection without adjuvant radiotherapy leads to long-term progression free survival in adult posterior fossa ependymoma patients*
S. Marx* (Greifswald, Deutschland), E. El Refaee, S. Langner, H. Schroeder
-
- DI.13.03 *Intraventricular ependymal tumors. Surgical management in adults.*
R. Schwarz* (Hamburg, Deutschland), T. Burkhardt, N. Humke, J. Matschke, M. Westphal, N. Schmidt
-
- DI.13.04 *Long term results of acoustic neurinoma treated with LINAC and Cyberknife based stereotactic radiosurgery: a follow up of 335 patients*
D. Ruess, L. Pöhlmann* (Köln, Deutschland), S. Grau, H. Treuer, M. Kocher, M. Ruge
-
- DI.13.05 *Long term follow-up of clinical outcome and quality of life in patients with vestibular schwannoma treated with gamma knife: A single center study of 392 patients*
C. Blume* (Aachen, Deutschland), H. Clusmann, M. Burkhardt, K. Sakreida, B. Huffmann
-
- DI.13.06 *Genes and molecular pathways involved in radioresistance of sporadic and NF2-associated vestibular schwannomas: a microarray and pathway analysis.*
I. Gugel* (Tübingen, Deutschland), E. Florian, P. Frank, C. Stefan, N. Sven, T. Marcos, T. Ghazaleh
-

Quality of life in patients with unilateral vestibular schwannoma

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Objective: “Wait and see” strategy is an option in managing patients with small vestibular schwannomas (VS). Besides risk of growth and worsening of hearing quality of life may be influence patients daily life. Therefore the present study focused on quality of life parameters in patients who are on “wait and see” strategy following MRI based diagnosis of small unilateral vestibular schwannoma.

Methods: In a prospective single center study sixty-five patients (mean age 64.4 years; male-female 32:33) who suffer from a small unilateral vestibular schwannoma (9.34 mm, range 1,5-23 mm) were included from 2013 to 2016 in this series. During follow-up besides clinical and neurological examination and MRI imaging all patients answered once the Short Form 36 (SF36) questionnaires to characterise Quality of Life (QOL). Additionally the severity of tinnitus was determined by the Mini-TQ-12 from Göbel and Hiller.

Results: During follow no lower QOL in patients with small vestibular schwannomas who are on “wait and see” strategy in comparison to Germany’s general population and in 53 patients (81.5 %) no tumour growth was detected. Patients with a tumour diameter larger than 10 mm do not suffer from stronger tinnitus, vertigo or unsteadiness than the group with an average tumour size which is smaller than 10 mm. 62 patients (95.4 %) showed ipsilateral hearing loss and three of them reported deafness (4.6 %). Severe vertigo or tinnitus are connected with lower levels of mental component scale (MCS) and physical component scale (PCS). This findings reduced QOL ($p=0.05$).

Conclusion: In our series QOL is not influenced in patients with unilateral untreated small vestibular schwannomas in comparison to Germany’s general population. This is a helpful information in advising patients during follow-up and find out optimal timing of individual treatment.

Gross total resection without adjuvant radiotherapy leads to long-term progression free survival in adult posterior fossa ependymoma patients

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Objective: Gross total resection often is avoided in posterior fossa ependymoma surgery due to the fear of permanent neurological deficits after operation. However, the extent of resection is a major prognostic factor for progression free and overall survival. Independent of the extent of resection, it is a broad accordance for adjuvant radiotherapy.

Methods: The authors present a consecutive series of posterior fossa ependymoma surgeries in adult patients since 2001 in a single neurosurgical department. Special attention was paid to the intraoperative extent of resection as well as the MR-morphological and clinical long-term follow-up.

Results: 8 patients (2f, 6m, mean age 41.9 years, range from 29 to 56 years) underwent surgery for posterior fossa ependymoma. All tumors were WHO°II. Tumor adherence was found to be in the caudal rhomboid fossa (below the facial colliculus) in all patients. Gross total resection has been achieved in all patients (100%) without significant permanent neurological deficits after surgery. Dissection of the tumor adherence in the rhomboid fossa has done with the four-hand suction-irrigation technique. None of the patients got a further treatment (chemotherapy, radiation therapy, second surgery). In none of these patients, tumor recurrence was seen on MRI after a mean follow-up of 101 months (ranging from 13 to 181 months). 6 patients (75%) are fulltime worker. One patient (12.5%) died 7 years after surgery due to lung cancer. One patient (12.5%) suffered from a major stroke in the middle cerebral artery territory 9 years after surgery.

Conclusion: Long-term progression free survival in adult patients suffering from posterior fossa ependymoma is obtainable by gross total resection without adjuvant radio- or chemotherapy. By careful bimanual microsurgical dissection and avoidance of bipolar coagulation at the floor of the fourth ventricle, the risk for permanent neurological deficits after surgery is low.

Intraventricular ependymal tumors. Surgical management in adults.

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Objective: Intraventricular ependymal tumors in adults represent a rare and challenging neurosurgical entity. The role of radiotherapy is subject to controversial discussion and chemotherapy has shown to be ineffective, therefore complete surgical resection remains the treatment of choice, but scientific data regarding the optimal treatment is sparse. We report our experience with 46 patients treated at our neurosurgical centre in a retrospective analysis.

Methods: 46 consecutive, patients (age<18y) with intraventricular ependymoma/subependymoma were treated at our institution between 1987 and 2016 and were included. Patient demographics, clinical presentation, imaging data, histology and surgical treatment with related morbidity was analyzed from patients charts, surgical reports. Clinical outcome was assessed using the modified Rankin Scale (mRS) and Spitzer Index for quality of life (SQLI).

Results: 35 male and 11 female patients with a mean age of 47 years (range 18 to 78 years) were included. 47 open surgeries and one biopsy were performed using suboccipital (n=31), frontal transcortical (n=12) and interhemispheric transcallosal (n=4) approaches. The most common tumor location was within the fourth ventricle (n=31) followed by the lateral ventricles (n=16). Gross total resection (GTR) was achieved in 39 operations (83%) and subtotal resection in 8 operations (17%). The overall rate of perioperative mortality was 4% (n=2). Postoperative morbidity in terms of neurological deficit was permanent in 13% (n=6) or transient in 8% (n=4). Neurological deficits presented as hemiparesis (n=1), cranial nerve disturbances (n=3), ataxia (n=1) and vertigo (n=1). Mean mRS was 1.75 at admittance, 1.71 at discharge and 1.54 at last Follow-up. Mean SQLI at last follow up was 9.5. Mean Follow-up was 52 months, mean Progression free survival was 42 months. Tumors were classified as subependymoma WHO grade I (n=25), ependymoma WHO grade II (n=20) and anaplastic ependymoma WHO grade III (n=3). The mean proliferation Index was 4.3. While no recurrence was seen in subependymoma WHO[°]I we observed 3 patients with recurrent tumors (WHO[°]II) and one patient with multiple recurrences (WHO[°]III). Two patients underwent radiotherapy after subtotal resection and one after tumor recurrence.

Conclusion: In our series we demonstrate that long-term tumor control with good clinical outcome and high quality of life can be achieved by surgical resection of intraventricular, ependymal tumors, making it the method of choice for this entity. Recurrence rates are especially low in subependymoma WHO[°]I, even after subtotal resection. Adjuvant therapy remains an option only for higher grade or recurrent tumors.

Long term results of acoustic neurinoma treated with LINAC and Cyberknife based stereotactic radiosurgery: a follow up of 335 patients

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Objective: Tumor control and functional hearing preservation are the main goals to be reached in the treatment of acoustic neuroma (AN). Stereotactic radiosurgery (SRS) has evolved as alternative first-line treatment for AN. Here, we report the clinical and radiological long term follow-up of patients with AN treated with LINAC or Cyberknife® based SRS.

Methods: In this single center retrospective analysis we consecutively included all patients with AN who underwent single fraction LINAC or Cyberknife® based radiosurgery between 1991 and 2015 with a minimum follow-up of 2 months. Patient data were analyzed in terms of tumor control (defined as no further intervention required), preservation of functional hearing and incidence of early and late treatment related complications (rated by using the Common Terminology Criteria for Adverse Events, CTCAE; v4.03).

Results: 335 patients (f:m = 176:159, median age = 58 years) were treated either with LINAC (n=270) or Cyberknife® (n=65) -based SRS. Median tumor volume was 1.1 ml ± 2.6 ml (0.1-23.7). The median radiation dose was 12 Gy (range 11-20) at a median isodose level of 72 % (31.9-86.21). Median follow-up was 30 months (2-224 months). According to the Koos classification we identified 53 (15.8%) Koos I, 180 (53.7%) Koos II, 42 (12.5%) Koos III and 60 (17.9%) Koos IV tumors. 70 patients had surgery prior to SRS.

The 2-, 5- and 10-year tumor control rate was 99%, 89% and 88%, respectively. Treatment failure was observed in 6.3% (n=21). Re-treatment included re-radiation in 2.7% and microsurgery in 3.6%. The Kaplan-Meier estimated an objective hearing preservation rate of 89% after 12 months, 80% after 24 months and 57% after 50 months. De novo permanent adverse events (CTCAE grade I and II) were objectively observed in 8,9% (n=30) cases.

Conclusion: SRS for AN leads to very good long term tumor control with a considerable rate of hearing preservation and a low rate of permanent side effects. SRS can be proposed as save and effective first line treatment alternative to - or in combination with - microsurgical resection.

Long term follow-up of clinical outcome and quality of life in patients with vestibular schwannoma treated with gamma knife: A single center study of 392 patients

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Objective: To evaluate long term follow-up of clinical outcome and quality of life (QL) of patients with vestibular schwannoma (VS) treated with stereotactic radiosurgery via Gamma Knife (GK).

Methods: Patients with small or medium sized VS, treated with GK between 1998 and 2012 were analyzed retrospectively. Baseline clinical parameters, imaging data and neurological status were recorded before GK treatment, 3 and 6 months after treatment and from the third year once a year. QL was assessed via questionnaires (SF-36, Glasgow Benefit Inventory (GBI), House and Brackmann Grade (H&B Grade). Overall, LQ assessment was at maximum 18 years after treatment.

Results: 392 patients were included (193 female, mean age 56 years). 69 patients underwent surgical resection before GK, 7 patients after GK treatment because of recurrence. Mean tumor volume was 1.89 cm³. Mean treatment dose was 13 Gy. In follow-up examinations tumor control rate was 98%. 50 % of 102 patients with audiometric testing after treatment showed a deterioration of at least one GR Class, 47 % had no change, and 3 % improved. Concerning the facial nerve no patient developed persistent palsy, two patients presented with transient palsy, and four with transient facial spasm. Trigeminal dysesthesia after treatment was transient in 15 patients (4 %), six patients (2 %) improved, one patient presented a new persistent deficit. During the clinical course, dizziness was constantly reduced to 15 % as well as tinnitus to 26 %.

At a mean of 136 months after GK treatment, QL questionnaires were sent to 273 contactable patients (67 %), 123 (45 %) were returned completed. The physical health component summary score of the SF-36 was slightly above the norm (mean = 53; 47–48 normal German population), while the mental health component summary score met the standard (mean = 47; 48–51 normal German population). Significant differences were observed in the GBI overall score comparing female (mean = 10.8) and male (mean = 1.2) patients (p = 0.008).

Conclusion: GK is a safe and effective treatment option for small- and medium sized VS as proved by long term follow-up clinical and LQ assessment. We found a high rate of tumor control and low morbidity. Our data showed no clinical relevant deterioration in terms of LQ caused by GK treatment.

Genes and molecular pathways involved in radioresistance of sporadic and NF2-associated vestibular schwannomas: a microarray and pathway analysis.

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Objective: Vestibular schwannomas (VSs) are benign tumors of the eighth cranial nerve which occur either as sporadic unilateral tumors or bilateral as a hallmark of neurofibromatosis type 2 (NF2). Besides microsurgical resection or chemotherapy in case of NF2-associated VSs, more recently stereotactic radiosurgery (SRS) and fractionated stereotactic radiotherapy (FSRT) have gained acceptance as effective alternatives. However, there is a subset of radioresistant tumors that continue to grow after radiation treatment. Radioresistant behavior at the molecular level as well as the differences between irradiated sporadic and NF2-associated VSs are not well understood. The objective of this study was to provide insight into the radiobiology of sporadic and NF2-associated VSs through gene expression profiling and pathway analysis.

Methods: 49 non-irradiated and 7 irradiated recurrent VS tumors were fresh-frozen at the time of surgical resection and RNA isolation was performed for cDNA microarray analysis (HG-U219 Array Plate, Affymetrix®). We utilized canonical pathway analysis (Ingenuity Pathway Analysis) to investigate pathways involved in radioresistance.

Results: A total of 195 probe sets (128 probe sets were up- and 67 downregulated) showed significant difference based on the criteria of P value < 0.01 and absolute fold change ≥ 2. These genes were involved in deregulation of important pathways known to be involved in radioresistance (e.g. NF-κB Signaling, STAT3 signaling, p53 signaling, ect.) resulting in proliferation, hypoxia, angiogenesis and cell cycle interruption.

Conclusion: Irradiated sporadic and NF2-associated tumors share common modifications of pathways which contribute to radioresistance in tumors and could be a reason for acquired resistance to radiation. These pathways and their participating genes might function as candidate therapeutic targets for radiosensitizers in the future.

DI.14 Hydrozephalus 2

Dienstag *Tuesday*, 16.05.2017, 10.40 – 11.50 Uhr *hrs*

- DI.14.01 *Relevance of postoperative imaging in VP-shunting procedures*
P. Schödel* (Regensburg, Deutschland), K. Kiene, E. Bründl, F. Zeman, A. Brawanski, K. Schebesch
-
- DI.14.02 *Influence of surgeon`s experience and placement modality on accuracy of external ventricular drains*
K. Brawanski* (Innsbruck, Austria), C. Freyschlag, M. Obermoser, C. Thomé
-
- DI.14.03 *Surgical management of trapped 4th ventricles in posthemorrhagic hydrocephalus - an institutional experience*
S. Sarikaya-Seiwert* (Düsseldorf , Deutschland), T. Beez, J. Klasen-Sansone, H. Steiger
-
- DI.14.04 *Secondary deterioration of idiopathic normal pressure hydrocephalus: natural course or treatment failure?*
D. Engel* (Tübingen, Deutschland), L. Franke, S. Adib, M. Schuhmann
-
- DI.14.05 *Electromagnetic-guided placement of the ventricular catheter in shunting for idiopathic intracranial hypertension*
E. Hermann* (Hannover, Deutschland), M. Polemikos, H. Heissler, J. Krauss
-
- DI.14.06 *Asymptomatic radiological precursors of iNPH*
D. Engel* (Tübingen, Deutschland), S. Adib, R. Schüle, F. Hennersdorf, M. Schuhmann
-
- DI.14.07 *Accuracy of intra-catheter endoscopy in shunting procedures*
S. Antes* (Homburg/Saar, Deutschland), S. Linsler, M. Salah, S. Senger, J. Oertel
-

Relevance of postoperative imaging in VP-shunting procedures

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Objective: This study was designed to evaluate the relevance of immediate postoperative imaging in ventriculoperitoneal-shunting (VP-shunting) procedures.

Methods: 461 consecutive patients (male 243, female 218; mean age 51.9 years) with VP-shunting procedures who presented during the ten years interval between 2002 and 2012 were included in the study. We reviewed the charts for type of hydrocephalus, type of shunting and of the utilized hardware, postoperative imaging consisting of cranial CT- or MR-scans and x-rays of the entire shunt system, re-operations and valve-adjustments in short-term course, ventricular and peritoneal catheter-malpositioning as well as intracranial bleeding complications.

Results: There were clinically relevant findings in postoperative CT- or MR-scans in 39 patients (8.5%), leading to re-operations in 18 (3.9%) patients and valve-adjustments in 23 (5.0%) patients. Therapeutic relevant findings on x-rays were seen in 11 (2.4%) patients resulting in re-operations in all cases, mostly requiring re-positioning of the peritoneal catheter (6 patients, 1.3%). There was no intracranial bleeding leading to immediate surgical revision. Valve-adjustments due to imaging (CT, MR or x-rays) or clinical findings (high or low intracranial pressure) had been made in a total of 36 patients (7.8%) at discharge.

Conclusion: This study confirms that postoperative cranial CT- or MR-scans are clinically relevant because of therapy-deciding findings in 8.5% of all patients. As radiographical relevant findings mostly occur in x-rays of the peritoneal catheter (1.3%), it should be considered to skip all postoperative x-rays of the VP-shunt except the abdominal x-rays in order to minimize the radiation exposure.

Influence of surgeon`s experience and placement modality on accuracy of external ventricular drains

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Objective: Placement of an external ventricular drain (EVD) for managing acute hydrocephalus and/or intracranial hypertension is a standard procedure, carried out mostly by neurosurgical trainees. The most common complications associated with EVDs are catheter misplacement, infection, hemorrhage and dislocation. The objective of the present single center analysis was to determine relationships between incidence of complications and the surgeons' level of experience/training and the modality used (bedside/OR).

Methods: A retrospective analysis of 219 patients with adequate imaging and follow-up data that had received a total of 232 EVDs between January 2010 and May 2015 was conducted. The position of the catheter tip (malposition was defined as: catheter tip outside ipsilateral lateral ventricle, third ventricle), hemorrhage and catheter dislocations and related infections were evaluated. Imaging parameters were obtained on the first CT scan after insertion. The complications were analysed in correlation to different levels of neurosurgical training and the circumstances of placement – whether the EVDs were inserted bedside or in the OR. Data were analysed with Chi-square and Fisher's exact test.

Results: 127 patients (54.7%) were female and 105 (45.3%) were male. The median age was 63 years (range 11 – 92 years). A total of 199 (85.8%) EVDs were inserted in the OR, whereas 33 (14.2%) were placed bedside. We found 32 (13.8%) malpositions and 200 (86.2 %) correctly placed catheters. The majority of EVDs (182, 78.4%) was placed by residents, only 50 (21.6%) were inserted by fully trained neurosurgeons. EVDs placed by residents were misplaced in 15.4% of cases (28 of 182) in comparison to 8.0% (4 of 50) by board-certified neurosurgeons ($p=0.247$). 13.1% (26 of 199) of all placed EVDs in the OR and 18.2% (6 of 33) of all placed EVDs bedside, showed a malposition ($p=0.419$). CSF infections occurred in 15.4% (28 of 182) of all EVDs placed by residents and 12.0% (6 of 50) of all EVDs placed by consultants ($p=0.656$). EVDs placed in the OR showed a CSF infection in 13.6% (27 of 199) and bedside placed EVDs in 21.2% (7 of 33) ($p=0.286$).

Conclusion: The level of resident's training showed no influence on the accuracy of EVD placement. Our analysis supported the equipoise of insertion modalities (bedside/OR) in terms of infections and misplacement.

Surgical management of trapped 4th ventricles in posthemorrhagic hydrocephalus - an institutional experience

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Objective: Intraventricular hemorrhage (IVH) is a common complication of premature neonates with small birth weight, which often leads to hydrocephalus and treatment with ventriculo-peritoneal (VP) shunting procedures. Trapped fourth ventricle (TFV) can be a devastating consequence of the subsequent occlusion of the cerebral aqueduct and foramina of Luschka and Magendie.

Methods: We retrospectively reviewed the charts of 65 patients with posthemorrhagic hydrocephalus treated with VP shunt and secondary endoscopic procedure between 2011 and 2016. The patients ranged in gestational age from 24.0 to 31.0 weeks, with an average age at first shunting procedure of 6.3 weeks. A radiographic (mean 2.2 years) and clinical (mean 2.2 years) long-term follow-up was achieved.

Results: In all cases the posthemorrhagic hydrocephalus were managed with supracerebellar VP shunt insertion. 18 (27.8%) patients showed TFV following VP shunting for IVH due to prematurity. 10 (15.4%) of these patients developed symptoms of posterior fossa compression. 8 (12.3%) were treated surgically with endoscopic fenestration of the 4th ventricle into the lateral ventricle in addition to the VP shunt. The remaining 2 patients were treated with an additional shunt tube insertion in the 4th ventricle connected to the VP shunt. All of these patients showed signs of radiographic improvement with stable or improved clinical examinations during postoperative follow-up. One of the patients with additional shunt tube in the 4th ventricle needed an early revision due to a broken tube in the connection area with the VP shunt.

Conclusion: The frequency of TFV among premature IVH patients is relatively high. Most patients with TFV are asymptomatic at presentation and can be managed without surgery. Symptomatic patients may be treated surgically for decompression of the fourth ventricle. An endoscopic procedure to avoid an additional shunt tube should be preferred whenever possible.

Secondary deterioration of idiopathic normal pressure hydrocephalus: natural course or treatment failure?

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Objective: Idiopathic normal pressure hydrocephalus (iNPH) has a naturally deteriorating course over time. A secondary deterioration during VP-Shunt (VPS) treatment is due to either natural deterioration of disease, insufficient VPS function or development of concomitant disease i.e. Alzheimer's disease (AD). The cause of this secondary deterioration cannot be determined without further investigation by i.e. a shunt infusion exam (SIE) or revision surgery.

Methods: All SIE data conducted 2013-2015 were reviewed. Exams and digital patient records of iNPH patients were included and reviewed for clinical course, shunt function and Alzheimers' CSF-testing.

Results: Between 2013 and 2015 132 patients with iNPH had contact with our neurosurgical department. Twenty SIEs were conducted in 19 patients, in whom VPS were implanted between 2009 and 2014 (mostly ProGAV valves, Miethke). Eleven exams showed an increased outflow resistance and exceeded the allowed critical shunt pressure. CSF of 1 of 4 patients with deteriorated dementia as primary symptom showed a high score for Alzheimer's. Ten revision operations were conducted in 9 patients. In 5 cases no clear defect was found. In these patients 2 ProGAV valves were replaced, 2 Miethke fixed gravitational devices were replaced for ProSA programmable gravitational devices. In 2 of these patients nothing was changed. The peritoneal catheter showed a higher resistance in 3 patients, 1 was operated twice and received a ProSA during the second operation. All operated patients showed an improvement in at least the first postoperative month. Patients who received a ProSA showed a prolonged improvement of at least 6 months.

Conclusion: SIE and CSF-Alzheimer's markers are valuable tools to distinguish a natural deterioration from insufficient VPS-function and concomitant Alzheimer's disease. Unnecessary revision operations can thereby be avoided. ProSA enables more CSF drainage and clinical improvement in patients with secondary deterioration.

Electromagnetic-guided placement of the ventricular catheter in shunting for idiopathic intracranial hypertension

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Objective: The mainstay of surgical treatment of idiopathic intracranial hypertension (IIH) is ventriculoperitoneal (VP) shunting. Because of the typical small and sometimes even slit ventricular size adequate positioning of the ventricular catheter is challenging. Here, we investigated the usefulness of electromagnetic (EM) guided ventricular catheter placement for shunting in IIH.

Methods: Twelve patients with IIH were selected for EM-navigated placement of a ventricular catheter for VP-shunting. The age of patients ranged from 5 to 56 years at the time of surgery (mean age: 27.4 years; median: 24 years). There were two children (5 and 11 years old) and 10 adults. Inclusion criteria for the study were patients with confirmed and medically refractory IIH. Patients underwent preoperative continuous epidural ICP-monitoring for 2 days to support diagnosis. In all patients EM-navigated placement of the ventricular catheter was performed using real-time tracking of the catheter tip for exact positioning close to the foramen of Monro. Postoperative CT scans were correlated to intraoperative screen shots to validate the position of the catheter.

Results: In all patients EM-navigated ventricular catheter placement was achieved, except in one in whom navigation accuracy was lost during surgery by accidental displacement of the dynamic reference frame (DRF). There were no intraoperative or postoperative complications. In all cases satisfactory positioning of the ventricular catheter was achieved. No proximal shunt failure was observed during follow-up at a mean of 33.7 months (range 2.5 – 76 months, median 30 months).

Conclusion: EM-navigated ventricle catheter placement in shunting for IIH is a safe and straight forward technique. It obviates the need for sharp head fixation allowing shunt placement with care.

Asymptomatic radiological precursors of iNPH

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Objective: Radiological Disproportionate Enlarged Subarachnoid-Space Hydrocephalus (DESH) is almost pathognomonic for idiopathic normal pressure hydrocephalus (iNPH). Others have shown in a population-based study, that tight high convexity (THC) might precede asymptomatic ventriculomegaly in patient, that are more likely to develop iNPH (Iseki et al., 2009&2014). For pathophysiological investigative purposes we conducted the search the other way around.

Methods: All available digital imaging (CT or MRI) and clinical data of all iNPH patients that had contact with the neurological or neurosurgical clinic in 2014 or 2015 were reviewed. Time of onset of symptoms, time of first imaging (whatever the indication was) and birth date were recorded. The patients that had a discrepancy between time of symptomatic onset and time of first imaging were investigated in depth.

Results: In 2014 and 2015 151 patients had had contact with either the neurological or neurosurgical department. Of six patients imaging was available before onset of symptoms (mean 6.3 years, range 2.9 – 10.5 years). All six patients had undergone testing by lumbar drainage or puncture within 2 years after onset and were diagnosed with iNPH. In 5 of 6 patients the first symptom was gait imbalance. The MRI conducted 10.5 years before onset of symptoms showed normal ventricular width with THC. All other images within a shorter time to symptomatic onset showed classic DESH.

Conclusion: In accordance with scarcely available literature DESH is prominent at least several years before onset of iNPH-symptoms. Before that time THC develops first. Further studies are needed to put these findings into the pathophysiological perspective of the development of iNPH.

Accuracy of intra-catheter endoscopy in shunting procedures

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Objective: The long-term function of a cerebral shunt is directly influenced by the placement of the ventricle catheter. In this study, an intra-luminal endoscope for best possible catheter positioning was used. Postoperative imaging and shunt failure rates were retrospectively evaluated.

Methods: Between January 2012 and June 2016, an intra-catheter endoscope was applied in 71 procedures. Endoscopic technique was used for catheter placement in first-time shunting or cerebrospinal fluid reservoir insertion (n=38), revision surgery in proximal shunt failure (n=13) and various intraventricular stenting procedures (n=20). Catheter positioning was graded on postoperative imaging using a 4-point scale. All patients were regularly followed up (mean, 31.6 months) to recognize ventricle catheter failures.

Results: Endoscopic application could be completed as intended in 68 of 71 procedures. Postoperative imaging could exclude complete misplacement of all catheters, but optimal positioning was only achieved in 64.7 % (44 of 68 cases). Four catheters had to be revised due to malfunction (failure rate, 5.8 %). Another five catheters had to be removed due to infectious complications or wound healing disorders. Direct correlations between catheter complications and suboptimal catheter positioning were not seen. Slit or distorted ventricles did also not prove to be a risk factor for the observed complications.

Conclusion: Complete misplacements can be avoided by using an intra-catheter endoscope. Confirmation of intraventricular location by direct view attributes to the low malfunction rate, especially in slit or distorted ventricles.

DI.15 Joint Meeting Session 7 – Various 2

Dienstag *Tuesday*, 16.05.2017, 10.40 – 11.50 Uhr *hrs*

- DI.15.01 *Keynote lecture - Neural tube defects: reality from present-day perspective*
Dieter Class (Magdeburg, Deutschland)
-
- DI.15.02 *Monitoring of pineal cysts in children*
A. Ali* (Manchester, United Kingdom), I. Kamaly
-
- DI.15.03 *Developing an in vitro model of disease spread in Parkinson's disease for mechanistic insight into dopaminergic graft pathology following stereotactic transplant*
A. Natalwala* (Edinburgh, United Kingdom), K. Dolt, Y. Chen, R. Yapom, T. Kunath
-
- DI.15.04 *Prospective multi-centre study of external ventricular drainage management and infection rate in the United Kingdom and Ireland*
A. Jamjoom* (Edinburgh, United Kingdom), A. Joannides, M. Poon, A. Chari, A. Koliass, J. Kitchen, M. Zaben, P. Brennan, P. Hutchinson, A. Ahmed
-
- DI.15.06 *A computer game for patients with Parkinson's disease - a new form of PC based physiotherapy*
R. Grunert* (Dresden, Deutschland), A. Krause, P. Themann, J. Meixensberger, D. Winkler
-
- DI.15.07 *Analysis of global DNA methylation spectrum in acute pain syndrome*
A. Barciszewska* (Poznan, Poland)
-

Monitoring of pineal cysts in children

Amjad Ali¹, Ian Kamaly¹

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Objective: A cohort of children with pineal cysts at the Royal Manchester Children's Hospital were identified to determine the progression and associated clinical features of pineal cysts. The objective of this study was to identify if there is a need to radiologically monitor pineal cysts in the absence of any clinical symptoms and signs.

Methods: Children with a formal radiological diagnosis of pineal cysts in their scan reports between 2009-2015 were included in the project. Those with other pathology were excluded from the study such as arachnoid cyst and brain tumours. Those whose cysts were later diagnosed as a different condition were excluded. Data was collected on the child's age of diagnosis, symptomatology, co-morbidities cyst size and radiological appearance, co-morbidities. Volumetric analysis of the cysts was done, with CSF volume and tumour volumes measured. All repeat follow-up scans were assessed.

Results: The total cohort included 99 children identified from radiological reports. Twenty-one children were excluded due to the presence of other brain abnormalities and absence of a measurable cyst. No symptomatic changes were identified in the clinical letters. An assessment of the follow-up MRI and CT scans revealed no change in the pineal cyst volume.

Conclusion: Most pineal cysts were found as incidental findings and all the children assessed in this cohort had no associated symptoms at the time of presentation. Volumetric measurements revealed there was no change identified in the pineal cyst size. With the absence of any clinical symptoms serial scanning may not be necessary for pineal cysts. This would prevent unnecessary distress and sedation for the children.

Developing an *in vitro* model of disease spread in Parkinson's disease for mechanistic insight into dopaminergic graft pathology following stereotactic transplant

Ammar Natalwala¹, Karamjit Singh Dolt¹, Yixi Chen¹, Ratsuda Yapom¹, Tilo Kunath¹

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Objective: Since the 1960s, there has been some success in targeted medical (L-Dopa) and surgical (deep brain stimulation) treatments for motor symptoms in Parkinson's disease (PD). However, these are non-disease modifying, each with limitations. An experimental and emerging therapy for PD involves stereotactic dopaminergic cell transplantation. Clinical trials in the 1990s were proof of concept as marked improvement was seen in some patients receiving fetal grafts into striatum. Although, on autopsy some grafts acquired Lewy body pathology, a hallmark of PD. This host-to-graft spread of disease is potentially a major hindrance for future treatments. We aim to develop an *in vitro* model of disease spread using transgenic cell lines over-expressing α -synuclein, the protein responsible for Lewy body pathology, for mechanistic insight into this process.

Methods: A human embryonic stem cell (hESC) line was transfected with an expression plasmid containing the human *SNCA* gene to produce several clonal transgenic lines over-expressing α -synuclein. Of these, the S37 line expressed eight-fold greater levels of α -synuclein than controls. The transgenic S37 and control hESCs were differentiated into midbrain dopaminergic neurons using a robust protocol, and culture media was seeded with recombinant monomers and pre-formed fibrils (PFFs) of α -synuclein. After 3 weeks, the neurons were fixed and immunofluorescence used to detect expression of phosphorylated α -synuclein at serine-129 (pSer-129), an early sign of Lewy pathology.

Results: Monomers of α -synuclein did not cause accumulation of phosphorylated α -synuclein in either S37 or control neurons. PFFs did cause the formation of phosphorylated α -synuclein structures in both sets of neurons. The pSer-129 α -synuclein immunostaining was observed in discrete short stretches within axons, an early sign of Lewy neurite formation. This preliminary work shows that the phosphorylated α -synuclein structures was more prevalent in S37 neurons, which highly express α -synuclein, than in control neurons.

Conclusion: We found that monomers of α -synuclein cannot seed Lewy body-like pathology in human dopaminergic neurons agreeing with work performed with mouse and rat neurons. Furthermore, α -synuclein PFFs can initiate signs of Lewy pathology (pSer-129 α -synuclein in axons) in both wild-type and S37 transgenic neurons, with the latter accumulating more pathology. This work establishes an important human model to study PD within neuronal networks where neurons that highly express endogenous α -synuclein may be more susceptible to Lewy pathology and disease. Further work will be done on S37 and other transgenic *SNCA* lines expressing varying α -synuclein levels to quantitatively correlate differences in rate of disease spread to the levels of α -synuclein protein expression. This work will be subsequently validated in a rat model of PD *in vivo*.

Prospective multi-centre study of external ventricular drainage management and infection rate in the United Kingdom and Ireland

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Objectives: To establish contemporary practice patterns and the infection rate of External Ventricular Drainage (EVD) in the UK and Ireland.

Methods: Clinical variables were prospectively collected over a 6-month period on patients who have an EVD inserted in 21 participating units. The primary outcome measure was 30-day EVD-related infection (ERI). A Cox Regression Model was used for multivariate analysis.

Results: A total of 495 EVD catheters were inserted into 357 patients equating to 4626 drainage days. Neurovascular (65%) was the most common aetiology for EVD insertion followed by tumours (18%) and trauma (7%). Of the catheters, 188 (38%) were antibiotic-impregnated, 161 (32%) were non-impregnated and 146 (30%) were silver-impregnated catheters. A total of 45 ERIs occurred giving the cohort an infection rate of 9%. Multivariate analysis adjusted for age and sex showed that EVD duration of ≥ 8 days had a significantly higher risk of ERI [HR=2.47(1.12-5.45); p=0.02] compared to catheters in-situ <8 days. There was no significant difference in ERI risk between the different catheter types in the multivariate analysis.

Conclusions: In the UK, EVD infection rate was 9% during the study period. The audit demonstrated wide variation in the choice of catheter type across the country with no significant difference in ERI rate between them. Importantly, it also highlighted that EVDs left in situ for ≥ 8 days have a higher risk of infection.

A computer game for patients with Parkinson's disease - a new form of PC based physiotherapy

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Objective: The physiotherapeutic care of patients with Parkinson's disease is an important support in the maintenance of mobility and the associated quality of life. Certain movements are reactivated or optimized by means of specific exercises, which helps to manage the illness in the best possible way. Due to the technical innovations in the field of soft- and hardware new possibilities arise as a complement to traditional physiotherapy.

The aim of this work was the development of a computer game for rehabilitation exercises especially for patients with Parkinson's disease which recognizes the patient's movement in real-time and which provides a basis for the correction of the patient.

Methods: Using a Microsoft Kinect camera®, the patient movements are recorded markerless and transferred into the computer game. The prototype consists of a basketball game in which the patients have to throw a ball into a basket as often as possible. The throw of the basketball is an exercise to train the swing of an extremity on the one hand and to train movements with a large action radius on the other hand. The functional requirements were developed in an interprofessional approach.

Results: A software prototype was developed, which included a training exercise in the form of a basketball game. The symptoms "freezing" as well as the Pisa syndrome are to be treated by repeated exercises with large swing and large range of movement. The player (patient) is guided through the game by acoustic and visual feedback which allows the patient a correction of the movements by himself. In addition, potentially motivation-enhancing mechanisms are applied in the form of highscores and automatic difficulty changes. The efficacy and overall usability of the program have been tested with 5 individual patients.

Conclusion: The mechanisms of the prototype, including direct acoustic or visual control, allow a much autonomous and effective practice without neglecting the fun of exercising. Due to the Kinect's markerless recording of the player's movements and the compatibility with every Windows PC, it should be possible to provide a system, which would be easy to install in patients home environment.

Analysis of global DNA methylation spectrum in acute pain syndrome

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Objective: Pain is the most basic sign of illness, being an overture to start diagnostics and treatment. However, more and more often in medicine we meet chronic pain, accompanying e.g. neoplastic disease, diabetes or degenerative spine disease, that lacks its warning character and becomes a disease itself. Such pain doesn't react on standard therapeutic methods, results in lowering quality of life, has a negative impact on patient's emotional and physical functioning and generates socio-economic costs. However, the cause of chronic pain as well as the objective assessment of pain intensity sensed by the patient, are still a challenge in medicine. Currently used methods rely only on the subjective feeling of the patient. Therefore there is a need for precise description of pain on the molecular level, for characterization of its various forms, what can be a base for personalized treatment assessment.

Methods: Peripheral blood samples were taken from patients with pain syndrome operated on lumbar discopathy before and after performing the procedure. DNA was hydrolyzed with micrococcal nuclease and snake venom phosphodiesterase, and then radioactively labeled using T4 polynucleotide kinase and [γ -³²P] ATP. Hot nucleotides' mixture was separated with thin layer chromatography (TLC). The chromatograms were assessed using Phosphoimager, and the amount of m⁵C represented as a ratio (R) of intensity of spots of m⁵C to m⁵C+C+T. For the analysis of the results statistical methods were used. The amount of m⁵C was correlated with pain intensity assessed by the patient (in VAS), pain duration, advancement of primary disease, comorbidities, treatment applied thus far and lifestyle, as well as laboratory tests' results.

Results: Our preliminary studies on a group of 50 subjects operated on lumbar discopathy show that the intensity of pain is associated with the decrease of global DNA methylation. The level of m⁵C in peripheral blood DNA of patients complaining about pain depends on its type and time of duration. Because there are no known specific human DNA demethylases, pain-associated DNA demethylation can be a result of changes in red-ox potential of the cell, as a consequence of oxidative stress. Therefore the decrease of m⁵C level has a great informative potential and can be widely used in the clinical setting. DNA analysis provides the precise global m⁵C content depending on the intensity and type of pain, allow the estimation of the extent and speed of global DNA methylation changes, impact of irritating factors and correlation with subjective pain assessment scale.

Conclusion: The obtained results showing a different range of DNA demethylation contribute to a better understanding of the molecular basis of pain. There is a possibility that in the future that epigenetic method will be used in clinical diagnostics and therapy design.

DI.16 Pädiatrische Neurochirurgie 4

Dienstag *Tuesday*, 16.05.2017, 10.40 – 11.40 Uhr *hrs*

- DI.16.01 *Development of intracranial hypertension after treatment of temporal arachnoid cysts: possible pathophysiology and 2 case reports*
D. Class, O. Melhem, J. Kohl, R. Firsching, O. Melhem* (Magdeburg, Deutschland)
-
- DI.16.02 *Advantages of U-shape dural opening in posterior fossa surgery in pediatric patients*
R. da Silva Freitas, C. Kural, M. Laffitte, M. Schuhmann, R. da Silva Freitas* (Tübingen, Deutschland)
-
- DI.16.03 *Tools to maximize radicality and functional preservation in pediatric patients undergoing surgery in eloquent areas*
M. Schuhmann* (Tübingen, Deutschland), M. Liebsch, T. Leao Tatagiba, C. Roder, S. Bisdas, S. Gröschel, M. Wilke
-
- DI.16.04 *Subduroperitoneal Shunts for treatment of chronic subdural hematoma in infancy*
A. Alaid* (Göttingen, Deutschland), H. Ludwig, H. Bock
-
- DI.16.05 *Use of intraoperative magnetic resonance imaging for the treatment of craniopharyngiomas in pediatric age*
M. Giordano* (Hannover, Deutschland), A. Samii, H. Bertalanffy, C. Di Rocco, M. Samii, R. Fahlbusch
-
- DI.16.06 *Severe dural tear and brain injury after vacuum extraction birth*
S. Senger, C. Flohr, O. Schofer, J. Oertel, S. Linsler, S. Senger* (Homburg, Deutschland)
-

Development of intracranial hypertension after treatment of temporal arachnoid cysts: possible pathophysiology and 2 case reports

Dieter Class¹, Osamah Melhem¹, Jana Kohl¹, Raimund Firsching¹

¹*Otto-von-Guericke-Universität, Universitätsklinik für Neurochirurgie, Magdeburg, Deutschland*

Objective: Temporal arachnoid cysts are well known intracranial space occupying lesions. They are rarely associated with increase in intracranial pressure (ICP). We report 2 patients with cysto-peritoneal shunts presenting with significant clinical worsening 18 and 6 years after primary shunt placement. At the same time progressive enlargement of the CSF spaces in CT and MRI studies was not noticed in both patients despite severe clinical symptoms. This clinical and radiological phenomenon appears comparable to similar findings in patients with hydrocephalus treated by shunt placement but the underlying pathophysiological mechanisms remain unclear.

Methods: Clinical and radiological data of 2 patients now in care of our department were reviewed as far as available as primary operations were performed in other clinics with both patients. Follow-up is complete as both patients were operated for shunt malfunction only this year in our department.

Results: One 3-year-old boy was treated because of a large temporal arachnoid cyst by a cysto-peritoneal shunt system in 1998. 2 shunt revisions were necessary and now in 2016 signs of progressive intracranial hypertension with papilledema and increasing epileptic seizures were noted. Shunt revision was performed at the age of 21 years. The other 9 year old boy was treated similarly with a cysto-peritoneal shunt device. No shunt revision was necessary until operation for shunt malfunction in 2016 at the age of 15 years. Clinical symptoms showed rapid improvement in both boys but radiological findings before and after the last operation were found unchanged.

Conclusion: Arachnoid cysts are classified according to size, location and free passage of CSF from the cyst to subarachnoid spaces which can be studied by cisternography or phase contrast MRI. In patients with a longer follow up after primary shunt placement who are now presenting with clinical signs of increasing intracranial pressure the situation is often unclear. Cysto-peritoneal shunts may be related to complex disturbances of CSF circulation. Radiological findings may be of little help in this situation. So even in the absence of radiological signs early shunt revisions are to be recommended in doubtful cases as in patients with hydrocephalus treated by a shunt system where real dilatation of the ventricular system is not seen.

Advantages of U-shape dural opening in posterior fossa surgery in pediatric patients

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Objective: Midline suboccipital approach is the standard approach for many posterior fossa pathologies. Y-shaped dural incision is the classical technique for dura opening, however duraplasty is necessary for watertight closure in the majority of cases. U-shaped durotomy is an alternative technique with several advantages. The aim of this study was to analyze the results of U-shaped durotomy in pediatric cases with median suboccipital approach.

Methods: 50 children underwent surgical treatment in the posterior fossa using U-shaped durotomy. 50% of cases had pilocytic astrocytoma, 25% medulloblastoma, 25% other (tumor) pathologies. We recorded extent of exposure, necessity of dural retraction sutures, percentage of primary dura closure versus duraplasty, and rate of postoperative CSF leaks, infections and revisions.

Results: U-shaped durotomy was easily applied in all cases. Intradural venous sinuses, if present in infants and small children, could all be addressed in a controlled manner without significant blood loss. No additional lateral dural retraction was necessary for full exposure, also for lateralized pathologies. The dura was closed by primary suture in 50/50 tumor cases, no duraplasty was performed. In the postoperative period, no CSF fistula or pseudomeningocele and no infection were observed, in one case a superficial wound revision because of skin dehiscence was necessary.

Conclusion: U-shaped dural opening can be easily applied in all pediatric posterior fossa lesions. Midline as well as lateral located lesions can be resected without additional dural retraction or cut. U-shaped durotomy in this series had a 0% rate of duraplasty for closure and 0% rate of CSF fistula and infections. Since Y shape technique has been abandoned in our service 8 years ago, a control group does not exist. Compared to literature reports on Y shape opening, which all describe a significant rate of duraplasty, CSF leaks, pseudomeningocele and infections, U shape opening seems to be the superior technique and can be recommended without restrictions.

Tools to maximize radicality and functional preservation in pediatric patients undergoing surgery in eloquent areas

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Objective: Extensive functional MRI, tractography and TMS are rarely used in children for the pre-operative work-up due to a presumed age related inability of children to perform accordingly in the scanner. We have shown, that a dedicated team in an appropriate environment is able to establish extensive functional imaging in awake children. This information, used for meticulous planning of surgical strategy, needs to be combined with intraoperative monitoring and imaging to optimize radicality and functional preservation.

Methods: 21 pediatric patients were included with either low grade glioma (n=14) or cavernomas (n=7) of central region, (left) temporal (region) or midbrain. They received: fMRI for language detection with up to 4 paradigms (n=10), fMRI of motor cortex (n=11), tractography of motor tract (n=13), tractography visual tract (n=9) and arcuate fascicle (n=3). TMS was performed in 5 cases. High resolution intraoperative ultrasound was used in 19 operations and iMRI in 9.

Results: The desired functional or tract information was obtained in all cases. Surgical corridors were defined according to those results. In one case family decided against surgery, in all other results helped to balance risk. Extended intra-operative neuromonitoring was used to confirm pre-operatively defined functionality if ever possible. One child underwent awake surgery because of arcuate fascicle involvement. Surgical goals according to intention to treat, which was mostly radical resection, could be achieved in all cases. There were no permanent new functional deficits except for partial loss of visual field in 1 case. Intraoperative ultrasound was most helpful, supplemented by iMRI, to achieve radicality.

Conclusion: Modern functional MRI and tractography are possible in awake children from 5 years onwards if an adequate study atmosphere is maintained. Tractography can be done for visual tract and arcuate fascicle visualization equally good as motor tractography. In combination with intraoperative neuromonitoring, high-resolution ultrasound and iMRI, this information enables the pediatric neurosurgeon to successfully „walk“ on the thin red line between radicality and functional impairment with reduced risks for harming. Thus, these time consuming additional techniques should be used whenever possible to make surgery of lesions in eloquent areas as radical and safe as possible and thus rewarding for surgeon and patient.

Subduroperitoneal Shunts for treatment of chronic subdural hematoma in infancy

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Objective: Children with macrocephalus due to chronic subdural hematoma often need different types of hematoma tapping or fluid diversity. Some hematomas occur in case of suspected shaken baby syndrome. Several authors have shown that even at the first admission to hospital immediately after trauma subdural hematomas consist of chronic hygroma fluid. Acute subdural blood obviously does not seem to be a prerequisite for a chronic hypodense fluid volume. Several authors have shown that bridging vein thrombosis in infancy could be important for the origin and formation of the subdural fluid collections. This is the reason, why in most cases fluid diversion has to be performed for longer treatment periods, mostly several weeks or months. Evidence based data does not exist, which makes it important to investigate and analyze the own data and experiences if sufficient numbers exist.

Methods: We have analyzed data of different types of shunt diversion in 36 cases of CSDH in infancy (age < 24 months) out of a cohort of shunt procedures using a specific prospective shunt registry. Most of the children were suspected to be victims of abusive head trauma. 88 % showed an escalating head enlargement with prominence of the fontanel and developmental delay. 30 % were diagnosed with additional parenchymal concussions, 44 % had disturbances of their vigilance. The treatment options were immediate transfontanel tapping (1), intermittent puncture using Omayo reservoir (3), external fluid drains for several days (9), single sided subduroperitoneal shunts with valve interposition of different types (19) and valveless shunts (4). All fluid collections consisted of blood degradation products (100 %). All children had CT or MRI scans before and 3 months after surgery, mean follow up time was 24 months.

Results: Macrocephaly as the most important sign of the space occupying subdural collection could be treated successfully in all cases with subdural shunting. Children with major concussive parenchymal trauma had a poor outcome. Other children were treated successfully and could overcome their developmental delay after 6 months. Typical complications were subgaleal fluid collection and occlusion of the subdural catheter.

Conclusion: Valveless shunting using catheters with widened perforations was the most effective method to prevent shunt obstruction. Shunt explantation after therapeutic drainage period was avoided in most cases.

Use of intraoperative magnetic resonance imaging for the treatment of craniopharyngiomas in pediatric age

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Objective: The use of high field intraoperative magnetic resonance imaging (iMRI) utility has been largely evaluated for the treatment of sellar lesions in adult patients. In this study we investigate the safety, advantages and limitations of high field iMRI for the treatment of craniopharyngiomas in pediatric age.

Methods: We analyzed 15 patients under 16 years of age affected by craniopharyngioma (22 surgeries). All patients were operated using iMRI (BrainSuite 1.5T). Pre- and postoperative neurological and endocrinological status, presence of residual tumor, number of intraoperative scans and complications were evaluated.

Results: The most common preoperative symptoms and signs were visual field deficit, hypophysial-hypothalamic dysfunction and intracranial hypertension. Of the 22 surgeries, 9 cases underwent the first surgery while 13 who suffered from recurrence had previous surgery. Regarding the 9 patients operated for the first time, a total removal of the lesion has been preoperatively planned and could be achieved in all cases. Considering the 13 procedures with recurrent tumors we could achieve a total removal in 10 and subtotal in 3 cases. In the 10 cases that underwent complete resection, 7 needed only 1 iMRI imaging that confirmed the total excision while residual tumor was detected in the other 3 cases at the iMRI imaging and required further removal. We had no intra- or postoperative complications due to the use of iMRI.

Conclusion: Use of iMRI for the treatment of pediatric craniopharyngiomas proved to be safe and effective in achieving complete tumor resection. We had no complications due to intraoperative imaging. The most important drawback of high-field iMRI was the difficult operative positioning, especially in younger children, due to the structure of the surgical table.

Severe dural tear and brain injury after vacuum extraction birth

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Objective: Traumatic brain lesions after vacuum extraction delivery are rare. Most common complication after operative vaginal deliveries is subgaleal hematoma applied by trained obstetricians. There are only single case reports about major complications after vacuum extraction delivery in the literature available. Here, the authors present a case of a severe brain damage and dura tear after vacuum extraction delivery.

Methods: A 2980-g female infant was born at 39 weeks via vacuum. The baby was in an occipitoposterior position when arrest of birth occurred. A VE was performed with Kiwi Omni Cup with one pull of 8 minutes duration. A large cephalic hematoma was visible directly after delivery at the frontal part.

Because of generalized epileptic seizure on second day after birth as MRI scan was performed demonstrating a severe dural tear with large subgaleal CSF accumulation and subgaleal haemorrhage. Also damage of the dorsofrontal lobe and a brain prolapse was detected.

Results: In the presented case surgical treatment of the dural tear was required. Five month after initial surgical closure of dural tear a revision surgery with new duraplasty and also fixation of an autologous bone graft was necessary cause of persistend CSF fistula. Additionally, ventriculoperitoneal shunting was necessary one week after second surgery cause of posttraumatic hydrocephalus. In last follow up after 11 month, the girl was noted to have recovered completely.

Conclusion: Long-term follow-up of babies born via vacuum extraction who experienced brain damage usually shows complete resolution of hemorrhage and show a regular neurological development as presented in this case. Surgery is only required in rare cases of severe dural ruptures preventing persisting CSF fistulas. In case of severe dural tears and possible posttraumatic hydrocephalus bone graft and external ventricular drainage or ventriculoperitoneal shunting might be necessary additional to duraplasty.

DI.17 Tumor 8 - Funktionelle Aspekte

Dienstag *Tuesday*, 16.05.2017, 10.40 – 11.40 Uhr *hrs*

- DI.17.01 *fMRI resting state connectivity between language areas as defined by direct electrocortical stimulation in low grade glioma patients*
J. van Lieshout* (Düsseldorf, Deutschland), M. Rapp, W. de Baene, G. Rutten
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- DI.17.02 *Intraoperative Change of the fractional anisotropy of the optic chiasma during resection of suprasellar Tumor as an early predictor of the visual outcome*
H. Metwali* (Hannover, Deutschland), M. Giordano, K. Kniese, A. Samii, M. Samii, R. Fahlbusch
-
- DI.17.03 *Neuronal network analysis of A-trains during vestibular schwannoma surgery in patients with and without a separate intermedius nerve*
S. Rampp* (Halle, Deutschland), C. Strauss, J. Prell
-
- DI.17.04 *Mapping of the Functional Integrity of the Brain Surface in Glioma Patients by Intraoperative Optical Imaging and Direct Cortical Stimulation*
M. Oelschlägel* (Dresden, Deutschland), T. Meyer, U. Morgenstern, G. Schackert, S. Sobottka
-
- DI.17.05 *Preoperative mapping of calculation function by rTMS in patients with parietal brain tumors and correlation with postoperative outcome*
S. Ille* (München, Deutschland), K. Giglhuber, K. Drummer, S. Maurer, B. Meyer, S. Krieg
-
- DI.17.06 *Evaluation of brain tumor regrowth in relation to motor areas – a multimodal approach*
T. Laub* (München, Deutschland), N. Sollmann, A. Kelm, B. Meyer, S. Combs, S. Krieg
-

fMRI resting state connectivity between language areas as defined by direct electrocortical stimulation in low grade glioma patients

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Objectives: The aims of this study were (1) to examine the extend of resting state functional connectivity between language regions of interest (ROI) as identified by intraoperative direct electrocortical stimulation (DES) and to compare these findings with negative control regions; (2) to determine whether Resting State Connectivity (RSC) can discriminate between DES-positive language regions and nearby DES-negative regions.

Methods: We conducted a retrospective study of 10 low-grade glioma patients with language positive DES regions on at least two separate cortical lobes. Language regions were identified by intraoperative DES. We compared seed to seed analysis of RSC between and within groups of positive and negative ROI. The latter regions were randomly chosen, both at close distance (10 mm, same gyrus) and farther away (> 10 mm, different gyrus).

Results: Median connectivity within the group of positive language ROIs (n=31) was significantly higher than within either the group of close- or far-negative controls, 0.332 [0.206-0.391] vs. 0.203 [0.049-0.291] and 0.215 [0.093-0.301] respectively ($p < 0.05$). The median connectivity between positive language ROIs did not significantly differ from the median connectivity between the close-negative and positive language seeds; 0.332 [0.206-0.391] vs. 0.282 [0.156-0.375] ($p > 0.44$), but it did differ from the median connectivity between the far-negative and positive language seeds; 0.332 [0.206-0.391] vs. 0.091 [0.028-0.230] ($p < 0.001$).

Conclusion: On a group level, median RSC correlates with DES for mapping of surgically relevant language areas in patients with LGG. However, RSC does not seem able to discriminate between positive or negative language ROIs on a surgical relevant resolution without a-priori knowledge. Surgical application of resting state protocols for identification of language function should therefore be addressed with caution. However, the results do suggest a shared neuronal and functional basis between both techniques.

Intraoperative Change of the fractional anisotropy of the optic chiasma during resection of suprasellar Tumor as an early predictor of the visual outcome

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Objective: The fractional anisotropy (FA) is one of the indices obtained from the DTI and indicates the neural integrity. In this study we correlated the intraoperative change in the FA of the optic chiasma after its decompression to the early and delayed visual outcome in patients with suprasellar tumors operated under intraoperative MRI control.

Methods: Thirty sequential patients with suprasellar tumors presented with chiasma compression syndrome were operated under intraoperative MRI control between March 2014 and March 2016 and included in this study. The FA of the optic chiasma was measured immediately before and immediately after tumor resection. The visual impairment score (VIS) was used to quantify the extent of ophthalmological disturbances before surgery, within 2 weeks, and 3 months after surgery. Wilcoxon Signed-Rank Test was used to compare the VIS before and after surgery and the FA before and after surgery. The correlation between the change in the FA and the early and late improvement of the VIS was tested using Spearman's rank correlation coefficient.

Results: The VIS improved significantly after surgery as assessed by Wilcoxon Signed-Rank Test. The FA values of the optic chiasma decreased significantly after decompression. Interestingly, the early and the delayed improvement of the VIS was strongly correlated to the decrease in the average FA values of the optic chiasma after its decompression. It can also predict delayed improvement in patients with early postoperative unchanged or even deteriorated visual status..

Conclusion: The intraoperative decrease of the FA of the optic chiasma is directly related the early and the delayed improvement of visual impairment. It could be used as an early predictor of the visual outcome even in patients with unchanged or even worsened early postoperative visual status.

Neuronal network analysis of A-trains during vestibular schwannoma surgery in patients with and without a separate intermedius nerve

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Objective: Specific pathophysiologic activity in the EMG of the facial muscles, so called “A-trains”, correlate with the degree of postoperative facial palsy after vestibular schwannoma surgery in the cerebello-pontine angle (CPA). However, it has been demonstrated that a separate intermedius nerve distinguishable from the facial nerve trunk in the CPA presents a confounder and causes a vast increase of A-train activity without correlation to the functional status. Due to the complex interplay of tumor size, potentially harmful surgical maneuvers, presence of a separate intermedius nerve, A-train activity and postoperative facial palsy, we investigated the use of a neuronal network, which is suited to capture such interrelations implicitly.

Methods: The amount of automatically detected A-train activity and tumor sizes of 144 patients who underwent first surgery for a vestibular schwannoma were used to train and evaluate a neuronal network (NN). The chosen architecture was a feedforward network with a single hidden layer. “Traintime”, the overall quantity of A-trains, of 9 channels (electrodes in the m. orb. oculi and oris, as well as in the perinasal muscles) and the tumor size (Koos classification) were used as inputs. The immediately postoperative facial nerve function (graded according to House and Brackmann, HB), as well as after approx. six month were uses as outputs. The 144 cases were automatically divided into training, validation and testing groups (70, 15, and 15%). The resulting estimated HB grades of the network were compared to the actual HB grades.

Results: A total of 70 patients presented without separate intermedius nerve. Spearman-correlation of traintime to postoperative HB without application of the NN methodology was 0.45 ($p < 0.0001$). The 74 patients with separate intermedius nerve showed a correlation of 0.15 ($p > 0.1$) and presented with significantly larger tumors ($p < 0.05$). Correlation of NN-estimated with actual HB grades was 0.68 ($p < 0.0001$).

Conclusion: Neuronal networks are able to compensate the confounding influence of a separate intermedius nerve, based on the total traintime per channel and the tumor size. The results suggest an interrelation of excess intermedius activity and tumor size.

Mapping of the Functional Integrity of the Brain Surface in Glioma Patients by Intraoperative Optical Imaging and Direct Cortical Stimulation

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Objective: The process of glioma resection is characterized by the trade-off between a maximization of tumor resection extent and the minimization of the risk for functional disorders of the patient. Several intraoperative techniques like 5-ALA fluorescence are available to provide morphological information about the tumor extent during the surgical procedure, nevertheless specific functional testing of brain tissue can only be performed in awake cases. Here, we present the first results of a novel approach to assess the functional state of the brain tissue by evaluating the hemodynamic response of the tissue that can be observed with Intraoperative Optical Imaging (IOI) after Direct Cortical Stimulation (DCS) of the exposed cortical surface.

Methods: Measurements with the optical imaging technique were performed as a proof of concept on three patients that underwent resection of superficial gliomas. The exposed cortical surface of each patient was directly electrically stimulated ($I_{\text{stim}} = 6 \text{ mA}$, $T_{\text{stim}} = 5 \text{ s}$) with a bipolar electrode on multiple stimulation sites while simultaneously images of the cortical surface were acquired with a camera attached to the surgical microscope. Light wavelength filtering was performed within the optical path of the camera at $\lambda = 568 \text{ nm}$ (**FWHM = 10 nm**). Hemodynamic responses were extracted from all stimulation sites using a dynamic linear model. Classification for tumor or non-tumor response was performed based on neuro-navigation data. Various characteristic features (peak signal amplitude, signal duration etc.) of the hemodynamic response were extracted and compared for both response types.

Results: The group of hemodynamic response models extracted from tumor tissue sites are characterized by a statistically significant lowered maximal signal amplitude of relative reflectance change compared to the hemodynamic response models extracted from non-tumor sites (Wilcoxon rank sum test, $p = 0.003$). The other calculated model features showed no significant difference. Furthermore, the results are revealing that several anatomical influences, e.g. a thickened arachnoid membrane or the stimulation over sulci may influence the stimulation results.

Conclusion: The investigations demonstrate evidence that intraoperative tissue differentiation by optical imaging of direct cortical stimulation might be possible. Significant differences were especially observed in the peak signal amplitude that correlates with the amount of blood volume changes.

Preoperative mapping of calculation function by rTMS in patients with parietal brain tumors and correlation with postoperative outcome

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Objective: In order to resect brain tumors while preserving the patient's brain functions, neurosurgeons apply intraoperative direct cortical stimulation (DCS) during awake surgery. Apart from language mapping, some highly specialized centers also map further higher cortical functions such as calculation function. Recently, the feasibility of mapping calculation function by repetitive navigated transcranial magnetic stimulation (rTMS) in healthy volunteers has been shown. The aim of the present study was to correlate the resection of calculation-positive sites in terms of rTMS with functional patient outcome of calculation performance.

Methods: Nine patients with right- or left-sided (7 right-, 2 left-sided) parietal brain tumors (7 gliomas, 2 metastases) underwent preoperative rTMS calculation mapping. We stimulated 52 previously determined cortical sites over the whole tumor hemisphere while patients performed a calculation task with 80 simple arithmetic operations. Pre- and postoperatively, patients performed a standardized number processing and calculation test (NPCT).

Results: The overall error rate (ER = calculation errors per stimulations) for tumor hemispheres was 7.3%. The resection of calculation-positive sites in terms of rTMS worsened the postoperative NPCT result in 6 cases. In 2 cases no calculation-positive sites were resected and the postoperative NPCT result was similar or better than preoperatively. In one case the postoperative NPCT result was better than preoperatively although calculation-positive sites were resected. According to these results sensitivity and negative predictive value are 100%, specificity is 66.7%, and positive predictive value is 85.7%.

Conclusion: The resection of calculation-positive sites in terms of rTMS correlated with postoperative NPCT results in 8 of 9 cases. Despite only presenting a low number of cases, rTMS might be a useful tool for preoperative mapping of calculation function. However, the reliability of the present results has to be evaluated in a larger series.

Evaluation of brain tumor regrowth in relation to motor areas – a multimodal approach

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Objective: Glioma cells spread towards blood-supply-sufficient microenvironments. Since neuronal activity in response to movement, for instance, induces a higher regional blood flow and oxygenation level in the respective area of activation, we examined whether glioma recurrences show a grow pattern towards motor-eloquent areas.

Methods: 60 patients with motor-eloquent high-grade gliomas (HGGs) were enrolled. All patients underwent magnetic resonance imaging (MRI) and navigated transcranial magnetic stimulation (nTMS) for motor mapping prior to surgery and suffered a relapse during long-term follow-up. Motor-eloquent areas were defined via nTMS and nTMS-based tractography. According to postoperative MRI, patients were separated into three groups: patients without a residual tumor (group 1), patients with a residual tumor moving away from motor areas (group 2), and patients with a residual tumor moving towards motor areas (group 3).

Results: Average growth towards motor areas mapped by nTMS was 2.1 ± 4.5 mm/month in the FLAIR sequences and 2.2 ± 6.1 mm/month in the contrast-enhanced T1-weighted sequences. The major growth direction was towards motor eloquent areas as defined by nTMS in all groups. Moreover, there was no significant difference in growth speed between the three groups for contrast-enhanced T1-weighted (group 1: 1.1 ± 2.0 mm/month, group 2: 1.4 ± 3.5 mm/month, group 3: 4.5 ± 7.7 mm/month) as well as FLAIR sequences (group 1: 1.5 ± 1.3 mm/month, group 2: 0.8 ± 3.4 mm/month, group 3: 3.8 ± 5.7 mm/month). Positive values mean growth towards the tumor.

Conclusion: This study suggests a new strategy to predict tumor regrowth patterns, which could improve the surgical but also radiotherapy planning.

DI.18 Tumor 9 - Meningeome B

Dienstag *Tuesday*, 16.05.2017, 10.40 – 11.50 Uhr *hrs*

- DI.18.01 *Expression and functional role of kinesin family members in meningioma*
G. Jungwirth* (Heidelberg, Deutschland), R. Warta, M. Simon, K. Lamszus, A. Unterberg, C. Herold-Mende
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- DI.18.02 *Gene expression of mitotic drivers TPX2 and RAN is upregulated dependent on meningioma grade and correlates with MIB-1 labeling index*
S. Telentschak* (Köln, Deutschland), G. Röhn, L. Görtz, N. Von Spreckelsen, P. Stavrinou, R. Goldbrunner, M. Timmer
-
- DI.18.03 *Meningioma in vitro-xenograft model - The missing link between an in vitro and in vivo meningioma model*
J. Walter, D. Freitag, U. Tiller, R. Kalff, J. Walter* (Jena, Deutschland)
-
- DI.18.04 *Postoperative facial nerve function after removal of skull base meningiomas involving the internal auditory canal*
G. Montibeller* (Curitiba, Brazil), M. Coelho Neto, R. Ramina
-
- DI.18.05 *Prognostic value of TERT promoter mutation in aggressive meningiomas*
A. Biczok* (München, Deutschland), T. Kraus, B. Suchorska, N. Terpolilli, C. Schichor, J. Tonn
-
- DI.18.06 *Seizures in Meningioma Patients: Potential Risk Factors and Influence of Anti-Epileptic Treatment.*
P. Baumgarten* (Frankfurt am Main, Deutschland), M. Sarlak, S. Bernatz, F. Gessler, V. Seifert, T. Freiman
-
- DI.18.07 *WHO grade of intracranial meningiomas differ with respect to patient age and Tumor location*
A. Wallrodt, M. Brodhun, S. Rosahl, R. Gerlach* (Erfurt, Deutschland)
-

Expression and functional role of kinesin family members in meningioma

Gerhard Jungwirth¹, Rolf Warta¹, Matthias Simon², Katrin Lamszus³, Andreas Unterberg¹, Christel Herold-Mende¹

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³*Department of Neurosurgery, University Medical Center Hamburg Eppendorf, Hamburg, Deutschland*

Objective: The kinesin superfamily (KIF) members are highly conserved motor proteins, which are classified into 14 families. Kinesins play an important role in cellular functions including transport of vesicles and mitosis. Overexpression of the motor protein KIF11 can induce premature sister chromatid separation, leading to unequal distributed genetic material and therefore may promote malignant progression. Kinesin proteins are involved in multiple cancer types including melanoma, retinoblastoma, and glioma. So far, kinesin family members have not been investigated in meningiomas yet. Hence, in this study we evaluated the role of kinesins in meningioma.

Methods: qRT-PCR of seventy-five meningioma tissues for KIFC1, KIF4A, KIF11, KIF14, and KIF20A was performed (WHO °I n= 24, °II n=20, °III n=31) and data was normalized to GAPDH and ACTB and to WHO °I meningiomas. For subgroup analysis, meningiomas were grouped into primary tumors without recurrence in given time interval (B), meningioma with malignant progression (M), recurrent (R), non-recurrent (NR) meningiomas and where data is not available (NA). Kinesin expression levels were divided into high and low-expressing groups by the median and correlated to progression-free survival. Only Simpson grade I-III° and primary tumors were included. For *in vitro* work, benign meningioma cell line Ben-Men-1 and malignant meningioma cell line NCH93 were used. NCH93 was derived from a patient with anaplastic meningioma. For proliferation assays, meningioma cells were transfected with two different siRNA (25 nM final concentration) or control-siRNA and relative cell growth was assessed by BrdU assay at indicated time points.

Results: As a first step, we selected kinesin family members from our initial gene expression array for further validation by quantitative real-time PCR. We evaluated the mRNA expression levels of kinesin family members KIFC1, KIF4A, KIF11, KIF14, and KIF20A in 24 meningioma tumor WHO grade °I, 20 grade °II and 31 grade °III meningiomas. The mRNA levels of all investigated kinesins showed a statistically significant increase with WHO grade. Subgroup analysis of benign meningioma as compared to recurrent and malignantly progressing meningioma revealed increased levels of all investigated kinesins. High expression of KIFC1 (p=.026), KIF11 (p=.048), and KIF14 (p=.017) was associated with a shorter progression-free survival of meningioma patients. Depletion of KIF11 via two different siRNAs inhibited cell proliferation by 91% and 95% on day 3 and 5 (p<.001) in the benign cell line Ben-Men-1 and by 56%, 72%, and 71% on day 1, 3 and 5 in the malignant cell line NCH93 (p<.001), respectively.

Conclusion: Taken together, KIF11 seems to play an important role in meningioma pathogenesis and thus may become a feasible target for meningioma therapy.

Gene expression of mitotic drivers TPX2 and RAN is upregulated dependent on meningioma grade and correlates with MIB-1 labeling index

Sergej Telentschak¹, Gabriele Röhn², Lukas Görtz², Niklas Von Spreckelsen³, Pantelis Stavrinou⁴, Roland Goldbrunner³, Marco Timmer⁵

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Objective: There is still no effective chemotherapy regimen for malignant meningiomas. Numerous studies on different malignancies indicate that Ran (**R**as-related **n**uclear protein), some components of its pathway and TPX2 (**T**argeting **p**rotein for **X**enopus kinesin-like protein **2**) are involved in tumorigenesis, cancer progression and tumor cell survival. Mitotic spindle formation is regulated Ran-dependently by TPX2. Due to its Ran-regulated transportation into the nucleus, TPX2 promotes DNA damage response. To evaluate a potential role of TPX2 and Ran pathway in meningiomas we measured their gene expression in different tumor types.

Methods: Using quantitative RT-PCR, gene expression was analyzed in 77 meningiomas including WHO I° (n=27), II° (n=31), III° (n=19) and 10 brain tissues as control. MIB-1 labeling indices were obtained from histopathology reports. Results were depicted by mean values (\pm SEM) in Arbitrary Units. Statistical analysis was performed using Mann-Whitney U test, Kruskal Wallis test with post hoc analysis, Spearman's correlation and Receiver Operator Characteristics (ROC) analysis. A value of $P < 0.05$ was considered significant.

Results: Significant TPX2 gene overexpression compared to control (0.42 ± 0.12) was detected in all meningioma WHO grades (I°: 0.91 ± 0.15 ; II°: 1.93 ± 0.28 ; III°: 4.33 ± 0.67). With increasing WHO grade there was a steady increase of TPX2 ($P < 0.01$). RAN was significantly overexpressed in WHO III° (2.42 ± 0.29) versus control (1.45 ± 0.12) and showed a significant rise from WHO I° to III° and from II° to III°. Spearman's correlation of RAN and TPX2 was moderate in first diagnosed tumors ($r = 0.518$, $P = 0.003$). In ROC analysis, TPX2 showed predictive properties as biomarker differentiating WHO I° from II°, II° from III° and I° from III° with the areas under the curve of 0.725, 0.791 and 0.912, respectively (each $P < 0.01$). MIB-1 labeling index correlated highly with TPX2 ($r = 0.865$) and moderately with RAN ($r = 0.619$) as well as with Ran pathway components RAN-BP1 ($r = 0.639$) and RCC1 ($r = 0.675$).

Conclusion: TPX2 and RAN were significantly overexpressed in malignant meningioma and correlated with MIB-1. This could implicate them as potential driving force for malignant transformation. Therefore, TPX2 and components of Ran pathway may represent future markers for diagnosis and prognosis as well as targets for chemotherapy in malignant meningioma.

Meningioma *in vitro*-xenograft model - The missing link between an *in vitro* and *in vivo* meningioma model

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Objective: Therapeutic options for non-operable or recurrent meningiomas are infrequent. Therefore new strategies for treatment are required. For analysis of potential therapeutic agents numerous techniques are already available, like 2D- or 3D cell culture systems. A few meningioma mouse models have already been described, but none of them is really reproducible, because of the benign biological behavior of most meningiomas. Most of the commonly used *in vitro* models do not reflect the original cellular organization and heterogeneous structure of a tumor. Since a reliable alternative is still missing, this study aimed at establishing a well manageable method to generate human meningioma in a comparable tumor niche.

Methods: We generated 0.5cm organotypic brain slices of C57/BL6 mice and cultivated these under standard conditions for human meningioma cells for 24 hours. Then we engrafted 1x10⁶ primary meningioma cells or a 2x2mm tissue fragment onto the slices. After cultivation for another 14 days, the slices were formalin fixed and cut into 10µm slices. Characterization of the engrafted cells or tissues was performed by hematoxylin and eosin staining as well as immunohistochemistry for EMA, Vimentin and Ki67.

Results: After cultivation we found "subjectively" growing and vital brain slices. Immunohistochemical analysis showed EMA-, Vimentin- and Ki67-positive cells. On the one hand we found tissue fragments as marker positive spots inside the mouse brain tissue. On the other hand after treatment with primary meningioma culture we found meningioma single cells migrated into the whole mouse brain slice.

Conclusion: We were able to co-cultivate human meningioma cells on and in mouse brain tissue slices in an *in-vitro*-xenograft model. The cultivated cells showed specific marker expression of meningioma tissue and were proliferative. In addition, the single cells showed a clear tendency for migratory behaviour. In summary, we established a well reproducible *in-vitro*-xenograft model as a preliminary stage for *in vivo* studies.

Postoperative facial nerve function after removal of skull base meningiomas involving the internal auditory canal

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Objective: Meningiomas arising within or around the internal auditory canal (IAC) may involve or infiltrate the facial and vestibulocochlear nerves. Surgical removal of tumor extension inside of the IAC preserving the function of involved cranial nerves is a challenge. The object of this study is to evaluate the outcome of facial nerve function after surgical removal of these tumors.

Methods: A series of 55 meningiomas with IAC involvement is presented. Tumor origin was the petroclival region in 40 cases (from a series of 107 surgically removed petroclival meningiomas), the cerebello pontine angle (CPA) in 9 patients (from a series of 39 cases) and pure intrameatal meningiomas in 6 cases. The tumors were removed through the retrosigmoid/transmetal (49 cases) and presigmoid (6 cases) approaches. The outcome of facial nerve function was evaluated according to the House & Brackmann (H&B) scale.

Results: Radical removal of tumor extension inside the IAC was possible in all cases. According to H&B scale the postoperative facial nerve function was: Grade I = 13 cases, Grade II = 20 cases, Grade III = 9 cases, Grade IV = 5 cases and Grade VI = 8 cases (transient in 5). VII/XII anastomosis was performed in the three cases. Hearing preservation was possible in 17 cases out of 40 patients with preoperative hearing. There was no mortality in this series.

Conclusion: Grade of involvement of IAC was an important factor in functional preservation of facial nerve and hearing. More drilling and wider exposure of the IAC is needed in comparison to vestibular schwannomas and the rate of facial nerve function preservation was lower. Removal of infiltrated dura inside the IAC is required to obtain grade 1 Simpson's resection. CPA meningiomas presented a higher rate of hearing preservation than petroclival meningiomas.

Prognostic value of TERT promoter mutation in aggressive meningiomas

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Objective: Transcriptional activating mutations in the promoter of the telomerase reverse transcriptase (TERT) gene occur at high frequency in various types of solid tumors. In atypical and anaplastic meningiomas, however incidence and significance of TERT mutations are still largely unknown. The aim of the present study was to investigate the frequency of TERT promoter mutations in a cohort of atypical and anaplastic meningiomas and to define prognostic significance for progression free survival and overall survival.

Methods: Patients undergoing surgical resection of WHO grade II and WHO grade III meningiomas from 01/2001 to 12/2014 were included into the analysis. TERT analysis for C228T and C250T mutations in the TERT promoter region was performed using PCR method. Patients were stratified into 2 groups (TERT mutation vs. TERT wild type). Univariate and multivariate analysis was conducted using molecular and histological factors as well as surgical features.

Results: During the follow-up time of 38.5 months, 88 patients with atypical (n=73) and anaplastic meningiomas (n=15) were included in the study. TERT promoter region C228T or C250T mutation was found to be mutated in 4 WHO grade II (5.5%) and 2 WHO grade III (13.3%) meningiomas. Presence of TERT mutations were equally distributed between genders (present in 5.7% female and 7.5% of male patients), age did not differ between the subgroups. Meningiomas harboring TERT mutation did not show a strong predilection for any location, with an equally distribution between convexity (n=3) and skull base location (n=3). Presence of a TERT mutation was associated with shorter progression free survival than TERT wild type (median PFS 12.5 month's vs 26 months). In the multivariate analysis, TERT promoter mutation had a strong independent prognostic value on overall survival (median OS 26 months vs 40 months) in aggressive meningiomas ($p=0.009$ HR=4.872).

Conclusion: Presence of TERT promoter mutation variant C228T and C250T was associated with shorter PFS and OS in aggressive meningiomas. TERT mutation status should be considered a clinically relevant prognostic factor in meningiomas WHO grade II and III identifying patients at higher risk for recurrence and progression.

Seizures in meningioma patients: potential risk factors and influence of anti-epileptic treatment

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Objective: Meningiomas belong to the most common intracranial neoplasms in adults. One of the most common clinical symptoms of meningiomas are seizures. However, it still remains unclear whether prophylactic preoperative anticonvulsive treatment is worthwhile. Furthermore it is not clear which patients are likely to experience seizures in the course of the disease. In recent years, many studies and meta-analyses addressed this question with particular contradictory results. Therefore, we aimed to identify the most important risk factors for seizures in patients with meningiomas with focus of anti-epileptic drugs.

Methods: We investigated a total of 556 patients (female 375 / male 181) that underwent meningioma resection in our hospital. The WHO grade at primary resection in 331 patients was grade I, in 197 patients grade II and in 9 patients grade III meningiomas. Recurrent tumors were also included in the study. The presence of pre- or intra-operative seizures, pre-operative edema, tumor localization, brain invasion and the administration of pre- or post-operative anti-epileptic drugs was correlated with the occurrence of post-operative seizures.

Results: In our cohort 58 patients showed tumor recurrence after a mean of 36 months (range 3 – 277 months) and 82 developed postoperative seizures. There was a significant correlation of postoperative seizures with edema ($p=0.004$), pre-operative seizures ($p=0.0006$), localization ($p<0.0001$) and supratentorial tumor localization ($p<0.0001$) as 81 of 82 patients with postoperative seizures suffered from supratentorial tumors. Patients with pre-operative speech disorders showed a higher seizure rate ($p=0.004$) whereas patients with sensory and / or motor deficits did not ($p=0.55$). Furthermore, patients that experienced postoperative seizures had a significantly poorer clinical outcome ($p<0.0001$). However, there was no correlation between postoperative seizures and anti-epileptic medication.

Conclusion: Our data suggest that there are distinct factors to identify patients with a higher risk of postoperative seizures after meningioma surgery. These patients face a significantly poorer clinical outcome. Therefore further studies evaluating the impact of prophylactic anti-epileptic drugs in patients with high risk for postoperative seizures are needed in order to improve the clinical outcome in meningioma patients.

WHO grade of intracranial meningiomas differ with respect to patient age and Tumor location

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Objective: Patients with WHO grade I and II intracranial meningiomas differ with respect to recurrence rate and overall survival. We aimed to investigate the relationship of patient age and meningioma location on the WHO grade.

Methods: A single institution data base of consecutive operated patients with intracranial meningiomas (January 2007 – March 2013) was reviewed. Patient characteristics, histological diagnosis (WHO 2007 classification), tumor location and size (MRI), outcome (mRS) and recurrence rates were analyzed retrospectively. Age was grouped into 3 different categories; group 1 (20-40 years), group 2 (41-60 years) group 3 (61-84 years).

Results: Of 240 patients 186 (77.5%) were female and 54 (22.5%) male. Mean age was not statistically different between female and male. 21 patients (8.8%) fell in age group I, 121 (50.4%) in group II, and 98 (40.8%) fell in age group III. 187 patients (77.5%) harbored a WHO^oI, 50 (20.4%) a WHO^oII, and 5 (2.1%) a WHO^oIII meningioma. Grading did not differ significantly between female and male patients ($\chi^2(2, N=240)=1,09, p=0,62$). WHO^oII and ^oIII meningiomas were significantly more frequent in age group I compared to age group II ($\chi^2(2, N=142)=11,00, p=0,004$), but did not differ between groups II and III, or I and III. Convexity meningiomas were significantly more frequent classified as WHO^oII meningioma compared to all other locations ($\chi^2(2, N=240)=19,83, p=0,000$). Short term outcome did not differ between age groups nor was it associated with tumor size. Recurrence rate was significantly higher in WHO^o II (5 out of 47, 10.2%) compared to WHO^o I patients (1 out of 178, 0.6%, $p<0.05$).

Conclusion: Younger patients suffer more frequently from WHO^oII meningiomas. Meningiomas located at the convexity are more likely to be classified as WHO^oII tumors.

DI.19 **Epilepsie**

Dienstag *Tuesday*, 16.05.2017, 10.40 – 11.40 Uhr *hrs*

- DI.19.01 *Intracellular recordings in patients with temporal lobe epilepsy*
T. Sauvigny* (Hamburg, Deutschland), O. Ohana, M. Westphal, D. Kuhl, T. Martens
-
- DI.19.02 *A second chance - reoperation after failed surgical treatment for extratemporal epilepsy*
G. Haaker* (Freiburg, Deutschland), D. Delev, B. Steinhoff, J. Nakagawa, C. Scheiwe,
A. Schulze-Bonhage, J. Zentner
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- DI.19.03 *Insular resections for drug-resistant epilepsy: results and prognostic factors*
D. Delev* (Freiburg, Deutschland), G. Haaker, B. Steinhoff, C. Scheiwe, J. Nakagawa,
A. Schulze-Bonhage, J. Zentner
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- DI.19.04 *Hippocampal astrogliosis in mesial temporal lobe epilepsy - another predictor for worse seizure outcome or a new disease entity?*
A. Grote* (Bielefeld, Deutschland), A. Becker, E. Hattingen, C. Helmstaedter, J. Schramm,
D. Delev
-
- DI.19.05 *Focal cortical dysplasia as a challenge for the epilepsy surgeon: could multimodal neuronavigation help?*
B. Sommer* (Erlangen, Deutschland), H. Hamer, I. Blümcke, M. Buchfelder, K. Rössler
-
- DI.19.06 *Connectivity delineating the propagation of ictal epileptic activity in stereo-EEG recording identified by global fiber tractography*
J. Nakagawa* (Freiburg, Deutschland), T. Hammen, M. Reisert, E. Kellner, I. Mader,
P. Reinacher
-

Intracellular recordings in patients with temporal lobe epilepsy

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Objective: Resection of the temporomesial structures is a well-established treatment for refractory temporal lobe epilepsy (TLE). The benefit of this procedure was shown repeatedly, yet, the precise extent of the epileptogenic zone and its cellular pathomechanisms are insufficiently understood. In this study we investigated spontaneous and chemically induced excitatory postsynaptic potentials (EPSPs) in slices of the human hippocampus and temporal lobe and compared the results with clinical findings.

Methods: From 08/2015 to 10/2016 we recorded intracellular activity using patch clamp technique in 23 patients with TLE who underwent neurosurgical resection of the putative epileptogenic zone. In 5 of the 23 patients an invasive stereotactic EEG-monitoring was conducted preoperatively to determine the seizure onset zone. Slices (350µm) of the hippocampus and temporal neocortex were prepared directly after surgical removal. A low magnesium solution was used to induce seizure-like activity in 19 slices. EPSPs were recorded in artificial cerebrospinal fluid and after infusion of the low magnesium solution in pyramidal cells of the CA1/subiculum region and of the temporal neocortex. Statistical comparisons were performed with ANOVA using SPSS 23.0.

Results: Single-cell recordings from 22 neurons were analyzed in this setting. Under baseline conditions, 2 neurons showed action potentials spontaneously. After infusion of the low magnesium solution, action potentials were detected in 16 neurons ($p < 0.001$). The amplitude and frequency of EPSPs not leading to an action potential did not differ between the conditions (1.06mV vs. 1.07mV and 1.42Hz vs. 1.23Hz). When administered, an AMPA receptor antagonist suppressed the EPSPs. All five patients with preceding invasive monitoring showed ictal activity *in vivo* and spontaneous and/or inducible action potentials with spiking frequencies up to 270Hz in the corresponding region *in vitro*.

Conclusion: *In vitro* ictal-like activity in the human temporomesial structures seems to depend on AMPAR-driven action potentials and not on subthreshold EPSPs. Comparisons with *in vivo* data from invasive electrophysiological monitoring suggest that the observed fast spiking action potentials correspond to ictal activity in these structures.

A second chance - reoperation after failed surgical treatment for extratemporal epilepsy

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Objective: Pharmacoresistant epilepsy is a devastating disease, severely influencing patients' quality of life. In approximately one third of the adult patients, the epileptogenic focus is localized outside the temporal lobe. Surgical resection of extratemporal focal epilepsy is a widely accepted treatment option. However, seizure control is only achieved in about 50% of the cases and a considerable number of patients continue to suffer from seizures. In these cases, reoperation may be a useful option. It was the aim of this study to analyze clinical and epileptological results in patients, who underwent reoperation due to failed surgical treatment of extratemporal epilepsy.

Methods: This single-center study comprises a consecutive series of 49 patients with extratemporal epilepsy who underwent reoperation after failed first surgery. Comprehensive data including preoperative diagnostic modalities, surgical treatment, histopathological findings, and clinical as well as epileptological outcome were analyzed.

Results: Reoperations were performed for residual lesions (n=26), recurrence of the resected pathology (n=5), and new hypothesis regarding the epileptogenic focus (n=18). Surgeries were located as follows: frontal (n=19), parietal (n=5), occipital (n=7) and insular (n=1). In 17 cases resection included more than one lobe. In 37 cases an extended lesionectomy and in 9 patients a lobectomy was performed, while 3 patients had a hemispherectomy. Histopathological evaluation of the resective specimen revealed focal cortical dysplasia (n=22), tumors (n=13), and gliosis (n=14). After a mean follow-up of 51 months, 18 patients (37%) remained seizure free (Engel I), and 23 (48%) had favorable outcome (Engel I-II). Temporary morbidity was encountered in 13 cases (26%), while permanent morbidity occurred in 9 cases (18%). There was no perioperative death. Resections including more than one lobe had higher complication rates as compared to circumscribed resections within one lobe (p=0.02). Complete resection of the epileptogenic focus (p=0.04) and lack of epilepsy typical potentials after operation (p=0.02) were associated with favorable seizure outcome (Engel I), while gliosis was a negative prognostic factor with respect to postoperative seizure control (p=0.01).

Conclusion: Second resective procedure can be taken into consideration in patients with failed surgical treatment for extratemporal epilepsy and may provide satisfying epileptological results with an acceptable morbidity. Patients, in whom complete resection of the epileptogenic focus is possible, seem to be suitable candidates for reoperation, while patients with gliosis are less likely to benefit from second operation.

Insular resections for drug-resistant epilepsy: results and prognostic factors

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Objective: Surgery is a widely accepted option for treatment of pharmacoresistant focal epilepsy. One of the greatest challenges, however, refers to patients in whom the epileptogenic zone encroaches upon areas of high functionality such as the insular cortex. The aim of this study was to analyze clinical and epileptological results and to provide prognostic factors influencing seizure outcome after insular resections for drug-resistant epilepsy.

Methods: This single-center study comprises a consecutive series of 53 patients, who underwent resective surgery of insular cortex due to pharmacoresistant epilepsy. Comprehensive data including preoperative diagnostic modalities, surgical treatment, histopathological evaluation, and clinical as well as epileptological outcome were analyzed with a particular focus on prognostic factors.

Results: Twenty-four patients underwent pure insular resections, whereas in the remaining 29 cases resection included parts of the temporal or frontal cortex. Histopathological evaluation of the operative specimens revealed tumors (n=24), focal cortical dysplasia (n=22), cavernomas (n=4) and gliosis (n=3). The resection in most patients with focal cortical dysplasia (n=18; 81%) comprised insular and neighboring frontal or temporal cortex, while the resection of most glial tumors (n=15; 68%) was restricted to the insular cortex only. Seizure outcome data were available from 49 patients. After a mean follow-up of 52 months, 28 patients (57%) were free from disabling seizures (Engel class I) and 35 patients (66%) had favorable seizure outcome (Engel classes I and II). There was no perioperative death. Permanent morbidity was encountered in 10 cases (19%) and included in most patients mild hemiparesis or dysphasia. The following prognostic factors were associated with excellent seizure outcome: MRI visible lesion (p=0.039), complete resection of the lesion (p=0.013) and younger age at surgery (<18 years) (p=0.032). Evaluation of histopathological findings revealed that glial tumors were associated with a poor seizure outcome (p=0.020).

Conclusion: Surgical treatment of pharmacoresistant epilepsy arising from the insular cortex provides satisfying results with seizure free rates of almost 60% and acceptable morbidity. Best epileptological outcome can be achieved in younger patients with dysplastic lesions that can be resected completely, while patients with glial tumors are less likely to become seizure free.

Hippocampal astrogliosis in mesial temporal lobe epilepsy - another predictor for worse seizure outcome or a new disease entity?

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Objective: Hippocampal sclerosis (HS) is the most frequent histopathological finding after hippocampal resection in patients suffering from drug-resistant mesial temporal lobe epilepsy (MTLE). However, in a number of cases the histopathological specimen reveals astrogliosis (AG) instead of HS. There is a controversial discussion about the role of astrogliosis on disease pathophysiology and its impact on the clinical course. The aim of this study was to investigate whether the course of epilepsy and postsurgical seizure outcome are different in patients displaying HS as compared to those with AG.

Methods: The authors retrospectively reviewed 635 patients (females n=325, 51%), who underwent either a standard anterior temporal lobe resection (ATL) or selective amygdalahippocampectomy (SAH) for drug-resistant MTLE between 09/1989 and 04/2012. Only patients with HS or AG were included in the study and distributed into two different groups according to the histopathological findings. Comprehensive data concerning the course of epilepsy and seizure outcome were evaluated. Seizure outcome was evaluated according to the ILAE classification.

Results: HS was diagnosed in 562 (88%) patients whereas 73 (12%) samples showed AG. The mean follow-up period was 56 months after surgery. At last available follow up 67% of the patients in the HS group were seizure free (ILAE 1) compared to 45% of the patients in the AG group ($p=0.0002$, $RR=1.7$, $CI=1.2-2.2$). The onset of epilepsy was earlier in the HS group than in the AG group (12.3 vs. 16.1 years, $p=0.0037$). A subgroup (20 AG and 40 HS) of pre-operative MRI images was analyzed for hippocampal signal intensity (SI), showing high SI value in all cases. Visual analysis revealed either hyperintense (AG 85%; HS 10%) or markedly hyperintense (AG 15%; HS 90%) ($p<0.001$) lesions, although the objective SI measurement showed no difference between groups. Duration of epilepsy was no prognosticator for the overall seizure outcome ($p=0.3$) either for AG or HS. The multivariate regression analysis confirmed astrogliosis ($p=0.0031$) as independent predictor for worse seizure outcome, while duration of epilepsy, type of surgery and side of surgery did not influence the final seizure outcome.

Conclusion: The histopathological finding of hippocampal astrogliosis in MTLE shows an important impact on the clinical course of epilepsy. Although patients with AG develop epilepsy later in life, they have a significantly worse chance to become seizure free after epilepsy surgery. These results suggest that astrogliosis and hippocampus sclerosis represent two different disease entities, a fact that should be critically taken into consideration when counselling patients with drug-resistant MTLE.

Focal cortical dysplasia as a challenge for the epilepsy surgeon: could multimodal neuronavigation help?

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Objective: Focal cortical dysplasia (FCD) one of the major causes of drug-resistant epilepsy. As long-term seizure control after surgery still remains disappointing, we evaluated our patient cohort using functional neuronavigation and intraoperative 1.5T-MRI (iopMRI).

Methods: In this retrospective study, 66 patients (33 female, 33 male, mean age 36.4 ± 12.7 yrs) with FCD and drug-resistant epilepsy underwent surgery in our Department between 2/2003 and 10/2016. Mean duration of epilepsy was 20.7 ± 12.9 years. Surgery was performed with the aid of neuronavigation and intraoperative 1.5T-iopMRI. Additional functional MR imaging (motor, memory and speech areas) and diffusion tensor imaging (DTI) for tracking neuronal fibers (language and pyramidal tracts) was acquired in 25 patients. We integrated three-dimensional intraoperative visualization of phase-2 electrodes in 15 patients.

Results: Of 66 patients undergoing surgery, complete resection was achieved in 91% (60/66). Remnant tissue according to the resection plan was detected with iopMRI in 13 patients (20%). After intraoperative update of neuronavigation, eight of these 13 patients undergoing re-resection were seizure free. Overall, complete seizure control (Engel Class IA) was 64% (42/66, mean FU 52.5 ± 33.1 months). Five patients had a permanent (6%, 4/66) and two patient a transient postoperative neurological deficit (5%, 3/66).

Conclusion: Epilepsy surgery in patients with FCDs can be enhanced with the aid of multimodal neuronavigation, leading to promising long-term seizure control. As a direct consequence of intraoperative MR imaging, the rate of complete resections of pathological tissue as well as the number of potentially seizure-free patients can be increased.

Connectivity delineating the propagation of ictal epileptic activity in stereo-EEG recording identified by global fiber tractography

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Objective: Focal epilepsy due to structural changes is a major cause of pharmaco-resistant epilepsy often treated by epilepsy surgery. Stereo-EEG recording enables the detection of the epileptogenic focus and propagation patterns of the epileptic activity. The intention of our study was to precisely delineate structural pathways of epileptogenic propagation by global fiber tracking and evaluate the possible diagnostic value for presurgical assessment.

Methods: Seven patients with focal epilepsy undergoing invasive epileptological assessment were included in the study. Pre-operative high-angular diffusion weighted images were acquired with 61 directions on a 3Tesla MRI scanner and whole brain global fiber tracking was performed. Multiple temporal and extratemporal depth electrodes were placed (mean n=10/patient) in frame-based stereotactic surgery. The electrode position was confirmed by post-operative MRI and the epileptogenic focus and early propagation pattern was evaluated by stereo-EEG recording. The exact electrode contact positions (total n=64) detecting the epileptogenic focus and the target points of early propagation were identified on the stereotactic treatment plan and were transferred into a MCP-based coordinate system. MRI T1w3D sequences were superimposed on color encoded DTI images, postprocessed for global fiber tracking and transferred into a common space using an inhouse software. Fiber tracts were extracted and connectivity was analyzed along the electroencephalographic propagation pathway. For control, fiber tracts originating in the epileptogenic lesion but without functional connectivity to randomly chosen contacts (n=28) were analyzed for structural connection.

Results: The exact localization of ictal epileptogenicity and delineation of fiber tracts by global fiber tracking provides evidence of significantly increased structural connectivity (47.2%) of the epileptogenic focus to regions of early propagation ($p < 0.001$) compared to those without detected propagation (34.7%).

Conclusion: The analysis of functional and structural connectivity based on a high spatial accuracy and global tractography methods reveals an increase of connectivity along pathways of early propagation of epileptic activity. This method therefore proves to be promising for further investigation regarding the connectivity of epileptogenic lesions and may offer an additional diagnostic method for profound presurgical assessment and subsequent operative therapy.

DI.21 Wirbelsäule – Bildgebung/Navigation

Dienstag *Tuesday*, 16.05.2017, 15.05 – 16.25 Uhr *hrs*

- DI.21.01 *Navigation-guided and 3D-imaging controlled minimally invasive posterior instrumentation in patients with pyogenic thoracolumbar spondylodiscitis - a feasibility study*
E. Thanasi, A. Tolou Ghanian Sabour, S. Kim, E. Uhl, K. Schöller, E. Thanasi* (Gießen, Deutschland)
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- DI.21.02 *Transpedicular C1 screw placement with help of intraoperative O-arm® imaging and navigation guidance*
G. Escobar Magana* (Gießen, Deutschland), M. Stein, M. Boroumand, J. Focke, E. Uhl, K. Schöller
-
- DI.21.03 *Comparison of Revision Rates in 3D C-Arm Fluoroscopy Navigated and Freehand Placed Pedicle Screws in the Thoracolumbar Spine - A Systematic Analysis of 8 Years of Pedicle Screw Placement*
J. Fichtner* (München, Deutschland), N. Hofmann, J. Kirschke, N. Buchmann, J. Gempt, B. Meyer, Y. Ryang
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- DI.21.04 *Value of virtually calculated low tube voltage monoenergetic datasets on a 3rd generation dual-source CT for the assesment of cervical spinal stenosis*
M. Arp* (Mannheim, Deutschland), G. Ehrlich, J. Gawlitza, T. Henzler, D. Hänggi, J. Perrin
-
- DI.21.05 *Use of a third generation dual-source CT for postoperative treatment in patients after spine surgery with metal implants. Experience in 25 patients.*
G. Ehrlich* (Mannheim, Deutschland), M. Arp, T. Henzler, D. Schulte, D. Hänggi, J. Perrin
-
- DI.21.06 *Radiological Findings in Patients Undergoing Thoracic / Lumbar Corpectomy for Osteoporotic Fractures - How Much Lordosis Did We Restore? - a Consecutive Series*
M. Vazan* (Dresden, Deutschland), M. Barz, B. Meyer, Y. Ryang
-
- DI.21.07 *Spinal navigation for posterior instrumentation of C1-C2 instability using a mobile intraoperative CT scanner*
J. Haemmerli* (Berlin, Deutschland), N. Hecht, B. Foehre, K. Arden, T. Liebig, J. Woitzik, P. Vajkoczy, M. Czabanka
-
- DI.21.08 *Accuracy of neuronavigated pedicle screw placement by using a robotic 3D flat panel C-arm CT in a hybrid operating room*
J. Perrin* (Mannheim, Deutschland), G. Ehrlich, D. Schulte, M. Arp, D. Hänggi
-

Navigation-guided and 3D-imaging controlled minimally invasive posterior instrumentation in patients with pyogenic thoracolumbar spondylodiscitis - a feasibility study

Enea Thanasi¹, Ashkan Tolou Ghanian Sabour¹, Seong W. Kim¹, Eberhard Uhl¹, Karsten Schöller¹

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Objective: Thoracolumbar spondylodiscitis often affects elderly and multimorbid patients. The resulting destruction of the disc and vertebral body can lead to spinal instability, therapy-refractory pain, and immobilization. A minimally invasive instrumentation with a percutaneous/transmuscular pedicle screw and rod system might be safe and sufficient to effectively restore the stability of the spine, and allow for fast pain reduction and ambulation.

Methods: Retrospective single center analysis of patients receiving a navigation-guided and 3D-imaging (O-arm®) controlled minimally invasive posterior instrumentation for thoracolumbar spondylodiscitis including cases with additional microsurgical drainage of epidural empyema. Demographic and perioperative data were extracted from electronic records. Comorbidities were quantified using the Charlson Comorbidity Index (CCI; score increases with disease severity). Operation time, intraoperative details, complications, and revision surgeries were meticulously analyzed. On postoperative CT scans the screw position was graded using the Gertzbein and Robbins classification. Outcome at hospital discharge was assessed with help of the Macnab criteria.

Results: We included 17 patients (m: n=11) with a median age of 72 years and a median CCI of 3 that were operated between 1/2013 and 10/2016. The median postoperative length of stay was 14 days. In 3 patients instrumentation included 1 segment, in 6 patients 2 segments, and in 8 patients ≥3 segments. Additional empyema drainage was carried out in 5 Patients. The median operation time was 187 minutes, and the median blood loss was 275 ml. Intraoperative screw revisions had to be conducted in 2 instances. The postoperative screw position was as follows: No breach: 97 screws; breach ≤2 mm: 8 screws; breach 2-4mm: 2 screws. Reoperation was necessary in 1 patient due to dislocation of the rod. There was no further surgery-related complication. 2 patients died during the hospital course 28 and 53 days after surgery, respectively, due to medical complications. The median Macnab Score at discharge was 2 indicating a good clinical outcome.

Conclusion: A minimally invasive image-guided posterior instrumentation allows for safe and effective treatment of spinal instability and pain due to thoracolumbar spondylodiscitis. However, long-term outcome including the ability to cure the infection in combination with standard antibiotic treatment has to be clarified in further studies.

Transpedicular C1 screw placement with help of intraoperative O-arm® imaging and navigation guidance

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Objective: Screw placement in the lateral mass of C1 via the lateral arch, i.e. transpedicular (TP) screw placement, has biomechanical advantages over the traditional lateral mass screw technique, and potentially reduces the risk of injuries to the paravertebral venous plexus and the C2 nerve root. Technical limitations due to the small dimensions of the C1 pedicle might be overcome by intraoperative 3D imaging and navigation guidance, which hypothetically allow for an accurate procedure and for a reduced need for revision surgery.

Methods: Retrospective single center analysis of patients receiving a TP C1 screw placement as part of a posterior cervical stabilization procedure using the O-arm® and StealthStation® navigation system. Operation time, intraoperative details, and revision surgeries were documented. The C1 intramedullary pedicle height (IMH) was measured on coronal CT scans at the midpoint of the vertebral artery groove. On postoperative CT scans the screw position was graded using the Neo classification (Neo et al., Spine 2005).

Results: The median age of our 22 patients (f: n=12) was 75 years. Indications for surgery were traumatic odontoid or complex C2 fractures in the majority of cases (n=19), that were combined with C1 arch fractures in 7 patients. Operation time improved from 202 min. in the first 11 patients to 150 min. in the last 11 patients. 40 screws were successfully placed via the C1 pedicle; in 4 patients TP screws could only be placed unilaterally. Measurements on CT scans showed that the IMH of the C1 pedicle was 1.63 ± 0.93 mm on the left, and 1.41 ± 0.79 mm on the right. Intraoperative C1 screw revisions had to be conducted in 5 instances. The IMH of pedicles with screw revisions was 1.19 ± 0.73 mm (range: 0-1.88mm), while the IMH of the pedicles without a screw revision was 1.56 ± 0.88 mm (range: 0-3.15mm). No postoperative pedicle perforation was documented in 24 screws, pedicle violations <2mm were found in 12 screws, and pedicle violations between 2 and 4 mm in 4 screws. There was no pedicle violation >4mm. 1 revision surgery was necessary due to screw loosening after 13 months.

Conclusion: The TP C1 screw placement using O-arm® imaging and navigation guidance is feasible in the majority of cases, also in patients with C1 arch fractures. The accuracy of screw placement is good, and revision surgery due to screw malposition can be eliminated. However, the IMH might be a technical limitation, which has to be evaluated in further studies.

Comparison of Revision Rates in 3D C-Arm Fluoroscopy Navigated and Freehand Placed Pedicle Screws in the Thoracolumbar Spine - A Systematic Analysis of 8 Years of Pedicle Screw Placement

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Objective: Higher accuracy rates of image-guided pedicle screw placement compared to freehand placement in the thoracolumbar spine has been proven in the literature. Image-guidance in spine surgery has increased significantly during the past decade; however, there is a lack of data concerning the impact of spinal navigation on revision surgeries due to misplaced pedicle screws (PS). This analysis is aimed at identifying the rate of revision surgeries for misplaced PS in 3D C Arm fluoroscopic navigation (3DFL) compared to freehand (FH) PS placement.

Methods: A systematic analysis of a total of 2150 patients (mean age 64 ± 14 years; range 14-97) with 12320 PS who underwent dorsal instrumentation of the thoracolumbar spine between January 2008 and December 2015 was conducted. To assess revision rates for misplaced PS, patients were divided into 2 groups. Group 1 comprised all patients undergoing surgery with use of 3DFL (January 2011-Dec 2015), group 2 all patients receiving surgery in the FH technique (January 2008-Dec 2015), respectively. The use of 3DFL was initiated in January 2011 in our department. The examined time period of the 3DFL group is therefore shorter. Postoperative CT-scans and or intraoperative 3D scans for verification and assessment of PS was routinely performed in all patients.

Results: There was an overall rate of revision surgeries for malpositioned PS of 2.9% (n=63 patients; n=15 thoracic, n=46 lumbosacral and n=2 thoracolumbar).

The revision rate of all pedicle screws was 0.8% (n=96 PS).

In the 3DFL group the rate of secondary revision surgeries was significantly lower with 1.3% (n=14 patients; n=6 thoracic, n=7 lumbosacral, n=1 thoraco-lumbar) compared to 4.8% (n=49 patients; n=9 thoracic, n=39 lumbar, n=1 thoracolumbar) in the FH group, respectively ($p < 0.001$).

There were 28 PS (0.4%) in the 3DFL (n=28 PS; n=12 thoracic, n=14 lumbosacral and n=2 thoracolumbar), compared to 68 PS (1.3%) in the FH group (n=68 PS; n=11 thoracic PS, n=54 lumbosacral PS and n=3 thoracolumbar PS) that needed revision surgery, respectively ($p < 0.001$).

Conclusion: The use of 3D C-Arm fluoroscopy navigated PS placement is able to significantly reduce the rate of revision surgeries for misplaced PS after dorsal instrumentation of the thoracolumbar spine compared to conventional FH technique.

Value of virtually calculated low tube voltage monoenergetic datasets on a 3rd generation dual-source CT for the assesment of cervical spinal stenosis

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Objective: Assessment of the cervical spinal cord and CSF spaces with CT remains difficult due to the low spinal cord to CSF attenuation differences on CT images. Thus, patients with suspected spinal stenosis frequently undergo MRI as well as cervical CT prior to surgery. CT is of particular importance for patients with contraindications for MRI or with metal implants producing artifacts. In dual-energy CT (DECT), two CT datasets are acquired with different x-ray spectra, which allow the specific differentiation of anatomical structures or the reduction of metal artifacts. Virtually calculated low tube voltage monoenergetic datasets calculated from DECT have the potential to increase the spinal-cord-to-CSF ratio (SC/CSF_{ratio}) due to increased spinal cord attenuation at lower keV levels. Thus, the aim of this study was to prospectively evaluate the diagnostic value of low tube voltage monoenergetic datasets in patients with spinal stenosis.

Methods: 55 patients with suspected spinal stenosis prospectively underwent DECT of the cervical spine on a 3rd generation dual-source CT. Low tube voltage monoenergetic datasets were calculated in 10 keV intervals from 40-190 keV intervals. The datasets were compared to standard 120 kVp CT datasets that were also calculated from the DECT raw data. For objective image quality evaluation, the CT attenuation difference between SC and CSF was calculated. Subjective diagnostic image quality was evaluated by an experienced and independent radiologist and neurosurgeon by choosing one subjectively best image quality in all acquired datasets.

Results: The attenuation difference between SC and CSF as objective marker for the spinal cord delineation continuously increased with decreasing keV levels from 24,5 HU (190 keV) to 39,2 HU (40 keV). From all monoenergetic datasets 80 keV images showed the highest subjective image quality. In 69% the 80 KeV dataset was chosen by the examining neurosurgeon and in 75 % by the examining radiologist [range 70-90KeV]. Compared to the standard 120 kVp datasets image quality of the 80 keV datasets was rated superior. The difference between objective and subjective image evaluation is explained by the higher image noise at 40 keV when compared to 80 keV.

Conclusion: Low keV datasets calculated from DECT increase objective and subjective diagnostic image quality of the cervical spinal cord when compared to standard CT. This is of particular importance evaluating the indication for surgery in patients with clinical symptoms suggestive for cervical spinal stenosis and contraindications for MRI or with metal implants causing artifacts.

Use of a third generation dual-source CT for postoperative treatment in patients after spine surgery with metal implants. Experience in 25 patients.

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Objective: Adequate evaluation of the spinal canal and the neuroforaminal pathologies in patients after spinal stabilization via CT or MRI remains a difficult task due to metal-related artifacts. Alternatively, more invasive imaging techniques like CT-myelography are often necessary. One promising image modality could be the use of a dual-energy CT that acquires two CT datasets with different X-ray spectra. This technology allows the reduction of metal-related artifacts and a better assessment of the neural structures. Aim of this study was to evaluate whether the detection of remnant, recurrent or adjacent spinal pathologies could be improved by use of a 3rd generation dual-source CT in patients after spinal stabilization.

Methods: Spinal imaging was obtained with a 3rd generation dual-source CT in all patients that were due for follow-up imaging or presented with new symptoms after cervical, thoracic or lumbosacral spinal stabilization. Low tube voltage monoenergetic datasets were calculated in 10 keV intervals from 40-190 keV. Software calculated standard CT protocol image sets were simultaneously generated for comparative analysis. The image quality was independently evaluated by two experienced neurosurgeons through choosing the subjectively best image quality of all performed datasets in comparison to standard CT imaging. A 5-point Likert scale was used regarding overall image quality, foraminal stenosis or other osseous pathologies.

Results: A total of 25 patients after spinal stabilization surgery were included. The gender distribution was balanced (12 men and 13 women). Mean age of the patient collective was 57 years (range 30-77y). Many of the patients had previously received cervical surgery (16 out of 25; 64%). The remaining collective of 9 patients (36%) had previously underwent lumbar stabilization. The overall image quality was rated superior by one neurosurgeon in 23 of the 25 cases and in 24 by the other neurosurgeon. A relevant reduction of metal-related artifacts was seen at higher keV ranges of 170 keV to 190 keV with the maximum artefact reduction seen at 190 keV. Newly detected osseous pathologies were visible in 8 of the 25 patients at 190 keV in comparison to only 2 with standard CT protocol or datasets below a 120keV.

Conclusion: Performing a 3rd generation dual-source CT for follow-up evaluations in patients after spinal surgery with metal implants seems to be a promising alternative to standard CT or MRI due to the immense reduction of metal-related artefacts. Additional invasive diagnostic methods could therefore be avoided in future. Furthermore, it can be used as an applicable modality in patients with contraindications for MRI.

Radiological Findings in Patients Undergoing Thoracic / Lumbar Corpectomy for Osteoporotic Fractures - How Much Lordosis Did We Restore? - a Consecutive Series

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Objective: Unstable osteoporotic fractures require often 360 degrees Fusion with posterior pedicle Fixation and a vertebral body replacement with a distractible cage. We analyzed the thoracolumbar geometry before and after both procedures.

Methods: Twenty-six consecutive patients (20 female, 6 male) with osteoporotic fractures of the thoracic and lumbar spine who underwent 360-degree fusion with posterior fixation using Polymethyl-methacrylate augmented pedicle screws and an expandable cage at our department between May 2013 and March 2015 were included.

The mean age was 71.73 ± 12.51 years (range 47 - 91 years). Since 3 patients had 2 non-adjacent fractures, we performed 29 corpectomies (16 lumbar, 13 thoracic). The cranial most level was Th3 the caudal most level was L5.

All patients underwent a baseline physical and neurological examination on admission. The diagnostic routine included MRI X-ray and CT scans. Postoperative measurements were done on upright x-rays following mobilization of the patient. The pre-/inter-/postoperative kyphosis/lordosis angle of the adjacent endplates was assessed.

Results: The mean local lordosis angle prior posterior fixation was -14.17 ± 22.41 degrees. For the patients with fractures of the thoracic spine, this was -28.00 ± 15.29 degrees (range $-57.80 - -3.90$ degrees) and for patients with lumbar spine fractures 0.20 ± 17.23 degrees (range $-20.50 - 30.60$ degrees) respectively.

After posterior fixation the average lordosis angle was -6.14 ± 20.56 degrees. It was -17.71 ± 13.83 (range $-47.60 - 5.10$ degrees) for thoracic fractures and 6.32 ± 16.98 degrees (range $-16.50 - 32.10$) for lumbar fractures. After the anterior column reconstruction and ambulation the local lordosis angle averaged at -5.15 ± 21.21 degrees.

The net lordosis gain was 7.05 ± 5.86 degrees (range $-6.10 - 19.70$ degrees) for the lumbar fracture group, whereas it was 9.31 ± 15.34 degrees (range $-4.10 - 48.00$ degrees) for the thoracic fracture group. We found no statistically significant difference between the pre-surgery and post-surgery measurements. There was no significant difference between the amount of lordosis restoration between the thoracic and lumbar fracture groups either.

Conclusion: The 360-degree Fusion with augmented pedicle screw fixation and anterior reconstruction with a distractible cage allowed a correction of the posttraumatic deformity by an average 9 degrees Lordosis. The correction was maintained on autonomous ambulation.

Spinal navigation for posterior instrumentation of C1-C2 instability using a mobile intraoperative CT scanner

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Objective: Spinal navigation techniques for surgical fixation of instable C1/2 pathologies are challenged by complex osseous and neurovascular anatomy, instability of the pathology and unreliable preoperative registration techniques. Intraoperative CT-scanner with autoregistration of C1/C2 promises adequate accuracy of spinal navigation without requiring further registration procedures. The aim of this study was to analyze accuracy and reliability of posterior C1/C2 fixation using intraoperative mobile-CT-scanner guided navigation.

Methods: From July 2014 to February 2016, 10 patients with instability of C1/C2 received posterior fixation using C2-pedicle and C1-lateral mass screws, and two patients received a posterior fixation from C1 to C3. Spinal navigation was performed using intraoperative mobile CT. Following navigated screw insertion in C1 and C2 intraoperative CT was repeated to check for accuracy of screw placement. Accuracy of screw positioning was retrospectively analyzed and graded by an independent observer.

Results: A total of 12 subjects were retrospectively analyzed, ten females and 2 males (mean age 80,7; range: 42-90). Instable pathologies (verified by fracture dislocation or by flexion/extension x-ray) included: 8 Anderson type II fractures, 1 instable Anderson type III fracture, 1 Hangman fracture Levine Effendi Ia, 1 complex Hangman-Anderson III and 1 destructive rheumatoid arthritis of C1-C2. In 4 patients, critical anatomy was observed: high riding vertebral artery (3 patients) and arthritis-induced partial osseous destruction of C1 lateral mass (1 patient). A total number of 52 screws were placed. Correct screw positioning was observed in 51 screws (98,1%). Minor pedicle breach was observed in 1 screw (1,9%). No screw displacement occurred (accuracy rate 98,1%).

Conclusion: Spinal navigation using intraoperative mobile CT scanning is reliable and safe for posterior fixation in instable C1/C2 pathologies with high accuracy in this patient series.

Accuracy of neuronavigated pedicle screw placement by using a robotic 3D flat panel C-arm CT in a hybrid operating room

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Objective: The continuously increasing number of spinal stabilization demands a constant improvement of accurate pedicle screw placement to reduce possible complications and postoperative morbidities. Consequentially the use of spinal navigation systems has become more frequent in the vast majority of spinal surgery centers. Common applied technologies include intraoperative mobile or stationary CTs and 2D or 3D fluoroscopy. We evaluated the accuracy of neuronavigated pedicle screw placement by use of a robotic 3D-flat panel C-arm CT (Artis Zeego, SyngoDynaCT, Siemens Health Care) combined with a spinal neuronavigation system (BrainLab Curve, BrainLab) in a hybrid OR setting.

Methods: Standard procedure was to place a midline incision above the spinal levels that were to be treated and then fixate the BrainLab spinal process reference to the most cranial level. Subsequently CT data was acquired with the robotic 3D flat panel C-arm CT followed by an automated registration process with the BrainLab Curve System. During this process, no added draping or repositioning of the patient was needed. All pedicle screws were then placed with the image-guided neuronavigation. As additional accuracy test of the navigational reference a standard a.p. X-ray was conducted after placement of the first pedicle screw in every surgery. Interbody cages were placed under fluoroscopic view with the same robotic C-arm system. Postoperative CT scans were performed to evaluate pedicle screw positioning. The grade of pedicle screw violation was classified into four groups: screws fully contained into the pedicle, perforated screws up to 2 mm displacement (Grade A), 2–4 mm (Grade B), and greater than 4 mm displacement (Grade C).

Results: A total of 136 navigated pedicle screws, 102 lumbosacral and 34 thoracic, were placed with the robotic 3D flat panel C-arm CT system within a time period of 12 Months at our institute. Postoperative CT evaluation revealed that 133 of the 136 screws were fully contained into the pedicles leading to an accuracy of 97.8%. 3 screws being 2.2% showed a Grade A displacement without the need of revision surgery. No Grade B or Grade C displacements were recorded. Furthermore, no robotic C-arm associated complications, e.g. injuring C-arm patient collisions or surgical field contaminations, could be detected.

Conclusion: Neuronavigational placement of pedicle screws with this unique robotic 3D flat panel C-arm CT in a hybrid OR shows equivalent accuracies to other high resolution intraoperative spinal navigation systems whilst simultaneously offering the benefits of conventional fluoroscopy e.g for interbody cage placement or verification of the reference accuracy on a large display system. Additional Studies will be conducted with detailed analysis of radiation exposure and surgery times.

DI.22 Vaskuläre Neurochirurgie 7

Dienstag *Tuesday*, 16.05.2017, 15.05 – 16.25 Uhr *hrs*

- DI.22.01 *Acute changes in brain metabolism in the early phase following experimental subarachnoid hemorrhage (SAH)*
N. Lilla* (Würzburg, Deutschland), H. Berger, U. Sonnewald, D. Hill, M. Wideroe, R. Ernestus, T. Westermaier
-
- DI.22.02 *Effects of s-ketamine on the incidence, hemodynamics and electrical characteristics of spreading depolarizations in patients with aneurysmal subarachnoid hemorrhage and in gyrencephalic swine models*
E. Santos* (Heidelberg, Deutschland), A. Olivares Rivera, S. Major, R. Sánchez Porras, M. Kentar, A. Unterberg, O. Sakowitz, J. Dreier
-
- DI.22.03 *In-vivo microscopy of acute vasospasm during and after experimental SAH*
T. Westermaier* (Würzburg, Deutschland), D. Köhler, N. Lilla, C. Stetter
-
- DI.22.04 *MR angiography for diagnosis of cerebral vasospasm in an experimental subarachnoid hemorrhage model in rats - establishment of reference values*
V. Malinova* (Göttingen, Deutschland), B. Iliev, K. Bleuel, I. Tsogkas, M. Psychogios, V. Rohde, D. Mielke
-
- DI.22.05 *Cerebrovascular elastogenesis in humans during ageing and disease*
D. Cooke, B. Buchholz, C. Matzenauer, R. Fernandez, R. Macdonald, D. Hänggi, N. Etminan, K. Hackenberg* (Mannheim, Deutschland)
-
- DI.22.06 *Non-invasive vascular neuromonitoring in patients with subarachnoid hemorrhage: impact of early magnesium sulfate administration on local cerebral microcirculation*
B. Sommer* (Erlangen, Deutschland), C. Weidinger, H. Schmitt, M. Buchfelder
-
- DI.22.07 *Dynamic 4D CT angiography for preoperative visualisation of the superficial temporal artery for extracranial-intracranial bypass surgery*
A. Abdulazim* (Mannheim, Deutschland), M. Meyer, H. Andrade-Barazarte, T. Henzler, S. Schönberg, D. Hänggi, N. Etminan
-
- DI.22.08 *Follow-Up imaging after clipping of ruptured aneurysms: what happens with the neck remnants?*
J. Konczalla* (Frankfurt, Deutschland), F. Gessler, S. Won, N. Dinc, M. Bruder, S. Tritt, V. Seifert
-

Acute changes in brain metabolism in the early phase following experimental subarachnoid hemorrhage (SAH)

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Objective: Metabolic changes following subarachnoid hemorrhage (SAH) with accumulation of metabolic products such as lactate, pyruvate and glutamate are described, the exact metabolic derangement and pathophysiology behind still not well understood. Especially information on metabolic changes in the early hours following SAH is rare, possibly explaining an onset of secondary brain damage during course of disease. This study was conducted to further investigate acute metabolic changes in the early phase following experimental SAH studied for the first time with *in vivo* injection of ¹³C-labeled glucose and acetate combined with *ex vivo* ¹³C magnetic resonance spectroscopy (MRS).

Methods: 18 male Sprague Dawley rats (250g-300g) were randomly assigned to one of two groups: 1) SAH induced by the endovascular filament model or 2) sham operated control animals. All animals received *in vivo* injection of ¹³C-labeled glucose and acetate before they were euthanized after 3 hours following SAH or sham operation. *Ex vivo* ¹³C MRS and HPLC of brain extracts were performed to study acute metabolic changes

Results: Three hours after experimental SAH, glycolysis was reduced in SAH hemispheres and mitochondrial metabolism in neurons was significantly impaired compared to sham operated rats. In detail, GABAergic neurons were not as much affected as Glutamatergic neurons and astrocyte metabolism seems to be more preserved.

Conclusion: For the first time, we could show significant metabolic changes in rat brains already 3 hours after SAH measured by ¹³C labelled MRS, giving more insight into the pathophysiology and detail of metabolic changes. Therefore, there is a potential treatment option already in the acute phase when the patient is entering the clinic, trying to prevent from secondary brain damage. Further studies will have to investigate the beneficial neuroprotective effect of possible therapeutic drugs.

Effects of s-ketamine on the incidence, hemodynamics and electrical characteristics of spreading depolarizations in patients with aneurysmal subarachnoid hemorrhage and in gyrencephalic swine models

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Objective: Electrical and hemodynamic characteristics of spreading depolarizations (SD) can be affected by the N-methyl-D-aspartate (NMDA) receptor antagonist ketamine, which has been shown to produce neuroprotection in animals with lissencephalic brains. The effectiveness of SD-targeted neuroprotective therapies could be evaluated in real time by measuring SD incidence. We investigated the effect of s-ketamine on SD characteristics in two translational porcine models and in patients with aneurysmal subarachnoid hemorrhage (aSAH) in whom multimodal neuromonitoring was performed.

Methods: In both animal models, SDs were monitored using electrocorticography (ECoG) and large field-of-view movement-compensated intrinsic optical signal (IOS) imaging, which enabled us to perform a long-term analysis of blood volume signals in regions of interest. In the first animal model (n=15), SDs were induced with drops of 1M KCl in both hemispheres at 1h-intervals during 18h (Group 1: control, Group 2: ketamine 2mg/kg/h, Group 3: 4mg/kg/h, each n=5). In a second model, the left middle cerebral artery was occluded (MCAo) which subsequently induced SDs. Animals were randomly assigned to either receive 5mg/kg/h ketamine or not (Groups 4 and 5, each n=5) and were monitored over 30h. 67 aSAH patients were prospectively monitored, including ECoG (mean 11 days). We retrospectively compared relevant variables of patients who received ketamine (n=31) vs. no-ketamine.

Results: Ketamine reduced the incidence of SDs in both porcine models (reduction to 35.7% in the KCl and 68.7% in the MCAo model using ketamine 4mg/kg/h). We also found significant changes in the electrical and hemodynamic characteristics (amplitude, duration, expansion, etc.). Following MCAo, SDs appeared, originating in the ischemic center and concentrically invading penumbra and normally perfused, surrounding tissue, subsequent SDs were generated at the rim of the permanently depolarized core. Ketamine was less effective in reducing the SD incidence, but it decreased the hypoemic and increased the hyperemic components. In patients, a mean of 2.7mg/kg/h s-ketamine reduced the SD incidence from 1.87 to 0.68 SDs/day (reduction to 36.6%) (Wilcoxon $p < 0.001$). Doses above the recommended therapeutic range (> 2 mg/kg/h) were more effective. In patients with CT-proven brain infarcts the efficacy of ketamine was lower than in patients without.

Conclusion: Ketamine has the capability to reduce the incidence and characteristics of SDs in gyrencephalic brain of both porcine model and aSAH patients. Most effective doses are above the recommended therapeutic range for sedation. More information is required before proceeding to a clinical trial.

In-vivo microscopy of acute vasospasm during and after experimental SAH

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Objective: Delayed vasospasm and delayed cerebral infarction are well-known sequelae after subarachnoid hemorrhage (SAH). Acute vasospasm has been postulated due to a discrepancy between quickly recovering cerebral vasospasm and long-lasting reduction of cerebral blood flow (CBF) in the first hours after SAH. To date, however, the onset and development of early vasospasm have not been visualized and are not completely understood. It was the aim of this study to visualize the changes of the cerebral vasculature before, during and in the first hours after experimental SAH using *in vivo* video microscopy of cortical vessels and the cortical surface.

Methods: Male Sprague-Dawley rats were assigned to either undergo experimental SAH using the endovascular filament model or a sham operation (n = 10). Local CBF was continuously measured using laser-Doppler flowmetry over the left frontal cortex. Mean arterial blood pressure and arterial blood gases were measured continuously. *In vivo* video microscopy (XCSource® USB 20-800x) of cortical vessels was performed through a cranial window (d = 3 mm) over the right fronto-parietal cortex. Video files and photographs were obtained before, during and 5, 30, 60, 120 and 180 minutes after SAH. Vessel diameter in predefined regions of interest was measured using AMCAP-Software and assessed with GraphPad PRISM software.

Results: During and in the first seconds after SAH, arterial vessels completely disappeared and slowly reappeared over the following minutes. In the following 3 hours, disperse focal vasospasms were seen in all parts of the visible areas of the cerebral vasculature. Vessel diameter decreased significantly in the regions of interest in all animals subjected to SAH. Small subarachnoid vessels were ls after SAH, No changes were observed in the sham-operated group at any time point. Mean vessel diameter in regions of interest significantly decreased after SAH. Interestingly, some vessels seem to recover after a while and re-contract later in other vessel sections.

Conclusion: For the first time, *in vivo* development/formation of vasospasm after SAH was shown. In contrast to delayed vasospasm onset after 48 – 72 hours, we see acute vasospasm/vasoconstriction after SAH which may lead to early secondary brain damage and ischemia. Further investigation is necessary to identify possible treatment options for early onset vasospasm.

MR angiography for diagnosis of cerebral vasospasm in an experimental subarachnoid hemorrhage model in rats - establishment of reference values

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Objective: Imaging plays an important role in the experimental research on subarachnoid hemorrhage (SAH). For the detection of cerebral vasospasm (VSP) conventional angiography is generally used, which is an invasive and elaborate technique with a possible subsequent increase in morbidity and mortality. Magnetic resonance angiography (MRA) would be a convenient noninvasive alternative for this issue. The definition of reference values is essential for a reliable interpretation of the MRA data. The aim of this study was to establish reference values for the diagnosis of VSP in the double-hemorrhage SAH model in rats.

Methods: SAH was induced in 25 Sprague Dawley male rats using the double-hemorrhage model. Five rats were operated as sham with injection of saline solution instead of blood. MRA (time of flight=TOF) was performed in all rats on day 1 (baseline), on day 2 and on day 5. Measurements of the vessel diameter were performed in all large basal cerebral arteries (basilar artery = BA, internal carotid artery = ICA, middle cerebral artery = MCA and anterior cerebral artery = ACA) by a blinded neuroradiologist. The baseline data were used to establish reference values for every vessel. The datasets of day 2 and day 5 were analyzed for the presence of VSP. The severity of VSP was defined as followed: vessel narrowing of <25% mild, 25-75% moderate and >75% severe VSP.

Results: A total of 90 MRA datasets of 30 rats were analyzed. The following reference values of the mean vessel diameter were established: BA 0.6mm, ICA 0.7mm, MCA 0.6mm and ACA 0.6mm. No VSP was found in the sham-group. In the SAH-group VSP was detected in 32% (8/25) on day 2 and in 55% (14/25) on day 5. On day 2 mild/moderate VSP was observed in 80% (6/8) rats and severe in two rats. On day 5 mild/moderate VSP was found in 50% (7/14) and severe VSP in 50% (7/14).

Conclusion: MRA allows a good visualization of the cerebral vasculature. With the implementation of the established reference values in this study, MRA provides reproducible results concerning the detection of VSP and its differentiation in three severity grades.

Cerebrovascular elastogenesis in humans during ageing and disease

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Objective: A major biomechanical contributor to maintain structural integrity of cerebral arteries throughout life is the protein elastin, which is predominantly localized in the internal elastic lamina (IEL). No data exists on the ability of the cerebrovasculature to synthesize elastin during ageing in response to hemodynamic challenge but it is well known that loss or degradation of the IEL results in e.g. cerebral aneurysm formation. We therefore investigated synthesis (i.e. elastogenesis) or loss of elastin in human cerebral arteries (CAs) throughout life and compared this to a non-malignant proliferative cerebrovascular disorder, i.e. brain arteriovenous malformations (AVMs).

Methods: Samples from cadaveric CAs or from patients undergoing surgical resection of brain AVMs were processed to ultra-purify elastin. The age of purified elastin extracted from cerebral arteries or from AVMs was relatively estimated using aspartic acid racemization (AAR) or absolutely measured using the ¹⁴C bomb-pulse technique. We constructed a mathematical model of ¹⁴C biological incorporation using variable elastin formation and degradation rates in human CAs to model physiological elastin turnover during life. We then applied this model to explain differences in elastin age in brain AVMs.

Results: A total of 65 CAs and 20 extra cerebral arteries collected from individuals during judicial autopsies aged between 9 months and 104 years as well 25 incidental or ruptured brain AVMs were processed to yield ultra-purified elastin for further analysis. Using a model based on an initial-value transport equation system in which elastin expanded from birth to age 19 and continued in steady state throughout life, we calculated the annual turnover rate of 1.7% for elastin in CAs. Conversely, the age of elastin in AVMs was tightly associated with date of resection rather than date of birth of the individual patient being treated for the AVM; the average elastin age in AVMs was 2-4 years. There was no evident difference ($p=0.175$, two way t-test between) in F¹⁴C levels (i.e. age of elastin) in ruptured ($n=9$) versus unruptured ($n=4$) AVMs.

Conclusion: Our data resulted in the first ever mathematical model to describe elastin turnover in arteries of the human brain: After adulthood has been reached, elastogenesis and degradation in CAs continue throughout life at low rates. Our data indicated that human CAs have minimal capacity to compensate structural damage derived from elastin breakdown or increased accumulated damage. In contrast, a hallmark of brain AVMs is elastogenesis, which indicates that AVMs are of non-congenital origin and/or undergo rapid vascular turnover. Even though our findings cannot elucidate the causality of elastogenesis in brain AVMs, they have important implications for the current understanding and potential molecular treatment of cerebrovascular disorders, including cerebral aneurysms.

Non-invasive vascular neuromonitoring in patients with subarachnoid hemorrhage: impact of early magnesium sulfate administration on local cerebral microcirculation

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Objective: Cerebral vasospasm is one of the major complications in patients with subarachnoid hemorrhage (SAH). In these cases, there has been a debate about the degree of neuroprotection related to magnesium. Thus, we investigated the influence of early intravenous administration of magnesium sulfate (MgSO₄) on local cerebral microcirculation during real-time vascular neuromonitoring.

Methods: Fourteen patients (11 female, 3 male, median age 56.5±9.7) with aneurysmatic SAH Hunt and Hess grades 2 to 5 due to an aneurysm of the anterior circulation were examined. We used a non-invasive combined laser-Doppler spectrophotometry system to measure capillary venous oxygenation (SO₂), post-capillary venous filling pressures (rHb), blood cell velocity (velo) and blood flow (flow) in 7 mm tissue depth. During microsurgical clipping of the aneurysm, a fiberoptic probe was placed onto the cortex next to the site of preparation to measure local microcirculation. Data samples of 60 seconds were recorded as baseline immediately before and 10 minutes after intraoperative application of a loading dose of 50mg/kg body weight MgSO₄ sulfate 10%.

Results: All of the fourteen aneurysms (ACA: 2, AcoA: 5, MCA: 7) were clipped successfully. Compared to baseline values, we observed an increase in median flow of 27% (9-67%), velo of 4% (1-45%) and SO₂ of 11% (2-39%) with no changes in rHb. Postoperative vasospasm was detected in 8 patients by transcranial ultrasound, however, only 2 patients had a related neurological deficit.

Conclusion: These preliminary results indicate that early intraoperative administration of MgSO₄ induced an increase of local cerebral microcirculation as detected during real-time measurement by non-invasive laser-Doppler spectrophotometry. To determine and verify this observation, further studies on clinical outcome and the exact dosage of MgSO₄ are needed.

Dynamic 4D CT angiography for preoperative visualisation of the superficial temporal artery for extracranial-intracranial bypass surgery

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Objective: Superficial temporal artery-to-middle cerebral artery (STA-MCA) bypass surgery continues to play an important role in the management of complex intracranial aneurysms, moyamoya vasculopathy as well as highly selected cases of symptomatic stenooclusive disease with exhausted cerebrovascular reserve capacity (CVR). Aside from hemodynamic assessment, e.g. using acetazoleamide-challenged perfusion computed tomography (PCT) for evaluation of CVR, visualization of the STA is required for the appropriate planning of the STA exposure during harvesting.

We investigated the potential of our standard preoperative perfusion imaging algorithm using dynamic 4D CT angiography (dCTA) for preoperative visualization of the STA in relation to preoperative CA (CA).

Methods: A prospective cohort of 13 patients with either stenooclusive vessel disease (n=11) or moyamoya vasculopathy (n=2) underwent acetazolamide-challenged whole-brain PCT and CA according to our standardized preoperative evaluation protocol prior to STA-MCA bypass surgery. DCTA images were extracted from the whole-brain PCT dataset. To analyze the accuracy of dCTA in the visualization of the STA, diameters of the STA including the frontal and/or parietal branches were measured and correlated with diameters measured on CA. For this purpose Pearson correlation coefficients were calculated. Moreover, dCTA studies were independently assessed by two vascular neurosurgeons with respect to accuracy for incision planning. We determined whether dCTA alone without CA was sufficient for a definite judgment.

Results: Mean diameters measured by dCTA vs. CA were 1.9 ± 0.4 mm vs. 2.0 ± 0.4 mm for the proximal STA (measured 2cm perpendicular to the external acoustic meatus (EAM)), 1.1 ± 0.3 vs. 1.2 ± 0.3 for the parietal branch (measured 6-7cm perpendicular to the EAM), and 1.4 ± 0.3 vs. 1.4 ± 0.3 for the frontal branch (measured 7-8cm perpendicular to the EAM). There was a strong correlation for the diameters of the STA ($r = 0.92$; $p < 0.01$), the frontal ($r = 0.96$; $p < 0.01$) and parietal branch ($r = 0.93$; $p < 0.01$) between dCTA and CA. Except for one case, where the parietal branch of the STA was not visible in the dCTA; dCTA imaging was rated sufficient for planning of the STA exposure without an additional diagnostic value for CA.

Conclusion: Our data highlight that dCTA derived from preoperative PCT imaging data is comparable to catheter angiography with respect to visualization of the STA in the preoperative assessment of STA-MCA bypass surgery. This strongly suggests that pretreatment imaging studies using CA, in addition to PCT imaging may be unnecessary for mere visualization of the STA, especially in view of the invasiveness, risk of thromboembolic complications, additional contrast administration, or radiation exposure of CA. However, in cases of uncertainty CA should be complemented for further evaluation.

Follow-Up imaging after clipping of ruptured aneurysms: what happens with the neck remnants?

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Objective: Whereas data of follow-up imaging after endovascular procedures is widely available, data after microsurgical clipping is rare. Nowadays, due to improved techniques in neuro-imaging (e.g. 3D angiography), neck remnants are identified more often. Therefore, we analyzed our patients who underwent 3D angiography after microsurgical clipping to assess neck remnants both postoperatively and after follow-up.

Methods: Patient and aneurysm characteristics and treatment results were collected prospectively and analyzed retrospectively (2007 – 2015) including data from patient records and a review of imaging findings.

Results: During the study period of 9 years, 217 ruptured aneurysms (up to 27mm) were treated by microsurgical clipping, requiring 364 clips (mean 1.7 clips, range 1-9). The majority (>70%) of the aneurysms were located in the middle cerebral artery (n=87, 40%) or anterior cerebral artery (n=71; 33%).

In the postoperative high-resolution 3D-angiography, a complete occlusion was detected in 147 aneurysms (68%) and a small neck or residual filling was shown in 70 aneurysms (32%).

Mean Follow-up time was 2 years with a maximum of 7.5 years.

Of the patients with a neck remnant or residual aneurysm at postoperative imaging, 9 patients died due SAH complications and 29 had a follow-up imaging. In follow-up imaging, none of these patients had a recanalization.

Further, 44 of 123 surviving patients with complete occlusion had a follow-up imaging. None of the patients with complete occlusion displayed neck remnants or aneurysm recanalization in the follow-up imaging. We identified two *de novo* aneurysms distant to the site of clipping in patients with completely occluded aneurysms (3 month and 17 months after initial treatment).

Conclusion: All patients with complete occlusion in postoperative imaging displayed a complete occlusion in follow-up. Follow-up imaging in patients with neck or aneurysm remnant after microsurgical clipping of ruptured aneurysms identified no recanalization. Therefore, despite an increasing incidence of aneurysm remnants due to 3D angiography, microsurgical clipping showed an excellent long-term durability also for incompletely occluded aneurysms.

DI.23 Joint Meeting Session 8 – Neurosurgical Techniques – Various

Dienstag *Tuesday*, 16.05.2017, 15.05 – 16.35 Uhr *hrs*

- DI.23.01 *Keynote lecture - Neurovascular surgical training. Is it still necessary?*
Christos Tolia (London, United Kingdom)
-
- DI.23.02 *Endoscopic vs. microscopic transsphenoidal tumor resection of pituitary adenomas: a systematic review and meta-analysis*
F. Zheng, X. Zhang, C. Hamisch, M. Timmer, P. Stavrinou, R. Goldbrunner, B. Krischek* (Köln, Deutschland)
-
- DI.23.03 *Software based temporal muscle reconstruction on CAD/CAM cranial implants as novel method to improve cosmetic results after cranioplasty*
J. Perrin* (Mannheim, Deutschland), U. Tokhi, O. Majewski, D. Schulte, D. Hänggi
-
- DI.23.04 *First laboratory and clinical experiences with a new 3D/HD exoscope for transcranial neurosurgical procedures*
P. Prömmel* (Zürich, Switzerland), M. Eördögh, A. Hickmann, P. Kurucz, N. Hopf, R. Reisch
-
- DI.23.05 *Minor complications in craniofacial surgery are more common than previously thought*
D. Shastin, S. Peacock, J. Goodden, J. Russell, M. Liddington, P. Chumas* (Leeds, United Kingdom)
-
- DI.23.06 *Failed foramen magnum decompression: failed restoration of intracranial compliance?*
E. Dyson* (London, United Kingdom), A. Chari, L. Thorne, A. Toma, L. Watkins
-
- DI.23.07 *The learning curve for endoscopic trans-sphenoidal resection of pituitary macroadenomas – a single institution experience, Leeds, UK*
J. Robins* (Leeds, United Kingdom), S. Alavi, A. Tyagi, P. Nix, N. Phillips
-
- DI.23.08 *Contemporary approaches to the ventral craniospinal junction*
M. Nowell* (Bristol, United Kingdom), G. Malcolm, N. Patel, C. Wigfield, R. Nelson
-

Endoscopic vs. microscopic transsphenoidal tumor resection of pituitary adenomas: a systematic review and meta-analysis

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Objective: The endonasal transsphenoidal approach to treat pituitary tumors is widely used. For the past 15 years, the endoscopic endonasal technique is used increasingly. However, there is no systematic review or meta-analysis comparing the rate of gross total tumor removal and complications between the microscopic and the endoscopic transsphenoidal technique.

Methods: In this paper, the authors report a systematic review and meta-analysis of gross tumor removal, mean operative time, postoperative complications such as the occurrence rate of cerebrospinal fluid leak, diabetes insipidus, hypopituitarism, epistaxis, comparing two techniques of pituitary adenoma resection. Randomized controlled trials and non-randomized cohort studies comparing the endonasal transsphenoidal microscopic technique to the endoscopic technique were considered for inclusion.

Results: Seven published reports of eligible studies involving 613 participants met the inclusion criteria. 277 patients were treated microsurgically and 336 endoscopically. Compared to the microscopic technique (M), the endoscopic technique (E) showed a significantly higher rate of gross tumor removal (63,8% versus 77,3%, $P=0.004$). However, there were no significant differences in mean operative time (M mean: 75.5min versus E mean: 64.5min, $P=0.43$), occurrence rate of cerebrospinal fluid leak (4.6% (M) vs. 4.8% (E), $P=0.64$), postoperative diabetes insipidus (4.8% (M) vs. 4.4% (E) ($P=0.69$), postoperative hypopituitarism (14.5% (M) vs. 9.6%(E) ($P=0.2$) or epistaxis (1.8% (M) vs. 0.6% (E), $P=0.44$).

Conclusion: Compared to the transsphenoidal microscopic technique, the endoscopic technique may have an advantage on achieving gross total tumor removal. Neither of the techniques seemed to have an advantage on the mean operative time, or the occurrence of postoperative complications.

Software based temporal muscle reconstruction on CAD/CAM cranial implants as novel method to improve cosmetic results after cranioplasty

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Objective: Cranioplasty after decompressive craniectomy (DC) is not only neurologically an essential part of the follow-up therapy for trauma and stroke patients but also of great cosmetic importance. Both autologous and artificial implants often show unsatisfying cosmetic results especially in the temporal muscle region due to temporal muscle atrophy or muscle resection during initial surgery. Mesh implants or bone cement are often used to intraoperatively reconstruct the temporal muscle defect but frequently lead to unsymmetrical visual results. Aim of this study was to directly integrate a temporal muscle reconstruction into the CAD/CAM cranial implant design to improve the cosmetic results after cranioplasty.

Methods: A common procedure for designing a cranioplasty implant is to mirror the residual bone of the non-decompressed contralateral skull. Our approach was to measure the distances from the intracranial midline to the outer skull and the outer border of the temporal muscle on the non-decompressed side in the axial view of the preoperative CT scans. The delta between skull and muscle border measurements were then added to the standard calculations (skull only) for the implant design thus leading to a thickening of the CAD/CAM implant in the temporal muscle region. The above-mentioned measurements were then repeated in the postoperative scans to objectively analyze the cranial symmetry after cranioplasty. Cosmetic results were evaluated by an independent examiner and were also self- and relative-rated by use of a questionnaire. The results were categorized in 4 grades: very good, good, moderate or poor.

Results: A total of 15 patients (8 male and 7 female) underwent CAD/CAM cranioplasty with integrated temporal muscle reconstruction at our institute. 9 of the 15 patients had suffered from ischemic stroke and 6 patients from severe head trauma partially with multiple skull fractures prior to DC. After cranioplasty one patient underwent revision surgery due to a postoperative epidural hematoma and one patient required a wound revision. No direct implant associated complications were detected. 13 (86.6%) of the 15 patients rated their cosmetic results as very good and 2 (13.3%) as good due to prominent scar tissue. Postoperative CT measurements revealed a high level of soft tissue symmetry of 93%.

Conclusion: Preoperative software based temporal muscle reconstruction for CAD/CAM cranial implants have shown to be a feasible method to improve the postoperative cosmetic results after cranioplasty. Surgical techniques and risks remain equal to those of standard CAD/CAM or autologous cranioplasty implying that this method is also safe. Further comparative analysis with standard cranioplasty will be conducted to solidify the cosmetic superiority of this method.

First laboratory and clinical experiences with a new 3D/HD exoscope for transcranial neurosurgical procedures

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Objective: The introduction of the operating microscope over half a century ago was the crucial step in the development of modern neurosurgery. Despite several especially ergonomic disadvantages, it is an indispensable tool in most of neurosurgical procedures today. Goal of the study was to evaluate a new 3D/HD exoscope operating system for transcranial minimal invasive neurosurgical procedures with capability to replace the operating microscope in the future.

Methods: In a first step, the 3D/HD exoscope (Vitom 3D, Karl Storz, Tuttlingen/Germany) was evaluated on 5 fixed as well as on 20 fresh cadavers. 31 keyhole approaches (supraorbital; supraorbital basal; mini-pterional, interhemispheric anterior, middle, posterior; subtemporal; transcortical; supracerebellar; retrosigmoidal; paramedian suboccipital) were performed in fresh human cadavers. After this preclinical evaluation, the 3D/HD exoscope was used in 9 neurosurgical procedures (1 transcortical resection of metastasis; 1 interhemispheric resection of metastasis; 2 median suboccipital resection of 4th ventricle tumor, intracerebellar metastasis and tentorial meningioma; 3 retrosigmoidal approaches for trigeminal neuralgia, facial spasm and retroclival meningioma; 1 two-level anterior cervical discectomy and fusion). The cases were performed subsequently in a 5 day period without preselection. Surgical manipulations were performed under visual control on a 3D monitor (Karl Storz, Tuttlingen/Germany). Performance was compared to a standard operating microscope (Carl Zeiss Meditec AG, Oberkochen/Germany) and 18 aspects of imaging and suitability were rated as inferior, equal or superior

Results: The 3D/HD exoscope showed equal or superior performance in all used transcranial keyhole approaches concerning resolution of details, depth of field and stereoscopic vision. Improved performance was most obvious in the retrosigmoid and paramedian suboccipital approach according to superior ergonomics. Continuous preparations up to 4 hours could be performed without adverse effects like headache or fatigue. The 3D/HD exoscopes depth of field was significantly larger compared to the standard operating microscope which reduces the need of frequent re-focusing while working in deep surgical fields.

Conclusion: The new 3D/HD exoscope was found to be suitable for use in transcranial Neurosurgery. It showed an overall superior performance in the close-to-reality fresh cadaver model using a variety of different keyhole approaches and during 9 neurosurgical procedures. Larger series with additional functionality like fluorescence and navigation will evaluate the potential of the 3D/HD Exoscope to replace the operating microscope in the future.

Minor complications in craniofacial surgery are more common than previously thought

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Introduction: Tabulation of complications is a common way of evaluating craniosynostosis practice. Due to the lack of standardisation in the literature, objective comparison is often difficult. The authors propose a new classification that builds on prospective data collection and is designed to systematically capture significant morbidity and also near-misses. Its uses include quality improvement and benchmarking between different techniques and centres. The complications are broadly divided into: (0) perioperative occurrences; (1) inpatient complications; (2) outpatient complications not requiring re-admission; (3) complications requiring re-admission (subdivided into surgical and non-surgical); (4) unexpected long-term deficit; (5) mortality. A further detail of each type is made by taking into account post-operative length of stay and time between discharge and event occurrence.

Methods: Over a period between January 2010 and January 2015, complications for all non-syndromic patients undergoing surgery were prospectively collected by craniofacial nurse specialist. Patient demographics, medical background, details of surgery, and follow up were then retrospectively added on the basis of medical notes, anaesthetic and operation charts, and electronic databases. All syndromic cases were excluded. Complications were defined as any unexpected event which has or could have resulted in a temporary or permanent damage to the child.

Results: Analysis of 108 consecutive procedures in 103 non-syndromic craniosynostosis patients undergoing surgery is presented. Mean follow up was 15.1 months. There was a much higher incidence of complications according to the proposed definition (35.9%) than what is commonly reported. Patients with co-morbidities affecting at least two systems had significantly more complications ($p=0.004$, Fisher exact test).

Conclusions: It is the authors' opinion that no complications however minor should be discarded as they will cause distress to families, have an important role during counselling, and may suggest potential areas for service improvement.

Failed foramen magnum decompression: failed restoration of intracranial compliance?

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Objective: There is increasing evidence that patients with Chiari Malformations (CMs) also have disorders of intracranial pressure (ICP).

The generally accepted treatment for patients with symptomatic CM is foramen magnum decompression (FMD). FMD carries a high rate of failure and complication. ICP dynamics in patients with persistent symptoms despite FMD have not been characterised. We sought to characterise the ICP dynamics of CM patients with persistent symptoms despite previous FMD.

Methods: Retrospective observational case-control study looking at ICP dynamics in patients with symptomatic CM, with and without previous FMD. All patients with CM were extracted from our department's ICP database. Patients were divided into two groups: Virgin Chiari Malformation (VCM) and failed Foramen Magnum Decompression (fFMD). Both groups were compared with a control group consisting of patients with normal ICP dynamics. We excluded patients with a CSF shunt system. Median ICP (mICP) and median pulse amplitude (mPA) were compared between the three groups.

Results: We identified 45 patients with Chiari malformations and ICP monitoring data. 12 were excluded for having an existing CSF diverting shunt. Of the 33 patients included, 22 were assigned to the VCM group and 11 were assigned to the fFMD group. All 11 fFMD patients were undergoing investigation for persistent symptoms. The control group consisted of 42 patients. mICP in the control group was 3.24 ± 2.99 mmHg (mean \pm standard deviation). mICP in the VCM group was 3.82 ± 3.74 mmHg (no significant difference to controls). mICP in the fFMD group was 3.04 ± 8.26 mmHg (no significant difference to controls). mPA in the control group was 4.14 ± 1.30 mmHg. mPA in the VCM group was 5.50 ± 2.06 mmHg (significantly higher than the control group $t=3.24$, 95% CI = 0.52 – 2.20 mmHg, $p=0.002$). mPA in the fFMD group was 5.47 ± 1.81 mmHg (significantly higher than the control group $t=2.79$, 95% CI = 0.37 – 2.29 mmHg, $p=0.007$).

Conclusions: Patients with CM exhibit increased ICP pulsatility, which is a measure of compliance. Untreated CM patients have similar overall mICP to normal patients, but significantly higher mPA. Whether increased mPA is part of the underlying pathophysiology of the development of CMs, or is a consequence of a posterior fossa anatomical variation, is yet to be established. It is possible that a spectrum exists between the two scenarios. Patients with persistent symptoms following FMD demonstrate persistently raised mPA, implying that either FMD has been inadequate or that despite adequate decompression, there is an ongoing persistent underlying abnormality of mPA. Whether the increased pulsatility is responsible for ongoing symptoms or not is yet to be investigated. CSF diversion may be a potential primary or secondary intervention to reduce mPA in patients with CM. Further research is required to see if this correlates to symptomatic improvement.

The learning curve for endoscopic trans-sphenoidal resection of pituitary macroadenomas – a single institution experience, Leeds, UK

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Objective: Does increasing operative experience result in greater endoscopic trans-sphenoidal resection of pituitary macroadenomas.

Methods: Study design was a retrospective cohort study of a single institute experience. The subjects were 96 patients who underwent endoscopic trans-sphenoidal resection of pituitary macroadenoma between December 2010 and April 2016.

Analysis of pre- and post-operative tumour volume (at three months) on MR imaging was undertaken for three neurosurgeons to compare percentage of successful resection against experience in performing surgery. Analysis of incidence of CSF leak and complications was also performed along with length of inpatient stay.

Results: A total of 96 patients (56 male, 40 female) with mean age 54 were included. Surgeon 1 performed 76 cases; Surgeon 2 performed 15 cases; and Surgeon 3 performed 5 cases. Non-functional macroadenoma was the commonest histology (46/96) with the remainder functional macroadenomas. Mean pre-operative tumour volume was 7.74cm³, 5.88cm³ and 3.85cm³ for Surgeons 1, 2 and 3 respectively. Mean post-operative tumour volumes were 1.77cm³, 0.94cm³ and 2.13cm³ for Surgeons 1, 2 and 3 respectively. This demonstrated mean percentage resections of 73.6% for Surgeon 1; 79.94% for Surgeon 2; and 42.5% for Surgeon 3. Regression analysis demonstrated a significant increase in tumour resection for surgeon 1 (p 0.14), however there was no significant difference in tumour resection for Surgeons 2 and 3 with increasing experience (p 0.79 and 0.45 respectively). Incidence of intraoperative CSF leak was found to be 11/76 for Surgeon 1; 3/15 for Surgeon 2; and 1/5 for Surgeon 3. Primary closure rate was 93.4% as only one patient needed revision repair for CSF leak. Analysis did not demonstrate a difference between experience and incidence of CSF leak. Excluding CSF leak, only three other complications were recorded. Mean length of stay was 5 days for Surgeon 1; 4 days for Surgeon 2; and 4 days for Surgeon 3, with no difference observed with increasing operative experience.

Conclusion: This study has demonstrated a significant increase in the resection of pituitary macro adenoma for one neurosurgeon over a period of 68 months of experience. This study has also demonstrated no difference in resection for two considerably smaller caseloads for two neurosurgeons in our centre. This study suggests that with increasing experience, a more aggressive resection of macroadenoma is achieved with trans-sphenoidal endoscopic pituitary surgery.

Contemporary approaches to the ventral craniospinal junction

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Design: Single centre retrospective case series

Subjects: 7 patients underwent approaches to the ventral craniospinal junction (clivus-C2) for: meningioma, schwannoma, chordoma, sarcoma, basilar invagination, inflammatory rheumatoid pannus and medullary compression secondary to delayed cranial settling.

Methods: We describe the technical considerations that determine the choice of operative approaches to the ventral craniospinal junction; the risks and benefits of each approach; and the requirement for stabilization

Results: Factors that influence the type of approach include: the extent of exposure in the sagittal plane relative to the hard palate; the location of the pathology relative to the neuroaxis in the axial plane and access to the tumour in the coronal plane. A C1/2 meningioma was approached by a transoral transpharyngeal microsurgical route; medullary compression secondary to basilar invagination by a transnasal endoscopic route; medullary compression secondary to inflammatory rheumatoid pannus by a transnasal transpharyngeal endoscopic route; clival chordoma by a transoral transpharyngeal combined microscopic and endoscopic route; medullary compression secondary to cranial settling by an endoscopic transnasal transphenoidal route; a foramen magnum schwannoma with ventral extension by a lateral transforaminal approach and a C2 sarcoma by a high cervical retropharyngeal route. The surgical approaches were well tolerated. One patient suffered significant complications due to a delayed CSF fistula.

Conclusions: Rare pathologies of the ventral craniospinal junction may be successfully managed using a combination of microsurgical and endoscopic anterior, anterolateral and posterolateral approaches.

DI.24 Joint Meeting Session 9 – Trauma 2

Dienstag *Tuesday*, 16.05.2017, 15.05 – 16.25 Uhr *hrs*

- DI.24.01 *Development of a predictive model for sustained elevations in intracranial pressure following traumatic brain injury*
J. Woodfield* (Edinburgh, United Kingdom), J. Emelifeonwu, A. Rodriguez, A. Demetriades, R. Chesnut, P. Andrews
-
- DI.24.02 *Acute traumatic coagulopathy (ATC) in the setting of isolated traumatic brain injury (iTBI) reduces time from injury to death*
L. Navaratne* (London, United Kingdom), A. West, R. Davenport, C. Uff, K. Brohi
-
- DI.24.03 *Perfusion-CT as a routine diagnostic tool in polytrauma patients with traumatic brain injury: a 9-month experience*
M. Mühmer* (Berlin, Deutschland), C. Munoz-Bendix, D. Remmel, R. Pannewitz, H. Steiger, P. Slotty
-
- DI.24.04 *Incidence, risk factors of seizures and functional outcome with its predictors in elderly patients (over 80 years) with acute subdural hematoma*
S. Won* (Frankfurt, Deutschland), D. Dubinski, N. Brawanski, A. Strzelczyk, V. Seifert, T. Freiman, J. Konczalla
-
- DI.24.05 *Severe Head Injury in Very Old Patients: To Treat or Not to Treat? Results of an Online Questionnaire Distributed to Members of the German Society of Neurosurgery*
C. Unterhofer* (Innsbruck, Austria), S. Hartmann, M. Ortler, C. Freyschlag, C. Thomé
-
- DI.24.06 *Impact of Obesity in Traumatic Brain Injury*
P. Czorlich* (Hamburg, Deutschland), P. Emami, M. Westphal, R. Lefering, M. Hoffmann
-
- DI.24.07 *Influence of Preoperative Hematoma Volume on Recurrence Rate in Chronic Subdural Hematoma*
C. Unterhofer* (Innsbruck, Austria), M. Bauer, C. Thomé
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- DI.24.08 *G-CSF seems to have an anti-apoptotic effect on spinal alpha-motoneurons after traumatic nerve lesion*
D. Keiner* (Homburg, Deutschland), J. Kühn, A. Huber, J. Oertel
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Development of a predictive model for sustained elevations in intracranial pressure following traumatic brain injury

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Objective: To develop and validate a model that uses clinical variables to predict the risk of sustained elevations in intracranial pressure (ICP) following traumatic brain injury (TBI) using data from two large TBI studies.

Methods: Logistic regression models were fitted to prospectively collected clinical data from the Eurotherm3235 trial.¹ Included participants that had sustained elevations in ICP (defined as ICP > 20 mmHg for at least 5 minutes) were compared with patients who were excluded from the trial because they did not develop elevated ICP. Models were compared for model fit and predictive function. The model with the highest area under the receiver operating curve (AUC) was tested using data from the Benchmark Evidence from South American Trials: Treatment of Intracranial Pressure (BESTTRIP) trial.²

Results: There were 387 randomised participants in the Eurotherm3235 trial with sustained elevations in ICP and 867 patients with clinical and demographic data who were screened but did not develop sustained elevations in ICP. BESTTRIP included 157 ICP monitored patients, and 111 had sustained elevations in ICP. The logistic regression model with the highest predictive function for raised ICP in the Eurotherm3235 trial data set included age, GCS motor score, pupil reactivity, and CT Marshall grade. In the Eurotherm3235 trial data, this model had an AUC of 0.68. When applied to the BESTTRIP dataset, the AUC was 0.53.

Conclusion: Clinical variables can predict the likelihood of a sustained rise in ICP following TBI. The model developed with the Eurotherm3235 trial dataset has lower discrimination in the BESTTRIP data set. This is likely to be due to the different clinical characteristics of the patients included in the two trials. Further training of the model on additional datasets may improve predictive ability and generalisability.

References:

1. Andrews PJD, Sinclair HL, Rodriguez A, Harris BA, Battison CG, Rhodes JKJ, Murray GD. Hypothermia for Intracranial Hypertension after Traumatic Brain Injury. *NEJM* 2015; 373(25): 2403-2412
2. Chesnut RM, Temkin N, Carney N, Dikmen S, Rondina C, Videtta W, Petroni G, Lujan S, Pridgeon J, Barber J, Machamer J, Chaddock K, Celix JM, Cherner M, Hendrix T. A Trial of Intracranial-Pressure Monitoring in Traumatic Brain Injury. *NEJM* 2012; 367(26): 2471-2481

Acute traumatic coagulopathy (ATC) in the setting of isolated traumatic brain injury (iTBI) reduces time from injury to death

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Objective: ATC has been well described in iTBI. However, there is no consensus on ATC within iTBI in terms of its clinical definition, incidence (7-86%) and mortality (17-86%). The first aim of this study was to develop a clinically relevant definition of ATC within iTBI. The second aim was to investigate whether the presence of ATC reduces time from injury to death from iTBI and therefore add to the evidence base that ATC directly contributes to poorer outcomes.

Methods: Single centre retrospective cohort study of patients admitted with iTBI (head AIS \geq 3, extracranial AIS < 3) to a major trauma centre from 2012 to 2016. Patients with incomplete data sets were excluded. Data extracted from the trauma registry included demographic data and admission data (ISS, GCS and coagulation bloods). The main outcome measures were in-hospital mortality and time to death

Results: During the study period 2445 patients were admitted with TBI. 675 were excluded due to extracranial AIS >2. 1322 patients had data complete for admission INR (overall mortality 13.9%). INR 0.9-1.1 (n=1065) had a mortality of 9.5%, INR 1.2 (n=127) had a mortality of 22.2% (p<0.01), INR 1.3 (n=56) had a mortality of 41.2% (p<0.01) and INR \geq 1.4 had a mortality of 43.2% (p<0.01). 1267 patients had data complete for admission APTT (overall mortality 13.7%). APTT 18-32 (n=1206) had a mortality of 11.2%, APTT 33-36 (n=27) had a mortality of 55.6% (p<0.01) and APTT >36 (n=34) had a mortality of 70.6% (p<0.01). 265 patients had data complete for admission fibrinogen (overall mortality 25.7%). Fib \geq 1.5 (n=195) had a mortality of 15.9%, Fib 1-1.49 (n=52) had a mortality of 42.3% (p<0.01) and Fib <1 (n=18) had a mortality of 83.3% (p<0.01). 1497 patients had data complete for admission platelet count (overall mortality 13.4%). Plt \geq 150 (n=1248) had a mortality of 11.1%, Plt 100-149 (n=179) had a mortality of 23.5% (p<0.01) and Plt <100 (n=70) had a mortality of 30% (p<0.01). For the second part of the study 1331 patients were included for having coagulation bloods on admission along with complete demographic and outcome data. Overall mortality was 14.1% (188/1331). ATC was present in 32.7% (435/1331). As expected, the ATC group had significantly higher rates of mortality (27.8% v 7.5%, p<0.01), transfusion requirements, ISS/AIS, older age and lower GCS. However, when deaths in the ATC group (n=121) were compared to deaths in the no ATC group (n=67) they were similar for age, gender, mechanism of injury, GCS, ISS and head AIS. The 'ATC died' group had significantly shorter time to death (4.8d v 9.3d, p=0.04) and more deaths within 24h of admission (28.9% v 14.9%, p=0.03)

Conclusion: These results suggest that the clinical definition of ATC within iTBI should be broadened to INR \geq 1.2, APTT >32, Fib <1.5 and Plt <150 to reflect the consistent findings that intermediate values are associated with higher mortality. iTBI patients with ATC appear to die faster when compared to a group, similar for age and injury severity, without ATC.

Perfusion-CT as a routine diagnostic tool in polytrauma patients with traumatic brain injury: a 9-month experience

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Objective: Secondary brain injury following severe traumatic brain injury (TBI) likely significantly contributes to overall TBI outcome. Perfusion deficits are thought to play an important role; these are at least partly triggered by local or global ICP increase. Perfusion-CT (PCT) is already established as an objective and sensitive examination tool to assess overall and local brain perfusion. We sought to determine the benefit of Perfusion-CT as an initial diagnostic tool after TBI in an emergency room setting suitable to support therapeutic decisions.

Methods: We introduced the use of Perfusion-CT as part of our standard diagnostic protocol after TBI. We prospectively analyzed every patient above 18 years of age in a 9-month period (January through September 2016) after TBI and a Glasgow Coma Scale (GCS) ≤ 8 . The PCT was obtained right after the non-contrast CT scan of the head and before the following diagnostics of the cervical spine and whole body scan.

Results: From the 42 patients evaluated, 28 were male and 14 female. Mean age was 57.4 years. Median GCS was 3. A total of 17 patients (40.5%) had an acute subdural hematoma (aSDH), 10 (23.8%) had cerebral contusions, 1 (2.4%) had an epidural hematoma, 7 (16.7%) had a concussion, 4 (9.5%) had traumatic subarachnoid hemorrhage and 3 (7.1%) an intraparenchymal hemorrhage. None of the patients presented adverse events due to the contrast agent. Delays in therapeutic decision were not considered significant by the local joint trauma team. A significant increase in mean transit time (MTT) was observed comparing the injured hemisphere with less/non-injured hemisphere in the whole population investigated (40.8 ds vs. 36.2 ds, $p=0.26$). When comparing different pathologies this effect was only seen in aSDH (48.5 ds vs. 36.8 ds, $p=0.028$). None of the other perfusion parameters did show significant differences.

Conclusion: Perfusion-CT as an initial diagnostic tool after TBI seems to be safe, efficient and feasible method to obtain additional information of brain tissue at risk in these patients. In aSDH a clear increase in MTT on the effected hemisphere is observed. The ongoing detailed analysis of the perfusion changes observed might improve pathophysiological understanding and decision making in trauma care.

Incidence, risk factors of seizures and functional outcome with its predictors in elderly patients (over 80 years) with acute subdural hematoma

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Background: Acute subdural hematoma (aSDH) is a common disease and is increasing in prevalence due to the aging demographic alteration. Yet, the functional outcomes, predictors for outcome and neurosurgical intervention in elderly patients, particularly over 80 years of age, remain unclear. Indeed, this cohort was under investigated in the past.

Method: The author analysed 68 consecutive patients with aSDH surgically treated in the neurosurgical department within the past nine years. Following parameters were assessed: baseline characteristics, admission clinical status, art of surgical procedures, clinical status 24 hours after operation, seizure, radiographic characteristics and comorbidities. Functional outcome was assessed by Glasgow Outcome Scale (GOS) at hospital discharge and three months follow-up (FU). GOS 1-3 were considered as unfavourable outcome.

Result: The mean age was 85 years (range 80-96) and 44% were female. Overall mortality rate was 28% at discharge and 48% at FU. Independent predictors for unfavourable outcome at discharge were GCS \leq 8 24 hours after operation ($p=0.001$) and pneumonia ($p=0.02$). At FU, GCS \leq 8 24 hours after operation ($p<0.001$) and cumulative comorbidities (≥ 5) ($p=0.05$) were significant parameters for unfavourable outcome. All patients with more than 6 comorbidities died at FU. Surgical treatment in comatose patient had significant higher mortality rate at discharge and FU compared to patients with non-comatose status ($p=0.04$). After FU, 23% of comatose patient and more than 50% of non-comatose patient had favourable outcome ($p=0.06$). The incidence of seizures was 44%. Predictors for seizures were GCS \leq 8 24 hours after operation ($p=0.02$) and left side hematoma ($p=0.02$). The occurrence of seizure was associated with unfavourable outcome as well.

Conclusion: Overall the outcome in elderly patient with aSDH improved in the course, depending on the severity of aSDH and the accumulation of comorbidities. Surgical intervention might be beneficial in non-comatose patients and patients with less than 5 comorbidities with obtaining favourable outcome in more than 50%, however particularly surgery in comatose patients with more than 6 comorbidities should be seriously discussed. In particular the occurrence of seizure is high and as an important determinant of outcome, the use of prophylactic antiepileptic treatment should be considered with wide range indication.

Severe Head Injury in Very Old Patients: To Treat or Not to Treat? Results of an Online Questionnaire Distributed to Members of the German Society of Neurosurgery

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Objective: Increasing life expectancy leads to aging of the population. It remains unclear, which factors influence neurosurgical decision-making when it comes to indications for e.g. evacuation of subdural hematomas in very old patients. Therefore, we aimed to investigate the importance of imaging criteria, patients' wishes or their next of kin's wishes and patient demographics on therapeutic decisions made by neurosurgeons.

Methods: An online questionnaire was sent to all neurosurgical units incorporated by the German Society for Neurosurgery (DGNC). The survey was based on the reported case of an unconscious 81-year-old patient with an acute subdural hematoma and consisted of 13 questions. Of these questions, 9 concerned indication and treatment plan and 4 evaluated the neurosurgeon's interest in gathering information on the patient's social circumstances and supposed patient's wishes or advance directives in case of severe illness.

Results: Of all interviewed neurosurgeons, 85% would perform an emergency operation. Midline shift (84%), hematoma thickness (81%) and the time between traumatic injury and treatment (81%) were considered the most important factors for surgical treatment. Of the respondents 44% responded that they would perform a large osteoplastic craniotomy, whereas 28% of the respondents said they would perform a decompressive craniectomy with duraplasty. Only 13% of the respondents considered a small osteoplastic craniotomy to be sufficient. Monitoring systems would be implanted by 72% of the respondents; especially ICP (intracranial pressure) monitoring would be used by 66%. To gather information on the social circumstances of the patient (66%) and to discuss with family members (57%) was felt to be either less important or unimportant.

Conclusion: Clinical decision making among German neurosurgeons in the case of elderly patients with severe traumatic brain injury is still heavily based on imaging findings. Previous social circumstances and patient wishes seem to be neglected. Thus, we propose an alternative, structured approach that respects the preferences of the patients and their surrogates.

Impact of Obesity in Traumatic Brain Injury

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Objective: Mortality and outcome in patients suffering from traumatic brain injury (TBI) is effected by many factors. One of these factors is the Body-Mass-Index (BMI) even if data on BMI and TBI are limited and for a severe obesity °II (BMI > 35 kg/m²) no data at all are existing. Aim of this study was to evaluate the impact of obesity in patients suffering from TBI.

Methods: A retrospective cohort analysis of patients suffering from severe TBI registered in the TraumaRegister DGU[®] of the German Trauma Society (DGU) from 2002 to 2009 was conducted. TBI was defined as an Abbreviated Injury Scale (AIS) in head of ≥3 and AIS in any other part of the body not exceeding the AIS of the head. The BMI was categorized in accordance with the WHO definition of obesity: Group: 1: BMI < 18.5 kg/m², 2: BMI ≥ 18.5 kg/m² - < 25 kg/m², 3: BMI ≥ 25 kg/m² - < 30 kg/m², 4: BMI ≥ 30 kg/m² - < 35 kg/m² (Obesity[°] I) and 5: BMI ≥ 35 kg/m² (Obesity[°] II). The evaluation included preclinical data, initial treatment in the emergency room (ER), clinical course and mortality in relation to the BMI.

Results: 1714 patients with complete datasets fulfilled the inclusion criteria. In 49 patients the BMI was lower than 18.5 kg/m², 885 patients presented with a normal weight (BMI ≥ 18.5 kg/m² - < 25 kg/m²), 604 patients presented with overweight (≥ 25 kg/m² - < 30 kg/m²), while 137 patients suffered from obesity[°] I (BMI ≥ 30 kg/m² - < 35 kg/m²) and 39 patients from a severe obesity ≥ °II (BMI > 35 kg/m²). Patients with obesity[°] I und °II were predominately male (75.9%, respectively 74.4%, p<0.001), older (p<0.001) and TBI was associated with traffic accidents (p<0.001). A Glasgow Coma Scale (GCS) ≤ 8 was less often recorded in obesity[°] I and II (p=0.005). Multivariate logistic regression analysis demonstrated that a BMI > 35 kg/m² was associated with a higher mortality risk (Odds ratio (OR) 3.219; 95% Confidence interval (95%CI) [1.073-9.655]), p=0.037). A GCS 3-8 (OR 5.802; 95%CI [3.007-11.196] p<0.001), preclinical cardiopulmonary resuscitation (OR 10.815; 95%CI [4.455-26.257] p<0.001), a systolic blood pressure < 90mmHg (OR 1.976; 95%CI [1.268-3.079] p=0.003) and an increasing severity of the TBI were associated with a higher mortality. A BMI of ≥ 25 kg/m² - < 30 kg/m² had no impact on the mortality rate (OR 0.788; 95%CI [0.531-1.170] p=0.238).

Conclusion: A BMI > 35 kg/m² in patients suffering from TBI seems to be associated with a higher mortality.

Influence of Preoperative Hematoma Volume on Recurrence Rate in Chronic Subdural Hematoma

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Objective: Recurrence rates after surgery of chronic subdural hematoma (cSDH) range from 0.35% to 33%. Many factors have been discussed. The role of preoperative hematoma volume (POV) was not sufficiently investigated. The aim of this study was to determine whether the initial hematoma volume had an impact on recurrence rate.

Methods: The study was conducted as a retrospective trial between 2008-2010. We analyzed all patients with cSDH within this period (n=164), who were treated by burr-hole craniotomy and standardized postoperative management. Those with bilateral hematoma and insufficient radiological screening were excluded. 104 patients were eligible. POV and volume at follow-up (FUV) (4-6 weeks) were calculated with BrainLab iPlanNet 3.5.0. Statistical analysis was performed using SPSS.

Results: Mean patient age was 73.2 years (range 45-98). 68% of patients were male (n=71). 19.2% of patients needed a revision (n=20). Mean POV was 92.6 cm³ (range 17.3-211.21 cm³), mean FUV was 33.2 cm³ (range 0-188.2 cm³), mean air volume was 2.34 cm³ (range 0-49.4 cm³). A ROC analysis on POV was performed. A cut-off value of 71.19 cm³ (Likelihood-ratio 1.51) was determined.

Conclusion: The results of our study showed an 1.5-fold risk for recurrence after surgery in patients with a POV of more than 71 cm³. Moreover, it seems to be important to perform a volumetric assessment of the initial hematoma volume to determine those patients with an increased risk of recurrence. Regarding the measured volume, extensive observation of this cohort is recommended.

G-CSF seems to have an anti-apoptotic effect on spinal alpha-motoneurons after traumatic nerve lesion

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Objective: Granulocyte-colony stimulating growth factor (G-CSF) has been observed to have direct protective effects on neurons. Besides its neuroprotecting effect, G-CSF fosters the formation of vessels after brain ischemia and improves the recovery of sensorimotor and cognitive functions in experimental models and in humans after stroke. In the present study, possible anti-apoptotic effects of G-CSF on nerves' α -motoneurons after sciatic nerve lesion in rats were evaluated.

Methods: Traumatic lesion has been applied to the right sciatic nerve in 48 rats. Twenty-four animals were treated with G-CSF and 24 animals were treated with intravenous glucose 5%-solution serving as control group. For histological analysis, spinal cord sections of 6 animals of both groups were removed at day 1, day 4, day 7 and day 14. α -motoneurons of both sides were counted and investigated for expression of cholin-acetyltransferase (ChAT), granulocyte-colony stimulating factor receptor (G-CSFR), and the proteins Bcl-2 and Bax. To proof evidence of anti-apoptotic effects within α -motoneurons, fluorescence double-staining was performed for ChAT/Bcl-2, ChAT/Bax and ChAT/G-CSFR.

Results: Counting of α -motoneurons revealed a significantly smaller number of ChAT-stained motoneurons on the lesioned side in animals of the control group at day 1 to day 14 ($p < 0.05$). In animals that were treated with G-CSF, numbers of α -motoneurons were equal. Additionally, significantly less α -motoneurons with Bcl-2- and G-CSFR-expression were counted on the lesioned side in animals of the control group ($p < 0.05$). Compatible with this, Bax-expression in animals of the control group was significantly higher on the lesioned side ($p < 0.05$). Fluorescence double-staining in α -motoneurons was positive for ChAT/Bcl-2, ChAT/Bax as well as for Chat/G-CSFR.

Conclusion: The application of G-CSF after nerve lesion seemed to have a strong neuroprotective effect in α -motoneurons of the sciatic nerve section. It was shown that the number of motoneurons decreased in animals of the control group whereas no difference was observed in animals treated with G-CSF. Concordantly, apoptotic effects were shown by decreased Bcl-2 expression and increased pro-apoptotic Bax-expression in motoneurons of animals treated with G5%-solution. These results indicate that the application of G-CSF contributes to anti-apoptotic effects after traumatic nerve lesion. The relevance of G-CSF, the precise mode of action as well the impact of these findings in the clinical situation will have to be examined in further studies.

DI.25 OP-Techniken 3

Dienstag *Tuesday*, 16.05.2017, 15.05 – 16.25 Uhr *hrs*

- DI.25.01 *Intraoperative computed tomography versus iso-C 3D C-arm imaging for navigated spinal instrumentation*
N. Hecht* (Berlin, Deutschland), H. Yassin, M. Czabanka, B. Föhre, T. Liebig, P. Vajkoczy
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- DI.25.02 *Management of sciatic nerve lesions after bony trauma and surgery - use of the extensible endoscope aided approach*
T. Kretschmer* (Oldenburg, Deutschland), T. Schmidt, C. Heinen
-
- DI.25.03 *Orbitozygomatic approach – transition from "large and lavish" to "small and simple"*
T. Kretschmer* (Oldenburg, Deutschland), T. Schmidt, C. Heinen
-
- DI.25.04 *Minimizing the approach to maximize the nasal quality of life in patients undergoing endoscopic pituitary surgery*
O. Müller* (Essen, Deutschland), B. Stuck, Y. Ahmadipour, K. Wrede, U. Sure, B. Hütter, N. El Hindy
-
- DI.25.05 *Less is more? Surgical treatment of perineuriomas.*
O. Gembruch* (Essen, Deutschland), C. Krogias, A. Junker, R. Leyrer, U. Sure, K. Wrede, A. Uerschels
-
- DI.25.06 *Influence of word characteristics on the rate of semantic language errors induced by repetitive navigated transcranial magnetic stimulation*
C. Schröter* (Köln, Deutschland), J. Pieczewski, C. Nettekoven, K. Thiele, R. Goldbrunner, C. Weiß Lucas
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- DI.25.07 *Perioperative corticosteroids in neurosurgery - risk factor for preoperative complications*
T. Burkhardt, C. Mende, A. Treitz, P. Czorlich, M. Westphal, N. Schmidt, C. Mende* (Hamburg, Deutschland)
-
- DI.25.08 *Anterior-posterior cervical instrumentation - the need and benefits in multilevel corpectomy and cervico-thoracic pathology*
M. Yavuz* (Münster, Deutschland), M. Klingenhöfer, S. Lüthge, N. Warneke, M. Schwake, W. Stummer, C. Ewelt
-

Intraoperative computed tomography versus iso-C 3D C-arm imaging for navigated spinal instrumentation

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Objective: Recent meta-analysis have evidenced the superior accuracy of navigated spinal instrumentation compared to non-navigated techniques. However, the benefit of intraoperative computed tomography (iCT) compared to iso-C 3D C-arm-based navigation remains unclear. The aim of the present study was to report our experience and accuracy of navigated pedicle screw insertion with iCT or 3D C-arm-based spinal imaging in 254 consecutive patients.

Methods: After exposure and attachment of the navigation tracking device, a first iCT or 3D C-arm scan was performed with automatic patient/image co-registration and navigated screw insertion. Screw positioning was then intraoperatively assessed by a second iCT or 3D C-arm scan, based upon which the *intraoperative* accuracy was determined. In cases that required intraoperative screw revision, navigated repositioning was performed based on the second iCT or 3D C-arm scan. Thereafter, a third iCT or 3D C-arm scan was performed to confirm repositioning. In cases with 3D C-arm navigation, a postoperative CT scan was routinely performed, based upon which the *final* accuracy was determined compared to the final iCT scan. The general intraoperative screw placement assessability through iCT or 3D C-arm and the *intraoperative* and *final* accuracies were retrospectively reviewed and analyzed by an independent observer.

Results: Between 2013 and 2016, 1527 pedicle screws were implanted in 260 patients with either iCT (1219 screws) or 3D C-arm (308 screws) based spinal navigation and automatic patient/image co-registration. The indications for surgery were degenerative disease (61%), infectious disease (11%), tumors (13%) and trauma (15%). Direct intraoperative screw assessment with iCT was successfully accomplished for each screw in all patients. In contrast, 39 of the screws implanted with the help of 3D C-arm imaging were intraoperatively not clearly assessable due to hardware artifacts and limited image quality. Regarding the overall precision rates, 3D C-arm-based spinal navigation yielded a comparable accuracy to iCT-based imaging (*intraoperative* accuracy: iCT 94.7% vs. 3D C-arm 89.4%; *final* accuracy: iCT 95.4% vs. 3D C-arm 91.6%). Regarding the region specific intraoperative performance, however, iCT-based screw insertion yielded a significantly higher accuracy in the cervical (iCT 98.8% vs. 3D C-arm 84.6%, * $p < 0.0001$) and thoracic (iCT 96.4% vs. 3D C-arm 83.3%, * $p < 0.0001$) regions, whereas no difference was detected in lumbar-sacral instrumentations (iCT 91.8% vs. 3D C-arm 90.0%; $p > 0.05$).

Conclusion: Both iCT and 3D C-arm-based spinal navigation solutions are able to provide high pedicle screw accuracy rates. However, immediate intraoperative screw placement assessability and screw placement accuracy in the cervical/thoracic spine appear to be limited with intraoperative 3D C-arm imaging alone.

Management of sciatic nerve lesions after bony trauma and surgery – use of the extensible endoscope aided approach

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Objective: Proximal sciatic nerve lesions pose a high risk for incomplete or failed regeneration and frequently present with severe pain in partial and fracture related injuries. Peroneal division lesions have a far lower regeneration potential than tibial division lesions. Lesion depth and thus potential for recovery is very difficult to assess. This results in therapeutic nihilism and a wait and see strategy also for those patients that have no chance for spontaneous recovery.

Relating to our personal series, which is based on early exploration and an expandable less invasive approach, we describe our management and the techniques employed.

Methods: Within a 6.5-year period we operated on 223 traumatic nerve lesions. Among them 14 sciatic nerves (6%). One crime related stab injury in discontinuity was grafted but excluded from this evaluation. All of the lesions were painful, in 8/13 to a severe extent (61%). All of them had at least a complete loss of peroneal motor function. All of them underwent a biportal approach apart from one, who received lengthy grafts at thigh level (war/blast injury).

Results: All patients at least underwent decompression and 11/13 had additional external neurolysis (2 without obvious external signs of scarring). In 11 patients the approach needed to be extended. Three patients were grafted, one in form of a split repair. One nerve underwent epineuriotomy, one had an additional pedicled fat flap to shelter nerve from implanted hip prosthesis. Eleven of 13 Patients stated to have had some benefit from surgery. All of the grafted patients had improvement with their pain syndrome. If external scar is the reason for motor impairment, decompression and neurolysis have the potential to also improve foot lift, which was however not the case after grafting the peroneal division.

Conclusion: External scarring with otherwise intact internal nerve structure is a frequent finding that holds a good prognosis if microsurgically treated with decompression and neurolysis. A major goal of high sciatic nerve reconstruction is restoration of protective sensory function to the sole of the foot as well as pain relief. There is good reasoning for early and stepwise exploration of major or painful sciatic nerve lesions.

Orbitozygomatic approach – transition from "large and lavish" to "small and simple"

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Objective: In selected cases a kranio-orbital extension of a classic pterional or lateral supraorbital approach can give the extra space to the dissection corridor that makes some pathology more amenable to resection. The classic orbitozygomatic approach (OZ) combines a fronto-temporal craniotomy with variable orbital unroofing and transection of the zygomatic process of the os-frontale. With this extensive bone-removal the temporo-frontal base is widely accessible and the trajectory angle is largened. However, the approach is time-consuming, tissue burdening, and risks temporal atrophy and enophtalmos. We describe a fast and simple, very tissue sparing modular minimized technical variant of the orbito-zygomatic (kranio-orbital) approach.

Methods: The classic technique uses a 6 step orbital unroofing technique, necessitating 6 major bone cuts. Variants are a one and two-piece method. Each of them uses a McCarty keyhole and variable additional burr holes. The reciprocating saw is inserted deeply into the bony orbit.

Precondition is extensive, multi layered temporal muscle and superficial fascia mobilization and incision with substantial muscle disconnection also close to its coronoid insertion plus extensive periorbital mobilization.

Due to extensive dissection with potential for unfavorable cosmetic result we abandoned this technique. In a first step we combined a conventional complete lateral supraorbital craniotomy (LSO) with separate orbital unroofing that is manageable via a regular combined skin-muscle flap. For bone exposure a skin incision of 7-10 cm suffices. The combined skin-muscle flap does not necessitate more than conventional temporal muscle incision and results in a favorable cosmetic result. We limit the use of the reciprocating saw to two minimal starter cuts on the medial and lateral orbital rim (thin blades, minimal bone loss) and use small straight and bent chisels two create the pyramidal bone fissures to unroof the orbit. The two-piece method enables unroofing under vision.

In a next step we changed to a single-piece OZ by combining the same but now u-shaped, uncomplete craniotomy with blind chisel unroofing via the orbital rim starter notches.

Results: This type of bone flap only takes 5-10 minutes longer than a standard LSO. It uses the same type of skin incision and the reinserted flap shows excellent alignment.

Conclusion: In the rare cases we need an orbitozygomatic skull base approach we nowadays limit it to a one-piece mini variant with a 7-10 cm skin incision and a combined skin-muscle flap due to ease of use, reduced invasiveness and excellent cosmetic result.

Minimizing the approach to maximize the nasal quality of life in patients undergoing endoscopic pituitary surgery

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Objective: The transnasal endoscopic approach to lesions in sellar region has been implemented in daily praxis. Yet, many patients suffer from diminished nasal quality of life. This is to propose a minimized endoscopic approach to the sellar floor in order to maintain physiological nasal conditions as far as possible.

Methods: From June 2015 to July 2016 a total of 47 consecutive patients have been operated for pituitary adenomas. All cases have been managed endoscopically with preservation of the inferior and middle turbinate as well as the much of the posterior part of the nasal septum as possible. The vomer was not resected on a regular base. The nasal ostium was bilaterally opened to allow the passage of the endoscope and the instruments, respectively. Rhino-septal splints were routinely placed postoperative and left in place for at least 9 days.

Results: There were 23 female and 24 male patients (mean age 55.8 years; range 18-89years, standard deviation 18y). Of 47 adenomas, there were 8 hormone secreting tumors. 7 cases were recurrent adenomas. All operations could be carried out without the necessity to extend the operative approach. Extent of tumor resection was not inferior compared to a cohort of patients operated before with a dramatically greater operative corridor. Visualization of the situs was sufficient in all cases.

Conclusion: Minimizing the endoscopic approach without sacrificing the middle turbinate and protecting as much of the posterior nasal septum and the vomer seems to be not associated with limited tumor resection. Patients nasal quality of life will be presumably better maintained, even though prospective studies are needed to prove this suggestion.

Less is more? Surgical treatment of perineuriomas.

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Objective: Perineuriomas (PN) are rare benign peripheral nerve sheath tumours with perineurial cell origin. Therapy regime is controversial and only sparse reports of single cases or small case series have been published. Aim of this report is to present our minimal surgical treatment regime and long-term neurological outcome in a series of 3 PN cases and compare it to the literature.

Methods: Retrospective analysis of 35 patients with a slow growing benign nerve sheath tumour treated over the last 3 years in our centre revealed a PN in three cases. Under microscopic assistance, the nerve was prepared over the affected distance followed by delicate opening of the epineurium over the complete distance and an interfascicular neurolysis. Intraoperative stimulation of each fascicle was performed and a biopsy was taken from a damaged fascicle with no motorfunction proving the diagnosis of an intraneural PN.

Results: Case One: A 56-year-old male patient with typical clinical and electroneurographical findings of carpal-tunnel-syndrome caused by a PN of the right median nerve presented to our neurosurgical department. The patient underwent 4 surgeries over a period of 30 years without long term benefit because of suspected carpal-tunnel-syndrome. Ultrasound and MRI of the right hand depicted nerve enlargement with hyperechoic perineurial tissue and still identifiable fascicular structure. Interfascicular neurolysis finally led to long term relief of the symptoms.

Case Two: A 16-year-old left-handed male patient presented with a PN of the left ulnar nerve. Symptoms lasted over two years, showing a progressive atrophy of the intrinsic muscles of the left hand. Electrophysiological testing revealed an impairment of the left ulnar nerve, MRI showed tumorous nerve swelling. After interfascicular neurolysis the patient is able to play the guitar again.

Case Three: A 17-year-old female patient complained about progressive impairment of foot elevation over a period of 3 years. Electrophysiological testing showed impairment of the left peroneal nerve and MRI of the left leg revealed a PN. Symptoms have slightly improved after interfascicular neurolysis.

Conclusion: Perineuriomas are rare benign tumours with a slow progression. Decompression and interfascicular neurolysis of the affected nerve showed subsidized improvement of the neurological deficits with good long term results and should be considered as an alternative to extended surgical treatment.

Influence of word characteristics on the rate of semantic language errors induced by repetitive navigated transcranial magnetic stimulation

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Objective: Repetitive transcranial magnetic stimulation (rTMS) to map cortical language functions by inducing “virtual lesions” during task performance (e.g., picture-naming) has recently been introduced into pre-surgical diagnostics in brain tumor patients. We investigated to which extent the characteristics of the objects (words) used in the task influence the occurrence of semantically related language errors.

Methods: Thirteen right-handed, healthy volunteers (female n=6/male n=7) were investigated in 3 consecutive sessions by 10Hz, 30Hz and 50Hz-rTMS. After determination of the individual threshold reflecting motor cortex excitability, online-rTMS was applied during a picture-naming task: black-and-white drawings (n=50) of everyday objects were presented simultaneously with rTMS. Errors were rated by two independent examiners using post-hoc video analysis. The frequency (number of errors per 100 rTMS pulses) of errors related to semantic processing (i.e., anomia and semantic paraphasia) was quantified. Error strength (as defined by no or not identifiable word response) was assessed. All objects allowing alternative naming responses (e.g., ball / football) were excluded. The remaining words were grouped by the number of syllables in one- (1S; N=19) and two-syllable words (2S; N=25). For each object, the word frequency was assessed and correlated to the error rates by Pearson's product moment correlation. Error rates were compared between 1S and 2S using McNemar's test for paired count data.

Results: The number of syllables (1S vs. 2S) had no influence on the total error rate (1S: mean N=73.9 errors/word vs. 2S: mean N=79.9) or the error strength (1S: mean N=19.5 vs. 2S: mean N=19.5). By contrast, the rate of anomias (1S: mean N=4.2 vs. 2S: mean N=6.4) increased with the number of syllables ($p < 0.01$), regardless of the word frequency in German language (n.s.). For semantic paraphasias, a weak statistical tendency was observed ($p = 0.11$), presumably due to few events (1S: mean N=1.4 vs. 2S: mean N=2.2).

Conclusion: Disruption of semantic word processing / word expression, induced by rTMS, seems to be significantly influenced by the complexity of the tested words, i.e., the number of syllables. Using longer words for language mapping might be favourable in order to increase the true-positive rate of mapping results.

Perioperative corticosteroids in neurosurgery - risk factor for preoperative complications

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Objective: Administration of corticosteroids is common practice in cranial neurosurgery to reduce edema during surgery and in the immediate postoperative period or to prevent post-operative nausea and vomiting (PONV). Corticosteroids are well known for their adverse effects. While currently no guidelines for steroid use in this context exist, the objective of this study was to assess the possible side effects of perioperative corticosteroids in a general neurosurgical patient collective.

Methods: In this retrospective analysis of surgically treated patients in the period between 08/2013-06/2014, patient age, sex, smoking, PONV and post-op complications (cerebro-spinal fluid (CSF) leakage, rebleeding, infection) were analyzed in relation to administration of dexamethasone (Dexa) using χ^2 tests, odds ratios (OR) and numbers needed to harm (NNH). Emergency surgeries, VP-Shunts and DBS, spinal or hypophysis surgeries and minors were excluded.

Results: 421 patients (193 male, 245 female, mean age 55 years range 17-90 years) were included, 343 tumor-, 29 epilepsy-, 49 vascular surgeries with 333 supratentorial and 88 infratentorial lesions, patients were stratified by the administration of Dexa, 303 patients received 40mg of Dexa, 21 received 4mg for prophylaxis of PONV, 5 of those also received 40mg during surgery, 102 did not receive steroids. The 40mg-Dexa group and No-Dexa group were balanced for age, gender, smoking habits, hospital stay and the number of supra and infratentorial surgeries, patients with 40mg of Dexa displayed a higher incidence of complications than those without any Dexa (15.2% vs. 5.9% $p < 0.01$, OR 3,34, number needed to harm (NNH) 9.9) or 4mg-Dexa group (0.0%). CSF fistulas were more common for patients with 40mg of Dexa, 10.4% vs. 2.0% ($p < 0.05$, OR 6,85, NNH 11.3). The rate of pneumonia was not raised for patients with steroids, but rebleeding occurred more often for 40mg of Dexa (5% vs. 1.7%, $p = 0.13$). The incidence of PONV was 18.1% overall (23.5% No Dexa, 25.0% 4mg Dexa, 16.1% 40mg Dexa ($p = 0.09$)). The presence of postoperative nausea and vomiting did not correlate with the incidence of complications such as rebleeding or CSF fistulas.

Conclusion: Dexa reduces the PONV rate, however in our study cohort perioperative Dexa is a significant risk factor for the development of CSF fistulas. PONV was not associated with pneumonia, CSF fistulas or rebleeding, therefore routine use of Dexamethasone is not recommended and should be administered only in selected cases.

Anterior-posterior cervical instrumentation - the need and benefits in multilevel corpectomy and cervico-thoracic pathology

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Objective: Postoperative stability of the cervical spine is affected by the increasing number of decompressed levels and also depending on the underlying disease. Considering the stability alone the anterior-posterior instrumentation seems to be the best choice. However, in multimorbid elderly patients the combined approach could be disproportionately risky. Therefore it is a balancing act between the extent of surgery for postoperative stability and patient safety. We report on our experience in anterior-posterior cervical instrumentation in complex spine reconstruction and the postoperative results.

Methods: We retrospectively identified 38 patients aged between 38 and 85 years (64 ± 10 years, 20 female vs. 17 male) over the last six years. The inclusion criteria were anterior-posterior instrumentation either including cervico-thoracic junction or multilevel (≥ 2) cervical corpectomy. Reasons for surgery were pathologic and traumatic fractures, advanced degeneration or purulent diseases of the cervical spine. All patients received postoperative computed tomography and follow-ups (8 ± 7 months, range 1–28 months).

Results: Patients were assigned into two groups, the larger group 1 (87%, $n=33$) received anterior-posterior cervical instrumentation in a one-stage approach, including 2 patients (5%) who were initially scheduled for unilateral instrumentation (anterior or dorsal) – in which early instability of the instrumentation during current hospital stay forced to immediate conversion to the combined (anterior and dorsal) approach. Group 2 (13%, $n=5$) in retrospect was treated in a two-stage procedure. Initial unilateral instrumentation led to instability in the course after a mean time of 11 months (range 1–28 months). None of the group 1 patients showed secondary instrumentation failure after the combined one-stage approach.

No patient died after the treatment and none showed lasting deterioration in the neurological outcome. Eight patients were unchanged (21%) and thirty patients improved (79%) in terms of sensorimotor function, pain level and / or spasticity.

Seven patients of group 1 (21%) developed complications like wound healing disturbances (6%, $n=2$), pleura effusion, urinary tract infection, Horner's syndrome, paralysis of the recurrent nerve and pneumonia (each 3% / $n=1$). Three patients (60%) of group 2 showed wound healing disturbances (40%, $n=2$) and pneumonia (20%).

Conclusion: Considering the lower morbidity and missing instability in the course, the anterior-posterior cervical instrumentation in multilevel corpectomy and cervico-thoracic junction pathology seems to be unrivaled at the moment – especially in regard of missing adequate alternatives.

DI.26 Beste Vorträge aus den DGNC-Sektionen

Dienstag *Tuesday*, 16.05.2017, 15.00 – 17.00 Uhr *hrs*

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- DI.26.01 *Anatomical considerations of the transnasal approaches to the central skull base*
M. Eördögh* (Hannover, Deutschland), G. Baksa, L. Patonay, I. Gawish, I. Sandalcioglu, H. Briner, R. Reisch
-
- DI.26.02 *Detection of circulating tumor cells after cement augmentation of vertebral metastases*
S. Eicker* (Hamburg, Deutschland), M. Mohme, M. Dreimann, S. Werner, S. Riethdorf, T. Gorges, F. Floeth, F. Bludau, M. Westphal, K. Pantel, H. Wikman
-
- DI.26.03 *Early decompression (less than 8 h) versus delayed surgical management improves the functional outcome after traumatic cervical spinal cord injury*
L. Grassner* (Murnau, Deutschland), B. Klein, C. Wutte, M. Vogel, V. Bühren, J. Vastmans, M. Strowitzki, D. Maier
-
- DI.26.04 *Combined treatment of self-assembling peptides and neural precursor cells after experimental cervical spinal cord injury*
K. Zweckberger* (Heidelberg, Deutschland), J. Wang, Y. Liu, M. Fehlings
-
- DI.26.05 *Variation of blood injection velocity in a new experimental model of non-aneurysmal SAH: any influence on intracranial pressure and cerebral perfusion in the acute phase?*
C. Conzen* (Aachen, Deutschland), K. Becker, W. Albanna, A. Höllig, H. Clusmann, U. Lindauer, G. Schubert
-
- DI.26.06 *Stereotactic Catheter Ventriculocisternostomy for Clearance of Subarachnoid Hemorrhage: A Matched Cohort Study*
Peter Reinacher (Freiburg, Deutschland)
-
- DI.26.07 *Der Einfluss des Alters, des Glasgow Coma Scale und der Pupillomotorik auf das Outcome bei schwerem Schädel-Hirn-Trauma: eine retrospektive Multicenter-Studie.*
Friederike Fritzsche (Hamburg, Deutschland)
-
- DI.26.08 *Subarachnoid blood acutely induces spreading depolarizations and early cortical infarctions*
Johannes Woitzik (Berlin, Deutschland)
-
- DI.26.09 *Feasibility, safety and efficacy of Subcutaneous Peripheral Nerve Field Stimulation (sPNS) for the treatment of refractory low back pain. Two-year single-center results.*
Basem Ishak (Heidelberg, Deutschland)
-
- DI.26.10 *Archery under the (EEG) hood: A pilot project on motor learning*
Julian Prell (Halle (Saale), Deutschland)
-
- DI.26.11 *The role of morphological changes in nerve ultrasonography of the peroneal nerve and its correlation with clinical outcome after surgical treatment of intraneural ganglion cysts*
A. Knoll* (Günzburg, Deutschland), A. Pala, M. Pedro, U. Bätzner, R. König, C. Wirtz, G. Antoniadis
-
- DI.26.12 *Tear-Drop-Technique – a non navigated iliac screw placement*
S. Nowak* (Greifswald, Deutschland), J. Müllerplacement
-

Anatomical considerations of the transnasal approaches to the central skull base

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The transnasal-transsphenoidal endoscopic approach to the skull base has a clear advantage both in surgical visualisation and manipulation, offering not only ideal representation of patho-anatomical details, but also unhindered surgical dissection. Nevertheless, important functional structures of the nasal cavity (e.g. the posterosuperior part of the nasal septum, the nasal turbinates) are often removed during transnasal surgical procedures in order to create the necessary space for the further course of the operation. This surgical invasiveness frequently causes unacceptable postoperative rhinological complications with impaired nasal function.

In this study, performed on fresh human cadavers, formalin-fixated cadaveric heads and macerated skulls, we describe the combined transethmoidal-paraseptal approach to the central skull base that meet the requirements to achieve wide exposure without extensive nasal damage.

After unilateral ethmoidectomy, the sphenoid sinus is approached laterally from the superior turbinate, directly through the posterior ethmoidal cells. Thereafter, the middle turbinate is lateralised and the sphenoidal recess exposed. Here, limited sphenoidal rostromy is performed, allowing wide bilateral exposure of the sphenoid sinus and central skull base.

Our anatomical data showed optimal transnasal endoscopic exposure with limited approach-related traumatization of the nasal cavity. In our interdisciplinary rhino-neurosurgical skull base centre, this approach was successfully introduced in the daily routine, allowing minimal sinonasal traumatization.

Detection of circulating tumor cells after cement augmentation of vertebral metastases

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Background: Cement augmentation via percutaneous vertebroplasty (VP) or kyphoplasty (KP) for treatment of spinal metastasis is a well-established treatment option. Leakage of the liquid cement out of the vertebral body into the surrounding vessels with subsequent embolization is, however, a wellknown risk of pressure directed injection. We assessed whether elevated intrametastatic pressure during cement augmentation results in an increased dissemination of tumor cells into the vascular circulation. Since circulating tumor cells (CTCs) may have a prognostic value, we further assessed marker expression (cytokeratin; K and HER2) and perioperative frequency.

Patients and Methods: In this single-center, prospective study, peripheral blood samples for CTC analyses were obtained from 19 patients with metastatic involvement of the spinal column. The blood was collected on three time points: preoperatively, 20 min post cement augmentation and four days postoperatively. CTC detection was performed using CellSearch™; an FDA approved automated immunomagnetic CTC detection system.

Results: Up to now, 19 patients were included (6 male and 13 female, mean age 61.1 years, range 45 - 76 years). Histopathological findings of the primary tumors showed breast- (n = 11, 57.9%), lung- (n = 3, 15.8%), colorectal (1), renal- (1), hepatocellular- (1), prostate- (1), and esophagealcarcinoma (1). Cement augmentation was performed in vertebral bodies of the thoracic (n = 12) or lumbar (n = 11) spine. In 7 patients multiple levels were augmented. EpCAM+/CK+ CTCs were detected preoperatively in 17 patients (mean: 26.8 CTCs/7.5ml blood, SD 47.7). 20 min post-surgery a significant increase of CTC was detected (mean: 64.7 CTCs, SD: 55.9, p < 0.05) and on day four the mean CTC count returned to the preoperative level (mean: 20.4, SD: 24.4, p = 0.005).

Conclusions: This is the first study to report that peripheral circulating tumor cells (CTCs) are temporarily significantly increased due to the vertebral cement augmentation procedure. If this CTC dissemination leads to new metastatic seeding or affects the prognosis will be assessed in future studies. Taken together, our findings provide a rationale for the development of new strategies to reduce the increased dissemination of CTC after vertebroplasty. Molecular analysis further gives new insights into CTC heterogeneity and the clonal dynamics involved in dissemination of tumor cells.

Early decompression (less than 8 h) versus delayed surgical management improves the functional outcome after traumatic cervical spinal cord injury

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Introduction: Traumatic cervical spinal cord injury affects the individual in a multi-faceted way. Early decompression of the spinal canal is recommended. The optimal time point for this intervention has been under debate for decades. This study evaluates if the neurologic as well as functional outcome is influenced by early surgical decompression (< 8h).

Materials and Methods: We performed a retrospective analysis at the Center for Spinal Cord Injuries (Trauma Center Murnau, Germany), a cross-regional level-I trauma center. Follow-up data was collected prospectively for one year after injury, according to institutional and international consensus criteria (EMSCI database – European Multicenter Study about Spinal Cord Injury). We included data acquired over a 10-year period (2004 - 2014). We only analyzed patients over 18 years with traumatic cervical spinal cord injury without concomitant extremity injury, traumatic brain injury or central cord injuries.

Results: We identified 70 patients (11 females), who met in- and exclusion criteria. Out of this population, 35 patients were decompressed within the first 8 h (average: 4.36 h after the insult) (= early group). After one year, patients from the early group showed a significantly higher gain in total motor score (TMS) points (27,1 versus 14,6; $p < 0,007$). Additionally, this patient cohort showed significantly better grades on the American Spinal Injury Association Impairment Scale (AIS) and a significantly higher AIS conversion rate (45,7% versus 20,0%; $p < 0,029$). This was reflected by a statistical significant segmental gain of the motor and neurological level. Furthermore, early operated patients were more likely to experience a significant greater difference in the Spinal Cord Independence Measure (SCIM: 45,8 versus 27,1; $p < 0,005$) within the follow-up period.

Conclusion: This study shows that an early surgical decompression not only leads to higher AIS conversion rates, but – most importantly – also to a better functional outcome (as indicated by the SCIM score).

Combined treatment of self-assembling peptides and neural precursor cells after experimental cervical spinal cord injury

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Objective: The pathophysiology of spinal cord injury (SCI) involves inflammation and tissue scarring interfering with regeneration and recovery. A combined treatment approach with self-assembling peptides (SAP) and neural precursor cells (NPC) might improve this inhibitory environment and neuronal regeneration.

Methods: Following cervical laminectomy, rats were subjected to SCI. After randomization (NPC, SAP, NPC+SAP, vehicle, sham) SAPs and NPCs were injected into the spinal cord 1 day and 14 days after trauma. All animals received growth factors subdurally and immunosuppressive therapy. Neurological function was assessed on a weekly basis. 4 weeks after SCI rats were sacrificed and cryosections were prepared for immunohistochemical staining.

Results: Animals treated with SAPs showed a larger amount of surviving NPCs (18.088 ± 4.044 vs. 11.493 ± 4.111 ; $n=6$; $p=0.019$) and greater levels of differentiation: neurons (8.7% vs. 5.8%; $p=0.015$) and oligodendrocytes (11.6% vs. 9.1%; $p=0.005$). Furthermore, animals treated with SAPs alone or as a combined approach with NPCs had smaller intramedullary cysts ($p=0.07$) and a larger percentage of preserved tissue. In the combined treatment group astrogliosis (GFAP density) and tissue scarring (CSPG density) were significantly reduced. Though the total number of motor-neurons was diminished, there was no significant difference between the groups. Synapto-connectivity (Synaptophysin-density) was increased both in the NPC and in the combined treatment group. Behavioral assessments showed improvements favoring the animals treated combinatorially 8 weeks after SCI.

Summary: Shaping the inhibitory environment using SAPs reduces astrogliosis and tissue-scarring, supports NPC survival and differentiation, and reduces intramedullary cyst formation leading to an improved neurological outcome.

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Variation of blood injection velocity in a new experimental model of non-aneurysmal SAH: any influence on intracranial pressure and cerebral perfusion in the acute phase?

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Introduction: Aneurysmal subarachnoid hemorrhage (aSAH) is hallmarked by rapid increase of intracranial pressure (ICP) and acute hypoperfusion contributing to early brain injury.

Non-aneurysmal SAH (naSAH) is assumed to result in less dramatic ICP changes and possibly preserved cerebral perfusion, thereby resulting in a better neurological outcome.

The purpose of our study was to develop an experimental model of naSAH by variation of injection velocity in order to determine the role of intracranial pressure variability on acute changes of cerebral perfusion after SAH.

Method: SAH in rats was induced by cisternal injection of 0.5ml arterial blood (AB) or 0.5ml normal saline (NS) in predefined time frames: group AB₁ 0.5ml/1min (n=8), group AB₁₀ 0.5ml/10min (n=11), group AB₃₀ 0.5ml/30min (n=7), group NS₁ 0.5ml/1 min (n=9); group NS₁₀ 0.5ml/10min (n=10). 11 sham-operated animals served as controls without any injection. Regional cortical blood flow (CBF), intracranial pressure (ICP) and mean arterial blood pressure (mABP) were recorded for 6 h after SAH.

Results: Maximum increase of ICP was highest in the rapid injection group (AB₁, p<0.001), but significance was lost after 60 minutes. ICP was significantly higher in the AB groups when compared to the NS groups throughout the observation period (plateau phase >1h post SAH, p<0.001). Maximum increase of mABP was significantly higher in the rapid injection group (AB₁) compared to AB₁₀ and AB₃₀ (p<0.001). With NS injection (NS₁, NS₁₀), no significant difference in mABP was detected pre- and post SAH.

CBF decreased significantly in AB₁, AB₁₀ and AB₃₀ compared to baseline pre-SAH (p<0.001, p<0.001, p<0.01 resp.). Maximum decrease was reached at different time points (AB₁ at 1min, AB₁₀ at 12min, AB₃₀ at 70min post SAH). Significant hypoperfusion was observed for 112mins in group AB₁, 165mins in group AB₁₀ and 90mins in group AB₃₀. NS injection led to a transient increase of CBF (p<0.01).

Discussion: Higher velocity of blood injection is associated with a higher increase of ICP, but changes do not extend beyond the hyperacute phase. Acute hypoperfusion is observed at all blood injection velocities, but not with saline injection. Variation of injection velocity may facilitate investigation of different SAH entities (aSAH vs naSAH) and their respective acute and chronic stages.

The role of morphological changes in nerve ultrasonography of the peroneal nerve and its correlation with clinical outcome after surgical treatment of intraneural ganglion cysts

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Objective: Intraneural ganglion cysts of the peroneal nerve are rare benign, non-neoplastic lesions that spread within the epineurium and predominantly affect the deep branch resulting in weakness of the anterior tibial muscle. Therefore ultrasonography is a helpful tool to detect extent of cyst and to evaluate morphology of the nerve. We have investigated morphology of the peroneal nerve after surgical treatment of intraneural cysts and its correlation with long-term outcome.

Methods: The standard surgical therapy was ligating and severing the articular branch and decompressing the cyst. 15 of collectively 34 treated patients were investigated prospectively clinical and by ultrasonography of the peroneal nerve using 15-7MHz sonic probe in MEAN 53 months after surgery (Range between 4 and 156 months). Results of morphological findings were correlated to clinical outcome. We distinguished between pseudoneuroma-like and neuromatous lesions as well as cyst recurrence. Clinical parameter were documented using the manual muscle testing grading system.

Results: Only 1 patient of re-examined collective developed recurrence cyst. Anterior tibial muscle palsy existed in MEAN 8 weeks before surgery and improved in almost all patients to M5. One patient did not recover, in which we could detect a neuromatous lesion of the motor branch in ultrasonography. We have identified a pseudoneuroma-like lesion in 13 patients. that affected lateral bundles without compression of other fascicles and with extension above the original cyst. Persistent articular branch was not found at all. Cyst recurrence could have been detected in 1 patient without compression of fascicular structures.

Conclusion: Neurosonography is a safe and fast method to evaluate postoperative result after decompression of an intraneural ganglion cyst. Furthermore, morphology of the nerve or cyst recurrence can be identified easily. Pseudoneuroma-like lesions of one lateral bundle, which are detected at 13 of 15 patients after surgical treatment of intraneural ganglion cysts correlate with complete muscle function restoration to M5. It could be an evidence of either pressure relief after decompression of an intraneural cyst or a sign of adherence of the collapsed cyst itself.

Tear-Drop-Technique – a non navigated iliac screw placement

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The rate of pseudarthrosis in the lumbosacral region is especially high in patients undergoing long spondylodesis. For this reason, several procedures were developed to further stabilize the lumbosacral segment (Galveston, Dunn McCarthy). The placement of iliac screws is technically and bio-mechanically an established procedure. The placement of iliac screws can be done both navigated and based on x-ray verification. In this study, verification of correct screw placement was done by intra operative 3d scan. The tear-drop technique showed a proper screw position in the intra operative 3D scan and therefor may be considered an alternative technique to the navigated screw placement.

DI.27 Intensivmedizin 3

Dienstag *Tuesday*, 16.05.2017, 15.05 – 16.15 Uhr *hrs*

- DI.27.01 *Neurosurgical challenges: intracranial urgencies and emergencies during pregnancy*
M. Esmailzadeh* (Hannover, Deutschland), B. Hong, E. Hermann, C. von Kaisenberg,
P. Hillemanns, J. Krauss
-
- DI.27.02 *The value of repetitive CT perfusion for detection of cerebral vasospasm-related hypoperfusion after aneurysmal hemorrhage*
S. Vulcu* (Bern, Switzerland), F. Wagner, R. Reitmeir, N. Söll, A. Raabe, J. Beck, W. Z'Graggen
-
- DI.27.03 *Occurrence of Spreading depolarization and impact on delayed infarct progression after malignant hemispheric stroke in C57/bl6 mice*
A. Zdunczyk* (Berlin, Deutschland), L. Schumm, X. Bai, S. Major, P. Vajkoczy, J. Woitzik
-
- DI.27.04 *Does the interruption of nimodipine administration lead to delayed cerebral ischemia in patients with aneurysmal subarachnoid hemorrhage?*
S. Hernandez Duran* (Göttingen, Deutschland), D. Mielke, V. Rohde, V. Malinova
-
- DI.27.05 *Vasospasm of the basilar artery following aneurysmal SAH - clinical observations and implications for experimental research*
N. Dinc* (Frankfurt, Deutschland), S. Tritt, J. Quick-Weller, J. Konczalla, J. Mersmann,
V. Seifert, C. Senft
-
- DI.27.06 *The Safety of Intraarterial Nimodipine Treatment of Severe Cerebral Vasospasm after Aneurysmal Subarachnoid Hemorrhage in Patients with Additional Unsecured Unruptured Intracranial Aneurysms*
J. Lang* (Hannover, Deutschland), F. Götz, J. Krauss
-
- DI.27.07 *Quantitative Assessment of the Subarachnoid Compartment in Correlation with the Development of Cerebral Vasospasm in Aneurysmal Subarachnoid Hemorrhage*
M. Scherer* (Heidelberg, Deutschland), L. Wessels, J. Jung, M. Möhlenbruch, A. Unterberg,
K. Zweckberger
-

Neurosurgical challenges: intracranial urgencies and emergencies during pregnancy

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¹Hannover, Deutschland

Objective: Obstetric causes of maternal mortality have been reduced over the past few years. Intracranial pathologies, however, may cause special problems when they become manifest during pregnancy. With regard to the hormonal, haemodynamic and anatomical changes during pregnancy, certain neurosurgical pathologies are particularly challenging and standard neurosurgical procedures might be inappropriate. Here, we present our experience in the surgical management of intracerebral pathologies during pregnancy.

Methods: Data of pregnant women who underwent surgery for intracranial pathologies within the period from 2005-2015 were collected and analysed.

Results: Nine pregnant women underwent a neurosurgical procedure within the study period. Maternal mean age was 35.4 years. Five women presented with intracranial haemorrhage (epidural haematoma (1), arteriovenous malformation (1), subarachnoid haemorrhage (2) and intracerebral haemorrhage (1)). The other four patients suffered from meningoleiomyosarcoma, cystic trigeminal schwannoma, anaplastic astrocytoma and glioblastoma. Mean gestational age at the time of bleeding was 31.1 weeks. Cesarean section was the mode of delivery in seven patients which resulted in live-born fetuses. In one woman, who suffered intracranial bleeding at week 18 of gestational age of the fetus, spontaneous abortion occurred. One infant was delivered spontaneously in gestational week 40. Development was unremarkable in all infants. All women underwent surgery for their intracranial pathology prior or after delivery of the fetus. Five women survived, while four women succumbed to the intracranial pathology.

Conclusion: Pregnant women with intracranial pathologies need a coordinated interdisciplinary approach to support the mother to deliver a viable and healthy child, and to timely approach the lesion. While contemporary care might insure survival for the majority of infants, maternal mortality still poses an extraordinary challenge.

The value of repetitive CT perfusion for detection of cerebral vasospasm-related hypoperfusion after aneurysmal hemorrhage

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Objective: Cerebral infarction in the context of vasospasm after aneurysmal subarachnoid hemorrhage remains a severe and dreaded complication. Therefore, early diagnosis of misery perfusion is crucial. It has already been shown that hypoperfused brain areas can be detected with CT perfusion (CTP) measurements in patients with acute clinical deterioration. The aim of this study was to evaluate if a single CTP at time of neurological deterioration is sufficient or if serial CTP examinations are needed to reliably detect the areas at risk. In addition, the perfusion parameters with the highest specificity and sensitivity were determined.

Methods: A retrospective analysis of all CTP examinations in a group of patients with aneurysmal subarachnoid hemorrhage, which were treated between 2012 and 2015 at the University Hospital Bern, was performed. Patients with CTP within 24 hours after aneurysm treatment (baseline CTP) and follow up CTP in the phase of vasospasm risk – or at point of neurological deterioration – were included. Two groups were divided – patients with deterioration, defined as GCS decrease of ≥ 2 or increase of NIHSS of ≥ 2 later than 5 days after hemorrhage, and patients without acute clinical deterioration. The following CTP parameters were analyzed for predefined brain regions: Mean Transit Time (MTT), Time To Peak (TTP), Time To Drain (TTD), Cerebral Blood Flow (CBF) and Cerebral Blood Volume (CBV). CTP parameter thresholds for (i) changes compared to the baseline examination, (ii) absolute values at the time point of deterioration and (iii) between-hemisphere differences at the time point of deterioration were determined and sensitivities and specificities were calculated.

Results: Fifty-six patients were finally included – 33 with and 23 without neurological deterioration. CTP parameters MTT, TTP and TTD showed the highest sensitivities and specificities for the symptomatic territory in case of acute diagnostic. Threshold values were 4.15 sec for MTT, 10.16 sec for TTP and 4.7 sec for TTD. Similar results were seen for inter-hemispheric comparisons with highest sensitivities and specificities for MTT, TTP and TTD. Comparison of CTP parameters acquired at the time point of clinical deterioration with a baseline examination yielded no additional diagnostic gain. Regarding all categories, TTD was CTP parameter with the highest sensitivity and specificity.

Conclusion: CTP parameters MTT, TTP and TTD offer the highest sensitivities and specificities in the detection of critically perfused brain regions. Based on our data, we conclude that baseline CTP does not provide additional diagnostic information and, therefore, a CTP in acute neurological deterioration is sufficient.

Occurrence of Spreading depolarization and impact on delayed infarct progression after malignant hemispheric stroke in C57/bl6 mice

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Objective: Spreading depolarization (SD) occurs in high frequency in patients with malignant hemispheric stroke (MHS) and is coupled either to hyperaemic or hypoaemic blood flow responses. After experimental focal ischaemia SD is a significant cause for secondary stroke progression during the initial period of infarct maturation. Due to the need of surgery SD is typically monitored 48 to 120 hours after stroke onset under clinical conditions. Currently it is not known by what extent SD contributes to stroke progression during this delayed period. In this current study we analyze neurovascular coupling and occurrence of SD in a later phase of experimental cerebral ischemia.

Methods: Permanent focal ischemia was induced by distal occlusion of the left middle cerebral artery in male C57/bl6 mice. 24h after MCA occlusion, spreading depolarization was induced with potassium chloride. The neurovascular response was measured by laser speckle contrast analysis. Infarct progression was evaluated by sequential MRI. Three study groups were analyzed: control group without SD induction, SD induction with potassium chloride and SD induction and Ketamine administration (25 mg/kg body weight i.p.).

Results: 24 hours after stroke onset we observed 0.2 ± 0.2 SD/hour. The mean duration was 1.6 ± 1.0 minutes. During potassium application the frequency and duration increased to 3.3 ± 0.7 SD/hour and 3.2 ± 3.5 minutes, respectively. Ketamin treatment reduced the number and duration to 2.4 ± 0.8 SD/hour and 1.36 ± 0.95 minutes, respectively. Neurovascular coupling was dependent on the distance from the ischemic region but did not differ between individual groups. Induction of SD significantly increased stroke volume even 24 hours after stroke onset, which could be prevented by additional ketamine treatment.

Conclusion: Induction of SD with potassium was significantly associated with stroke progression even 24 hours after stroke onset. Therefore, SD might be a significant contributor for delayed stroke progression. Ketamine might be a possible drug to prevent SD induced stroke progression.

Does the interruption of nimodipine administration lead to delayed cerebral ischemia in patients with aneurysmal subarachnoid hemorrhage?

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Objective: Nimodipine is routinely used for vasospasm prophylaxis and thus for prevention of delayed cerebral ischemia (DCI) after aneurysmal subarachnoid hemorrhage (aSAH). Hypotension due to vasodilatation can be a side effect of nimodipine. Catecholamines are then applied to maintain mean arterial pressure and cerebral perfusion. In case of DCI, catecholamines are also used to induce hypertension as part of the triple-H therapy. The high need for catecholamines and associated side effects could lead to an interruption of nimodipine. The aim of this study was to evaluate the interaction between the administration of nimodipine and catecholamines, and to investigate its impact on the incidence of DCI.

Methods: We gathered data concerning nimodipine and norepinephrine administration in patients with aSAH admitted to our center from January 2012 to October 2015 and performed a retrospective analysis. In all patients, nimodipine was started on day 1 after aSAH. In case of hypotension and need of more than 10µg/h norepinephrine, nimodipine was stopped. The incidence of DCI, infarction and vasospasm diagnosed by transcranial Doppler sonography (TCD) was also collected. Bivariate correlation analysis was performed using the Spearman's rho (ρ). For statistical analysis, IBM® SPSS® Statistics Version 21 was used.

Results: A total of 170 patients, 106/170 (62%) females and 64/170 (38%) males, with aSAH were included in the study. Mean age was 54 years (range: 25 – 90). In sum, 90/170 (53%) had nimodipine interruption, while noradrenaline was administered in 94/170 (55%) of patients. DCI, infarction, and TCD-vasospasm were seen in 85/170 (50%), 42/170 (25%), and 66/170 (39%) of cases, respectively. A positive, statistically significant correlation was found between nimodipine interruption and norepinephrine administration (ρ 0.442, $p < 0.001$). Additionally, a positive correlation was found between nimodipine discontinuation and DCI (ρ 0.431, $p < 0.001$), infarction (ρ 0.254, $p = 0.001$), and TCD-vasospasm (ρ .385, $p < 0.001$).

Conclusion: Our analysis reveals a higher incidence of DCI, infarction, and vasospasm in patients with aSAH when nimodipine is interrupted. Nimodipine interruption also correlated with norepinephrine administration. Future studies with a larger patient population are needed to evaluate the appropriate norepinephrine cut-off at which nimodipine should be discontinued.

Vasospasm of the basilar artery following aneurysmal SAH - clinical observations and implications for experimental research

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Objective: The basilar artery is frequently used as reference vessel for laboratory investigations of cerebral vasospasm (CVS) in many experimental models. However, it is unclear whether this artery is representative in regards to the clinical manifestations and sequelae of basilar artery CVS in humans following aneurysmal subarachnoid hemorrhage (SAH).

Methods: In a prospective observational study we have been analyzing all patients admitted to our department with SAH for the occurrence and sequelae of CVS, beginning January 1, 2016. Age, admission state, Hunt & Hess (HH) grading, Fisher scale, location of cerebral infarction and duration of cerebral vasospasm were taken into account. Specifically, we sought to identify patients with CVS of the basilar artery. All patients were treated on ICU, received nimodipine prophylaxis and underwent CT-A to confirm CVS when suspected from routine TCD examinations. When TCDs were unsuspecting, patients had routine CT-A on day 6-9 following SAH to rule out CVS. When CVS was present, patients received specific treatment, and repeat CT-A was performed to detect CVS associated ischemia and to ascertain normalization of vessel diameter before patient discharge. As per institutional protocol, all patients with CVS detected in the posterior circulation had MRI examinations instead of CT-A.

Results: Between January 1 and October 31, 2016, 67 patients were treated for aneurysmal SAH. 35 (52.2%) patients were HH grades 1 or 2, and 32 (47.8%) patients were HH grades 3 to 5. Median age was 54 years. CVS occurred in 43 (64.2%) patients, and 19 (28.4%) patients developed associated cerebral infarctions. In 10 (14.9%) patients, CVS significantly affected the basilar artery. Poor grade (HH 3-5) patients were more likely to develop basilar artery CVS than other patients (25.0% vs. 5.7%, $p < 0.05$). Patients with basilar CVS developed cerebral infarction in a frequency comparable to other patients with CVS (50% vs. 42.4%, $p = 0.73$), but none of these infarctions occurred in the vertebro-basilar territory (cerebellum, medulla, pons, mesencephalon) even though vessel diameter was dramatically reduced according to CT- and/or MR-angiography.

Conclusion: In an ongoing study, basilar artery CVS does not appear to be followed by cerebral infarction in the basilar artery territory, presumably due to a vascular privilege of this vessel and its perforating branches. In contrast, brain ischemia can frequently be observed in the territories of other major arteries (internal carotid, anterior/middle cerebral arteries) affected by CVS. While the underlying mechanism for this intriguing observation needs to be elucidated, our data question the value of experimental studies on CVS performed with animal basilar arteries.

The safety of intraarterial nimodipine treatment of severe cerebral vasospasm after aneurysmal subarachnoid hemorrhage in patients with additional unsecured unruptured intracranial aneurysms

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Objective: Selective intraarterial nimodipine administration is an established treatment option for patients with severe cerebral vasospasm after aneurysmal subarachnoid hemorrhage (aSAH). However, the safety in patients with additional unsecured unruptured intracranial aneurysms is unknown.

Methods: Analysis of a series of 97 patients treated with intraarterial nimodipine for severe medically refractory cerebral vasospasm according to a standardized regimen (2 mg nimodipine diluted with 20 ml 0,9 % NaCl and an infusion rate of 1 ml/min) after aSAH. The ruptured aneurysms were secured by clipping or coiling in all patients. 17 patients (17,5 %) were identified with a total of 21 coexisting unruptured unsecured intracranial aneurysms.

Results: There were 17 patients (3 men, 14 women with a mean age of 54,2 years, range 36-76 years). The unruptured unsecured intracranial aneurysms had a mean diameter of 3,6 mm (range 2-7 mm). The most frequent aneurysm locations were middle cerebral artery (8 aneurysms) and internal carotid artery (8 aneurysms). Two patients had multiple additional aneurysms (4 in one patient and 2 in the other). No aneurysm ruptured during therapy and no alteration of aneurysm configuration was radiologically observed. Furthermore, no other adverse effects were noted.

Conclusion: Selective intraarterial nimodipine application for treatment of severe cerebral vasospasm is safe in patients with coexisting small unsecured unruptured intracranial aneurysms.

Quantitative assessment of the subarachnoid compartment in correlation with the development of cerebral vasospasm in aneurysmal subarachnoid hemorrhage

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Objective: With the traditional Fischer grade often being inconclusive in today's multislice CT, imaging surrogates to evaluate the risk of cerebral vasospasm (VS) in aneurysmal subarachnoid (SAH) hemorrhage are still ill-defined. This study aimed to evaluate if quantitative measures of the subarachnoid compartment including hemorrhage and cerebrospinal-fluid (CSF) volumes correlate with the development of VS in SAH.

Methods: Over a 5-year period, 129 consecutive SAH-cases with repeat angiography taken on mean day 7±3 after ictus to clear clinical delayed cerebral ischemia (DCI) were retrospectively identified. Computer-assisted volumetric analysis was performed for SAH and CSF using an automatic segmentation tool on initial (<24h) CT scan after ictus. VS evident on repeat angiography after SAH defined primary outcome and regression analysis was performed for volumetric measures.

Results: Repeat angiography showed VS in 107 patients while VS was absent in 22 cases. Median Fischer grade was 4 (range 1-4, p=0.49) in both groups. SAH-grade (WFNS) showed a trend towards higher median values in patients with VS (3 vs. 2.5, range 1-5, p=0.06, respectively). Method of aneurysm occlusion (52 clipping vs. 74 coiling) had no association with VS (p=1.0). Patients with VS exhibited significantly greater clot volume and reduced CSF volume in the subarachnoid compartment compared to patients without VS (SAH: 34.0±30.0ml vs. 17.8±19.5ml, p<0.05 and CSF: 63.2±31.2ml vs. 90.5±61.7ml, p<0.01, respectively). Odds ratio (OR) to develop VS was increased 6-fold for patients with a SAH/CSF ratio above 0.25 (OR=6.1 95% C.I. 2.2 – 16.4, p<0.001).

Conclusion: Besides SAH volume, spare CSF had a strong association with VS, while Fischer grade failed to discriminate VS from non-VS patients. SAH/CSF ratio could serve as a promising surrogate for image-based risk-stratification for VS. This will help to customize neuromonitoring measures in patients at risk for VS after SAH. Clinical applicability and validity of SAH/CSF ratio has to be evaluated in future prospective series.

DI.28 Intensivmedizin 4

Dienstag *Tuesday*, 16.05.2017, 15.05 – 16.25 Uhr *hrs*

- DI.28.01 *Brain death: past, present, and future*
D. Moskopp* (Berlin, Deutschland)
-
- DI.28.02 *Brain Death and Organ Donation in Patients Suffering from Aneurysmal Subarachnoid Hemorrhage*
P. Czorlich* (Hamburg, Deutschland), T. Sauvigny, G. Söffker, S. Kluge, J. Grensemann, M. Westphal, N. Schmidt
-
- DI.28.03 *Passive Leg Raising in Neurosurgical Intensive Care Patients. A prospective Trial.*
M. Bauer, C. Freyschlag* (Innsbruck, Austria), D. Basic, M. Popovscaia, E. Münch, L. Schürer, C. Thomé
-
- DI.28.04 *Hyponatremia on the neurosurgical intensive care unit - do patients still fare worse?*
A. Grzywotz* (Essen, Deutschland), I. Kreitschmann-Andermahr, O. Müller, U. Sure, D. Müller
-
- DI.28.05 *Incidence and intensive care management of intraoperative air embolism in semisitting position*
F. Ebner* (Tübingen, Deutschland), K. Decker, H. Hurth, F. Behling, U. Birkenhauer, J. Steiner, M. Tatagiba
-
- DI.28.06 *The administration of gelatine based colloids is safe in patients with signs of hypovolemia after elective intracranial surgeries*
H. Hurth* (Tübingen, Deutschland), U. Birkenhauer, J. Steiner, D. Schlak, M. Tatagiba, F. Ebner
-
- DI.28.07 *Elective craniotomy for intraventricular tumors: postoperative challenges*
R. Schär* (Bern, Switzerland), C. Schwarz, W. Z'graggen, A. Raabe, J. Beck
-
- DI.28.08 *Predicting of short-term outcome in spontaneous cerebral hemorrhage, can we rely on the outcome grading scores?*
D. Al Safatli* (Jena, Deutschland), R. Kalff, C. Ewald
-

Brain death: past, present, and future

Dag Moskopp¹

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History: Up until now, relevant authors inaccurately claim that the concept of brain death was invented in Boston 1968 for the single purpose to harvest organs. It needs to be clarified that the concept of brain death has evolved in Europe between August 27th, 1952 (Björn Ibsen's day) and March 11th, 1960 (Pierre Wertheimer's day) entirely unrelated to the harvesting of organs for transplantation. In his speech on November 24th, 1957, pope Pius XII accepted the termination of intensive care treatment under the condition, that "the soul has left the body".

Status quo in Germany: The author has determined brain death 442 times since 1987. - Since July 2015 the current "Richtlinie der Bundesärztekammer" is valid - including some changes in correlation to the preceding "Richtlinie" (1998).

In consequence, it could be verified for 2015/6, that 52% of all German "Entnahmekrankenhäuser" (n=1261) cannot determine brain death by members of their own staff because either a neurosurgeon and/or a neurologist is lacking. - The exact follow up of diagnostic steps is sometimes unclear (eg. accidental finding of cerebrovascular stand-still before clinical examination: is in that case a second proof of cerebrovascular stand-still necessary?) - There are different postulates for blood-pressure according to the procedures (clinical examination: "no shock" and systolic value; CTA and DSA > 80 mm Hg mean; transcranial Doppler/Duplex: > 60 mm Hg mean; cerebral perfusion scintigraphy: without value). - The postulates for CTA in the "Richtlinien" do not exactly correspond to the referenced publication of Welschehold et al, and sometimes get in contrast to results of classical angiography (cf. Kautzky, Zülch et al 1976, vs. CTA type of "stasis filling", that systematically generates false negative results) - Basic problems with the obligatory sheets (blue color hinders fax copy; missing patient identification on page 2) have already been solved by a proposal of the Deutsche Stiftung Organtransplantation (DSO). - No publication has been found to validate the given lower limit of paCO₂ (35mm Hg) before starting an apnoe-test.

Conclusion and Outlook: "Brain death" ("Hirntod") is the surest medical diagnosis, if the respective "Entscheidungshilfen" / "Richtlinien" have been applied since 1982/1998. No false positive or negative result of this diagnosis has become known until now. - Nevertheless there is urgent need for an update of the current "Richtlinie" concerning procedural, redactional and a few conceptual items. - In addition, the personal proceeding of all respective data to the representative of the DSO, in case of organ donation, is mandatory. - As nearly 50% of all brain death protocols since July 2015 disclose different degrees of inconsistencies (Bösebeck 2016), every exam for specialization in neurosurgery should contain at least one question concerning the determination of brain death.

Brain Death and Organ Donation in Patients Suffering from Aneurysmal Subarachnoid Hemorrhage

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⁵University hospital Hamburg-Eppendorf, Klinik und Poliklinik für Neurochirurgie, Neurosurgery, Hamburg, Deutschland

Objective: Aneurysmal subarachnoid hemorrhage (SAH) is a life threatening disease with a mortality rate of ~20%. In part of the deceased patients cause of death is an irreversible loss of brain functions also known as brain death which is a precondition for a possible organ donation in Germany. Aim of this study was to evaluate the rate of brain deaths as well as the rate of realized organ donation in a cohort of SAH patients (pts.). Additionally demographic and clinical parameters were examined to identify factors that affect the rate of organ donation.

Methods: We performed a retrospective analysis of a single-center cohort of SAH pts. in a 6 year period. The rates of brain death and realized organ donation were examined in relation to age, gender, initial Glasgow Coma Scale (GCS), Hunt & Hess, WFNS and Fisher grade, proof of rebleeding or intracerebral hemorrhage, localization and treatment of the aneurysm, initial signs of cerebral herniation, cardiopulmonary resuscitation and the duration of treatment on the intensive care unit (ICU). The level of significance was set to < 0.05.

Results: 403 SAH pts. in total were included in this study. The case fatality rate was 18.6% (75pts). Brain death was determined in 37 patients (49.3%) and organ donation was completed in 24 patients (32.0%). In 26 patients (34.7%) organ donation was declined either prior or post determination of the brain death. In accordance to the presumed patients' will in 23 patients (30.7%) no further SAH or ICU specific treatment was performed. Due to medical contraindications an organ donation was impossible in 2 patients (2.7%). Determination of brain death was associated with an age of < 60 years ($p=0.001$), a lower GCS ($p=0.045$) and higher WFNS grade ($p=0.018$). All other evaluated factors had no impact on the rate of brain deaths. An organ donation was realized in 11 of 12 men (91.7%) while organ donation was realized in just 52% of female patients (13 of 25 women; $p=0.018$). All other factors had no impact on the rate of organ donations.

Conclusion: We present one of the first reports dealing with the issue of brain death and organ donation in patients suffering from SAH with a rate of realized organ donation of 34.7% in all deceased patients. Further studies and efforts are necessary to improve this rate in Germany.

Passive Leg Raising in Neurosurgical Intensive Care Patients. A prospective Trial.

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Objective: Individual volume management in critically ill patients is crucial to avoid adverse events and improve outcome. Hyper- as well as hypovolemia are known to worsen the prognosis of critically ill patients. Therefore, a goal-directed therapy (GDT) to reach normal and supranormal values of cardiac output and oxygen delivery (DO₂) is beneficial to prevent perioperative complications and organ failure. GDT and continuous ScvO₂ (PiCCO) monitoring showed a significant increase in postoperative outcome in elective surgery. To stabilize hemodynamics and optimize cardiac preload, individual fluid responsiveness should be assessed. Passive leg raising (PLR)-induced changes in cardiac output reliably predict fluid responsiveness in the majority of non-neurological ICU population.

To date, no study has evaluated the use of the passive leg raising-test in patients with intracranial pathology due to a potential risk of increase in intracranial pressure (ICP). The purpose of this study was to test the clinical feasibility and utility of PLR in the neurosurgical intensive care unit (NICU).

Methods: Between January 2016 and September 2016 10 patients with subarachnoid hemorrhage (SAH) or severe TBI were enrolled. Data was collected prospectively, after approval by the university ethics committee. Acquisition of echocardiography prior to testing to evaluate patients ejection fraction to avoid cardiac adverse events during PLR was done. PLR-test was accomplished within 48 hours (acute phase) after TBI/SAH, a second test within day 5-8 postoperatively (subacute phase), provided an initial ICP < 20 mmHg. All patients had an intraparenchymal ICP and Licox probe.

Statistical analysis was performed using SPSS statistics. A probability P value of less than 0.05 was considered significant.

Results: TBI patients (n=6) were all male, whereas all SAH patients (n=4) were female. Mean patient age was 55.6 years (range 35-76). All but two patients were able to undergo testing twice. One patient was transferred to another hospital, the other one died unrelated to the study.

Overall, 18 PLR-tests could be performed. One maneuver had to be terminated due to increase of ICP over 25 mmHg. The ICP elevation was self-limiting. In 17 tests, no hazardous increase of ICP was found neither in the first 48 hours (mean 8.45 mmHg, range 4-16), nor in the subacute phase (mean 9.12 mmHg, range 3-18).

PtbO₂ was measured continuously while testing and was collected the following 10 minutes, which revealed a mean increase of 1.22 mmHg.

Conclusion: We could demonstrate no significant increase in ICP during the acute phase, as well during the subacute phase. Additionally, these data show a tendency towards an increase of PtbO₂ after PLR. The results of this small prospective study demonstrate the feasibility and utility of PLR in neurosurgical intensive care unit patients and provides a basis for further studies.

Hyponatremia on the neurosurgical intensive care unit - do patients still fare worse?

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Objective: Hyponatremia is a common electrolyte disorder in neurocritically ill patients and has in the past been found to be associated with increased morbidity and prolonged in-hospital treatment. In the last years, owing in part to the introduction of antidiuretic hormone receptor (ADH) antagonists to the management portfolio of hyponatremia, the topic of sodium disorders has received increasing clinical attention. The present retrospective study was performed to gain an overview of the current incidence and clinical parameters of patients with hyponatremia on a neurosurgical intensive care unit (ICU).

Methods: Retrospective single-center chart analysis of all patients who fulfilled the following criteria: Treatment for more than one day on our ICU between January 1st 2014 and December 31st 2015, and a Na⁺ level below 135 mmol/l at least twice and a Na⁺ level of or below 130 mmol/l at least once during ICU stay (n = 82 patients, Na⁺-group). Additionally, 67 patients, who also spent more than one day on the neurosurgical ICU but with normonatremia (Na⁺ >135 and < 145 mmol/l) served as the control group (CG). The groups were compared with respect to age, length of stay on the ICU, number of control cranial computed tomography (CCT) scans performed during inpatient treatment, length of overall hospital stay and mortality. SPSS was used for data analysis. Normally distributed data were compared by t-tests and non-normally distributed data by Mann-Whitney-U tests. Nominal data were analyzed using the χ^2 -test or Fisher's exact test if expected frequencies were below five.

Results: There were no differences between groups with regard to sex but patients in the CG were significantly younger (p=0.033) than the patients with hyponatremia. Patients of the Na⁺-group spent significantly more days on the ICU (8.3 ± 7.77 vs. 5.7 ± 7.45 , p < 0.001), were hospitalized for an overall longer time (29.6 ± 22.23 vs. 21.4 ± 16.72 days, p = 0.002) and received more cranial computed tomography scans (4.5 ± 3.24 vs. 2.5 ± 2.23 , p < 0.001) than the CG. There was no difference between groups in regard to mortality, with 12 (14.6%) cases of death in the Na⁺-group and 6 (9.0%) cases in the CG (p=0.324).

Conclusion: The present study shows that our patients with hyponatremia had prolonged ICU and in-hospital treatment times. Interestingly, they also received cranial imaging significantly more often than patients in the CG which may be due to hyponatremia-related disturbances of consciousness. A stringent focus on optimal sodium correction should be one of the treatment goals for such patients.

Incidence and intensive care management of intraoperative air embolism in semisitting position

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Objective: To report about intensive care therapies after intraoperative air embolism in semisitting position.

Methods: We analyzed operating reports, ICU charts and imaging of 244 consecutive patients operated in semisitting position for a lesion in the cerebello-pontine angle. We evaluated the intraoperative and postoperative course as well as in 87 patients specifically the observed changes on intraoperative transesophageal echography graded from 0 (No air embolism) to IV (Air bubbles in the TEE with a drop of EtCO₂>3mmHg and drop of the middle arterial blood pressure >20% and/or increase of heart rate >40%) or V (Grade IV causing hemodynamic instability requiring cardiopulmonary resuscitation). The cases of two patients suffering a prolonged ICU stay due to intraoperative air embolism are illustrated.

Results: According to the TEE grading system 41,5% had no air embolism (grade 0), 45% minimal air bubbles (grade I), 9% air bubbles with a drop of EtCO₂ ≤3mmHg (grade II) and 4,5% air bubbles with a drop of EtCO₂>3 mmHg (grade III). No grade IV or V occurred. All patients with intraoperative air embolism have a postoperative chest x-ray. The blood gas analysis is assessed paying special attention to the Horowitz index. Antioxidant drugs are administrated. From the 244 consecutive patients 2 needed prolonged intensive care because of the intraoperative air embolism in semisitting position: The first patient, a 55 year old woman operated on a petrous bone meningioma developed atelectasis on the chest X-ray with mild functional disturbance. She was extubated on postoperative day 1. The further course was uneventful. The second patient, a 58 year old man operated on a vestibular schwannoma T4A developed an acute respiratory distress syndrome (medium-severe according to the Berlin definition) requiring prolonged intubation and ventilation. The intensive care included fluid restriction, avoidance of colloid fluids, administration of antioxidant drugs, protective ventilation with low tidal volumes. The patient showed a protracted hospital stay but finally recovered well and turned back to his professional life. Grade and time duration of the air embolism predict the immediate postoperative course. All patients with air embolism grad I to III showed good medium and long term outcomes.

Conclusion: Grade of intraoperative air embolism as well as time duration of air embolism are significant risk factors for developing pulmonary complications after surgery in semisitting position. An immediate intensive care treatment stabilizes rapidly the pulmonary situation and leads to good clinical outcomes.

The administration of gelatine based colloids is safe in patients with signs of hypovolemia after elective intracranial surgeries

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Objective: To evaluate adverse effects of administering gelatin to neurosurgical patients with postoperative signs of hypovolemia after elective intracranial surgeries being monitored at a neurosurgical intensive care unit (ICU).

Methods: We performed a retrospective study in our department on 100 consecutive patients operated electively on an intracranial pathology and showing postoperatively clinical signs of hypovolemia. All patients were treated with intravenous colloid fluids containing gelatin and monitored at the neurosurgical ICU. Since former studies have reported severe adverse effects of gelatin in intensive care patients we analyzed the ICU charts for anaphylaxis, renal failure, respiratory distress, bleeding complications and hypercoagulation. Pre-existing pulmonary, renal, thromboembolic conditions and history of bleeding complications or cardiac failure were compiled. In addition vital parameters, blood gas analyses, central venous pressure and the need of catecholamine therapy were compared before administration of gelatin, after 2 hours, after 6 hours and after 24h hours. Blood laboratory findings including blood count, clotting as well as renal parameters were compared postoperatively before administration of gelatin with the findings after one day.

Results: None of the patients presented with severe adverse effects such as anaphylaxis, the need of renal replacement therapy or prolonged ventilation time due to pulmonary edema. One patient presented with multiple thromboembolic complications. Due to extremely elevated D-dimer levels immediately after the operation the presence of thrombosis before gelatin administration was highly suspective. One patient required another surgery due to a major bleeding in the area of operation after initiation of preterm postoperative low-dose heparin therapy. There was no significant difference in laboratory findings before gelatin administration and after one day. Thirtythree percent of the patients were suffering from a preoperatively known minor limitation of their pulmonary, renal and/or cardiac function and/or had a history of thromboembolism. There was no difference in findings between patients with and without preexisting conditions.

Conclusion: Based on our findings we conclude that the use of gelatin based colloids in neurosurgical patients undergoing elective intracranial surgeries is safe even in patients with a history of minor respiratory, renal and/or cardiac disease and/or former thromboembolism.

Elective craniotomy for intraventricular tumors: postoperative challenges

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Objective: Following craniotomy for intraventricular tumors patients often show a tendency for delayed postoperative awakening. Consequently early postoperative neurological monitoring is challenging and a head CT is frequently ordered to rule out postoperative complications. Our goal was to quantify time to extubation and critical postoperative events after elective craniotomies for intraventricular tumors as compared to craniotomies for extraventricular lesions.

Methods: We prospectively enrolled all electively performed craniotomies on patients older than 18 years from November 2011 until August 2016. Extubation was aimed for postoperatively in the OR for all cases. CT scanning within 48 hours after surgery was performed only in cases of unexpected neurological findings or prolonged somnolence after cessation of sedation. The two patient groups (intraventricular tumors vs. extraventricular lesions) were compared in terms of time to extubation, need for emergency head CT and urgent operative revision within 48 hours. The prospective study on elective craniotomies was registered at ClinicalTrials.gov (NCT01987648).

Results: Of 977 elective craniotomies 26 (2.7%) were performed for intraventricular tumors. Mean time to extubation after skin closure in the group with extraventricular lesions (group 1) was 25.5 minutes (\pm standard deviation 26.2) and 34.0 minutes (\pm 27.3) in the group with craniotomy for intraventricular tumors (group 2) ($p = 0.104$). In group 2 urgent head CTs were statistically significantly more often ordered than in group 1 (rate 34.6% and 11.5%, respectively, odds ratio 4.09 (95% confidence interval 1.78-9.40), $p = 0.002$). The rate for urgent operative intervention within 48 hours in group 2 was 3.8% (1 case, external ventricular drain) compared to 1.9% in group 1 (18 cases, OR 2.07, 95% CI 0.27-16.15, $p = 0.404$).

Conclusion: Craniotomy for intraventricular tumors is associated with a higher rate of critical events postoperatively such as a higher rate of CTs, and a tendency for delayed emergence from anesthesia. This cohort requires especially close and diligent postoperative monitoring.

Predicting of short-term outcome in spontaneous cerebral hemorrhage, can we rely on the outcome grading scores?

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Objective: Intracerebral hemorrhage (ICH) is a life threatening entity, and an early outcome assessment is mandatory for optimizing therapeutic efforts.

Methods: We retrospectively analyzed data from 342 patients with spontaneous primary ICH, treated in our institution in the last 8 years, to evaluate possible predictors of 30-day mortality considering clinical, radiological, and therapeutical parameters. Then we applied the three widely accepted outcome grading scoring systems [(ICH score, FUNC score and intracerebral hemorrhage grading scale (ICH-GS))] on our population to evaluate the correlation of these scores with the 30-day mortality.

Results: From 342 patients (mean age: 67 years, mean Glasgow Coma Scale [GCS] on admission: 9, mean ICH volume: 62.19 ml, most common hematoma location: basal ganglia [43.9%]), 102 received surgical and 240 conservative treatment. The 30-day mortality was 25.15%. In a multivariate analysis, basal GCS, bleeding volume and infratentorial hematoma location were significant predictors for the 30-day mortality. Regarding the validated outcome grading scores, we found, using Pearson correlation, a correlation of 0.986 between ICH score and 30-day mortality ($P < 0.001$), 0.853 between FUNC score and 30-day mortality ($P = 0.001$), and 0.924 between ICH-GS and 30-day mortality ($P = 0.001$).

Conclusion: Our study compared three validated outcome grading scores and showed that the ICH score and the ICH-GS accurately predict short-term mortality. The FUNC score, originally designed to estimate the 90-day outcome, correlated to a lesser degree with the mortality at 30 days in our study cohort.

MI.01 Vaskuläre Neurochirurgie 8

Mittwoch *Wednesday*, 17.05.2017, 08.00 – 09.30 Uhr *hrs*

- MI.01.01 *Impairment of neurovascular coupling after subarachnoid hemorrhage*
C. Conzen* (Aachen, Deutschland), W. Albanna, M. Weiß, K. Kotliar, H. Clusmann, A. Höllig, G. Schubert
-
- MI.01.02 *Genetic background in patients with aneurysmal subarachnoid hemorrhage*
T. Sauvigny* (Hamburg, Deutschland), N. Schmidt, J. Regelsberger, M. Alawi, M. Westphal, G. Rosenberger
-
- MI.01.03 *The moon, the planets and the sun – influence on subarachnoid hemorrhage*
A. Herten* (Essen, Deutschland), R. Jabbarli, P. Dammann, B. Hütter, O. Müller, U. Sure, K. Wrede
-
- MI.01.04 *The role of extracellular RNA (eRNA) for microglia activation following subarachnoid hemorrhage*
R. Xu* (Berlin, Deutschland), U. Schneider, A. Okute, V. Kalberlah, S. Fischer, K. Preissner, P. Vajkoczy
-
- MI.01.05 *The heart-brain axis in the setting of subarachnoid hemorrhage*
R. Xu* (Berlin, Deutschland), C. Oeing, J. Vorbäumen, U. Schneider, P. Vajkoczy
-
- MI.01.06 *Pathoanatomical features of ruptured MCA mirror aneurysms compared to the non-ruptured side*
A. Petridis* (Düsseldorf, Deutschland), C. Capone, P. Cappabianca, U. Sure, H. Steiger, H. Maslehaty
-
- MI.01.07 *Cerebrovascular manipulation leads to excessive release of endogenous Neuropeptide Y*
K. Schebesch* (Regensburg, Deutschland), E. Bründl, P. Schödel, J. Scheitzach, S. Bele, A. Brawanski, M. Proescholdt
-
- MI.01.08 *Asymmetry of the anterior cerebral artery in patients with aneurysmal subarachnoid hemorrhage: The phantom menace!*
M. Shah* (Freiburg, Deutschland), M. Reinhard, R. Rölz, C. Scheiwe, R. Jabbarli
-
- MI.01.09 *Flow diverter stents in the endovascular treatment of previously clipped ruptured aneurysms: a feasibility study*
A. Romagna* (Salzburg, Austria), C. Schwartz, M. Kral, P. Winkler, A. Abdul Rahman
-

Impairment of neurovascular coupling after subarachnoid hemorrhage

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Objective: Outcome after subarachnoid hemorrhage (SAH) is significantly determined by early brain injury (EBI) and delayed cerebral ischemia (DCI). Experimental data identified impairment of neurovascular coupling (NVC) as an important contributor to both EBI and DCI, but clinical proof of its existence could not be provided so far. Retinal vessel analysis (RVA) allows non-invasive assessment of the neurovascular unit. Using RVA, we aimed to assess the integrity of NVC in patients with SAH.

Methods: In a prospective study, we performed RVA in 24 patients with acute SAH (group A: day 5-14) and eleven patients at the time of follow-up (group B: mean 90 ± 35 ds after SAH), and included 35 age-matched healthy controls (group C). Data was acquired using a Dynamic Vessel Analyzer (Imedos Systems UG, Jena) for examination of retinal vessel dimension and neurovascular coupling (NVC) using flicker-light excitation (FLE).

Results: Diameter of retinal arteries were comparable for all groups, while veins were significantly dilated after SAH compared to the control group ($p < 0.001$). NVC of retinal arteries was significantly impaired early after SAH (A) as characterised by attenuated dilatation ($p < 0.001$) and reduced area-under-the-curve ($p < 0.01$) after FLE when compared to the control group (C). Partial recovery over time was observed for group B, though arterial dilatation was delayed ($p < 0.05$). Venous response to FLE was significantly delayed after SAH (A: $p < 0.001$; B: $p < 0.05$), but not diminished. Vessel response to FLE was not influenced by treatment with nimodipine.

Conclusion: To our knowledge, this is the first clinical study to document impairment of neurovascular coupling in patients with SAH. Using retinal vessel analysis, distinct differences of compromise were detected for the arterial and venous compartment of the neurovascular unit. Recruitment will continue to facilitate a correlation analysis with clinical course and outcome.

Genetic background in patients with aneurysmal subarachnoid hemorrhage

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Objective: The risk for intracranial aneurysms (IA) and aneurysmal subarachnoid hemorrhage (SAH) is increased among patient's family members, however, the genetic background of the disease is still poorly understood. Although large genome wide association studies identified several single nucleotide polymorphisms, true pathogenic mutations have not been discovered yet. A better knowledge of the genetic background is essential to understand the molecular and cellular dysfunctions in SAH and to spot patients at risk for IA rupture.

Methods: We analyzed patients with SAH and multiple unruptured aneurysms from two families using Illumina HiSeq™ 2500 platform. In a next step we extended Whole Exome Sequencing analyses to a larger patient cohort (n=25). Diseases associated with SAH such as Marfan's syndrome, Ehlers-Danlos syndrome or polycystic kidney disease were clinically excluded. Subsequently, statistical analyses using the Burrows Wheeler Aligner, Genome Analysis Toolkit, SAMtools and gene ranking were performed.

Results: WES and bioinformatic statistics revealed several candidate genes for SAH, which we ranked based on the identified mutation type and position as well as the pathophysiological relevance of the gene product. This resulted in *PIK3R3* (coding for Phosphatidylinositol 3-Kinase, Regulatory subunit 3), *COL5A1* and *COL4A1* (coding for Collagen type V alpha 1 and type IV alpha 1, respectively) as top candidate disease genes.

Conclusion: Our analysis revealed *PIK3R3* as a strong candidate disease gene for SAH, however, final verification of a phenocritical role for mutations in *PIK3R3* has to be investigated. Notably, knockdown of *PIK3R3* increases vascular smooth muscle cell proliferation and neointimal formation in a rat model. Taken together, these results emphasize the possible role of *PIK3R3* in the pathophysiology of SAH and IA formation. Our findings might contribute to develop future tests to assess the risk of SAH in a routine clinical setting.

The moon, the planets and the sun – influence on subarachnoid hemorrhage

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Objective: Frequency of aneurysmal subarachnoid hemorrhages (aSAH) has complex fluctuations. This long-term retrospective study analyzes influence of moon phases, planetary conjunctions and transits and solar activity on occurrence of aSAH.

Methods: Dates of SAH events and basic demographic data for all consecutive patients (n = 956) treated in our vascular center for aneurysmal subarachnoid hemorrhage between January 2003 and December 2015 (4748 days) were retrieved from our continuously maintained database. Daily fraction of the Moon illuminated at midnight 1 hour east of Greenwich was accessed from the U.S. Naval Observatory (USNO) and lunar phases were calculated. Data on planetary conjunctions and transits (Mercury, Venus) was also retrieved from the USNO. Daily solar activity data was accessed from the Space Weather Prediction Center of the US National oceanic and Atmospheric Administration (NOAA). Influence of moon phases and planetary conjunctions and transits on aSAH frequency was analyzed by Monte Carlo simulations (1,000,000 permutations). Correlation of fraction of the moon illuminated and aSAH occurrence was analyzed by Poisson regression. Influence of solar activity (radioflux F10.7 index, Space Environment Services Center (SESC) sunspot number and sunspot area, solar flares, solar proton and electron flux, planetary A-index) on aSAH frequency was also analyzed using Poisson regression. Statistical analysis was carried out with the STATA software package (Stata/MP 14.2 for Linux 64-bit).

Results: The study group comprised 317 (33.2%) male and 639 (66,8%) female patients ($p < 0.001$) with an average age of 54,69 years (standard error of the mean 0.44, range 0 – 89). Monte Carlo simulations did neither show influence of the moon phase nor of planetary conjunctions and transits on aSAH frequency. Poisson regression did neither show influence of the fraction of the moon illuminated nor of solar activity on aSAH occurrence. Interestingly, Poisson regression showed week influence of the radioflux (F10.7 index) on aSAH occurrence when analyzing subsamples of the dataset.

Conclusion: Moon phases, planetary conjunctions and transits as well as solar activity did not influence aSAH occurrence in our long-term aSAH dataset. Correlations found in previous studies might be explained by of small sample sizes or short observation periods.

The role of extracellular RNA (eRNA) for microglia activation following subarachnoid hemorrhage

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Objective: Previous studies have shown that Microglia (MG) accumulation and activation within the brain induces neuronal cell death after experimental subarachnoid hemorrhage (SAH), contributing to secondary brain injury. Recently, the role of self-extracellular RNA (eRNA) has been postulated as a potential “Danger-associated molecular pattern” (DAMP): endogenous eRNA is released from cells upon tissue damage, inducing proinflammatory and prothrombotic processes. This study aimed at investigating whether the eRNA may trigger the activation of innate immunity following SAH.

Methods: Experimental SAH in mice was induced utilizing a filament perforation model in male C57Bl/6-mice. Presence of SAH was confirmed with Magnetic Resonance Imaging on the first postoperative day. Sham operation was performed for the corresponding control group. Mice were treated with RNase1 (42 µg/kg) intravenously, an antagonist of endogenous eRNA. NaCl injections were used for the control group. Mice were then sacrificed at 3 time points: day1, day7 and day14 (n=6 for each subgroup; n_{total}=72). Double-immunofluorescence (IF) staining for ribosomal RNA and Phalloidin (for F-actin) was used to quantify content of eRNA. IF staining was performed to characterize MG (Iba-1), vessel characteristics (cd31/col-IV) and neuronal association (NeuN), and visualized by confocal imaging. MG density was quantified using the ratio of Iba-1 over DAPI positive cells in different subregions of the brain (basal, cortical, median). MG-perivascular association was determined by the percentage of Iba-1 positive cells adjacent to vascular structures.

Results: SAH mice demonstrated a higher content of endogenous eRNA compared to Sham animals. Moreover, MG density increased in SAH peaking on day 7 (Sham vs. SAH: 3% vs. 6.5%, p=0.04), and treatment with RNase1 significantly lowered MG density (6.5% vs. 2.4%, p=0.01). This effect was most prominent in the basal part of the brain, and less striking in the cortical and median aspects. Furthermore, MG homed to the vascular niche as demonstrated by co-staining of Iba-1 and cd31 (Sham vs. SAH: 14% vs. 32%, p=0.008), and administration of RNase1 abrogated this MG-perivascular association *in vivo* (32% vs. 16%, p=0.002). While neuronal-MG interaction increased in SAH (Sham vs. SAH: 18% vs. 32%, p=0.008), it was not significantly affected by RNase1 treatment.

Conclusion: In experimental SAH, eRNA is released into the subarachnoid space and distributed within the brain. This effect is paralleled by an increase in MG density and homing to the vascular niche, which can be rescued by treatment with RNase1, an effective tissue- and vessel-protective endonuclease. RNase1 may exert its intrinsic effect by hydrolysis of eRNA, thereby reducing a neuroinflammatory cascade in SAH. Conclusively, targeting eRNA may represent a potential treatment strategy in reducing secondary brain injury.

The heart-brain axis in the setting of subarachnoid hemorrhage

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Objective: Cardiac dysfunction occurs in up to 20% after subarachnoid hemorrhage (SAH), which has been previously described as neurogenic stunned myocardium. Current paradigm suggests that the interplay between cardiac dysfunction and cerebral perfusion may be triggered via hypercatecholaminergic events, which in turn may lead to secondary brain injury; however, this effect is poorly understood. Thus, the aim of the study was to investigate cardiac function after experimental SAH.

Methods: Using male C57Bl/6 mice, experimental SAH was induced via a filament perforation model (n=18), while Sham operation was conducted for the corresponding control group (n=9). The presence of SAH was verified with Magnetic Resonance Imaging (MRI) in all operated animals. Transthoracic cardiac echocardiography was then performed on all mice to elicit diastolic and systolic function on day 1, day 7, and day 14. Diastolic function was assessed by determining mitral inflow patterns (E/E' ratio) and mitral annulus velocities (E/A ratio), while left ventricular ejection fraction (LVED) was measured for systolic function. Furthermore, the heart weight on each time point was determined following scarification.

Results: In SAH mice, impaired diastolic function was observed as demonstrated by reduced E/A ratio (Sham vs. SAH: 2,3 vs. 1,5; p=0,04). This effect was most prominently seen after 1 week, but a trend was already apparent after 1 day. Left ventricular ejection fraction was not affected in the setting of SAH (Sham vs. SAH: 68% vs. 64%). To elicit whether diastolic dysfunction may stem from cardiac hypertrophy, heart weight was measured after mice sacrifice. Indeed, the heart weight increased in SAH mice by 11,7% (Sham vs. SAH: 136 mg vs. 152 mg; p<0,05).

Conclusion: The above-mentioned model can be utilized to examine the brain-heart axis in the setting of SAH. In experimental SAH mice, a significant impact on diastolic dysfunction is observed after inducing SAH injury, paralleled by an increase in heart weight. Further studies are needed to investigate the pathophysiological patterns that underlie this axis in neurogenic stunned myocardium.

Pathoanatomical features of ruptured MCA mirror aneurysms compared to the non-ruptured side

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Objective: The aim of this study was to define predictive pathoanatomical factors for rupture for middle cerebral artery (MCA) mirror bifurcation aneurysms.

Methods: Bicenter retrospective analysis of ruptured MCA bifurcation aneurysms with simultaneous presence of an un-ruptured MCA bifurcation mirror aneurysm. The parameters measured and analyzed with the statistic software R were: neck, dome and width of both MCA aneurysms including neck/dome and width/neck ratio, shape of the aneurysms (regular vs. irregular), inflow angle of both MCA aneurysms, diameter of bilateral A1 and M1 segments, the frontal and temporal M2 trunks, as well as the bilateral diameter of the carotid artery (ICA).

Results: N = 44 patients (15 male, 29 female, mean age 50.1 years) were analyzed. The size of the dome was highly significant ($p=0.0000069$). The size of the neck ($p=0.0047940$) and width of the aneurysms ($p=0.0056902$) and the aspect ratio, were at the stated significance level slightly non-significant. The shape of the aneurysms was bilaterally identical in 22 cases (50%). In cases of asymmetric presentation of the aneurysm shape, 19 (86.4%) ruptured aneurysms were irregular and 3 (13.6%) were regular shaped ($p=0.001$).

Conclusion: Extra-aneurysmal flow dynamics in mirror aneurysms are non-significant, and aneurysmal geometry does not seem to play a role as predictor for rupture. Only size and shape were predictors of aneurysm rupture. It seems like under same conditions one of the two aneurysms suffers changes in its wall and starts growing more or less stochastically. Newer imaging methods should enable us to see which aneurysm has an unstable wall in order to predict the rupture risk. In case of MCA mirror aneurysms the larger one with or without shape irregularities is the unstable aneurysm and this is the one which needs to be treated.

Cerebrovascular manipulation leads to excessive release of endogenous Neuropeptide Y

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Objective: Neuropeptide Y (NPY), mainly responsible for the cerebro-vascular tone under physiologic conditions, is stored in perivascular nerve fibers around cerebral arteries and its excessive release due to subarachnoid hemorrhage has been shown repeatedly. In this prospective study we sought to evaluate the levels of NPY over time due to surgical and endovascular manipulation of the cerebral vasculature.

Methods: Prospectively, 38 patients have been included (m:f=21:17; mean age 51.3 years). Anterior circulation aneurysms (=vascular group), were treated in 24 patients (endovascular subgroup n=12, clipping subgroup n=12) and the levels of NPY in plasma were compared to 14 patients in the non-vascular group (lumbar disc herniation subgroup n=10, convexity meningioma subgroup n=4) at different time points: 1) day before surgery, 2) intraoperatively, 3) 6 hours postop., 4) 72 hours postop., and 5) 40 days postop. Plasma levels of NPY were determined by means of a competitive enzyme immunoassay (EIA).

Results: Except for time point 1 and 3, the levels of NPY ranged significantly higher in the vascular group compared to the non-vascular group. In the subgroup analysis, the levels of NPY in the clipping subgroup were the highest during the complete observational period, reaching statistical significance (p=0.026).

Conclusion: To the best of our knowledge, this study is the first to prospectively evaluate the plasma levels of endogenous NPY in neurosurgical patients. The results impressively show the excessive release of NPY due to direct manipulation of cerebral arteries. This could be a novel approach towards a better understanding of functional outcome in patients with cerebro-vascular malformations.

Asymmetry of the anterior cerebral artery in patients with aneurysmal subarachnoid hemorrhage: The phantom menace!

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Objective: An asymmetry of A1-segments (A1SA) of anterior cerebral arteries (ACA) is an assumed risk factor for development of anterior communicating artery aneurysms (ACOOA). It is unknown whether A1SA is also of clinical relevance after aneurysm rupture. This study investigates the impact of A1SA on the clinical course and outcome in patients with aneurysmal subarachnoid hemorrhage (SAH).

Methods: 594 consecutive SAH patients treated at our institution between January 2005 and December 2012 were analyzed. The occurrence and severity of cerebral infarctions in the ACA territories were evaluated upon the follow-up computed tomography scans up to 6 weeks after SAH. Moreover, the risk for unfavorable outcome (defined as >3 points on the modified Rankin scale) at 6 months after SAH was assessed.

Results: A1SA was identified in digital subtraction angiographies of 127 patients (21.4%) and was strongly associated with ACOOA ($p < 0.0001$, odds ratio (OR)=13.7). A1SA independently correlated with occurrence of ACA-infarction in patients with ACOOA ($p=0.047$) and the remaining SAH cohort ($p=0.015$). Among patients undergoing ACOOA coiling, A1SA was independently associated with the severity of ACA infarction ($p=0.023$) and unfavorable functional outcome ($p=0.045$, OR=2.4).

Conclusion: A1SA is a common anatomic variation for SAH patients and is strongly associated with ACOOA. Moreover, the presence of A1SA independently increases the likelihood of ACA-infarction. In SAH patients undergoing ACOOA coiling, A1SA carries the risk for severe ACA-infarction and, therefore, unfavorable outcome.

Flow diverter stents in the endovascular treatment of previously clipped ruptured aneurysms: a feasibility study

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Objective: The rate of intracranial aneurysm remnants/recurrences after microsurgical clipping varies between 2% and 42%. The optimal management for these patients, however, remains a matter of debate. Especially repeat surgery bears a high risk of periprocedural complications due to scarring and anatomic distortion from prior procedures. This study aims to evaluate the risk-/benefit-profile of flow diverter stents as an endovascular treatment options for these patients.

Methods: The patient database of our neurovascular hybrid center was queried to identify patients with clipped aneurysms who subsequently underwent endovascular treatment with flow diverter stents (intraluminal, self-expanding). The outcome analysis consisted of an assessment of clinical parameters (modified Rankin Scale; mRS) and the postinterventional angiographic occlusion status (Sindou classification).

Results: Six patients (median age: 51 years) underwent endovascular treatment via flow diversion of recurrent clipped aneurysms. Treatment was necessary in two patients due to progressive neurological dysfunction and in four patients due to angiographic proof of an increasing aneurysm size. Locations of the aneurysm were the middle cerebral artery (n=2), the anterior communicating artery (n=2), the posterior communicating artery (n=1) and the bifurcation of the internal carotid artery (n=1). Median aneurysm size was found to be 0.45 cm (range: 0.1-1.9 cm). All patients had a prior history of subarachnoid hemorrhage; time from primary clipping to recurrence was 10.6 years (range 6.9 months – 30.9 years). Complete radiological aneurysm occlusion was feasible in 5 cases, a remnant portion of the aneurysmatic sac (Sindou grade IV) on early angiography was seen in one case only. Two patients who had suffered from preinterventional neurological deficits (visual deficits and sensorimotor dysfunction) showed a complete remission of symptoms on last follow-up; the last recorded mRS was 0 in 3 cases and 1 in 3 patients. No periprocedural morbidity or mortality was recorded and none of the patients required retreatment in the median follow-up of 8 months.

Conclusion: This preliminary case series suggests that endovascular treatment via flow diverter stenting of aneurysms remnants after prior microsurgical clipping is a feasible treatment concept with a low-risk profile which might prevent the treatment burden of repeat surgery.

MI.02 Vaskuläre Neurochirurgie 9

Mittwoch *Wednesday*, 17.05.2017, 08.00 – 09.30 Uhr *hrs*

- MI.02.01 *The role of ABO blood group in subarachnoid hemorrhage*
D. Dubinski* (Frankfurt am Main, Deutschland), S. Won, J. Konczalla, J. Mersmann, V. Seifert, C. Geisen, E. Herrmann, C. Senft
-
- MI.02.02 *Fusiform aneurysms of vertebrobasilar complex: presentation, natural history and treatment options*
M. Wostrack, A. Wagner, S. Prothmann, D. Hedderich, S. Wunderlich, B. Meyer, J. Lehmborg, E. Shiban* (München, Deutschland)
-
- MI.02.03 *Primary decompressive hemicraniectomy in poor grade aneurysmal subarachnoid hemorrhage*
S. Brandecker* (Bonn, Deutschland), A. Hadjiathanasiou, C. Wispel, V. Borger, P. Schuss, H. Vatter, E. Güresir
-
- MI.02.04 *How likely am I to clip an aneurysm? Question from a resident's point of view - Trends in surgery for intracranial aneurysms during residency*
Y. Wang* (Berlin, Deutschland), F. Kramer, S. Hammersen, D. Moskopp
-
- MI.02.05 *Functional outcome after decompressive craniectomy in patients with aneurysmal subarachnoid hemorrhage*
D. Ludyga* (Köln, Deutschland), N. von Spreckelsen, C. Hamisch, P. Stavrinou, R. Goldbrunner, M. Reiner, G. Brinker
-
- MI.02.06 *Non-aneurysmal subarachnoid hemorrhage: factors influencing shunt dependency - a single-center series and multivariate analysis*
P. Schuss* (Bonn, Deutschland), A. Hadjiathanasiou, S. Brandecker, Á. Güresir, H. Vatter, E. Güresir
-
- MI.02.07 *Individuals with single or multiple intracranial aneurysms: What are the odds?*
R. Jabbarli* (Essen, Deutschland), M. Darkwah Oppong, A. Herten, R. Frantsev, P. Dammann, K. Wrede, U. Sure
-
- MI.02.08 *Vessel dimension and reactivity in the acute phase of aneurysmal and non-aneurysmal subarachnoid hemorrhage*
C. Zaeske* (Aachen, Deutschland), C. Conzen, W. Albanna, K. Kotliar, H. Clusmann, A. Hoellig, G. Schubert
-
- MI.02.09 *Treating innocent intracranial aneurysms: Is there a difference in psychological impact between clipping and coiling?*
B. Hütter* (Essen, Deutschland), P. Wittek, K. Wrede, O. Müller, U. Sure, M. Forsting, P. Dammann
-

The role of ABO blood group in subarachnoid hemorrhage

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Objective: Rupture of an intracranial aneurysm usually presents with an acute onset, requires multidisciplinary intensive care treatment, and the overall death and disability rates are high. The ABO blood type is known to play an important role in hemostasis, thrombosis and vascular NO response. The aspect of ABO blood type in onset, clinical progress and outcome after SAH are to date largely unexplored. We conducted this study to elucidate the association of ABO blood type on the occurrence and outcome of aneurysmal SAH.

Methods: In our retrospective study 470 aneurysmal SAH-patients treated at our institution were included. We performed a chi-squared test (χ^2 -test) for comparison between blood types and WFNS admission status, cerebral vasospasm, delayed infarction and associated intracerebral hemorrhage and fisher grade for analysis for their association with SAH.

Results: No significant difference between blood type and the reviewed variables for SAH outcome were identified. WFNS admission status. (Odds ratio: 1.12 95% CI: 0.7-1.6 p: 0.56). SAH-associated ICH (Odds ratio: 0.81 95% CI: 0.5-1.3 p: 0.36). Cerebral vasospasm (Odds ratio: 1.08 95% CI: 0.7-1.6 p: 0.71). (Odds ratio: 1.23 95% CI: 0.8-1.8 p: 0.30). Fisher grade (Odds ratio: 1.13 95% CI: 0.7-1.6 p: 0.19)

Conclusion: Although a possible relationship between the ABO blood group and the clinical course of SAH patients was hypothesized, our study showed no significant influence of patient's ABO blood type on cerebral vasospasm onset, SAH-associated intracerebral hemorrhage or delayed infarction.

Fusiform aneurysms of vertebrobasilar complex: presentation, natural history and treatment options

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Objective: Fusiform vertebrobasilar aneurysms are rare and may have a disastrous clinical course. Surgical or endovascular treatment options are usually limited. We describe the clinical features of 40 consecutive patients and discuss possible therapeutic options.

Methods: We retrospectively evaluated clinical presentation, treatment procedures, and outcome of 40 consecutive patients with the diagnosis of fusiform vertebrobasilar aneurysm, which were seen at neurosurgical, neurological and neuroradiological departments of our clinic between March 2006 and October 2016. Currently, follow up is available for 22 patients (55%) with a median duration of 27.5 months.

Results: The median age was 68 years (min 21, max 90). Men (n=29, 72.5%) were affected more than twice as frequently as women (n=11, 27.5%). The median maximal diameter of aneurysms was 13 mm (min 6, max. 29 mm). While 14 patients (35%) were asymptomatic, 13 patients (32.5%) presented with embolic ischemic events of thalamus or brainstem, 6 patients (15%) presented with supratentorial embolic strokes and 4 (10%) patients were symptomatic due to brain stem compression. Aneurysm rupture occurred in 3 patients at the initial presentation (7.5%). At the time of the first diagnosis, 18 patients (45%) were significantly disabled with modified Rankin score (mRS) ≥ 3 . Arterial Hypertension and global atherosclerotic vascular changes were observed in 26 (65%) and 14 (35%) cases, respectively. Eight patients (20%) exhibited additional intracranial aneurysms, in 6 patients (15%) abdominal or thoracic aortic aneurysms were diagnosed. During the follow up, the clinical status of 13 patients (32.5%) impaired with decline in mRS score, 10 patients (25%) died due to aneurysm-associated complications. Severe disability (mRS 4 and 5) and death events were significantly more frequent in patients with symptomatic aneurysms ($p=0.03$). Eleven patients (27.5%) underwent invasive treatment: endovascular therapy (stenting with or without aneurysm coiling) was applied in 8 cases, surgical treatment (superficial temporal artery-posterior cerebral artery low flow bypass) in 3 cases. Other 29 patients were conservatively treated by either antiplatelet or anticoagulation therapy. During the follow up, 5 events (62,5%) of severe disability or death are documented in the endovascular group vs. 1 event (33%) in the surgical group vs. 5 events (37.5%) among conservatively treated symptomatic aneurysms.

Conclusion: Rupture of fusiform vertebrobasilar artery aneurysms is rare. Patients frequently present with already disabling symptoms due to aneurysm-associated embolic ischemia or mass effect. The natural history is aggressive, first of all for initially symptomatic aneurysms. Surgical treatment can be considered for carefully selected patients despite significant perioperative morbidity.

Primary decompressive hemicraniectomy in poor grade aneurysmal subarachnoid hemorrhage

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Objective: Aim of this study was to analyse the effect of primary decompressive hemicraniectomy (pDC) on clinical outcome in patients with poor grade aneurysmal subarachnoid hemorrhage (SAH).

Methods: 61 consecutive poor grade SAH patients were analyzed between 10/2012 and 05/2016. Information including patient characteristics and outcome were prospectively collected in a computerized database. pDC was performed due to clinical signs of herniation or brain swelling according to the treating surgeon. Outcome was analyzed according to modified Rankin Scale (mRS) and dichotomized into favorable (mRS 0-3) and unfavorable outcome (mRS 4-6) after 6 months.

Results: Of 61 patients with poor grade SAH, 32 underwent pDC and 29 did not. Mydriasis was present in 22 patients with and in 8 patients without DC (69 % versus 28 %, $p = 0.002$), and additional ICH in 66 % vs. 24 % ($p = 0.002$) respectively. Favorable outcome did not differ between the two groups (22 % versus 21 %).

Conclusion: Despite of a worse clinical status at presentation (significant higher rate of mydriasis and additional ICH), poor grade SAH patients with pDC achieve favorable outcome in a significant number of patients. Therefore treatment and pDC should not be omitted in this severely ill patient collective.

How likely am I to clip an aneurysm? Question from a resident's point of view – Trends in surgery for intracranial aneurysms during residency

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Objective: The management of ruptured and unruptured aneurysms has always been one of the core competencies in Neurosurgery. Intracranial surgery for aneurysms requires high skill and level of experience. This study evaluates the incidence and outcome of clipping and coiling procedures in a single institution and the impact on training in open neurovascular surgery. How high is the probability of clipping an aneurysm as a resident with respect to patient safety and outcome?

Methods: We identified all patients with ruptured and unruptured intracranial aneurysms between 2008 and 2016. Angiogram-negative subarachnoid hemorrhage was excluded. Clinical grading was assessed by the Hunt&Hess classification. We reviewed the mode and frequency of treatment according to elective (unruptured) or emergency (ruptured) cases. We evaluated the data of 0° MCA aneurysms and defined the outcome after treatment by determinants of new and the severity of persistent neurological deficits. We estimated the probability of numbers of unruptured 0° MCA aneurysms treated by a resident.

Results: 327 patients presented, 90 electively, 237 with ruptured aneurysms between 2008 and 2016, 220 female, 107 male, median age 53 years. 146 patients (61,6%) received endovascular treatment and 69 (29,1%) patients underwent surgery in the emergency group. Due to the high surgical requirements operations on ruptured aneurysms were performed by the head of department. In the elective group 43 patients (47,8%) received endovascular treatment, 42 patients (46,7%) underwent surgery. In the group of unruptured aneurysms 0° MCA aneurysms permit the easiest surgical access with minimal brain retraction and can be treated by 5th year and 6th year residents under the supervision of an experienced surgeon. In total 23 unruptured 0° MCA aneurysms received surgical and 6 endovascular treatment. In average 3-4 unruptured 0° MCA aneurysms are treated surgically per year. In the surgery group 1/23 (4,3%) patient and in the endovascular group 1/6 (16,7%) patient suffered from severe complication with a high grade of disability after treatment. No mortality occurred in both groups. Restitutio ad integrum could be achieved in about 65% of the cases in both groups.

Conclusion: According to the official German training charter no respective operative experience is required for trainees during residency. The future of microsurgical expertise in the field of the management of aneurysms depends on the quality and frequency of training. Our study and training program for experienced residents show that the selection of unruptured 0° MCA aneurysms for the microsurgical management results in good prognosis compared to the outcome of the endovascular technique. To maintain competence in aneurysm surgery changes in training requirements should be made.

Functional outcome after decompressive craniectomy in patients with aneurysmal subarachnoid hemorrhage

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Objective: Decompressive hemicraniectomy (DHC) has been shown to improve outcome in patients with malignant hemispheric stroke. Comparable results should be expected in patients with subarachnoid hemorrhage (SAH) and intracranial hypertension due to ischemia or brain swelling. However conclusive data on DHC in SAH are still missing. In a first approach, we therefore descriptively evaluated outcome in this subgroup, in regard to patient and SAH characteristics, time point of DHC and its indication.

Methods: In a retrospective single centre analysis, all patients with aneurysmal subarachnoid hemorrhage receiving DHC, treated between January 2006 and December 2014, were identified. Timepoint and indication for DHC, age, initial clinical status, aneurysm localization and treatment, secondary hydrocephalus as well as neurological outcome (modified Rankin scale) were analysed. A mRS of ≤ 3 at last FU was defined as favourable outcome. For statistical analysis, Mann-Whitney-U-Test was applied.

Results: Fifty patients were evaluated (median age 49.5 (range, 26- 76) years). Initial WFNS grade was I in 11 patients (22%), II in 5 patients (10%), III in 6 patients (12%), IV in 7 patients (14%) and V in 21 patients (42%). 23 Aneurysms were localized at the middle cerebral artery (46%), 9 at the internal cerebral artery (18%), 12 at the anterior communicating artery (24%), 5 at the posterior communicating artery (10%) and one at the posterior cerebral artery (2%). Aneurysm treatment consisted of surgical clipping in 32 patients (64%), endovascular treatment in 17 patients (34%) and no treatment in one patient (2%). The indication for DHC was intracerebral hemorrhage in 9 patients (18%), secondary brain swelling in 22 Patients (44%) or infarction in 19 patients (38%). Craniectomy was rarely performed primarily on the day of bleeding (16%, n=8), but mostly secondarily (84%, n=24). At a median follow up of 19,5 weeks (range 0.3- 402.4), favourable outcome was noticed in 9 Patients (18%). The mortality rate was 24% (n=12). Functional outcome was not associated with timepoint or indication for DHC, age, initial clinical status, aneurysm localisation and treatment or secondary hydrocephalus.

Conclusion: We found no prognostic factor for functional outcome after DHC, but favourable outcome was achieved in almost one- fifth of these vitally endangered patients. Therefore, DHC should be considered as a treatment option in intracranial hypertension after SAH.

Non-aneurysmal subarachnoid hemorrhage: factors influencing shunt dependency – a single-center series and multivariate analysis

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Objective: Patients presenting with spontaneous, non-aneurysmal subarachnoid hemorrhage (nSAH) are known to have a good prognosis. Nevertheless, some patients might develop shunt-dependent hydrocephalus throughout the treatment course. We therefore analyzed our neurovascular database to identify factors determining shunt-dependency after nSAH.

Methods: From 2008 to 2016, 131 patients suffering from spontaneous nSAH were admitted to our department. NSAH was defined as angiogram-negative, spontaneous SAH. Information, including patient characteristics, previous intake of anticoagulation or antiplatelet medication, presence of acute hydrocephalus, radiological features, shunt-dependency during treatment course and functional neurological outcome were assessed and further analyzed. Patients were stratified according to the distribution of cisternal blood into patients with perimesencephalic SAH (PMSAH) versus nonperimesencephalic SAH (NPSAH). Outcome was assessed according to the modified Rankin Scale (mRS) at 6 months and stratified into favourable (mRS 0-2) versus unfavourable (mRS 3-6). A multivariate analysis was performed to identify predictors of shunt-dependency in patients suffering from nSAH.

Results: Overall 18 of 131 patients suffering from spontaneous nSAH developed a shunt-dependent hydrocephalus (14%). In detail, patients with NPSAH developed significantly more often shunt dependency during treatment course, when compared to patients with PMSAH ($p=0.02$). Furthermore, patients with initial insertion of external ventricular drainage (EVD) due to acute hydrocephalus developed significantly more often shunt-dependent hydrocephalus, when compared to patients without initial EVD ($p<0.0001$). In the multivariate analysis, "previous EVD insertion" was the only significant and independent predictor for shunt dependency in patients with nSAH ($p<0.0001$).

Conclusion: Overall, the rate of shunt-dependent hydrocephalus in patients with nSAH was 14% in the present series. Univariate analysis revealed NPSAH-blood distribution and the necessity of initial EVD insertion as significant risk factors for shunt dependency in patients with angiogram-negative SAH. However, multivariate analysis identified initial EVD insertion due to acute hydrocephalus as significant and independent predictor for shunt dependency in patients suffering from nSAH.

Individuals with single or multiple intracranial aneurysms: What are the odds?

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Objective: Patients with multiple intracranial aneurysms (MIA) are less common compared to patients with single aneurysms. However, the true incidences and the risk factors for MIA require proper evaluation. Moreover, the association between the presence of MIA and the risk / clinical course of subarachnoid hemorrhage (SAH) is still the matter in controversy.

Methods: This study was based on the institutional aneurysm database with 2451 individuals consecutively treated between January 2003 and June 2016. The database contains the radiographic characteristics of intracranial aneurysm(s) upon conventional angiography, as well as the demographic and clinical data of treated patients. The correlations with MIA were evaluated using univariate and multivariate analyses.

Results: 843 patients (34.4%) presented angiographically with MIA (ranging between 2 and 9 aneurysms). Most individuals suffered from two (n=541, 64.2%) or three intracranial aneurysms (n=191, 22.7%). Female (p<0.0001, adjusted odds ratio (aOR) =1.48) and elderly patients (with the cutoff at >45 years upon the receiver operating characteristic curve, p=0.004, aOR=1.35) were more likely to have MIA. There were no associations with the race (p=0.454), the history of SAH (p=0.843) and the size of the largest identified aneurysm (p=0.3065). The number of MIA independently correlated only with the female sex (p<0.0001). There was no statistical difference (p=0.8353) in the functional outcome of SAH patients with single and MIA.

Conclusion: The female sex is the major risk factor for MIA. The association between MIA and higher patients' age may proceed from the development of new aneurysms over the lifetime. In our series, patients with MIA were not at a higher risk for SAH.

Vessel dimension and reactivity in the acute phase of aneurysmal and non-aneurysmal subarachnoid hemorrhage

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Objective: Despite comparable initial imaging findings in both aneurysmal and non-aneurysmal subarachnoid haemorrhage (aSAH, naSAH), the clinical course of patients with naSAH is usually benign, implying a significant difference in the underlying pathophysiology. Recent data suggests early alterations of vessel diameter and responsiveness (neurovascular coupling = NVC) in aneurysmal SAH as documented by non-invasive retinal vessel analysis (RVA). Using RVA, we evaluated differences in vessel dimension and the integrity of NVC in patients with aSAH and naSAH in the early phase after rupture.

Methods: In a prospective study, we performed RVA in 13 patients with aSAH (HH I-III°, mean age 53.8±12yrs) and nine patients with naSAH (mean age 54.8±8.4yrs) within the early phase after hemorrhage (day 1-4) and included 35 age-matched healthy controls. Data was acquired using a Dynamic Vessel Analyzer (Imedos Systems UG, Jena) for examination of retinal vessel dimension and neurovascular coupling (NVC) using flicker-light excitation (FLE).

Results: Retinal arteries were significantly dilated only in patients with aSAH ($p < 0.01$), whereas patients with naSAH featured vessels dimensions comparable to healthy controls. Early arterial dilatation may be interpreted as a reflexory response to a more pronounced metabolic demand in aSAH patients. Compared to healthy controls, neurovascular coupling was impaired in both aSAH and naSAH patients, as documented by diminished (aSAH: $p < 0.001$; naSAH: $p < 0.01$) and delayed (aSAH: $p < 0.001$; naSAH: $p < 0.001$) vasodilatory response.

Conclusion: To our knowledge, this is the first clinical study to compare retinal vessel dimension and reactivity after aneurysmal and non-aneurysmal SAH. Using retinal vessel analysis, initial vasodilation is observed only in patients with aneurysmal SAH, possibly indicative of an increased metabolic demand. Neurovascular coupling is impaired in both hemorrhage entities. Recruitment will continue to facilitate a more detailed correlation analysis with clinical course and outcome.

Treating innocent intracranial aneurysms: Is there a difference in psychological impact between clipping and coiling?

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Objective: In an increasing number of patients innocent intracranial aneurysms (IA) are detected incidentally. Beyond microsurgical clipping the option of endovascular coiling of IA raised rapidly in the last two decades. Effectivity of both methods in terms of occlusion completeness and neurological morbidity is a point of debate. Furthermore, the psychological impact of both treatment options remains as of yet unclear. Therefore, we analyzed the psychological burden of either surgical or endovascular occlusion of IA.

Methods: A consecutive series of 125 patients was available for a standardized telephone interview who have been treated by endovascular coiling or surgery for an IA at the University Hospital of Essen. Of these, 96 (77%) agreed to take part in the study. Both groups were statistically comparable in a wide range of sociodemographical and clinical parameters ($p > .05$, respectively). The interviews were performed in a strictly standardized manner by a specially trained interviewer who was neither neurosurgeon nor neuroradiologist. The phone calls covered the standardized interview versions of the Impact of Event Scale (IES), the Hospital Anxiety and Depression Inventory (HADS) and several ad hoc questions.

Results: Of the 96 participants 59 (61%) were treated by coiling and 37 (39%) were operated upon an IA. Both groups were comparable in terms of age, delay treatment follow-up, aneurysm location and further clinical variables ($p > .05$, respectively). Levels of anxiety (HADS), intrusion (IES) and avoidance (IES) were equally distributed between both groups ($p > .05$, respectively). Those patients who have been treated by coiling exhibited more depression (HADS) and were more stressed by arousal (IES) and had a higher level of treatment-related psychological burden (IES Total score; $p < .05$, respectively). No significant effect of an earlier psychological illness or of an adverse event during the treatment could be detected ($p > .05$, respectively).

Conclusion: Patients after endovascular treatment exhibit an increased psychological burden, a higher level of arousal and more depressive symptoms as compared to those whose aneurysms have been clipped surgically. Differences in the acute clinical course did not influence the late psychological impact. Beyond other psychological factors it can be speculated that patients after coiling query whether their aneurysm has been completely neutralized. This should be addressed by future studies.

MI.03 Tumor 10 - In-vitro A

Mittwoch Wednesday, 17.05.2017, 08.00 – 09.20 Uhr hrs

- MI.03.01 *Pharmacological WNT inhibition acts synergistically with chemo- and radiotherapy in glioblastoma through aldehyde dehydrogenase 3A1*
A. Suwala* (Düsseldorf, Deutschland), K. Koch, U. Kahlert, J. Maciaczyk
-
- MI.03.02 *Silencing of the nucleocytoplasmic carriers Karyopherin $\alpha 2$ suppresses gliomagenesis in the U-87MG glioblastoma cell line*
K. Gousias* (Bochum, Deutschland), A. Datsi, M. Stallkamp, B. Pintea, R. Martinez
-
- MI.03.03 *Six extracellular vesicle related genes can explain the pro-tumorigenic behavior of heterogeneous high grade gliomas*
F. Ricklefs* (Hamburg, Deutschland), M. Mineo, A. Rooj, J. Godlewski, E. Chiocca, M. Westphal, A. Bronisz
-
- MI.03.04 *Stem cell associated tumor spheres of high grade gliomas - valid markers apart from CD133*
F. Klippel* (Jena, Deutschland), D. Freitag, C. Ewald, R. Kalff, J. Walter
-
- MI.03.05 *Targeting brain tumor stem cells by interfering with choline metabolism: Evidence for an EMT-choline oncometabolic network*
K. Koch, R. Hartmann, A. Suwala, D. Maciaczyk, D. Willbold, U. Kahlert, J. Maciaczyk* (Düsseldorf, Deutschland)
-
- MI.03.06 *Expression of iNOS, VEGF-A and AQP4 in human peritumoral brain edema tissue and their correlation with brain edema*
S. Trnovec* (Rostock, Deutschland), B. Trnovec, K. Mursch, S. Sola, H. Volkmar, J. Piek, P. Babál
-
- MI.03.07 *The omics landscape of tumour metabolism in glioblastoma multiforme*
D. Heiland* (Freiburg, Deutschland), A. Gäbelein, J. Wörner, P. Franco Jimenez, S. Heynckes, D. Pfeifer, S. Weber, I. Mader, O. Schnell
-
- MI.03.08 *A NF- κ B in vivo reporter system allows molecular insights into brain tumor progression and therapy response*
M. Ratliff* (Mannheim, Deutschland), R. Xie, G. Solecki, K. Karimian, W. Wick, D. Hänggi, F. Winkler
-

Pharmacological WNT inhibition acts synergistically with chemo- and radiotherapy in glioblastoma through aldehyde dehydrogenase 3A1

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Objective: Glioma Stem Cells (GSCs) are considered to be responsible for Glioblastoma's (GBM's) dismal prognosis. Wntless (WNT) promotes their radio- and chemoresistance. We were able to show that pharmacological WNT blockade by means of porcupine inhibition with LGK974 acts synergistically with Temozolomide (TMZ) and γ -irradiation in terms of growth *in vitro*. Downstream global transcriptome profiling and targeted protein analyzes identified ALDH3A1, a protein that catalyzes the oxidation of aldehydes, to be exclusively regulated under combination therapy.

Methods: At first we investigated different cell lines on their MGMT promoter methylation status to define cell lines resistant to the standard chemotherapeutic drug TMZ. For further analyzes we chose two cell lines resistant and sensitive to TMZ, respectively. IC₅₀ concentrations of TMZ and LGK974 as well as IC₅₀ dose concerning irradiation were defined by means of suppressed viability. Effectiveness of different concentration of each single therapy and in combination with LGK974 was determined to create a drug-response-curve for analyzing synergy. Performing an Affymetrix GeneChip gene expression microarray we searched for genes involved in the observed synergistic effect and validated our results on gene and protein expression levels (qPCR/Western Blot) by using knockdowns created by CRISPR/Cas9.

Results: We observed a significant synergy of combining irradiation/TMZ and LGK974 in all cell lines. Microarray analysis revealed ALDH3A1 to be a potential effector of WNT inhibition. Knocking down of ALDH3A1 led to reduced viability *in vitro*.

Conclusion: Our results confirm the potential benefit of combining TMZ or irradiation with the WNT inhibitor LGK974 to overcome therapy-resistance in GBM, which seems to be independent of base line MGMT activation levels. Furthermore we hypothesize that ALDH3A1 might serve as an efficient therapeutic target to induce sensitivity against TMZ in glioma cells.

Silencing of the nucleocytoplasmic carriers Karyopherin a2 suppresses gliomagenesis in the U-87MG glioblastoma cell line

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Objective: We have previously shown that karyopherin a2 (KPNA2), an important nucleocytoplasmic shuttling receptor, is overexpressed in malignant diffuse astrocytomas and, moreover its expression is inversely associated with patient prognosis. However, the pathophysiological contribution of KPNA2 to gliomagenesis is still partially devised. Our study aims for the first time to further elucidate the promoting role of KPNA2 in the pathogenesis of glioblastoma by means of analysing a variety of human glioblastoma cell lines.

Methods: Cell culture analysis has been conducted on U-87MG, U-373MG, U-138MG and U-118MG commercial human glioblastoma cell lines. Nuclear and cytoplasmic expression of KPNA2 has been evaluated quantitatively via flow cytometry (BD FACS Canto). Silencing of KPNA2 has been conducted by small interfering RNA (siRNA). The proliferative capacity of the cells has been determined via flow cytometry. KPNA2^{wild type} vs. KPNA2^{knock down} glioblastoma cells have been compared in terms of proliferation capacity, cell cycle function as well as subcellular localisation of known transcription factors, such as Oct4, NF-kB and c-Myc. Statistical analysis used standard procedures.

Results: U-87MG glioblastoma cell lines showed higher proliferation, less adherence, outgrowth in 3D clusters as well as higher expression of KPNA2, all of them conferring higher malignant behaviour, in comparison to the remaining cell lines. Silencing of KPNA2 in those cells highly expressing KPNA2 significantly decreased its proliferative capacity ($p < 0.05$). Further, siRNA interference of KPNA2 resulted in G1 cell cycle phase arrest in the U-87MG cell line in the first 48 hours ($p < 0.05$). KPNA2 silencing led to increased subcellular translocation of all above mentioned transcription factors.

Conclusion: This study confirms also in *in vitro* glioblastoma models that a high expression of KPNA2 is associated with a more malignant phenotype. While increased expression of KPNA2 in human glioblastoma cells promotes proliferation, invasion and aggressiveness of the tumorigenic cell pattern, silencing of KPNA2 was associated with a less malignant profile of U-87MG cells. Our results strongly suggest that silencing of KPNA2 may play an important role in modulation of the most malignant features of GBM cells.

Six extracellular vesicle related genes can explain the pro-tumorigenic behavior of heterogeneous high grade gliomas

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Objective: High grade gliomas display cellular hierarchical heterogeneity descending from a subpopulation of glioma stem-like cells (GSCs). The lack of experimental models hinders our understanding of intratumoral interactions and therefore cannot reflect the complex subpopulation dynamics within the tumor microenvironment. Extracellular vesicles (EVs) shed by tumor cells have recently been identified to serve as major conduits in cell-cell communication but have not been studied in a subtype specific manner.

Methods: 8 patient-derived GSCs were chosen after clustering to either the mesenchymal (M) or proneural (P) subtype. Bioinformatic analysis was used to examine mass spectra profiles of GSC EVs followed by validation via immunoblotting of cell culture and patient serum EVs. EV release and transfer was visualized by stable PALM-dtTomato M GSC or PALM-GFP P GSC and subsequent confocal microscopy imaging. Changes in gene expression profiles were tested by RT-PCR. Migration of P and M GSCs was monitored *in vitro* and *in vivo*.

Results: We identified over 1400 proteins within the EV proteome which shown subtype-dependent signature with different biological and molecular modules. Retrospective data extrapolated from the TCGA database revealed that 3 genes of either M or P subtype-specific EV proteome were associated with worse outcome in the other patient subtype. Accordingly, transfer of P and M EVs and their protein cargo led to increased pro-tumorigenic traits *in vitro* and *in vivo* with a subtype-specific uptake pattern and migratory/invasion phenotype. The subset of P EV proteins were identified as promoting glioma invasiveness, and cancer promoting molecules which build the network pathways with its cellular subtype specific effectors.

Conclusion: The secretion and uptake of EV mediates dynamic intra-tumoral interactions between cells from the same and different subtypes, providing a foundation for understanding how tumor heterogeneity affects patients' outcomes. Furthermore specific protein composition might enable detection of tumor derived EVs that could work as biomarker.

Stem cell associated tumor spheres of high grade gliomas - valid markers apart from CD133

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Objective: Stem cell associated cells with CD133 as the most popular marker are considered an important factor for the treatment failure in high grade gliomas. But during the last years, the relevance of the surface protein CD133 has become more and more an issue of discussion.

In this study we define possible further marker genes describing stem cell and proliferation properties in a tumor sphere model.

Methods: We defined 4 groups of glioblastoma cells being cultivated under different conditions. Group A (n=5): Cells isolated according to an established tumor stem cell isolation protocol, Group B (n=4): Cells from a commercial cell line, Group C (n=6): Cells from adherent primary glioblastoma cell cultures. Group A-C were cultured in serum-free sphere medium to induce a spherical growth pattern, while adherent primary cultures were cultured as Group D (n=6) in serum medium.

The three sphere groups were compared according certain features associated to stem cells, like the time to create spheres, metabolic activity (via MTT-assay) and migration ability. Differentiated or sphere stages were control via immunofluorescence staining.

Presuming the maximum fraction of potential stem cell like cells in group A, we analyzed the following markers via RT-qPCR: *CD133*, *MUSASHI-1*, *SOX2*, *OCT4*, *NANOG*, *NESTIN*, *GFAP* and *NOTCH1* with group A as reference.

Results: The stem cell isolated spheres of group A needed in mean 12d more ($p=0,012$) to create greater spheres and migrated more strongly ($p=0,001$) with also a ten times lower metabolic activity ($p=0,004$ till $0,016$) compared to the sphere induced groups (B, C). All spheres showed mostly CD133 on immunofluorescence staining.

On mRNA-level, there was a downregulation of *MUSASHI-1*** (17-680 fold), *NESTIN**** (10-130), *NOTCH1* (5-15 fold), *GFAP*** (250-1900 fold) and *Sox2** (4-12 fold) and an increased gene expression of the cell surface marker *CD133* (12-24 fold) in groups B-D compared to group A. *OCT4* (0,5-1,4 fold) and *SOX2* (in Gr. C: 1,1 fold) showed no regulation (*significant). *NANOG* was not representatively detected.

Conclusion: Concerning our data, Musashi-1 is a more valid marker, supporting through the data of physiological level, to define tumor stem cell subpopulation than CD133. Additionally, the significantly increased *NESTIN*- and *NOTCH1*-expression correlated with *MUSASHI-1* and seems to be associated with stem cell like properties

Targeting brain tumor stem cells by interfering with choline metabolism: Evidence for an EMT-choline oncometabolic network

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Objective: Glioblastoma (GBM) is the most lethal primary brain tumor in adults with a median survival of less than two years. High levels of therapy resistance, strong cellular invasiveness and rapid cell growth demand aggressive multimodal therapies. Recent evidence has pointed to the existence of brain tumor stem cells (BTSCs), cells exhibiting stem cell properties which are thought to be responsible for tumor dissemination, relapse and chemo resistance. BTSCs have been associated with the expression of mesenchymal features as a result of epithelial-mesenchymal transition (EMT).

Methods: Using high resolution proton nuclear magnetic resonance spectroscopy (¹H NMR) following dual metabolite extraction we analyzed the metabolism of GBM cell cultures both after EMT inhibition and differentiation of the cells to reduce stem cell character. Furthermore we compared metabolic response to different culture conditions and forced differentiation protocols.

Results: Induction of EMT and the stem cell character of GBM cells correlate with changes in their intracellular metabolome promoting cholinic phenotype, characterized by high intracellular levels of phosphocholine and total choline derivatives. Furthermore, interference with choline metabolism by targeting choline kinase alpha (CHKα) reversed EMT in GBM cells as we observed reduced invasiveness, clonogenicity, and expression of EMT associated genes.

Conclusion: Interfering with cellular metabolism could be a powerful strategy to suppress EMT and target chemo-resistant BTSCs through impairing their mesenchymal transdifferentiation. Moreover, the newly identified BTSC-oncometabolic network could be used to monitor the invasive properties of glioblastomas and the success of anti-BTSC therapy.

Expression of iNOS, VEGF-A and AQP4 in human peritumoral brain edema tissue and their correlation with brain edema

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Objective: NO is synthesized in living organisms by the enzyme NO-synthase (NOS I-III) and plays an important role in physiological as well as in pathological processes within the brain. One of these processes is the cerebral edema, which may become a life-threatening problem. Cerebral edema is defined as a high content of water in the brain tissue. The peritumoral brain edema is a typical example of vasogenic edema, when the blood-brain barrier function fails due to angiogenesis. Histological studies have demonstrated an increased expression of various factors in the tumor cells that stimulate angiogenesis, which is designed to compensate local hypoxia. Such factors are NOS and vascular endothelial growth factor (VEGF). An elevated expression of Aquaporin 4 (AQP4) has also been demonstrated, especially in cells of glial tumors. NO is a cofactor in the regulation of VEGF expression and is also involved in the regulation of AQP4 function. However, the expression of these factors in human peritumoral edematous tissue and their correlation with peritumoral edema volume has not been investigated so far.

Methods: In this study, we assessed the expression of iNOS, AQP4 and VEGF-A in peritumoral edematous brain tissue in 50 patients (31 suffering from glioblastoma, 2 anaplastic astrocytoma, 1 malignant meningioma, 2 lymphomas and 14 metastases) in whom the tumor was excised by supra-maximal resection. The study had been approved by our local ethic committee. 3 patients with glioblastoma underwent frontal lobe resection. From these patients it was possible to obtain non edematous brain tissue, which was used as control. The expression of iNOS, AQP4 and VEGF-A was investigated by immunohistochemical staining. Volume of tumor and peritumoral edema was measured with BrainLab software, the edema index (EI) was calculated as a ratio: edema volume + tumor volume / tumor volume. Furthermore, we correlated the expression of iNOS, AQP4 and VEGF-A with the peritumoral edema volume expressed by EI.

Results: We detected increased expression of iNOS, AQP4 and VEGF-A in the examined tissue when compared to the control brain tissue. We also observed a significant correlation between the expression of AQP4 and the EI. There was no significant correlation between increased expression of iNOS and VEGF-A in peritumoral edematous tissue and the EI.

Conclusion: Based on our results, we can regard the expression of AQP4 as a quantitative marker of EI, while the expression of iNOS and VEGF only as qualitative attributes of EI. Elucidation of peritumoral edema constituting pathways and factors affecting the extent of peritumoral edema is the key to causal therapy of edema and thus, further studies on interaction pathways between tumor and brain tissue should proceed

The omics landscape of tumour metabolism in glioblastoma multiforme

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Objective: Tumorigenesis is driven by the reprogramming of cellular metabolism, which derives directly or indirectly from genetic or epigenetic alterations. The purpose of this study was to analyze the global metabolic/transcriptomic profile of glioblastoma (*in-vivo* 21 patients and *ex-vivo* 33 patients) by newly designed bioinformatical tools and to validate altered metabolic pathways in an established glioblastoma cell-model.

Methods: In a first step, a wide spectrum of genetic and metabolomic “high-throughput” methods were performed to compute an integrative metabolomic/transcriptomic network (H-MRS, 1D-NMR, RNA-sequencing, expression array, next-generation sequencing). Different bioinformatical tools were then combined to compute the network. In the second step, our investigated network was validated in a glioblastoma cell-model, which integrates 6 different stem-like cell lines cultured under normoxia/hypoxia conditions. Identified altered metabolic pathways were validated within the cell-model and analyzed with above described analytic approaches. Additionally, two newly designed bioinformatical tools were investigated to model the dynamic processes of tumor specific metabolic alterations by a Bayesian approach (MetaAnalysis and MetabolicTracking)

Results: First, the metabolomic/transcriptomic network resulted in numbers of tumor specific alterations particularly affected the energy, cell-cycle and neurotransmitter metabolism. However, the metabolite creatine was found to be highly connected within different expression subgroups (proneural vs. mesenchymal) and other biological functions such as invasiveness and cell-cycle. Secondly, the cell-model validation showed a metabolic shift of creatine into energy-associated substrates (glycine, serine) and away from neural-associated metabolic pathways (glutamate, proline, arginine) under hypoxia conditions. This metabolic shift could be rescued by increasing the creatine-source within the cells, which also resulted in a reshaped GBM subgroup pattern on the transcriptional level.

Conclusion: Creatine was identified as a central connector between proneural-, or mesenchymal associated metabolic/transcriptomic alterations. Therefore, our results highlight the strong coherence between metabolic and genetic alteration and accentuates the relevance of an evaluation of tumor-metabolism in glioblastoma multiforme.

A NF- κ B in vivo reporter system allows molecular insights into brain tumor progression and therapy response

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Objective: Glioblastoma is the most common primary malignant brain tumor in adults. It is highly resistant to treatment as the invasiveness limits complete resection, the dynamic tumor genome, multiple pathways driving the malignant phenotype, and the blood brain barrier, which limits the availability of drugs to the tumor.

Evidence suggests a significant role for NF- κ B in the gliomagenesis and the mechanism of treatment resistance making NF- κ B a potentially potent target for treatment. However, increasing evidence suggests a great cellular heterogeneity in glioma, making it important to understand which glioma cell types are dynamically driven by certain molecular pathways, and how that relates to their function in progression and resistance. Therefore, we established an in vivo reporter system based on NF- κ B responsive promoter (RE) elements driving green fluorescent protein (gfp) to monitor the expression of this transcription factor.

Methods: Ten tandem repeats of the NF- κ B RE (GGGACTTTC) were designed, annealed and ligated into the HIV-1 based lentiviral vector pLVX Puro (Clontech Laboratories, Inc. A Takara Bio Company, CA USA) by replacing the CMV promoter with NF κ B elements. GFP was subcloned into the multiple cloning site of pLVX Puro.

The integrity of the plasmid was verified by sequencing analysis. Its reliability as a NF- κ B reporter was verified in vivo and *in vitro*.

Using a chronic cranial window mouse model two-photon microscopy allows for consecutive in vivo imaging to observe different biological processes such as tumor growth, angiogenesis, and tumor repair after laser ablation and radiotherapy.

Results: While cells grown under stem like conditions *in vitro* were highly NF- κ B reporter positive, only few cells were positive in the established tumor *in vivo*, and that this changed dynamically depending on distinct states of tumor progression, and in response to lesions in the tumor area that were repopulated - "repaired" - by tumor cells. Furthermore, we were able to show that TNF α induced NF- κ B reporter activity significantly *in vitro*. Radiotherapy led to a significant increase in reporter GFP expression in vivo as well as *in vitro*, to the extent that most cells became reporter positive. Pre-existing reporter-positive cells differed from reporter negative cells with respect to resistance against cytotoxic stress. NF κ B reporter positivity did not colocalize with established "stem cell" markers Mushashi, Nestin and Sox2 using immunohistochemistry on tumor slices grown in our mouse model.

Conclusion: Our results suggest a role for NF- κ B expression during GBM resistance to treatment and progression after radiation, in a heterogeneous manner. We will further analyze cell fate and cell morphology during irradiation and tumor "repair" with regard to their NF- κ B positivity, and will include this data in the presentation, including inhibitory strategies of the NF- κ B pathway.

MI.04 Tumor 11 - In-vitro B

Mittwoch Wednesday, 17.05.2017, 08.00 – 09.20 Uhr hrs

- MI.04.01 *Augmentation of Tumor Treating Fields (TTFields) effects on Glioblastoma cells by mitotic checkpoint inhibition*
A. Keßler* (Würzburg, Deutschland), F. Gross, M. Hahn, T. Linsenmann, R. Ernestus, M. Löhr, C. Hagemann
-
- MI.04.02 *Revisiting the "go or grow" hypothesis in glioma in vivo*
M. Ratliff* (Mannheim, Deutschland), K. Karimian, G. Solecki, M. Osswald, W. Wick, F. Winkler, D. Hänggi
-
- MI.04.03 *Combined inhibition of mitochondrial matrix chaperones and Bcl-xL yields synthetic lethality in glioma*
G. Karpel-Massler* (Ulm, Deutschland), C. Shu, J. Bruce, P. Canoll, D. Altieri, M. Siegelin
-
- MI.04.04 *Comparison of standard chemo- and radiotherapy versus riluzole treatment on viability of brain tumor stem-like cells in in vitro*
M. Ninkovic* (Göttingen, Deutschland), S. Sperling, T. Aung, S. Martin, V. Rohde
-
- MI.04.05 *Effect of a new drug. Vacquinol-1 on Glioblastoma cell lines*
P. Sander* (Ulm, Deutschland), H. Mostafa, A. Soboh, A. Pala, C. Wirtz, A. Catanese, M. Georgieff, E. Schneider
-
- MI.04.06 *Evidence and generation of potential pluripotent human meningioma cells*
D. Freitag* (Jena, Deutschland), F. Klippel, A. Koch, J. Walter, C. Ewald, R. Kalff
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- MI.04.07 *Chick chorioallantoic membrane assay of human glioma cells for observation of their biological behavior*
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Augmentation of Tumor Treating Fields (TTFields) effects on Glioblastoma cells by mitotic checkpoint inhibition

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Objective: Treatment of glioblastoma (GBM) patients with Tumor Treating Fields (TTFields) in addition to standard therapy showed significant increase in progression free and overall survival (EF-14 trial). TTFields are alternating electric fields with low intensity (1-3V/cm) and intermediate frequency (100-400kHz) that disrupt cell division through the inhibition of spindle fiber formation. The chemotherapeutic agent Vincristine also inhibits spindle fiber formation but in contrast to TTFields, Vincristine therapy is associated with severe side effects. The spindle assembly checkpoint (SAC) diminishes the therapeutic effects of spindle damaging agents by monitoring the correct segregation of sister chromatids. Monopolar spindle 1 (MPS1), the key regulator of SAC, when combined with Vincristine shows a synergistic effect on GBM growth in mice. Therefore, MPS1 inhibition could increase the efficacy of TTFields.

Methods: Utilising the Novocure in vitro™ laboratory research system, 30,000 human GBM U87 cells were treated with TTFields (200kHz) alone or with 4µM of the MPS1 inhibitor MPS1-IN-3 (IN3) either alone or in combination with TTFields. Cell numbers and apoptosis (Annexin V staining) were evaluated after 24h, 48h and 72h of treatment. Cell numbers were also evaluated at 24h and 72h after end of treatment (eot).

Results: Treatment with TTFields plus IN3 resulted in an earlier response. After 72h, the cell number decreased by 77.5% compared to TTFields alone ($P = 0.0201$) and by 50% compared to MPS1-inhibition with IN3 ($p = 0.0344$). While the cells treated with TTFields alone decreased for another 24h after eot and then started to recover, the combination of TTFields and IN3 resulted in a decrease of cell numbers by a further 92% at 72h after eot of TTFields ($p = 0.0086$). All cells recovered in instances when IN3 treatment ended after 72h. The combination treatment of TTFields plus IN3 induced an early stage of apoptosis in 44% of the cells, compared to 14% with TTFields alone ($p = 0.0002$) and 4% with IN3 alone ($p < 0.0001$).

Conclusion: TTFields are an approved new treatment modality for GBM. A combination of physically damaging the spindle apparatus by TTFields and the chemical inhibition of the SAC led to earlier and prolonged effects, which significantly augment TTFields efficacy..

Revisiting the "go or grow" hypothesis in glioma *in vivo*

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Objective: Glioblastoma is one of the most devastating cancers. Tumor cell infiltration into the surrounding normal brain tissue confounds the limits of standard treatment. It is currently believed that infiltrating tumor cells have low proliferation rates. The "go or grow" hypothesis postulates that migration and proliferation spatiotemporally exclude each other.

Methods: We evaluated the "go or grow" hypothesis using *in vivo* multiphoton laser scanning microscopy (MPLSM) on S24 primary glioblastoma stem cells (GBMSCs, kept under serum-free, stem-like conditions) in NMRI nude male mice (n = 478 cells in n = 4 mice) with a chronic cranial window. We used a lentiviral-based vector expressing a Tet-Off controlled histone H2B-GFP (Tet-Off-H2B-GFP) reporter gene for the detection of label retaining cells in human glioblastoma.

Results: Our dynamic *in vivo* microscopy data show that those glioblastoma cells that have migrated away from the tumor bulk significantly express reduced nuclear GFP-staining compared to the tumor cells within the tumor mass. This suggests that GBMSCs with particularly high migration properties also have a history of high proliferation. However, a low number of slow-cycling GBMSCs was detectable at the invasive front. Ongoing experiments investigate how slow-cycling vs. fast-cycling GBMSCs contribute to other aspects of glioma progression, e.g. participation in the tumor microtube-connected glioma network.

Conclusion: In summary, the Tet-Off-H2B-GFP lentiviral reporter represents a convenient and elegant system to study cumulative tumor cell proliferation in relation to other important features of tumor biology. First results using S24 primary glioblastoma stem cells suggest that the "go or grow" hypothesis might have to be revisited.

Combined inhibition of mitochondrial matrix chaperones and Bcl-xL yields synthetic lethality in glioma

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Objective: We show that combined targeting of the mitochondrial Hsp90 chaperone network and inhibition of the anti-apoptotic Bcl-2 family member Bcl-xL induces synthetic lethality in human gliomas.

Methods: The biological and molecular effects of a combined treatment with the Bcl-xL inhibitor ABT263 and the mitochondrial Hsp90 chaperone inhibitor Gamitrinib-TPP were examined in different pre-clinical glioma models including primary cultures, glioma stem-like cells *in vitro* and multiple human patient-derived orthotopic glioblastoma xenografts (PDX) *in vivo*.

Results: Combined treatment with ABT263 and Gamitrinib-TPP yields a synergistic anti-proliferative and pro-apoptotic activity. On the molecular level, this response is mediated by a strong induction of endoplasmic reticulum-stress which was characterized by an increased activation of activating transcription factor 4 through a PERK-dependent mechanism and subsequent up-regulation of pro-apoptotic Noxa. *In vivo*, the combination therapy lead to a significant prolongation of survival in two orthotopic patient-derived xenograft models of glioblastoma.

Conclusion: Combined inhibition of mitochondrial matrix chaperones and Bcl-xL represents a promising new therapeutic strategy for the treatment of gliomas.

Comparison of standard chemo- and radiotherapy versus riluzole treatment on viability of brain tumorstem-like cells in *in vitro*

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Objective: Glioblastoma (GBM) therapy remains focused on maximal surgical resection followed by concurrent radiation and chemotherapy using temozolomide (TMZ). Since a small subpopulation of tumor stem-like cells has the capacity to initiate tumor and mediate radio- and chemoresistance, targeting these cells is a potential model for control of GBM. In our previous study we showed that riluzole, a drug used for the treatment of amyotrophic lateral sclerosis, decreases cell viability of GBM stem like cells. Here we investigated the effect of standard after-operation therapy versus riluzole and their combination on these cells in an *in vitro* system.

Methods: The effect of TMZ, radiation (5 and 10 Gy) and riluzole as well as their combination on the cell viability of two GBM stem-like cell lines was examined. Viable cell population was determined using 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) in *in vitro* assay. Riluzole influence on proliferation was measured using staining with propidium iodide. All experiments were performed in triplicate.

Results: Cell viability of two different GBM stem like cell lines; #11 and #64, derived from primary GBM tissue samples, was significantly reduced after riluzole application. Treatment of the cells with the TMZ or with radiotherapy of 5 or 10 Gy alone did not show an effect. Combination of these two treatments with riluzole confirmed riluzole effect. The percentage of proliferating cells declined with riluzole treatment compared to the untreated control sample ($p= 0.022$ and $p= 0.051$).

Conclusion: The results presented in this study demonstrate that riluzole alone, but not TMZ or radiation, significantly inhibits cell viability of two GBM stem like cells. This drug decreases also proliferation of these cells. We suggest riluzole for further examination as potential treatment in GBM therapy.

Effect of a new drug. Vacquinol-1 on Glioblastoma cell lines

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Objective: To evaluate the potential use of a novel chemotherapeutic drug called “Vacquinol-1” (Kitambi et al. 2014) against glioblastoma multiforme, we established a long-term cell culture system to address the kinetic activity.

Methods: Fresh tumor tissue was minced and trypsinized, then subjected to Ficoll-separation and culture using endotoxin-free fetal calf serum and Iscove’s modified essential medium. Permanent cell lines were established 4-8 weeks after culture initiation. Different concentrations of Vacquinol-1 were added to the cell culture and the effects of caspase 3/7 activation but lack of any other sign of apoptosis and viability were compared with the effect on stem cell lines derived from tooth pulpa cells.

Results: A concentration of 7 μ M Vacquinol-1 resulted in significantly impaired growth characteristics of GBM cell lines as determined by IncuCyteZOOM assisted proliferation assays. Exogenous ATP lead to a dramatic salvage effect when it was titrated into the Vacquinol-1 assays. Titration of ATP revealed an optimum at 1-10 μ M ATP. The effect was likely due to activation of the TRPM7 channel in GBM cells lines. To substantiate this finding, we tested the effect by 200 μ M of Carvacrol, known to inhibit TRPM7 (Chen et al, 2015). Co-titration of Vacquinol-1, ATP and Carvacrol showed, that the sensitivity of Vacquinol-1 induced cell death in GBM derived cell lines could be increased by Carvacrol.

Conclusion: At 7 μ M, Vacquinol-1 induced a rapid cell death in all GBM cell lines, occurring with massive cell blebbing. Morphological criteria of Vacquinol-induced cell death demonstrate that cell death is not related to apoptosis despite of caspase 3/7 activation. The effect of Vacquinol-1 was sensitive to neutralization by low concentrations of ATP, likely to activate TRPM7 channels. The effect by carvacrol on TRPM7 is the current target of further investigations.

Evidence and generation of potential pluripotent human meningioma cells

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Objective: Pluripotent cells do not only play an essential role in developmental biology but also in carcinogenesis and malignancy of tumors. These cells represent a special subgroup or state of cancer stem cells. Pluripotent cells are able to form every other cell type and are characterized by specific expression profiles of the key transcription factors NANOG, Sox2 and OCT4. In the past we identified cells incorporating NANOG even in human meningiomas. With this study we want to establish a suitable *in vitro* model for a stable isolation and cultivation of potential tumor stem cells and compare them with induced pluripotent cells (iPCs) from non-pathological and pathological meningeal cells.

Methods: Potential meningioma stem cells (PMSC) were isolated from 50 specimens of individual patients (WHO °I: n=37, WHO °II: n=11, WHO °III: n=2) and characterized by various physiological parameters, immunocytochemistry (Vimentin, Nestin, EMA, Ki67, Nanog, Oct4, Sox2, CD44, Musashi-1) and qPCR (NANOG, OCT4, SOX2, MIB1, MSI1, CD44).

iPCs of primary dura cell cultures (n=1), primary meningioma cell cultures (n=2) and immortalized meningioma cell lines (n=2) were generated by mRNA transfection. Of these mRNA level of NANOG, SOX2, OCT4, KLF4, CMYC as direct regulators of pluripotency, MSI1 and CD44 as stem cell markers were measured in iPCs and meningioma stem cells qPCR, too. Pearson correlation analysis was performed for statistical evaluation.

Results: We could isolate stable PMSC from 39 samples (78%). In addition, we found a significant higher median relative protein expression for Nanog (7.5% vs 0.0%; p=0.037) and lower for Vimentin (100% vs. 85%; p=0.002), and Oct4 (30 vs. 5%, p=0.026) in the isolated PMSC compared to the corresponding differentiated primary cell cultures. We detected significantly higher relative mRNA levels (x fold to mean expression) for NANOG (1.55 vs 0.44, p=0.001), MIB1 (0.66 vs. 1.15, p=0.022) and MSI1 (1.77 vs. 0.26, p=0.000) compared to the primary cell cultures.

All transfected cell cultures showed morphological changes towards an iPCs typical phenotype. We found high similarities in expression changes of NANOG (4.2 to 5.7) and OCT4 (1.7 to 1.5) between the isolated and the reprogrammed group. We established a positive correlation of isolated cells with iPCs over all genes (r=0.756, p=0.019).

Conclusion: From human meningiomas we could reproducibly isolate cells highly expressing markers for stem cells as well as features of pluripotency. In addition we were able to reprogram pathological and non-pathological meningeal cells into iPCs. The specific gene expression for pluripotency of these iPCs and of isolated meningioma stem cells showed significant correlations.

In summary, the isolated meningioma stem cells expressed a high number of pluripotency-regulating genes and can therefore be identified as potential pluripotent meningioma stem cells (PPMSCs).

Chick chorioallantoic membrane assay of human glioma cells for observation of their biological behavior

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Objective: The chick embryo chorioallantoic membrane model (CAM) assays has been widely used to study angiogenesis and invasion of brain tumors. It constitutes an easy model including tumor angiogenesis that is optical accessible during tumor growth. Furthermore, investigation of tumorbiology in the CAM model helps to reduce animal experiments. However, tumor observation is only possible for a limited period. Our aim was to use the CAM assay for the investigation of tumor growth of human glioma cells lines with different genotyp and observe the biological characteristics.

Methods: We used different genetically modified U87 cell lines: U87 EGFP, U87 *IDH-1*wildtype, U87 *IDH-1*mutation. Cells were either cultured as adherent cells or as spheroids and implanted on embryonic day 7, 8 or 10 on the CAM (4×10^6 cells / egg, n=10 for each cell line). Tumor growth of U87-EGFP cell lines was monitored by fluorescence microscopy Tumors were allowed to grow until day E15(embryonic day E15), removed from the egg and fixed in formalin. Images of the wholemount preparation were obtained. The tissue was cryoprotected using sucrose, embedded in cryomedia and cryosections of 10 μ m thickness were prepared. Sections were analyzed using haematoxylin and eosin stain or immunohistochemistry for Ki67, CD38 and α -SMA.

Results: Our results demonstrate that both, adherent U87 cells and U87 spheroids can be used for tumor induction in the CAM model and form glioma within one week. The tumors exhibited angiogenetic effects, high proliferation rates and the morphological characteristics of glioma. Utilization of adherent U87 cell lines resulted in higher survival rate of chicken embryo and higher rates of tumor formation than that with U87 spheroids ($p < 0.05$). However, CAM with U87 spheroid cell lines model could be more favorable to study the glioma angiogenesis and antiangiogenesis. Comparison of tumor fromationra rate and the viability of the chicken embryo regarding the timepoint of tumor implantation showed that E10 is the most suitable day for implantation of the cell lines on the CAM. U87 *IDH1* mutation and U87 *IDH1* wildtype cell lines likewise formed tumors on the CAM retaining their initial genotype. Initial tests confirmed, that monitoring tumor formation using optical methods like fluorescence microscopy, Raman spectroscopy or label-free mulitphoton microscopy is feasible.

Conclusion: Our experiments provide a simple, fast-growing and effective chick embryo chorioallantoic membrane model of glioma. It opens the possibility to study the mechanisms of tumor formation using advanced optical techniques beyond *in vitro* settings without the need to perform animal experiments.

Evidence of adiponectin receptors in human brain tumors

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Objective: Adiponectin (Acrp30), a 30-kDa component C1q-related protein, is an adipocyte-secreted hormone that plays an important role in the development and progression of several malignancies. Recent *in vitro* studies demonstrate the antiangiogenic and tumor growth-limiting properties of adiponectin. Studies in both animals and humans have investigated adiponectin and adiponectin receptor regulation and expression in several cancers types. Many different cancer cell types express the signaling of AdipoR1 and respond to adiponectin. The role of the Adiponectin/AdipoR system in human cerebral neoplasms remains unclear. The potential involvement of the system in glioblastoma has been already discussed in recent published data. In summary, our data demonstrate that the adiponectin system is expressed not only in malignant brain tumors such as glioma but also in meningiomas.

Also Leptin, a 16 kDa polypeptidic hormone synthesized essentially by adipose tissue, was first described as a regulator of body weight and energy balance. Furthermore, leptin can activate migration and invasion, and is a potent angiogenic factor acting independently or through upregulation of vascular endothelial growth factor. In addition, leptin can amplify some oncogenic pathways via transactivation of receptors for epidermal growth factor and insulin like growth factor I. We examined the expression of leptin receptor (Ob-R) in human meningioma.

Methods: Series of frozen surgical samples derived from malignant intracranial tumors and proteins from meningiomas cell lines lysates were size-fractionated and analyzed by real time PCR and Western blot (WB).

Results: The expression of Adipo R1 was evaluated by real time PCR and confirmed WB in protein lysates. The expression of both Adipo-R1 was weakly positive in benign meningioma, bronchial- and breast cancer, but was considerably increased in aggressive forms of meningioma, oligodendroglioma and glioblastoma, where the labeling was the most intense.

The expression of Leptin-Receptors was evaluated by WB in protein lysates. The expression of Leptin-Receptor was negative in benign meningioma, but was overexpressed in aggressive forms of meningioma and malignant brain tumors.

Conclusion: The present study shows clear evidence for an expression of Adiponectin/AdipoR1 in both benign and malignant neoplasms of the brain. Both markers were highly expressed in glioblastoma, oligodendroglioma and high-grade meningioma, while lower expression of Adiponectin/AdipoR1 was noted in low-grade meningioma and metastasis. The relationship between the adiponectin system and the development of primary neoplasms of the brain remains unclear.

The potential role of leptin in human brain tumors has never been explored. It has been shown the leptin and ObR mRNA expression in various intracranial tumors. We showed the expression of Leptin-Receptor was negative in benign meningioma, but was overexpressed in aggressive forms of meningioma and malignant brain tumors.

We therefore recommend further *in-vivo* as well as *in-vitro* investigation to unveil possible beneficial values of the Adiponectin/AdipoR system and of the leptin/leptin-receptors for the diagnosis and treatment of cerebral tumors.

MI.05 OP-Techniken 4

Mittwoch *Wednesday*, 17.05.2017, 08.00 – 09.10 Uhr *hrs*

- MI.05.01 *The vestibular schwannoma surgery learning curve: modern series of a young neurosurgeon*
E. Shiban, S. Viktoria, B. Meyer, J. Lehmborg* (München, Deutschland)
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- MI.05.02 *Do Statins Reduce the Rate of Revision Surgery in Chronic Subdural Hematoma?*
J. Klein* (Dresden, Deutschland), G. Schackert
-
- MI.05.03 *2 micron Laser assisted neuroendoscopic procedures: Clinical experience of two different institutions with 469 patients*
H. Ludwig* (Göttingen, Deutschland), C. Kural, M. Schuhmann
-
- MI.05.04 *Stereotactic implantation of cysto-ventricular catheters in patients with craniopharyngeomas: An effective method to control cyst size and improve conditions for radiotherapy.*
C. Steiert* (Freiburg, Deutschland), S. Marianne, R. Rölz, M. Shah, I. Mader, V. Coenen, P. Reinacher
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- MI.05.05 *Clival and craniocervical chordoma: high efficacy of the endonasal approach*
J. Lehmborg* (München, Deutschland), E. Shiban, B. Meyer
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- MI.05.06 *Venous air embolism in the semi sitting position: a retrospective Analysis in 755 patients*
H. Elkayekh, S. Al-Afif, J. Krauss, H. Elkayekh* (Hannover, Deutschland)
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- MI.05.07 *Intraoperative MR imaging of cerebral oxygen metabolism during resection of brain lesions*
K. Rössler* (Erlangen, Deutschland), A. Merkel, M. Zimmermann, B. Sommer, M. Buchfelder, A. Stadlbauer
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The vestibular schwannoma surgery learning curve: modern series of a young neurosurgeon

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Objective: To demonstrate and quantify the learning curve for microsurgical removal of vestibular schwannoma by a young surgeon.

Methods: We reviewed all cases vestibular schwannoma operated by the senior author between October 2006 and May 2015. Health-related Quality of life was analysed using the EuroQOL questioner at last follow via telephone interview.

Results: 112 consecutive cases from October 2006 to May 2014 were identified. The senior author performed all surgeries. 39% were male, 61% female; mean age was 58 years (range 18-85). According to the Hannover Classification, 9% were rated as T1, 16% as T2, 34% as T3, and 41% as T4. Six patients (5%) had previous surgery, eight patients (7%) had radiotherapy and 2 patients had both surgery and radiotherapy. Complete and subtotal resections were achieved in 71% and 29% of cases, respectively. Newly developed postoperative facial nerve palsy was seen in 13 cases (11%). 10 of those 13 cases (77%) were seen during the first 40 surgeries. Hearing preservation in T1/2 schwannomas was achieved in 80%, in patients with T3 tumours in 81%, and in large T4 tumours in 65%. Six patients suffered a cerebrospinal fluid fistula (5%), one patient required a ventriculoperitoneal Shunt following surgery.

Conclusion: The learning curve in our series was evident. Facial nerve preservation correlated with surgical experience. Hearing preservation was more associated with tumor size.

Do Statins Reduce the Rate of Revision Surgery in Chronic Subdural Hematoma?

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Objective: Recent studies suggest a beneficial effect of atorvastatin in avoiding surgery in patients with chronic subdural hematoma (cSDH). The role of statins on patients who underwent surgery for cSDH is controversial. A prospective study, which had found a favorable effect, had to be retracted due to methodological flaws. Other studies focused on conservative treatment. We evaluated the effects of statins in a large cohort of patients operated on for cSDH.

Methods: All patients who were operated on for cSDH for the first time between January 2012 and June 2016 at our institution were included in a retrospective study. Patients with cSDH attributed to a preceding craniotomy, low cerebrospinal fluid syndrome, brain malformations or those who died within three months of the initial surgery for unrelated causes were excluded. We evaluated the rate of revision surgery overall, residual hematoma as well as recurrence necessitating revision surgery, acute postoperative hemorrhage, newly developed postoperative epilepsy, wound healing disturbance, and infection. One-sided Fisher exact test was used for comparisons.

Results: We identified 283 consecutive patients with a mean age of 74.6 years (range 25–97 years), 186 (66%) were male. 54 patients (19%) required revision surgery; 24 (8.5%) due to recurrence, 22 (7.8%) due to residual hematoma, and 10 (3.5%) due to acute postoperative hemorrhage. One wound healing disturbance (0.35%) without surgical consequence and one infection occurred.

75 patients (26.5%) received statin therapy with simvastatin being the most frequently used drug and fluvastatin as well as atorvastatin being administered in fewer patients. The rate of male patients in the statin vs. no-statin group was 77% vs. 61% ($p = 0.009$), the mean age was 76.0 vs. 74.1 years. No difference was found for overall revision surgery (19% vs. 19%, $p = 0.6$), recurrence (8.0% vs. 8.7%, $p = 0.65$), residual hematoma (6.7% vs. 8.2%, $p = 0.45$), acute hemorrhage (4.0% vs. 3.4%, $p = 0.52$), and postoperative epilepsy (1.3% vs. 2.9%, $p = 0.41$). Male sex as a confounding factor which might worsen the outcome in the statin group was excluded as female patients had a numerically higher rate of revision surgery (23% vs. 17%, $p = 0.17$) and residual hematoma (11% vs. 5.9%, $p = 0.09$).

Conclusion: Our results do not confirm a beneficial role of statins in patients being operated on for cSDH. Different effects of atorvastatin and other statins may be hypothesized.

2 micron Laser assisted neuroendoscopic procedures: Clinical experience of two different institutions with 469 patients

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Objective: The aim of this study is to present the clinical experience of 2 university hospitals on the use of 2-micron continuous wave laser in neuroendoscopic procedures and to discuss the safety and efficiency of this system in selected and appropriate lesions of central nervous system.

Methods: Four hundred and sixty nine cases underwent neuroendoscopic procedures using 2-micron continuous wave laser between September 2009 and January 2015. The data of the patients were retrospectively reviewed. Of the 469 cases, 241 (51%) were children and 228 (49%) were adults. The mean age was 27,5 years (ranged between 3 days and 83 years old) and 263 (56%) patients were male and 206 were female. Intraoperative ultrasound was used in 230 cases and neuronavigation was used in 239 patients for intraoperative orientation.

Results: A total of 524 neuroendoscopic procedures was performed in 469 patients. Laser-assisted endoscopic third ventriculostomy was the most common surgical procedure and it was performed in 302 (64%) cases. Cyst fenestration was performed in 124 (26%) cases, septostomy in 45, tumor biopsy in 41, tumor resection in 8 and choroid plexus coagulation in 3 cases. Postoperative complications were oculomotor palsy, subcutaneous cerebrospinal fluid collection, CSF fistula, subdural hygroma, rhinorrhea, hypoglycemia and diabetes incipidus. None of these complications was directly related to laser surgery.

Conclusion: The 2-micron continuous wave laser neuroendoscopy is a safe and effective procedure for endoscopic third ventriculostomy, septostomy, cyst fenestration and intraventricular tumor resection. Larger studies are needed to obtain better clinical outcomes.

Stereotactic implantation of cysto-ventricular catheters in patients with craniopharyngeomas: An effective method to control cyst size and improve conditions for radiotherapy.

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Objective: Craniopharyngeomas as benign extra-axial tumors frequently containing cystic formations are typically located in the sellar region. They mostly cause symptoms like visual impairment, visual field defects and endocrine disorders. Due to high potential morbidity associated with radical resection, several less invasive surgical methods followed by radiotherapy have been developed. We investigated stereotactic implantation of cysto-ventricular catheters as new method to control cystic components.

Methods: We analyzed clinical data of all patients with craniopharyngeomas treated primarily with stereotactic cysto-ventricular shunting in our hospital between 04/2013 and 05/2015. Special focus was safety of this technique as well as improvement of symptoms and reduction of cyst volumes compared pre- to postoperatively and at follow-up examinations.

Results: Eight patients received cysto-ventricular catheters in order to control cyst size (5 male, 3 female, mean age 69,5 years). Mean duration of surgery was 47,5 minutes. Three patients underwent operative revision to correct catheter position. Except one parenchymatous bleeding without acute or chronic neurological deterioration, no further complications (bleeding, infection, epilepsy or new neurological problems) occurred. Visual impairment improved in 7 of 8 affected patients; visual field defects improved in 6 of 7 affected patients. Endocrine disorders remained stable without deterioration. All patients were treated with radiotherapy (1 prior to, 7 after surgery). Volumetric analysis demonstrated a mean reduction of cyst volume of 90,1 % postoperatively and further of 93,6 % at follow-up (mean follow-up 19,1 (9-37) months) compared to preoperative values. Total tumor volumes (including solid tumor and cysts) were reduced by 82,7 % at follow up after completed radiotherapy.

Conclusion: Based on our data stereotactic implantation of cysto-ventricular catheters in patients with craniopharyngeomas seems to be a minimally invasive method to improve ophthalmological symptoms, to control cystic components and thus to reduce total tumor volume. This leads to improved conditions for radiotherapy. Given the low surgical morbidity as well as the effective drainage of tumor cysts, this method combined with radiotherapy should be considered in the treatment of selected craniopharyngeomas.

Clival and craniocervical chordoma: high efficacy of the endonasal approach

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Objective: Clival and craniocervical chordomas are slow growing but clinically malignant neoplasms. The proximity of these tumors to vital structures may allow a gross total resection but virtually never a free margin. Therefore, we hypothesized, that patients would benefit from adjuvant radiation therapy, preferentially protons or ions, even if gross total resection was achieved. A small series is presented in which this clinical practice was implemented.

Methods: Between 2006 and 2016, 15 patients (10 female/5 male, median age 52y, range 19/79) with clival and craniocervical chordomas underwent 25 resections. 9 of these patients presented with double vision due to abducens or oculomotor palsy, 1 with deterioration of visual acuity and field as well as pituitary insufficiency, 1 with nasal obstruction, 2 with unilateral palsy of the caudal cranial nerves and craniocervical instability, 1 with vertigo, 1 incidental. 3 patients were biopsied before. The maximal tumor diameter ranged from 14 to 72 mm. A pure endoscopic transnasal approach was primarily applied, in 1 patient an anterior cervical approach was added. 7 patients received proton beam, 4 heavy ions, 2 photon, 1 none, 1 scheduled for protons.

Results: Gross total resection was achieved in 13 and subtotal resection in 2 cases during primary surgery. 8/8 abducens and 1/1 oculomotor palsies resolved, visual acuity and field improved and pituitary insufficiency remained, breathing improved, caudal cranial nerve palsies remained unchanged, neck pain resolved after dorsal craniocervical fusion. In 1 patient, aggravation from caudal CN palsy to plegia was encountered. One patient complains prolonged nasal discomfort with crusting. 1 patient died due to mayor head trauma after second resection of a regrowth and second radiation. The remaining are progression free after a median follow-up of 56 months, range 2-121. 2 patients presented with irradiation induced necrosis of the mesial temporal lobe, 1 was surgically excised. 1 patient developed a probably radiation induced sarcoma of the condyle/petrous bone and died 6 months after its diagnosis.

Conclusion: The low mortality rate of 2/15 after a median follow-up of 52 months allows the recommendation for radiation following radical surgery. But all effective therapy has morbidity, 1 surgically induced caudal CN palsy, and radiation induced 1 sarcoma and 2 temporal necrosis.

Venous air embolism in the semi sitting position: a retrospective Analysis in 755 patients

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Objective: Venous air embolism (VAE) is a potentially serious complication of the semi sitting position. In this study, we wanted to investigate the Safety of the semi-sitting position analyzing over a 20-years period.

Methods: The incidence of VAE and its perioperative management were analyzed retrospectively in a consecutive series 755 patients who were operated between 1996 and 2016. The occurrence of relevant VAE was defined by detection of bubbles in Doppler/transesophageal echocardiography (TEE), decrease of PtCO₂ (4 mmHg) and/or an unexplained drop of arterial blood pressure (systolic > 10mmHg).

Results: There were 347 women and 408. Mean age at surgery was 49 years (range 1-87 years). Medical condition according to ASA was classified as I =386 (51.1%), II=303 (40.1%) and III=66 (8.8%), mean body mass index 26.07 kg / m² (range 11-58 kg / m²). Surgery was performed for infratentorial lesions in 730 patients (96.7%), supratentorial lesions in 11(1.4%) and cervical lesion in 14 (1.9%). VAE was detected in 95 in series (12.5%) by Doppler /TEE, by a decrease of PtCO₂ in 38 (5%) and by drop in systolic Blood pressure in 30 (4%). VAE was detected in 29 (4%) patients during craniotomy before opening the dura, in 58 patients (61%) after opening the dura, and in 8 patients (8.42%) after closing the dura. There was no statistically significant difference in the incidence in VAE between lateral suboccipital craniotomy (70/582; 12%) and medial suboccipital craniotomy (25/148; 16.9%) (P= 0.13). Four patients had postoperative a neurological deficit related to VAE which resulted in severe morbidity two. There was no motility.

Conclusion: In our series, the VAE overall was rather rare and in general, a treatable complication. TEE represents the most sensitive method for the detection of air embolism. Our results suggest that the semi sitting position is relatively safe and that the overall advantages outweigh the associated risks.

Intraoperative MR imaging of cerebral oxygen metabolism during resection of brain lesions

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Objective: Tissue oxygen tension is an important parameter for brain tissue viability and its non-invasive intraoperative monitoring in the whole brain is of highly clinical relevance. The purpose of this study was the introduction of a multiparametric quantitative blood oxygenation dependent (qBOLD) MRI approach for intraoperative examination of oxygen metabolism during the resection of brain lesions.

Methods: Sixteen patients suffering from various brain lesions (10 glioblastomas, 3 low-grade gliomas, 1 meningioma, 1 cavernoma and 1 AVM) were intraoperatively examined twice (before craniotomy and after gross-total resection) using the qBOLD technique and a 1.5 Tesla MR scanner, which is installed in an operating room. The MR protocol included T2*- and T2-mapping, and dynamic susceptibility-weighted (DSC) perfusion. Data analysis was performed using a custom-made in-house MatLab software for calculation of maps of oxygen extraction fraction (OEF) and cerebral metabolic rate of oxygen (CMRO₂) as well as of cerebral blood volume (CBV) and flow (CBF).

Results: Perilesional edema showed a significant increase in both perfusion (CBV +21%, CBF +13%) and oxygen metabolism (OEF +32%, CMRO₂ +16%) after resection of the lesions. However, in perilesional non-edematous tissue only oxygen metabolism (OEF +19%, CMRO₂ +11%) was significantly increased, but not perfusion. No changes were found in normal brain. Fortunately, no neurovascular adverse events were observed.

Conclusion: This approach for intraoperative examination of oxygen metabolism in the whole brain is a new application of intraoperative MRI additionally to resection control (residual tumor detection) and updating of neuronavigation (brain shift detection). Namely, it may help to detect neurovascular adverse events early during surgery.

MI.06 Funktionelle Neurochirurgie 3

Mittwoch *Wednesday*, 17.05.2017, 08.00 – 09.20 Uhr *hrs*

- MI.06.01 *Investigation of stereoencephalography electrode placement techniques in patients with refractory focal epilepsy: study protocol for a single-blinded randomised case control parallel group trial*
V. Vakharia* (London, United Kingdom), A. Mcvoy, A. Miserocchi, R. Rodionov, S. Ourselin, J. Duncan
-
- MI.06.02 *Experience with the Neuromate Robot in 60 Robot-assisted stereotactic biopsies*
H. Yasin, H. Hoff, M. Simon, H. Yasin* (Bielefeld, Deutschland)
-
- MI.06.03 *The therapy of ankle movements in multiple Sclerosis with ActiGait - a implantable drop foot stimulator*
D. Martin* (Dresden, Deutschland), W. Polanski, A. Schulz, M. Jöbges, T. Ziemssen, G. Schackert, T. Pinzer, S. Sobottka
-
- MI.06.04 *Feasibility, safety and efficacy of Subcutaneous Peripheral Nerve Field Stimulation (sPNS) for the treatment of refractory low back pain. Two-year single-center results.*
B. Ishak* (Heidelberg, Deutschland), H. Brunn, S. Schuh-Hofer, A. Unterberg, R. Ahmadi
-
- MI.06.05 *Microvascular decompression for trigeminal neuralgia: preliminary results and an open invitation to join a european multicenter retrospective study*
E. Shiban* (München, Deutschland), B. Schatlo, F. Christian, R. Veit, T. Claudius, D. Pedro, B. Meyer, J. Lehmberg
-
- MI.06.06 *Modulation of autonomic nervous system function by deep brain stimulation of the subthalamic nucleus: comparison between outcome groups using a structural fingerprint technique*
H. Roy* (Oxford, United Kingdom), T. Aziz, M. Kringelbach, H. Fernandes, T. van Hartevelt, J. Fitzgerald, A. Green
-
- MI.06.07 *Neuronal firing activity and molecular findings in the basal ganglia after striatal transplantation of dopamine neurons in hemiparkinsonian rats*
R. Rumpel* (Hannover, Deutschland), M. Alam, A. Ratzka, J. Krauss, C. Grothe, K. Schwabe
-
- MI.06.08 *The human globus pallidus internus is sensitive to rewards - evidence from intracerebral recordings*
T. Münte, J. Marco-Pallares, S. Bolat, M. Heldmann, G. Lütjens, W. Nager, J. Krauss* (Hannover, Deutschland)
-

Investigation of stereoencephalography electrode placement techniques in patients with refractory focal epilepsy: study protocol for a single-blinded randomised case control parallel group trial

Vejay N. Vakharia¹, Andrew Mcvoy¹, Anna Miserocchi¹, Roman Rodionov¹, Sebastien Ourselin¹, John Duncan¹

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Objectives: To determine the optimal surgical technique for Stereoencephalography (SEEG) electrode insertion. SEEG was first described by Talairach and Bancaud (1965) and is a key feature of presurgical evaluation of patients with refractory focal Epilepsy. The procedure involves the stereotactic placement of 8-16 electrodes within predefined brain targets to help determine the seizure onset zone prior to definitive surgical resection. Current techniques involve the use of a stereotactic frame, frameless neuronavigation systems and robotic trajectory guidance systems. The main complications associated with this technique are haemorrhage and infection. To date there are no published prospective control studies comparing different SEEG techniques.

Methods: We are initiating a single blinded randomised case control parallel group single centre trial comparing SEEG electrode insertion between the currently used frameless neuronavigation system (Vertek arm, Medtronic) and a robotic trajectory guidance system (iSYS1, Medizintechnik GmbH). The primary outcome is to compare the operative time for electrode bolt insertion between the two techniques. The secondary outcomes are to compare:

- a. Accuracy of SEEG depth electrode placement, as assessed by skull entry point, error of angle of implantation of intracranial bolt and distance of the actual electrode tip compared to the target point as defined by the preoperative plan and target region sampled.
- b. Incidence of clinically significant and non-clinically significant radiologically detected post-operative haemorrhages
- c. Infection rate
- d. New post-operative neurological deficits

Discussion: SEEG electrode placement using stereotactic frame based methods are cumbersome and time consuming. High-volume centres have developed frameless systems at the relative expense of accuracy. Robotic trajectory guidance systems have been proposed to provide the benefits of frameless techniques with accuracies comparable to frame-based systems. We have performed pre-clinical studies recreating implantations on patient specific 3D printed phantoms which support this. Cumulative summation analysis revealed a minimal learning curve and superior entry and target point accuracies with the iSYS1 system. A meta-analysis of the literature revealed only poor quality (level 3) clinical evidence comparing the different SEEG techniques.

Conclusion: It is important that new techniques are compared to the previous 'gold-standard' through well designed and methodologically sound studies before they are introduced into widespread clinical practice. To our knowledge this would be the first randomised control trial comparing SEEG techniques.

Experience with the Neuromate Robot in 60 Robot-assisted stereotactic biopsies

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Objective: Stereotactic biopsy is a standard procedure in neurosurgery. While frame-based stereotaxis is considered the gold standard, some centers also utilize frameless imaging-based techniques and more recently robot systems. Here we report a retrospective analysis of our experience with 60 consecutive biopsies performed in our institution using the Neuromate Robot.

Methods: Between March 2013 and August 2016, 60 robot-assisted frameless biopsies were performed in 59 consecutive patients (age: 20-86 yrs., average: 63 yrs., male: 33) with 18 deep (insula, basal ganglia, thalamus, midbrain), 7 bilateral or callosal and 34 lesions deemed unresectable due to an otherwise eloquent localization. We retrospectively analyzed the histopathological results as well as complications and the duration of the procedures.

Results: A definite histological diagnosis could be established in 54 patients (92%) including 25 glioblastomas, 8 PCNSL, 3 metastases, 15 other tumors and 3 inflammatory processes. There were no infectious complications. Six patients (10%) suffered from an early surgery-related neurological worsening, which persisted in 2 cases (3%). Intracerebral haemorrhages requiring operative treatment was observed in 2 patients (3%). The average operating time was 45 ± 17 minutes.

Conclusion: Frameless stereotactic biopsies using the Neuromate Robot are an alternative to frame-based stereotaxis with a similar diagnostic yield and comparable complication rates.

The therapy of ankle movements in multiple Sclerosis with ActiGait – a implantable drop foot stimulator

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Objective: Direct stimulation of the peroneal nerve by the ActiGait implantable drop foot stimulator is a potent therapy that was described previously for stroke-related drop foot. The authors report here successful long-term application of the ActiGait implantable drop foot stimulator in patients with multiple sclerosis (MS).

Methods: Six patients with MS and 2 years of persisting central leg paresis received an implantable ActiGait drop foot stimulator after successful surface test stimulation. Ten weeks and 1 year after surgery, their gait speed, endurance, and safety were evaluated. Patient satisfaction was assessed with a questionnaire.

Results: In the 20-m gait and Timed Up and Go tests, stimulation with the ActiGait stimulator significantly reduced the time needed, on average, by approximately 23.6% 10 weeks after surgery, and the time improved further to 36.3% after 1 year. The median distance covered by patients with the stimulator after 6 minutes of walking increased significantly from 217 m to 321 m and remained stable for 1 year; the distance covered by patients after surface stimulation was 264 m. Patients with an implanted ActiGait stimulator noticed pronounced improvement in their mobility, social participation, and quality of life.

Conclusion: The ActiGait implantable drop foot stimulator improved gait speed, endurance, and quality of life in all patients over a period of 1 year. It may serve as a new therapeutic option for patients with MS-related drop foot.

Feasibility, safety and efficacy of Subcutaneous Peripheral Nerve Field Stimulation (sPNS) for the treatment of refractory low back pain. Two-year single-center results.

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Objective: Chronic low back pain is challenging to treat, especially in patients with multiple spine surgeries. Minimal invasive neurostimulation therapies, such as sPNS, have been introduced to improve pain relief, quality of life and functional capacity when conservative treatment and medical management have failed. However, the interest in sPNS has been increasing over the past few years. At present no clear guidelines exist for indication, use and follow-up of this system. The goal of our study was to assess usefulness, safety and efficacy of sPNS in patients with chronic low back pain.

Methods: 26 consecutive patients with chronic low back pain who had failed conservative treatment for at least 6 months were prospectively included in our study. Two electrodes were implanted in the subcutaneous tissue at a depth of 1 cm vertically with a maximum distance of 10 cm to each side in the region of maximum pain, as identified by each individual patient. All patients have had a 14 day trial of stimulation with electrodes connected to an external neurostimulator to assess response. A minimum of 50 % pain relief was required for implantation of the permanent neurostimulator system. Visual analog scale (VAS), Oswestry Disability Index (ODI) and quality of life (EQ-5D) were measured preoperative and at 6- and 24-months follow-up.

Results: Out of 26 patients 13 had a permanent neurostimulator implantation after a successful trial. The pain medication including opioid analgesics could be reduced in 92 % of patients after 24 months. In those patients we demonstrated a significant improvement of VAS, ODI and EQ-5D at 6-months, which deteriorated in three patients at 24-months follow-up without significant difference to the 6-months results. In two patients the preoperative marked pain area increased by half after 24 months. The complication rate was 23 % (3 of 13, hardware failure, electrode dislocation and silicone intolerance) and is comparable to published data. Concerning the non-responder (13 patients) we

could find a high correlation to posterior lumbar stabilization in three or more levels.

Conclusion: sPNS is a novel, safe and effective procedure for the treatment of chronic low back pain and may provide advantages over interventional treatments including intrathecal therapy and spinal cord stimulation. Further prospective data collection is necessary to establish guidelines for recommended use.

Microvascular decompression for trigeminal neuralgia: preliminary results and an open invitation to join a European multicenter retrospective study

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Objectives: Treatment of all patients with classic trigeminal neuralgia (TN) begins with drug therapy. The gold standard remains carbamazepine. However, the efficacy of carbamazepine is compromised by its adverse effects. Furthermore, after long-term follow-up (5 – 16 years) only 22% of participants still find carbamazepine effective. Aim of this study is to assess the clinical outcome following the surgical treatment of TN and find potential factors for treatment failure.

Methods: A multicenter retrospective data analysis will be performed. The following factors will be analyzed as possible risk factors for treatment failure: 1) Duration of symptoms 2) Low/high volume centers 3) Technique: Neurovascular interposition or neurovascular transposition 4) Number of affected nerve branches 5) Presence or absence of neurovascular conflict on MRI 6) Indication for surgery: medical treatment failure (persisting pain) or intolerable adverse effects of the medication. With a study power of 80%, 688 patients will be needed. Primary outcome is pain-free patients at last follow up.

Results: For now 265 patients from 4 institutions have been analysed. Follow-up data was obtained from 186 (73%). 122 patients were male (47.7%); mean age was 64 years. Mean duration of symptoms until surgery was 49.53 months (4,1 years). From 155 patients with available imaging data 115 (74.2%) had a visible conflict on the MRI. 64% of patients were pain free at last follow up. Facial hyposthesia was the most common complication and was seen in 9.4% of patients. There were no mortalities.

Conclusion: Microvascular decompression for trigeminal neuralgia is a safe and effective treatment modality. More institutions are invited to join our European wide effort.

Modulation of autonomic nervous system function by deep brain stimulation of the subthalamic nucleus: comparison between outcome groups using a structural fingerprint technique

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Objective: Deep brain stimulation (DBS) of the subthalamic nucleus (STN) has been shown to modulate autonomic nervous system activity. Harnessing this effect could have clinical benefits for subjects with symptoms of autonomic dysfunction, however, the mechanism responsible for autonomic changes with STN DBS remains unclear. The aim of this study was to use whole-brain tractography to identify elements of the connectivity 'fingerprint' of the DBS electrodes that are associated with post-operative changes in autonomic symptoms.

Methods: Eight subjects with Parkinson's disease were recruited. All subjects completed the COMPASS-31 autonomic symptom questionnaire before surgery and nine months after implantation of STN DBS (range 5-24 months). Diffusion-weighted and T1-weighted pre-operative MRI scans were obtained for each patient, and pre- and post-operative stereotactic CT scans were also performed. We used a previously described analytic pipeline (Fernandes et al 2015) to model the volume of activated tissue (VAT) for each electrode, parcellate the brain into 116 cortical, subcortical and cerebellar areas ('network nodes') based on the automated anatomical labeling (AAL) template, and apply probabilistic tractography to the VAT on a voxel-by-voxel basis. Permutation-based paired t-tests were then used to identify significant differences in connectivity profile between the groups with 'positive' and 'negative' autonomic outcomes. We also identified nodes that survived a 5% threshold in all subjects within either the 'positive' or the 'negative' outcome group.

Results: The 'positive autonomic outcome' group had stronger connectivity between the stimulated areas and the left rolandic operculum, right post-central gyrus, right supramarginal gyrus, and right cerebellar vermis than the 'negative autonomic outcome' group, but that 'negative outcome' group displayed stronger connections with the right cerebellum (AAL cerebellar area 9) ($p < 0.05$). Using the second method of comparison, connections to the thalamus bilaterally and the left caudate survived thresholding in all subjects with positive autonomic outcomes, but not in all subjects with negative autonomic outcomes.

Conclusions: There are clear differences between connectivity fingerprints of the 'positive' and 'negative' autonomic outcome groups. The use of pre-operative tractography to predict electrode locations and stimulation settings that generate 'positive autonomic outcome' connectivity profiles could facilitate improved consistency in achieving a good autonomic outcome following STN DBS and should be the subject of future study.

Neuronal firing activity and molecular findings in the basal ganglia after striatal transplantation of dopamine neurons in hemiparkinsonian rats

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Objective: In Parkinson's disease patients, as well as in the 6-hydroxydopamine (6-OHDA) lesioned rat model, the loss of nigral dopaminergic neurons and the resulting dopamine (DA) depletion in the striatum (STR) lead to altered neuronal activity and enhanced beta activity in various regions of the basal ganglia (BG). Intra-striatal DA cell graft implantation has been shown to functionally re-innervate the host brain and restore DA input.

Methods: To further increase our understanding of neuronal activity in the BG of a grafted brain, we implanted DA cell grafts into the STR of 6-OHDA lesioned rats and examined the effect on neuronal activity of the entopeduncular nucleus (EPN, the equivalent to the human globus pallidus internus), the output nucleus of the BG, and the globus pallidus (GP, the equivalent to the human globus pallidus externus), a key region in the indirect pathway, under urethane anesthesia. In addition, we performed qRT-PCR analysis of specific GABAergic markers in the STR and both pallidal regions.

Results: Injection of DA agonists in 6-OHDA lesioned rats significantly improved the rotational behavior after DA graft implantation, which was accompanied by alleviated EPN firing rate and reinstated patterns of neuronal activity in the GP and EPN. Analysis of oscillatory activity revealed enhanced beta activity in both regions, which was reduced after grafting. While lesioned and grafted rats displayed typical gene expression changes in the STR, DA grafts also induced novel expression changes of GABAergic markers in the GP.

Conclusion: In summary, electrophysiological data indicate physiological restoration of BG towards normal activity by DA graft integration.

The human globus pallidus internus is sensitive to rewards - evidence from intracerebral recordings

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Objective: The globus pallidus internus (GPI) is the final output relay of the basal ganglia for the control of movements but has also been shown to belong to a second pathway projecting to the lateral habenula. This latter pathway is related to reward processing. This prompted us to record, in eight patients receiving deep brain stimulation of the GPI for the alleviation of movement disorders, local field potentials while these patients performed a lottery task.

Methods: The task entailed choosing between a higher and a lower number, which changed their color after the patient's choice with red (green) signaling a loss (win, in Euro cents) corresponding to the chosen number.

Results: Surface recordings showed a feedback related negativity from a frontal midline site, while time domain averages in the GPI showed differential modulation depending on the valence of the stimulus with polarity inversion indicating that this reward-modulated activity was indeed generated locally. Furthermore, wavelet decomposition of the LFP showed a reward-related response in the high beta / low gamma range.

Conclusion: We conclude that human GPI is involved in reward processing, possibly in relation to the lateral habenula.

MI.07 Infektionen

Mittwoch *Wednesday*, 17.05.2017, 08.00 – 09.30 Uhr *hrs*

- MI.07.01 *Diagnostic red flags: steroid-treated CNS lymphoma mimicking autoimmune inflammatory demyelination*
A. Barrantes-Freer, S. Hernandez Duran* (Göttingen, Deutschland), A. Bleckmann, H. Schildhaus, W. Brück, C. Stadelmann
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- MI.07.02 *Interleukin-6 in the cerebrospinal fluid for predicting EVD-associated ventriculitis in patients with severe aneurysmal subarachnoid hemorrhage*
M. Lenski* (München, Deutschland), M. Schmutzer, V. Hüge, J. Briegel, C. Schichor, J. Tonn, N. Thon
-
- MI.07.03 *CMV infection in glioblastoma leads to increased pericyte invasion and a pro-angiogenic phenotype*
H. Krenzlin* (Mainz, Deutschland), K. Grauwet, P. Behara, M. Griessler, M. Gutknecht, C. Cook, A. Chiocca, S. Lawler
-
- MI.07.04 *Infection Rate in a shared two-room Intraoperative MRI Concept*
O. Bozinov* (Zürich, Switzerland), N. Dinevski, J. Sarnthein, J. Velz, M. Neidert, L. Regli
-
- MI.07.05 *Does Wound Dehiscence in Cranioplasty with Customized Implants always warrant explantation?*
D. Mielke* (Göttingen, Deutschland), T. Engstrand, U. Birgersson, V. Rohde, L. Kihlström
-
- MI.07.06 *Incidence and outcome of patients suffering from meningitis due to infectious spondylodiscitis or spondylitis*
I. Janssen* (München, Deutschland), E. Shiban, J. Rainer, B. Meyer, Y. Ryang
-
- MI.07.07 *CSF Infection related to external ventricular drain- antibiotic treatment always necessary?*
J. Scheitzach* (Regensburg, Deutschland), S. Bele, K. Schebesch, A. Brawanski, P. Schödel, E. Bründl
-
- MI.07.08 *Current treatment concepts for iatrogenic ventriculitis: a nationwide survey in Germany*
N. Von Spreckelsen* (Köln, Deutschland), S. Telentschak, J. Hampl, R. Goldbrunner, S. Grau
-
- MI.07.09 *Effect of the "bundle approach" on the frequency of EVD-associated infection*
A. Anani* (Hannover, Deutschland), B. Hong, H. Heissler, J. Lang, J. Krauss
-

Diagnostic red flags: steroid-treated CNS lymphoma mimicking autoimmune inflammatory demyelination

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Objective: The presence of inflammation and demyelination in a central nervous system (CNS) biopsy points towards a limited, yet heterogeneous group of pathologies, of which multiple sclerosis (MS) represents the principal consideration. Inflammatory demyelination has also been reported in patients with clinically suspected primary central nervous system lymphoma (PCNSL) especially when steroids had been administered prior to biopsy acquisition. The histopathological changes induced by corticosteroid treatment can range from mild reduction to complete disappearance of lymphoma cells. It has been proposed that in the absence of neoplastic B cells these biopsies are indistinguishable from MS, yet despite the clinical relevance, no histological studies have specifically compared the two entities.

Methods: In the present work we analyzed CNS biopsies from eight patients with inflammatory demyelination in whom PCNSL was later histologically confirmed, and compared them with nine well defined early active multiple sclerosis lesions. Formalin-fixed, paraffin-embedded CNS biopsy material was obtained from the archives of the Institute of Neuropathology, Göttingen. Tissue sections were analysed using standard histochemical and immunohistochemical techniques. Statistical analysis and plotting was performed using the R software.

Results: In the patients with steroid-treated PCNSL (ST-PCNSL) the interval between first and second biopsy ranged from 3-32 weeks; all of the patients had received corticosteroids before the first, but not the second biopsy. ST-PCNSL patients were older than MS patients (mean age: ST-PCNSL: 62±4 years, MS: 30±2 years), and histological analysis revealed numerous apoptoses, a patchy rather than confluent pattern of demyelination and a fuzzy lesion edge. The loss of Luxol fast blue histochemistry was more profound than that of myelin proteins in immunohistochemistry, and T cell infiltration in ST-PCNSL exceeded that in MS by around 5-fold ($p=0.005$).

Conclusion: Our data indicate that the extent of inflammation and the pattern of demyelination, even in the absence of B cell blasts, suffice to raise the diagnostic suspicion of an underlying lymphoma and may serve to distinguish it from classical autoimmune inflammatory demyelination.

Interleukin-6 in the cerebrospinal fluid for predicting EVD-associated ventriculitis in patients with severe aneurysmal subarachnoid hemorrhage

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Objective: Aim of this study was to investigate in patients with aneurysmal subarachnoid hemorrhage (SAH) and external ventricular drain (EVD) whether interleukin-6 concentrations in the cerebrospinal fluid (IL-6_{CSF}) could be useful to early identify patients at risk for cerebral vasospasm (=cVS_{SAH}) or EVD-associated ventriculitis (=VC_{SAH}).

Methods: IL-6_{CSF} levels were collected daily in 63 consecutive patients with SAH and EVD for 17 consecutive days after SAH. VC_{SAH} was diagnosed 17 times, cVS_{SAH} 27 times and 19 patients had an uneventful course without additional complication after SAH (=SAH-).

Results: Whereas highest IL-6_{CSF} levels were measured on the 2nd day in uneventful SAH-, cVS_{SAH} and VC_{SAH} were associated with peak values on the 8th day (=d8). Mean IL-6_{CSF}_{d8} concentrations were significantly higher in patients with VC_{SAH} (7549 ± SD 4744 pg/ml) than in patients with cVS_{SAH} (2482 ± SD 2395 pg/ml, p= 0.002) or SAH- (853 ± SD 649 pg/ml, p= 0.02). IL-6_{CSF} had good diagnostic potential on day 8 after SAH for diagnosing VC_{SAH} (AUC_{d8}= 0.852 [95%CI: 0.707; 0.997], threshold= 2900 pg/ml, sensitivity= 92.3%, specificity= 73.7%). Patients undergoing clipping or coiling showed no significant differences in the mean IL-6_{CSF} concentrations.

Conclusion: Time-dependent reference values of IL-6_{CSF} for diagnosing VC_{SAH} were introduced by this study. IL-6_{CSF} concentrations above the 90th percentile of aseptic courses (SAH- and cVS_{SAH}) or IL-6_{CSF} concentrations above 2900 pg/ml after the 8th day are helpful for predicting VC_{SAH} early.

CMV infection in glioblastoma leads to increased pericyte invasion and a pro-angiogenic phenotype

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Objective: Cytomegalovirus (CMV) is a ubiquitous member of the herpes virus family with a prevalence of between 50-100% in the human population and lifelong persistence. While normally clinically benign, severe cases are observed in neonates and immunocompromised patients. Over the last decade, CMV has been associated with glioblastoma (GBM) and other tumors. The aim of this study is to clarify the interrelationship between CMV and GBM, as to elucidate its contribution to GBM progression.

Methods: Pericytes, proneural (PN) and mesenchymal (MES) human GBM cell lines were assessed via flow cytometry for permissiveness to CMV (Towne Strain) infection. Cytokine expression pre- and post-infection was analyzed using Real-time-PCR. Transwell migration and endothelial tube formation were evaluated in co-culture with infected and uninfected GBM cell lines. C57BL/6 mice were infected with murine CMV (MCMV- Δ m157) at P2 and syngeneic GL261 tumor cells were implanted at week 14 after latent infection was established. Murine as well as human brain sections were analyzed by immunofluorescence staining.

Results: CMV was found to closely co-localize with tumor vessels in patient derived GBM specimens. Interestingly *in vitro* studies confirmed a high permissiveness of pericytes for CMV infection. GBM cells, permissive for CMV, had a proneural, rather than a mesenchymal signature. In addition, upregulation of pro-angiogenic cytokines such as IL-6, TGF-beta and angiogenesis inducing receptor PAR-1 upon CMV infection was confirmed by RT-qPCR. Transwell assays revealed increased migration towards CMV infected cells after 48h. GBM cells towards infected pericytes: 1.5-fold ($p=0.07$); pericytes towards infected GBM cells: 1.48-fold ($p=0.009$). Further, co-culture of human brain microvascular endothelial cells (HBMEC) and CMV infected PN cells led to the establishment of larger (160%, $p<.0001$) and more complex (number of junctions 9.5 (-) vs. 21 (+), $p<.0001$) tube formation on Matrigel compared to non-infected PN cells. *In vivo*, tumors formed by GL261 cells in MCMV infected mice ($n=10$) showed significantly higher numbers of infiltrating pericytes and were better vascularized compared to those of uninfected animals ($n=10$).

Conclusion: In this study, we show for the first time that pericytes are permissive for CMV infection. Infected GBM cells are characterized by a proneural signature. CMV induces a high cytokine production upon infection and establishes a pro-angiogenic microenvironment. Enhanced tube formation of HBMEC *in vitro* and the increased migration of GBM and pericytes towards infected cells, suggests a contribution of CMV to model the tumor microenvironment. Moreover, tumors show higher pericyte infiltration and increased angiogenesis *in vivo*. We conclude that CMV may cause GBM progression by increasing diffuse infiltration and angiogenesis via paracrine signaling.

Infection Rate in a shared two-room Intraoperative MRI Concept

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Objective: We determined the infection rate of all neurological surgeries involving a modern two-room intraoperative MRI concept.

Methods: We included all 195 consecutive procedures that were performed at our institution with a high-field ioMRI, shared by Neurosurgery and Neuroradiology, between April 2013 and June 2016 (109 craniotomies and 86 endoscopic transsphenoidal procedures). The incidence of surgical site infections (SSI) within three months after surgery was assessed retrospectively for both operative groups.

Results: Of the 109 craniotomies, six patients (6%) developed an SSI, including one superficial SSI, two cases of bone flap osteitis, one intracranial abscess and two cases of meningitis/ventriculitis. Wound revision surgery due to infection was necessary in four patients (4%). Of the 86 transsphenoidal skull base surgeries, six patients (7%) developed an infection, including two non-CNS intranasal SSIs (3%) and four cases of meningitis (5%). Nine patients (10%) had a postoperative CSF leak. Unplanned reoperation was necessary in five transsphenoidal patients with an infection (6%). After the first year of experience, the infection rate dropped significantly to one.

Conclusion: The use of a two-room ioMRI in neurosurgical procedures requires meticulous sterile caution and seems to hold infection rates to an acceptable rate compared to other studies. The drop of infection rates in the second half of the study underlines the importance of surgical staff training after the introduction of a shared-resource ioMRI.

Does Wound Dehiscence in Cranioplasty with Customized Implants always warrant explantation?

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Objective: Cranioplasty using autologous bone grafts or alloplastic implants are associated with risks of bone resorption, infection and/or protrusion through the skin. Wound dehiscence with implant exposure and signs of infection usually calls for implant removal in order to avoid serious complications.

Methods: In a cohort of 69 patients having received a custom made ceramic implant a total of 6 wound dehiscences with implant exposure were encountered. The wound dehiscences occurred in 4 female and 2 male patients out of which half had been treated initially for either a traumatic brain incident or tumor growth. 4 patients had suffered from previous implant failures due to infection or extensive postoperative oedema. In all cases the wound opening occurred through the incision located over the implant exposing the implant surface. In these patients wound edges were revised and superficial layers of the exposed ceramic surface of the implant were trimmed using a scalpel in order to mechanically remove any potential contaminant. Thereafter, the area was treated with antibiotics and, due to often very fragile and thin patient skin, the wound openings were closed with various skin flap techniques.

Results: Out of the 6 patients who underwent wound revision 5 recovered well and followed an expected post-operative course. Only 1 patient suffered from a persistent wound dehiscence with multiple wound infections which lead to the implant being removed six months post-surgery.

Conclusion: In case of a wound dehiscence the selected course of action might not necessarily be explantation. The custom made design and structure of an implant may enable either partial removal or trimming of an implant without the need to remove the entire implant.

Incidence and outcome of patients suffering from meningitis due to infectious spondylodiscitis or spondylitis

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Objective: Meningitis is a rare but severe complication of patients with infectious spondylodiscitis. The incidence of this possibly fatal disease remains unclear due to a lack of studies reporting incidence and outcome of these patients. Aim of this retrospective monocentric study was to evaluate the incidence, clinical course and outcome.

Methods: A retrospective analysis of our clinical database was performed. Between January 2010 and June 2016 of 282 patients admitted to our department for spondylodiscitis, 14 patients (8 male, 6 female) (4.9%) suffered from an associated meningitis. Mean age at presentation was 70.5 ± 10.75 yrs (range 48-88 yrs). We assessed clinical findings, laboratory tests, treatment and outcome.

Results: Diagnosis of meningitis was confirmed by CSF examination. Mean CSF cell count gained by lumbar puncture (n=10), external ventricular drainage (n=2) or lumbar drain (n=2) was $9899.23/\mu\text{l} \pm 17524.78/\mu\text{l}$ (range 303-51528/ μl). Mean time to diagnosis was 8.5 ± 8.2 days (range 1-27) after admission to our department. CSF examination was performed because of mental status change, coma or meningism. At time of hospital admission ten patients presented with neurological deficits (paraparesis n=6; tetraparesis n=4). Two patients required ICU treatment with ventilation at that time. Mean hospital stay was 37.4 ± 21.2 days (range 10-89). Eight patients required ICU treatment for an average of 19.7 ± 16.8 days. Tracheotomy was necessary in two cases. Successful isolation of the microbial or fungal organisms was possible in 13 cases. We found staphylococcus aureus in seven patients, enterococcus faecium, streptococcus group B, candida albicans, klebsiella pneumoniae, clostridium perfringens or mycobacterium tuberculosis in one case each. Two patients developed hydrocephalus, one patient experienced cerebral infarction and epileptic seizures either because of meningitis or septic embolism. One patient died due to multiorgan failure, a 85 year old women was transferred to the palliative care unit after she became comatose and showed no improvement of her neurological status after a few weeks of treatment. At the time of transfer to the rehabilitation centre nine patients were still impaired by neurological deficits.

Conclusion: Bacterial meningitis due to bacterial or fungal spine infections is a rare but severe condition carrying a high morbidity and mortality. In patients with spine infection who present with somnolence and confusion an associated meningitis should be ruled out as soon as possible by CSF examination.

CSF Infection related to external ventricular drain- antibiotic treatment always necessary?

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Objective: Diagnosis of cerebrospinal fluid (CSF) infection in patients with external ventricular drainage is often done by clinical symptoms and/or laboratory values such as cell count or glucose values. But there seems to be a mismatch between the number of clinically diagnosed CSF infections and microbiological pathogen detection in the CSF of these patients. This study was conducted to analyze the ratio between clinically diagnosed and treated CSF infections and the confirmation of bacteria in the CSF by microbiological examination.

Methods: Retrospectively we analyzed the charts of all patients treated for EVD-associated CSF infections between 01/2011-06/2016. We checked for clinical signs of CSF infection like nuchal rigidity, elevated cell count in CSF and low glucose. In addition we examined all cases with regard to microbiological examination of the CSF and detection of bacteria. We also checked for antibiotic treatment of the CSF infection.

Results: A total of 214 patients were treated for CSF infection between 2011 and 2016. Most of these patients showed typical clinic symptoms of a CSF infection. All patients had an increased cell count often combined with low glucose in the laboratory CSF examination. Nearly all of them were treated with intravenous antibiotics. Interestingly, in only half of the cases CSF or the tip of the ventricle drain was sent to the microbiological laboratory. The majority of these samples was sent for microbiological evaluation in the years 2013-2016. In only one third of these samples pathogen detection occurred. In some of these cases there was only microscopic pathogen detection without microbial growth after incubation.

Conclusion: We saw a significant increase of microbiological pathogen examinations of CSF since 2013 before starting antibiotic treatment. This reflects the fact that we started to rethink the definition of CSF infection by using only clinical signs as well as the potential use of antibiotics. Interestingly in less than half of the examined samples a bacterial infection could be detected. That means in times with increasing resistance to antibiotics criteria for definition and treatment of CSF infections should be clearly formulated. That rises the question if clinical symptoms of a CSF infection are sufficient enough or if a microbiological pathogen detection is necessary before starting an antibiotic therapy particularly in patients with subarachnoid hemorrhage?

Current treatment concepts for iatrogenic ventriculitis: a nationwide survey in Germany

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Objective: Iatrogenic ventriculitis is a common complication in patients being treated with external ventricular drains (EVD). To date, the treatment of ventriculitis is subject to hospital specific standards without clear guidelines for modality, timeframe and choice of antibiotic treatment. Our objective was to depict the treatment concepts currently performed in German hospitals.

Methods: A standardized questionnaire consisting of 18 multiple choice questions, each with the ability to provide additional individual answers, covering the diagnosis and treatment of iatrogenic ventriculitis as well as general handling of EVDs was sent to 121 neurosurgical hospitals registered in the "Deutsche Gesellschaft für Neurochirurgie" (DGNC) (German Society for Neurosurgery).

Results: Thirty-one out of 121 hospitals returned the questionnaire. While diagnostics are performed similarly in most hospitals, the treatment varies remarkably. Nine of the 31 (29%) hospitals never apply antibiotics intrathecally, 11 (35,5%) do so only in few (10-20%) cases, while 7 (22.7%) do this routinely and the other centers vary their treatment. Similar results were obtained for type of antibiotics, timing of treatment and handling of EVDs. While the targeted systemic therapy after pathogen and resistance identification is similar, the choice of initial antibiotics varies, as well as the type of drug used for intrathecal therapy. Out of all applied systemic antibiotics Vancomycin n=21 (67,8%) and Meropenem n=20 (64,5%) are the most common combination, but many others including, Ceftriaxone, Metronidazol, Linezolid, Piperacillin, Rocephin, Fosfomycin and Ceftazidim are used.

In addition, there is no clear practice regarding EVD-handling. 12 (38,7%) hospitals do not replace the EVD after a new diagnosis of ventriculitis, 11 (35,5%) do so once after the diagnosis, and 8 (25,8%) regularly switch EVDs after a certain amount of time, even without signs of infection. (7-20 days).

Conclusion: For treating iatrogenic ventriculitis, various treatment strategies are pursued. The results of this questionnaire show the urgent need for defining a standard treatment algorithm.

Effect of the "bundle approach" on the frequency of EVD-associated infection

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Objective: EVD is one of the most frequent operations in neuro-surgery. In spite of a lot of progress in hygiene and meticulous peri-, intra- und postoperative measures, EVD-associated infections have remained a big challenge until today. The incidence of EVD-associated infections is still mentioned in the corresponding literature today as being up to 40% . In order to minimize the number of these infections, polypragmatic measures called "Bundle Approach" were introduced in our clinic in 2006, which include disinfection of hands and skin, wound care, bandage exchange and liquor extraction.

This study examines the effect of these measures on the incidence of EVD-associated infections.

Methods: The characteristics of all patients, divided in two groups: group A (all patients during the period of January 2000 until December 2005) and group B (all patients during January 2006 until December 2010) were compared. Patients who had had a EVD in other hospitals or who suffered already from ventriculitis, were excluded. The *bundle approach* includes a very strict disinfection of hands and skin, wound care, bandage exchange and liquor extraction. After the incidence of the EVD-associated infections, the risk factors were evaluated as well as the different main and side diseases, microbiological test results, and perioperatively used antibiotics.

Results: A total of 349 patients (group A: n=141; group B: n=208) were included in this study. In 41 patients (29%) of group A and 10 patients (4,8%) of group B an EVD-associated infection ($p < 0.0001$) was found. Microbiological findings in the Liquor cerebrospinal of the patients of both groups showed mainly staphylococcus.

Conclusion: The *bundle approach* resulted in a significant reduction of EVD-associated infections.

MI.08 Hydrozephalus 3

Mittwoch *Wednesday*, 17.05.2017, 08.00 – 09.30 Uhr *hrs*

- MI.08.01 *Outcome of 77 patients nine years after shunt surgery for idiopathic normal pressure hydrocephalus (iNPH)*
J. Lemcke* (Berlin, Deutschland), S. Rot, P. Gutowski, U. Meier
-
- MI.08.02 *Sonication improves the detection of microorganisms in ventriculo-peritoneal shunt associated infections*
T. Finger* (Berlin, Deutschland), V. Prinz, B. Simon, R. Nora, T. Andrej, V. Peter
-
- MI.08.03 *Safety and function of programmable ventriculo-peritoneal shunt valves: An in vitro 7 Tesla magnetic resonance imaging study*
B. Chen* (Essen, Deutschland), P. Dammann, R. Jabbarli, H. Quick, U. Sure, O. Kraff, K. Wrede
-
- MI.08.04 *Frequency and treatment of hydrocephalus prior to and after surgery for posterior fossa tumors in adult patients*
S. Marx* (Greifswald, Deutschland), M. Reinfelder, H. Schroeder, J. Baldauf
-
- MI.08.05 *Technical malfunction of programmable valves*
D. Class* (Magdeburg, Deutschland), D. Karagiannis, J. Kohl, R. Firsching
-
- MI.08.06 *Behandlungsergebnisse bei idiopathischem Normaldruckhydrozephalus nach Anlage eines Shuntsystems mit verstellbarem Differenzdruckventil und integrierter Gravitationseinheit*
P. Ertl* (Hannover, Deutschland), M. Polemikos, H. Heissler, E. Hermann, J. Krauss
-
- MI.08.07 *CSF dynamics during neuroendoscopy of obstructive hydrocephalus: What can we learn from Real Time MRI?*
H. Ludwig* (Göttingen, Deutschland), H. Bock, S. Dreha-Kulaczewski
-
- MI.08.08 *Optimal valve selection in treatment of adult hydrocephalus - Selection depended on the origin etiology?*
M. Hohenhaus* (Freiburg, Deutschland), M. Brühl, D. Heiland, M. Shah
-
- MI.08.09 *Anatomical landmarks in the retroclival region during endoscopic third ventriculostomy: the clival line*
P. Kurucz* (Stuttgart, Deutschland), L. Barany, O. Ganslandt
-

Outcome of 77 patients nine years after shunt surgery for idiopathic normal pressure hydrocephalus (iNPH)

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Objective: Shunt surgery with programmable valves and anti-siphon devices is known to improve the clinical outcome of a majority of patients with iNPH within a one year-period of time. The aim of this study was to analyze the long term-outcome of iNPH patients after surgery in order to determine how many years of nursing dependency can be saved for the patients by modern shunt surgery.

Methods: The departments shunt database was screened for patients who underwent surgery for iNPH and had complete follow up data after 3, 6 and 9 years. The outcome was measured by the Kiefer score and compared by the NPH recovery rate.

Results: Between 1997 and 2006, 300 patients underwent ventriculoperitoneal shunt surgery due to iNPH. At the reference date, 74 patients had died for several reasons. Two hundred fifty two patients had at least a complete 3-year follow up, 143 patients had a follow up time of 6 years and 77 patients had follow up data 9 years after surgery.

The mean age of our patients was 64 years (33-83) years at the time of surgery and 78 years (47-95 years) at the time of follow up.

The mean Kiefer score 9 years after surgery was significantly lower indicating a clinical improvement (3.8 vs. 7.5 points, $p=0.049$)

58 (23%) of the patients after 3 years showed an excellent clinical outcome measured with the NPH recovery rate. 16% showed good clinical results, 36% had a satisfactory and 25% a poor clinical outcome.

6 years after surgery, 47% of the 143 patients had an excellent and 24% a poor outcome.

At the 9-year-follow up, 38% of the 77 patients showed an excellent improvement, 27% had good and 19% satisfactory results. 16% of the patients did not benefit.

Conclusion: We achieved a responder rate of 84% on VP shunt surgery with programmable valves after a follow up period of 9 years. Modern shunt surgery seems to be able to save several years of nursing dependence for a majority of the patients.

Sonication improves the detection of microorganisms in ventriculo-peritoneal shunt associated infections

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Objective: Antimicrobial treatment of ventriculo-peritoneal (VP) shunt infections is challenging when the causative pathogen is unknown. This study evaluates the feasibility of sonication of explanted shunts to improve the microbiological detection rate.

Methods: All consecutive patients undergoing revision surgery because of VP shunt infection from January 2015 until October 2016 were evaluated. Intraoperative tissue samples, wound swabs and cerebrospinal fluid (CSF) were collected for microbiological examination. The removed implants were additionally sent for sonication to detect biofilm bacteria.

Results: We included 25 patients with a shunt infection with a median age of 51 years (16-82), 40 % were male (n=10). In 12 patients tissue samples, CSF and wound swabs were analyzed, in 13 patients the explanted shunt was additionally sent for sonication. All 13 sonicate cultures showed a positive microbiological result (100%), whereas in cases with conventional microbiological methods the causative microorganism was identified only in 50% (6 out of 12) (p=0,002). If analyzed by method, all 13 sonicate cultures (100%) were positive and 12 out of 25 conventional microbiological analysis results (48%) detected the causative agent (p=0,001.) In 16 patients (64%), antimicrobial treatment was started preoperatively. In those patients, the pathogen was detected in all 9 sonicate cultures (100%), whereas conventional methods grew pathogen only in 28.6% (2/7) (p=0,001) .

Conclusion: In VP shunt-associated infections all sonicate cultures grew the causative pathogen, despite prior antimicrobial treatment, whereas the microbiological yield with conventional methods was statistically significantly lower, regardless whether patients received prior antimicrobial treatment or not. The implementation of sonication for removed VP shunts into the clinical routine may substantially increase the rate of pathogen detection and allow pathogen- and susceptibility-adapted treatment, thereby potentially improving the treatment outcome.

Safety and function of programmable ventriculo-peritoneal shunt valves: An in vitro 7 Tesla magnetic resonance imaging study

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Objective: In the last years, the quantity of ultra-high field magnetic resonance imaging (MRI) studies demonstrating diagnostic benefits in neuro imaging has increased rapidly. This in vitro study tests function, safety and image artifacts of the two worldwide most frequently implanted programmable ventriculo-peritoneal (VP) shunt valves in a 7T MRI system.

Methods: All tests were performed using a whole-body MRI system (Magnetom 7T; Siemens Healthcare, Germany). Three proGAV 2.0 programmable VP-shunt valves (Miethke GmbH, Germany) and 3 CODMAN CERTAS® Plus programmable VP-shunt valves (Codman & Shurtleff, Inc., MA), all certified as 3T MR conditional, were tested in a three-step procedure. 1) Deflection angle tests were performed at the location of the highest static magnetic field gradient (5 T/m) close to the scanner opening. 2) The valves were fixed on a standard spherical phantom in 3 positions (a. strictly lateral, b. strictly cranial, c. cranial with 22.5° tilt anteriorly) and tested for keeping the programmed pressure setting and ability to be reprogrammed. 3) The valves were fixed on a spherical phantom and positioned strictly right lateral in the head coil. Scans were performed for both VP shunt models separately, including MPAGE, gradient echo and spin echo sequences.

Results: Deflection angles were moderate (13°, 14°, 13°) for the proGAV 2.0 programmable VP-shunt valves and close to critical (43°, 43°, 41°) for the CODMAN CERTAS® Plus programmable VP-shunt valves. The proGAV 2.0 programmable VP-shunt valves kept the programmed pressure settings and were reprogrammable in position a and b. In position c, the valves kept their pressure setting, but ability to be reprogrammed was lost. The CODMAN CERTAS® Plus programmable VP-shunt valves changed their pressure setting and ability to be reprogrammed was lost in position a, b and c, respectively. A magnetometer also showed reversed polarity of the permanent magnets that are the crucial part of the programming mechanism within both valves. The image signal homogeneity was unaltered by the shunt valves in the center of the phantom and image artifacts adjacent to the valves were tolerable.

Conclusion: Both tested programmable VP-shunt valves are unsafe for use in 7T systems in their current design. Altered programming mechanisms using permanent magnets with sufficient magnetic coercivity may allow development of programmable VP-shunt valves that are conditional for use in 7T MR systems.

Frequency and treatment of hydrocephalus prior to and after surgery for posterior fossa tumors in adult patients

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Objective: Conclusive data about the incidence of hydrocephalus prior to surgery and the resolution of hydrocephalus after posterior fossa tumor removal in adult patients has not been mentioned in detail. Whether there is a need of managing hydrocephalus before tumor surgery or not is still a matter of debate.

Methods: The authors present a consecutive series of posterior fossa tumor surgeries in adult patients between 2005 and 2014 of a single neurosurgical department. Presence of hydrocephalus before and after surgery as well as its respective treatment was assessed.

Results: 254 adult patients harbouring vestibular schwannomas (32.7%), metastases (26.8%), meningiomas (19.3%) and other lesions (21.2%) were included in the study. 52 patients (20.5%) suffered from symptomatic hydrocephalus at the time of diagnosis (21f, 31m, mean age 57.4 years, range from 21 to 87 years). Treatment options for hydrocephalus was early tumor surgery in 82.7% (n=43; group 1), ETV prior to tumor surgery in 13.5% (n=7; group 2) and EVD prior to tumor surgery in 3.8% (n=2; group 3). After tumor removal, further CSF diverting procedures were necessary in 11.6% (n=5) of patients in group 1. Neither patients of group 2 nor 3 had to be treated again for ventricular enlargement. Mean follow-up of patients was 26 months (range from 1 to 113 months).

Three of 254 patients (1.2%) developed a new hydrocephalus after tumor surgery while no hydrocephalus was present prior to tumor surgery in these patients.

Conclusion: The present study revealed a clinically relevant hydrocephalus related to posterior fossa tumors in adult patients in 20.5% at the time of diagnosis. The primary treatment remains tumor removal itself, but contains a risk of persisting hydrocephalus (11.6%) requiring further surgery.

Technical malfunction of programmable valves

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Objective: The use of programmable valve systems offers the possibility to adjust pressure settings according to need especially in a growing child. Increasingly sophisticated technology includes various therapeutical options but the possibility of shunt malfunction or technical failure of the implanted valve itself is reality, too. We report on 9 patients with an isolated technical failure of a CODMAN HAKIM and a SOPHYSA POLARIS programmable valve.

Methods: We reviewed the clinical course and radiological findings of 9 patients (6 children and 3 adults) treated at our department between 2007 and 2016. CODMAN HAKIM and SOPHYSA POLARIS programmable valves were used. Results of the examination of the explanted valves by the manufacturing companies are included. Special attention was paid to the mechanisms which could be considered a likely cause of valve failure like trauma, inflammation, repeated adjustment procedures and MRI examinations with different technology and magnetic field strength applied.

Results: 3 adults and 5 children had a CODMAN HAKIM programmable valve: in 7 patients revision was necessary due to stator dislodgement and 1 girl had a similarly defective valve but the shunt system at present seemed to be no longer needed so it was left in place. Time span between implantation and revision of the valve was between 5 and up to 15 years. 1 child had a SOPHYSA POLARIS valve which could not be adjusted as the boy suffered from overdrainage syndroms so revision was necessary 3 years after primary implantation. Head trauma involving the valve system with close connection to the time of damage of the valve was not associated with failure of the valve. Exposure to magnetic fields with the exception of MRI scannings was not reported. No isolated causative mechanism for valve failure was detected.

Conclusion: Stator dislodgement in a programmable valve and the failure to adjust valve pressure settings in a symptomatic patient are very rare conditions but when occurring possibly connected to serious complications. Mostly surgical revision with implantation of a new valve was necessary to secure shunt function. No single causative mechanism could be detected in our patient group. Advantages and risks of different valve systems available should be reflected in an international database to come to further conclusions and to establish recommendations for daily treatment worldwide.

Behandlungsergebnisse bei idiopathischem Normaldruckhydrozephalus nach Anlage eines Shuntsystems mit verstellbarem Differenzdruckventil und integrierter Gravitationseinheit

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Einführung: Der idiopathische Normaldruckhydrozephalus (iNPH) ist eine behandelbare Erkrankung des älteren Menschen, die mit Gangstörungen und kognitiven Defiziten sowie einer Dranginkontinenz einhergeht. Goldstandard in der Behandlung ist die Anlage eines liquorableitenden Shunts unter Zwischenschaltung eines Ventilsystems. Programmierbare Ventile ermöglichen auch nach der Operation weitere Justierungen der Drainage. Ferner lassen sich Überdrainagen durch Verwendung einer Gravitationseinheit reduzieren. Die Evaluation der Behandlungsergebnisse bei iNPH ist erschwert, da oftmals unterschiedliche Ventiltypen zum Einsatz kommen. Wir stellen die Ergebnisse eines großen Patientenkollektivs vor, bei welchem über einen Zeitraum von 10 Jahren ausschließlich das gleiche Shuntsystem verwendet wurde.

Methodik: Alle Patienten wurden einem präoperativen standardisierten Assessment unterzogen (inklusive großvolumiger Lumbalpunktion). In den Jahren zwischen 2005 bis einschließlich 2014 wurden 182 konsekutive Patienten nach Bestätigung der Diagnose iNPH in die Studie eingeschlossen. Die Shuntversorgung erfolgte mittels Miethke proGAV[®]-Ventilen mit integrierter Gravitationseinheit (Christoph Miethke GmbH & Co. KG, Potsdam). Bei 179 Patienten wurde eine ventrikuloperitoneale Ableitung angelegt, bei 3 Patienten erfolgte eine ventrikuloatriale Ableitung.

Ergebnisse: Das mittlere Alter bei Shuntanlage betrug 73 Jahre (81 Frauen und 101 Männer). Beim ersten Follow-Up 3-4 Monate postoperativ zeigten 98% der Patienten eine Verbesserung der Symptome. Für 140 Patienten war ein Langzeitverlauf evaluierbar (Mittel 2,5 Jahre, bis zu 7 Jahre), dabei wiesen noch 82% eine Symptomverbesserung auf. Der Grad des initialen Outcomes korrelierte mit dem langfristigen Therapieergebnis. Darüber war eine prädiktive Abschätzung der Prognose im Langzeitverlauf möglich.

Bei 131 Patienten erfolgten Anpassungen der Ventilstufe. Shuntrevisionen waren in 21 Fällen notwendig, häufigste Ursachen waren Fehllagen des Shunts und Ventildefekte. Subdurale Hygrome oder Hämatome traten bei 42 Patienten auf. Diese konnten durch Anpassungen der Ventilstufe behandelt werden, nur in 15 Fällen war eine operative Entlastung notwendig. Ein signifikanter Einfluss auf das Therapieergebnis zeigte sich nicht.

Die Gangstörung besserte sich am häufigsten (96%) und am deutlichsten, gefolgt von der Demenz (78%) und der Inkontinenz (73%). Mit steigendem Schweregrad der präoperativen Symptomausprägung sank die Wahrscheinlichkeit eines guten Behandlungserfolgs.

Schlussfolgerung: Durch die Verwendung eines Shuntsystems mit programmierbarem Differenzdruckventil und integrierter Gravitationseinheit kann ein langfristiger Therapieerfolg bei der Mehrzahl der Patienten mit iNPH gesichert werden. Im Vergleich mit der Literatur kann die Häufigkeit von Re-Operationen reduziert werden.

CSF dynamics during neuroendoscopy of obstructive hydrocephalus: What can we learn from Real Time MRI?

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Objective: Contemporary hydrocephalus concepts are still mainly derived from the work of Dandy (1913) and Key and Retzius (1875). These historical classifications base on few animal experiments in which the production of CSF was demonstrated at about 80 % originating from choroid plexus and absorption in arachnoid villi. Cardiac gated MRI has further supported the idea of bulk flow and dynamical piston like CSF dynamics out of the ventricles towards arachnoid absorption. Even recent publications conclude mixing and diffusion characteristics but no directed flow in cerebral and spinal CSF. These classifications still do not fit the pathophysiological concepts behind several CSF related diseases as normal pressure hydrocephalus, pseudotumor cerebri and Chiari malformation. Even in obstructive hydrocephalus endoscopically gained visualisation of trapping mechanisms does not support the common concepts of craniocaudal directed CSF movements and their disturbances. Recent flow studies applying Real Time-MRI have opened new insights into CSF dynamics identifying respiration dependent CSF movements (Dreha-Kulaczewski et al, 2015) which are in contrast to our current concepts.

Methods: Video analysis (N=88) of intraoperatively documented trapping mechanisms during microsurgery or neuroendoscopy (N=116) and analyzation of flow void signals by pre- and postoperatively obtained MRI (N=108) in different types of pediatric obstructive HC have been conducted to reveal breathing related CSF movement and dynamics. The mechanisms of trapping were investigated for underlying breathing induced flow characteristics.

Results: Trapping mechanisms could be identified in 85 % of MRI and different types of obstructive HC. Intraoperatively documented CSF flow dynamic was in 64 % related to ventilated breathing and moved in an upward direction from spinal canal towards the head.

Conclusion: 85% of MRI in obstructive HC consist of a trapping component of CSF flow in an opposite movement direction from spinal spaces into the ventricles or into cystic compartments. This observation resembles a movement from bottom to top and not vice versa, which is in agreement with recent Real Time MRI measurements. The implication of an upward directed CSF flow may shift our concepts of the underlying pathophysiology of different subtypes of hydrocephalus.

Optimal valve selection in treatment of adult hydrocephalus - Selection depended on the origin etiology?

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Objective: The etiology of adult hydrocephalus is heterogeneous with idiopathic NPH (50%), posthemorrhagic (23%) and posttraumatic hydrocephalus (12.5%) as most common. Mechanical failures of shunt systems are described with a vast range in 5% to 64%. Averaging the recent literature, valve-related under- and over-drainage syndromes occur in about 10-20% each and are associated with an increased morbidity. The valve selection is discussed controversial because of low level of evidence. Before May 2014 we implanted by default differential pressure valves without gravitational unit in all our patients. Afterwards, according to the SVASONA-Trial which showed that gravitational devices prevent over-drainage complications in idiopathic NPH patients, we changed our policy. Purpose of this study was to evaluate the implantation of differential pressure valves without gravitational unit concerning valve-related complications and the occurrence of those adverse events in relation to the hydrocephalus etiology.

Methods: We retrospectively analyzed all adult patients who underwent shunt implantation in our department between March 2010 and May 2014 concerning valve-related revisions. The relative risk of shunt failures was calculated by an univariate and multivariate regression model. Subgroups were characterized by the different hydrocephalus etiologies and alpha-level was determined on 5% to achieve statistical significance with a power of 0.9.

Results: Overall 510 patients were included and 273 (53.5%) were male. Median age was 69 (range 18 to 92) years. Valve-associated complications requiring revision surgery occurred in 93 (18.2%) patients, whereas 66 (12.9%) showed over-drainage with subdural hygroma and 27 (5.3%) mechanical valve dysfunction. Idiopathic NPH (n=137) and patients after tumor surgery (n=113) built the largest populations in addition to patients with hydrocephalus after trauma (n=58), intracerebral hematoma (n=80), subarachnoid bleeding (n=81) and other entities (n=41). Concerning these different etiologies, shunt implantation after tumor resection showed a significant lower risk for over-drainage complications (OR 0.4; CI 0.2-0.9; p<0.05). There was a trend to a reduced risk after subarachnoid bleeding (OR 0.5, CI 0.2-1.2, p=0.16) and increased rates in idiopathic NPH (OR 1.4; CI 0.8-2.5; p=0.20) and after intracerebral hematoma (OR 1.7; CI 0.8-3.1; p=0.12), without reaching significance. For valve under-drainage no significant differences for the several entities could be detected.

Conclusion: Hydrocephalus patients with differential pressure valves without gravitational units show no increased revision rates compared to the literature. The risk of over-drainage is reduced in patients receiving a shunt after intracranial tumor resection. Under-drainage rates do not differ significantly between the various hydrocephalus etiologies.

Anatomical landmarks in the retroclival region during endoscopic third ventriculostomy: the clival line

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Objective: Endoscopic third ventriculostomy (ETV) is a well-accepted treatment option in selective cases of obstructive hydrocephalus instead of ventriculoperitoneal shunt placement. A sufficient flow from the ventricular system to the subarachnoid spaces requires perforation of the arachnoid membranes located in the retroclival region. This maneuver is a generally known critical point to achieve an optimal long-term outcome. Our goal was to investigate the complex arachnoid relations in the retroclival region from the viewpoint of ETV and define some landmarks which can be useful during the subarachnoid dissections.

Methods: 50 fresh human cadaveric specimens were dissected under macroscopic, microscopic and endoscopic control to describe the arachnoid relations in the retroclival region.

Results: We could verify the existence of multiple arachnoid layers perimesencephally above-, in the level-, as well as below the tentorial edge. This construct was completed ventrally by the Liliequist's membrane complex and the anterior pontine membranes located parallel to and on both sides of the basilar artery. The basal attachment of these ventrally located membranes forms a white-grey thickening on the inner surface of the outer arachnoid and has an inverted U-shape. The base of the U-shape located in the level of the dorsum sellae. We refer this structure as "clival line" according to its anatomical location. During ETV if the arachnoid dissections were performed ventrally to the clival line the outer arachnoid was opened and the basilar artery trunk could not be visualised which resulted only a limited flow to the subarachnoid spaces (mainly ventriculo-subdural). If the perforation on the arachnoid membranes was placed directly behind (dorsal to) the clival line the top of the prepontine cistern could be directly reached through the Liliequist's membrane complex without opening the outer arachnoid and creating an involuntary retroclival subdural shunting. This approach provides an optimal route to the relevant arachnoid membranes of the retroclival region and they could be surely perforated to visualise the basilar artery trunk. This step is mandatory to secure a free flow between the ventricular system and the interpeduncular as well as prepontine cisterns.

Conclusion: Among many other factors the sufficient arachnoid dissection is a critical point to achieve satisfactory long-term outcome after ETV. The clival line is an important anatomical landmark which helps to perform these dissection safely to achieve an optimal flow through the third ventricular floor into the basal cisterns.

MI.09 Mapping / Elektrophysiologie 1

Mittwoch *Wednesday*, 17.05.2017, 08.00 – 09.20 Uhr *hrs*

- MI.09.01 *Plasticity of motor representations in patients with brain lesions: a navigated TMS study*
L. Bulubas, N. Sollmann, N. Tanigawa, B. Meyer, S. Krieg* (München, Deutschland)
-
- MI.09.02 *TMS-induced language errors: more a result of motor-speech disruption?*
C. Weiß Lucas* (Köln, Deutschland), J. Pieczewski, C. Nettekoven, V. Neuschmelting, K. Thiele, C. Grefkes, R. Goldbrunner
-
- MI.09.03 *Spatial diffusivity-analysis improves the prognostic value of TMS-based deterministic DTI of the pyramidal tract*
T. Rosenstock* (Berlin, Deutschland), D. Giampiccolo, H. Schneider, S. Runge, I. Bährend, P. Vajkoczy, T. Picht
-
- MI.09.04 *Integration of navigated transcranial magnetic stimulation data in the clinical workflow*
N. Sollmann, B. Meyer, S. Krieg* (München, Deutschland)
-
- MI.09.05 *Improved reliability of intraoperative language mapping through preoperative nTMS and baseline linguistic scores*
I. Bährend* (Berlin, Deutschland), V. Schwarzer, H. Schneider, M. Freymann, P. Vajkoczy, T. Picht, K. Faust
-
- MI.09.06 *Using nTMS M1 face mapping for ROI seeding in diffusion tractography allows to depict important speech associated network components*
J. Pieczewski* (Köln, Deutschland), C. Nettekoven, V. Neuschmelting, M. Hoevels, M. Tittgemeyer, R. Goldbrunner, C. Weiß Lucas
-
- MI.09.07 *Disentangling the role of the primary motor cortex and the supplementary motor area on force control by short bouts of rTMS*
L. Wiesinger* (Tübingen, Deutschland), M. Tatagiba, G. Naros
-
- MI.09.08 *Preoperative rTMS language mapping in speech eloquent brain lesions: a matched cohort study*
P. Hendrix* (Homburg/Saar, Deutschland), S. Senger, A. Simgen, C. Griessenauer, J. Oertel
-

Plasticity of motor representations in patients with brain lesions: a navigated TMS study

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Objective: The present study investigates the spatial distributions of motor representations in terms of tumor-induced brain plasticity by analyzing navigated transcranial magnetic stimulation (nTMS) motor maps derived from 100 patients with motor eloquently located brain tumors in or adjacent to the precentral gyrus (PrG).

Methods: 8,774 motor evoked potentials (MEPs) were elicited in 6 muscles of the upper and lower extremity by stimulating four gyri (superior frontal gyrus=SFG, middle frontal gyrus=MFG, PrG, and postcentral gyrus=PoG) in patients with five possible tumor locations (frontal tumor: n=24, Rolandic tumor: n=35, postcentral tumor: n=17, temporal tumor: n=5, and parietal tumor: n=19). Regarding the MEP frequency of each muscle-gyrus subdivision per patient, the expected frequency was 3.53 (8,774 divided by 100 patients, further divided by 6 muscles and 4 gyri). Accordingly, the patient ratio for each subdivision was calculated by defining the per-patient minimum data points as 3.

Results: 60.71% of the MEPs were elicited in the PrG. The overall and tumor-location specific patient ratios were rather high (APB-in-PrG: 93.00%) and balanced, indicating robust motor representations in the PrG. Regarding the motor representations in SFG and MFG, the overall patient ratios were much lower (APB-in-SFG: 16.00%, APB-in-MFG: 36.00%). The tumor-location specific patient ratios were higher for frontal tumors in both gyri (ADM-in-SFG 29.17%, ADM-in-MFG 50.00%) than for other tumor locations. This suggests that the finger representation reorganization in these frontal gyri, which corresponds to location of dorsal premotor areas, might be due to within-premotor reorganization rather than relocation of motor function from PrG into premotor areas one might expect from the Rolandic tumors.

Conclusion: Reorganization of the finger motor representations might be limited along the middle-to-dorsal dimension of the dorsal premotor areas (posterior MFG and SFG) and might not cross rostrally from the primary motor cortex (PrG) to the dorsal premotor cortex.

TMS-induced language errors: more a result of motor-speech disruption?

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Objective: Using navigated repetitive transcranial magnetic stimulation (rTMS) to disrupt language function during an online-task (e.g., picture-naming) is a novel mapping technique, which has recently been introduced into pre-surgical diagnostics in brain tumor patients. However, results are variable. Not only the task itself but also the distinct error categories may strongly influence mapping results. Therefore, we studied the test-retest-reliability and the spatial localization of rTMS-induced naming errors related to motor-speech function in contrast to semantic language errors.

Methods: 13 right-handed, healthy volunteers were investigated three times each in consecutive sessions (short-term: 2-5 days, long-term: 21-40 days) by 10Hz-rTMS. After determination of the individual threshold for motor cortex excitability, rTMS was applied "online" during a picture-naming task: black-and-white drawings of everyday objects were presented simultaneously (triggered, delay = 0 ms) with rTMS. The rTMS bursts lasted for 1.5s (15 pulses) and were applied over the frontolateral, parietolateral and superior/middle temporal area of the left hemisphere, using a grid for guidance. Errors were rated by two independent examiners by a post-hoc video analysis. The error frequency (number of errors per 100 rTMS pulses) as well as spatial representation and reliability of distinct motor-speech-related errors (i.e., speech arrest and dysarthria) were compared to language errors associated with semantic processing (i.e., anomia and semantic paraphasia). Test-retest-reliability was assessed by the average intraclass correlation coefficients for a fixed rater (ICC).

Results: Overall, speech/language errors occurred only rarely: Amongst the four analyzed error categories, dysarthria was most frequent (4.0 ± 2.5 %) while only very few semantic paraphasias were induced (0.5 ± 0.4 %). Motor-speech errors were found significantly more often than semantic language errors ($p < 0.01$). In comparison to semantic errors, the test-retest-reliability of the error rates was lower for motor-speech errors (motor-speech: ICC=0.45 vs. semantic: ICC=0.64). By contrast, the spatial reliability was higher for motor speech errors and showed a clear accumulation over M1 and the premotor cortex, especially for the category "arrest".

Conclusion: The novel approach of using rTMS for language mapping is still challenging due to the high variability of induced errors and possible interpretations. Most rTMS-induced picture-naming errors seem to be at least partially due to motor network disruption rather than to interference with non-motor language processing. Further studies, combining different neuroimaging techniques and online-EEG, are mandatory to elucidate the neurophysiological mechanisms and particular network effects of rTMS during language tasks.

Spatial diffusivity-analysis improves the prognostic value of TMS-based deterministic DTI of the pyramidal tract

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Objective: Navigated transcranial magnetic stimulation (nTMS) combined with diffusion tensor imaging (DTI) is used preoperatively in patients with eloquent-located brain lesions and allows analyzing non-invasively the spatial relationship between the tumor and functional areas (e.g. the motorcortex and the corticospinal tract [CST]). Combining neurophysiological data and data provided by nTMS-based fiber tracking (FT) can be used to stratify patients with motor associated tumors into high and low risk cases with impact on the further treatment strategy. In this study, we examined the diffusion parameters FA (fractional anisotropy) and ADC (apparent diffusion coefficient) within the CST in different locations and analyzed their usefulness for predicting the patients' motor outcome.

Methods: Prospectively collected data of 30 patients undergoing bihemispheric nTMS mapping prior to surgery of motor eloquent high-grade gliomas were analyzed. The following data were scrutinized for both hemispheres after tractography based on nTMS-motor positive cortical seeds and a 2nd region of interest in one layer of the caudal pons defined by the color-coded FA-map (ROI): the pre- and postoperative motor status (after day of discharge und 3 months), the closest distance between the tracts and the tumor (TTD), the fractional anisotropy (FA) and the apparent diffusion coefficient (ADC). The latter as an average within the CST as well as specific values in different locations (peritumoral, mesencephal, pontine).

Results: Eight (27%) out of 20 (67%) patients treated as high risk cases suffered from a paresis that did not recover over time whereas no patient deteriorated postoperatively whose tumor location had been determined as uncritical ($p = .027$). Lower average FA-values within the whole affected CST are significantly associated with deteriorated postoperative motor function ($p = .002$) where higher average ADC-values are significantly related to an impaired postoperative motor status ($p = .026$). Detailed analysis within the CST revealed that the diffusion parameters are especially disturbed on a peritumoral level and that the degree of their impairment correlates with motor deficits (FA $p = .007$, ADC $p = .007$). No significant segmental variation was seen in the healthy hemisphere.

Conclusion: Navigated TMS-based motor DTI not only offers data for analysing the spatial relationship between tumor and functionally essential tissue but also provides information on the structural integrity of the tracts, which improves the prediction of postoperative motor outcome. Further prospective studies are needed to validate the nTMS-based prediction of the patient's outcome.

Integration of navigated transcranial magnetic stimulation data in the clinical workflow

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Objective: Navigated transcranial magnetic stimulation (nTMS) is increasingly used for mapping of various brain functions in neurosurgical departments worldwide. However, when a department starts integrating nTMS data into the clinical workflow, smooth implementation into the existing hospital information system (HIS) and picture archiving and communication system (PACS) are mandatory to promote the use of the newly available data. However, standardized and comprehensive approaches that go beyond the mapping procedure itself have not yet been described.

Methods: To create an effective workflow with regard to nTMS, we present the results of our 6.5 years of experience and progressive integration into clinical software systems and workflow.

Results: After indication for nTMS mapping (motor, language, arithmetic function) is made, registration of the patient within the HIS can be easily achieved by a tailored software mask which can be programmed individually by the manufacturer of the HIS (SAP SE, Walldorf, Germany). This mask includes relevant patient details, contraindications for nTMS, mandatory imaging data, and appointment planning. The same mask can then be used for documentation of the results of the nTMS mapping and nTMS-based tractography, including stimulation details, infiltrated areas, and distances to functionally relevant brain areas. As another important part, nTMS data can be imported into the PACS as DICOM via PACS integrator software (GEMED, Ulm, Germany). In this form, nTMS data can also be used during tumor board discussions. For the surgical planning, nTMS data is then also imported into the neuronavigation software (iPlan Net, BrainLAB, Feldkirchen, Germany). Objects are created from the nTMS data and are then used for nTMS-based tractography of the corticospinal tract or language pathways.

Conclusion: Optimized integration of nTMS data can be achieved by standard software available in most departments. Its easy integration and availability is crucial to promote acceptance and use of nTMS data in clinical routine.

Improved reliability of intraoperative language mapping through preoperative nTMS and baseline linguistic scores

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Objective: Repetitive navigated transcranial magnetic stimulation (rnTMS) and direct cortical stimulation (DCS) during awake surgery are complementary tools to locate speech functional areas of the brain. However, patients show inter-individual differences in their preoperative linguistic capabilities, which can impact the validity of intraoperative DCS mapping. We developed a standardized approach which utilizes preoperative aphasia scores and rnTMS to screen patients for their capability to perform reliable object naming during awake surgery.

Methods: We prospectively included 18 patients with language-eloquent brain tumors, scheduled for awake surgery. Aachen Aphasia Score (AAS), Demtect Score (DS) and Berlin Aphasia Score (BAS) were used to evaluate linguistic eloquence of each patient preoperatively. Moreover, all patients underwent 3 runs of naming all objects without rnTMS (baseline run), from which only promptly and correctly named objects were retained for later rnTMS mapping. These selected objects were also used for the intraoperative baseline testing and DCS mapping under level 2 of Ramsay Sedation Score.

Results: The degree of preoperative language impairment significantly correlated with the incidence of errors during preoperative as well as intraoperative baseline errors (AAT $p=0.01$, BAS $p=0.001$, DS $=0.001$). Patients with significant aphasia (BAS ≥ 2 , AAT ≥ 1) and cognitive impairment (DS ≥ 2) committed over 50% of incorrect or delayed namings in the preoperative baseline ($p=0.001$). Despite utilizing only the images retained after preoperative baseline naming, these patients still made significantly more mistakes during intraoperative baseline naming than patients with less severe aphasia. Moreover, the dosage of anaesthetic medication significantly correlated with the incidence of errors during intraoperative baseline naming (propofol $p=0.028$, remifentanil $p=0,036$), despite stopping all systemic analgetic and sedative medication at least 8 min before testing.

Conclusion: Patients with significant aphasia (BAS ≥ 2 , AAT ≥ 1) and cognitive impairment (DS ≥ 2) are not able to perform reliable intraoperative object naming and are therefore not suited for this procedure. In addition, dosages of analgetic and sedative medication during craniotomy should be kept as low as possible to allow for reliable intraoperative cognitive testing.

Using nTMS M1 face mapping for ROI seeding in diffusion tractography allows to depict important speech associated network components

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Objective: The preservation of important white matter tracts is extremely important to optimize the functional long-term outcome after brain tumour surgery. Depicting important fibres of the language network is very challenging. We here studied the use of navigated transcranial magnetic stimulation (nTMS) to depict the primary motor representation of the tongue (M1) for reconstruction of tracts connected to the motor-speech network.

Methods: 13 healthy volunteers were investigated by nTMS mapping of M1. The hotspot, i.e. the cortical site of the highest motor evoked potential (MEP) amplitude, of the tongue representation was localized. The 3D-coordinate of the respective voxel (site of max. calculated electrical-field strength) was visualized in a 3D view of the brain (FSL). The hotspot was then replaced at the nearest border between grey and white matter in order to allow for comparison with anatomical region-of-interest (ROI) seeding. Anatomical ROIs were placed at the same subcortical level by a blinded, experienced, second investigator in the middle of the lateral third of the precentral gyrus. Both ROIs were enlarged by $r=5$ mm and served as origins for probabilistic fibre tracking (FSL). The reconstructed fibres were segmented according to anatomical knowledge. Tracts were visualized with MRICron and 3D Slicer. The anatomy- vs. nTMS-based tractography results were compared regarding the reconstruction of the following tracts using McNemar's Chi-squared test for paired binomial data: short anterior / short posterior / long segment of the arcuate fasciculus (saAF, spAF, IAF) and frontal Aslant tract (frAT).

Results: Using M1 of the tongue as a single seeding-ROI for tractography, was a highly robust technique for reconstruction of at least one segment of the AF (TMS: N=13/13; anatomical: N=11/13; n.s.). In comparison of anatomical vs. nTMS-based seeding-ROI techniques regarding the different segments/ tracts, only the saAF was reconstructed significantly more often when using the nTMS-ROI (nTMS: 85%; anatomical: 31%) whereas no difference was observed for the spAF (nTMS: 62% vs. anatomical: 85%) and the IAF (nTMS: 92% vs. anatomical: 85%). Apart from the AF, also the frAT, which seems to play a crucial role for speech production, was reconstructed in most cases using the tongue-M1-seed for tractography (both 85%). Preliminary results regarding diffusion metrics and numbers of aberrant fibres point towards the use of nTMS for seeding-ROI determination being advantageous compared to anatomical ROI-seeding.

Conclusion: Using the M1 tongue core region as a single seeding-ROI in diffusion tractography allows to depict motor-speech associated fibres like the anterior segment of the AF. Compared to anatomical ROI-seeding, this approach may offer a higher accuracy and thus avoid erroneous fibre reconstruction, particularly in areas of unfavourable signal-to-noise-ratio.

Disentangling the role of the primary motor cortex and the supplementary motor area on force control by short bouts of rTMS

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Objective: Tumors in motor eloquent brain regions are frequently associated with a partial loss of contralateral voluntary movements. Furthermore, neurosurgical removal of these tumors carries the risk of amplifying the deficits. Surgical interventions in the primary motor cortex (M1) are associated with a weakness of the voluntary movement, i.e. paresis. In contrast, tumor removal in the supplementary motor area (SMA) causes an akinesia (i.e. SMA syndrome) attributed to a disturbance of motor planning and execution. However, the exact contribution of the M1 and SMA to force control is not well understood. The present study aimed to evaluate the effects of temporary perturbation of M1/SMA function by short bouts of rTMS on contralateral force output.

Methods: Eleven healthy, right-handed subjects were enrolled in the present study. The task consisted of abduction movements of the right thumb connected to a custom-made manipulandum. After determining the individual resting motor threshold (rMT) of the Abductor pollicis brevis muscle (ABP) and its maximum force output (MFO), subjects were asked to apply six different target force (TF) levels indicated by visual cues. Feedback of the current force output was provided on a screen. Just prior to the visual cue, rTMS (2 s, 5 Hz, 90% rMT) was randomly applied either to M1 or to SMA, causing transient virtual lesioning. Several task parameters, i.e. reaction time (RT), time to target force (TTF), scaling error (SE) and target force error (TFE), were analyzed and compared to trials with sham rTMS.

Results: rTMS to the SMA resulted in a significant reduction of RTs independent of the TF. However, there were no significant effects on TTF by any rTMS protocol. While there was positive TFE for lower TF levels (i.e. overshooting), rTMS of the SMA resulted in a negative TFE (i.e. undershooting) in trials with high TF levels. In contrast, there was a reduced force output after rTMS to M1 independent of the TF. Finally, SE was increased only after rTMS to the SMA.

Conclusion: Transient virtual lesioning of SMA was associated with an impairment of force scaling during trials with lower force levels. In contrast, there was no impairment of force scaling after rTMS to M1; however, transient virtual lesioning of M1 revealed a reduction of maximum force output. The present study suggests an involvement of left SMA in force control of the contralateral hand providing further insights in the pathophysiology of the postoperative SMA syndrome.

Preoperative rTMS language mapping in speech eloquent brain lesions: a matched cohort study

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Objective: Repetitive language mapping is an evolving noninvasive modality to map cortical language distribution. The value of preoperative rTMS language mapping for function preservation in surgery of speech eloquent lesions under general anesthesia remains to be determined.

Methods: To analyze value of rTMS language implementation in the preoperative routine, the authors performed a matched-pair study. Prospectively, 20 consecutive right-handed patients with a malignant, left-sided perisylvian language eloquent brain tumor were enclosed. All patients were subjected to surgical resection under general anesthesia guided by preoperative rTMS language mapping (rTMS group, 2014 – 2016). Matching was performed with 20 patients that underwent surgical resection in the pre-rTMS era (pre-rTMS group, 2009 – 2013). The patients' language performance status was ranked from grade 0 to grade 3 (none, mild, medium, severe).

Results: Comparison of rTMS vs pre-rTMS groups revealed equal rates of gross total resection, of tumor residual, and of complications. Required time for the entire surgical procedure was significantly shorter in the rTMS group ($p = 0.039$). Preoperatively, 14/20 patients in the rTMS and 13/20 patients in the pre-rTMS group suffered from language deficits ($p = 0.380$). One week after surgery, 8/14 patients (57.1 %) in the rTMS group but only 1/13 patients (7.7 %) in the pre-rTMS group experienced improvement of language performance status ($p = 0.013$). Moreover, at six weeks follow-up in the outpatient clinic, language performance status was significantly better in the rTMS group ($p = 0.048$).

Conclusion: Preoperative rTMS language mapping has the potential to provide beneficial functional outcomes, particularly in the early postoperative phase. Therefore, preoperative rTMS language mapping is a valuable tool for the resection of language eloquent lesions under general anesthesia.

MI.11 Vaskuläre Neurochirurgie 10

Mittwoch *Wednesday*, 17.05.2017, 11.00 – 12.30 Uhr *hrs*

- MI.11.01 *Endoscopic-assisted harvest of frontal STA branch in EC-IC bypass surgery; An anatomical study.*
A. Tortora* (Düsseldorf, Deutschland), H. Sadat, J. Cornelius, J. van Lieshout, H. Steiger, A. Petridis
-
- MI.11.02 *Safety and efficacy of rescue treatment for delayed vasospasm after subarachnoid hemorrhage*
M. Weiss, W. Albanna, C. Conzen, M. Wiesmann, H. Clusmann, G. Schubert, M. Weiß* (Aachen, Deutschland)
-
- MI.11.03 *Ferritin in Cerebrospinal Fluid and Serum as a Predictive Marker for the Development of ischemic Brain Infarction after Subarachnoidal Hemorrhage*
K. Graf* (Gießen, Deutschland)
-
- MI.11.04 *Intracranial aneurysms in patients with acromegaly - should we screen for them?*
A. Grzywotz* (Essen, Deutschland), I. Kreitschmann-Andermahr, D. Müller, N. Unger, A. Ringelstein, U. Sure, O. Müller
-
- MI.11.05 *The unruptured intracranial aneurysm and subarachnoid hemorrhage common data elements project: results from the unruptured intracranial aneurysms subcommittee*
K. Hackenberg* (Mannheim, Deutschland), G. Rinkel, J. Suarez, L. Macdonald, D. Hänggi, N. Etminan
-
- MI.11.06 *Interrater Agreement in the radiological characterization of ruptured intracranial aneurysms based on CT-angiography*
N. Maldaner* (Zürich, Switzerland), O. Bozinov, R. Daniel, P. Bijlenga, D. Zumofen, M. Stienen, L. Regli, J. Burkhardt
-
- MI.11.07 *Size of aneurysm matters in subarachnoid hemorrhage*
T. Sauvigny* (Hamburg, Deutschland), N. Schmidt, J. Regelsberger, M. Westphal, P. Czorlich
-
- MI.11.08 *Systemic HMGB1, a novel predictive biomarker for cerebral vasospasm in patients with aneurysmal subarachnoid hemorrhage*
S. Muhammad* (Bonn, Deutschland), S. Chaudhry, A. Güresir, B. Stoffel Wagner, H. Vatter, E. Güresir
-
- MI.11.09 *Serum markers in aneurysmal and non-aneurysmal subarachnoid hemorrhage - A prospective comparative study*
W. Albanna* (Aachen, Deutschland), C. Conzen, M. Weiss, H. Clusmann, G. Schubert
-

Endoscopic-assisted harvest of frontal STA branch in EC-IC bypass surgery; An anatomical study.

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Objective: Extracranial to intracranial (EC-IC) bypass using superficial temporal artery (STA) donor represents a versatile technique in the treatment of Moyamoya, complex aneurysms and controversially also in cerebrovascular insufficiency. STA harvest is usually performed with a direct skin incision over the course of the parietal branch, which is also ideal for craniotomy targeting the distal Sylvian fissure. In some patients, however, frontal branch is also needed, requiring a larger curvilinear incision or a second incision. This increases morbidity and the risk of pseudomeningocele and skin necrosis, and may cause esthetic problems especially in patients with low STA bifurcation. This anatomical study presents the technique for endoscopic-assisted harvesting of the STA frontal branch.

Methods: In the Heinrich Heine University neurovascular research lab, a cadaveric specimen was treated with Thiel-fixation. After flushing vessels, red- and blue-colored latex injections were used to enhance visualization of the vascular tree. After microsurgical harvesting of the STA parietal branch, the frontal division was endoscopically dissected using a 0° optic (Karl Storz, Tuttlingen, Germany).

Results: A linear skin incision is performed starting 1cm ventral to the tragus and extending cranially to the superior temporal line. After division of the galea, STA parietal branch running in the loose areolar tissue over the temporal fascia superficial lamina is exposed along with the superficial temporal vein parietal branch and the trigeminal nerve auriculotemporal branch dorsal to the artery. The STA parietal branch is then isolated microsurgically proximal to distal, dividing small anastomotic and muscular branches. After identification of the proximal STA frontal division at the bifurcation, endoscopic vision is used to dissect the artery rostrally in the subgaleal space as far as the frontal bone where the artery turns superiorly and courses over the frontalis muscle. Temporal and zygomatic branches of the facial nerve are exposed caudal to the STA frontal division along with the frontal branch of the superficial temporal vein. Major arterial branches are divided with respect to the continuity of the main trunk. After a typical incision of the temporoparietalis muscle, craniotomy and dural opening, the frontal and parietal branches of the STA are distally interrupted to prepare the bypass.

Conclusion: Endoscopic-assisted harvesting of the STA frontal branch is advantageous for use in EC-IC bypass surgery. This technique avoids complications associated with a longer curvilinear or a second skin incision, reduces morbidity, and improves cosmetic outcome. Meticulous knowledge of neurovascular anatomy, particularly of the subgaleal space, is required to perform a safe dissection avoiding facial nerve injury.

Safety and efficacy of rescue treatment for delayed vasospasm after subarachnoid hemorrhage

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Objective: Critical hypoperfusion following aneurysmal subarachnoid hemorrhage is usually treated by induced hypertension (iHTN) and – if refractory – may be extended to intraarterial or intravenous nimodipine application (iaN, ivN) and/or balloon angioplasty (BA).

However, implementation of these rescue efforts remains largely empirical for a lack of supporting evidence, while the associated risk profile is also unclear. The present study evaluates the safety and efficacy of conservative (iHTN) and extended (iaN, ivN, BA) rescue treatments (ERT) for cerebral vasospasm.

Methods: Forty-nine patients (mean age 54.6±12.4 years) necessitating iHTN ≥180mmHg and/or at least one ERT were prospectively enrolled into this study.

To assess efficacy, we evaluated neurological status, functional monitoring (lactate/pyruvate ratio as determined by cerebral microdialysis, brain tissue oxygen = $p_{ti}O_2$, transcranial doppler ultrasonography) and imaging (CT perfusion, angiography) 24 hours periprocedurally and determined clinical outcome at 3-6 months. Safety parameters included immediate procedure-related complications as well as subsequent adverse effects in context of vasopressor therapy.

Results: In this cohort, 43 conservative (iHTN) and 51 extended rescue treatments (iaN n=20; BA n=13; BA+iaN n=6; ivN n=12) were initiated.

No serious complications with endovascular treatment were noted. iHTN and iaN, but not BA or ivN resulted in significantly increased vasopressor requirements with reduction or termination of prophylactic enteral nimodipine treatment in 45% and 63% of cases, respectively ($p<0.001$). Neurological improvement was noted in 76% of awake patients with iHTN. Only iaN, but not BA or ivN resulted in significant improvement of $p_{ti}O_2$ ($p<0.01$) as well as improvement of cerebral metabolism in 50% of cases. A subgroup analysis showed that patients with systolic pressure <150mmHg prior to iHTN profited significantly more in terms of $p_{ti}O_2$ than patients >150mmHg ($p<0.05$).

With iaN and BA, CTP and DSA were improved in 86 and 93% of cases, respectively, but only in 63% of cases with ivN and 59% in iHTN (CTP; DSA not available). In 49% of cases with iHTN additional ERT was required and 37% of ERT needed repeated treatment or remained ultimately refractory. Overall outcome was favorable in 57% with sole iHTN and in 40% with additional ERT.

Conclusion: iHTN was well tolerated with reasonable outcome, but ultimately insufficient to forestall relevant hypoperfusion in half of all patients. Provided a detailed decision tree and treatment algorithm, ERT can provide a relatively safe and effective treatment option in those highly-selected patients where conservative treatment options are exhausted. In addition to the inherent risk profile of each ERT, efficacy as determined by functional assessment may vary and should be taken into consideration when opting for extended rescue therapies.

Ferritin in Cerebrospinal Fluid and Serum as a Predictive Marker for the Development of ischemic Brain Infarction after Subarachnoidal Hemorrhage

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Objective: Our study investigates the relation of the mean quotient of ferritin in CSF and serum to ischemic brain infarction in SAH patients.

Methods: Prospective study including patients with aneurysmal SAH (modified Fisher Grade 4: 90% and modified Fisher Grade 2: 10%) and early aneurysm obliteration (first 72h). The ferritin levels in the cerebrospinal fluid (CSF) and serum were measured daily over two weeks after hemorrhage (CSF/Serum ratio). Ischemic brain infarction was evaluated by computertomography 14 days after hemorrhage. Statistical significance between patients with and without infarction was calculated using the Mann-Whitney-U-test.

Results: So far 20 patients (7 male, 13 female) with a median age of 58 could be included. In 5/20 patients an ischemic brain infarction was observed. Initial serum and CSF ferritin concentrations were 252 ± 284 ng/ml (mean \pm SD) and 109 ± 70 ng/ml in patients with brain infarction and 195 ± 162 ng/ml and 451 ± 770 ng/ml in patients without brain infarction. During acute care the mean ferritin concentration in serum and CSF increased over time and reached a maximum plateau between day 8 to 11 with a mean serum concentration of 577 ± 719 ng/ml and a mean CSF concentration of 2838 ± 3518 ng/ml in patients with brain infarction and of 341 ± 250 ng/ml and 18340 ± 1632 ng/ml in patients without brain infarction. Furthermore, the ratio of mean serum and CSF concentration was significantly increased in patients with brain infarction (13.5) compared to patients without brain infarction (6.8, $p<0.01$).

Conclusion: The ferritin CSF/Serum ratio seems to be a predictive marker for the development of ischemic brain infarction after SAH. However, these results need further evaluation in a larger cohort.

Intracranial aneurysms in patients with acromegaly - should we screen for them?

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Objective: Patients with acromegaly suffer of a number of comorbidities, related to growth hormone (GH) and insulin-like growth factor-1 (IGF-1) excess, caused by the GH secreting pituitary adenoma. Next to somatic disfigurement and arthralgia, systemic complications include diabetes, cardiovascular disease, and hypertension. Another comorbidity of relevance for the neurosurgeon which has recently come to the focus of attention is the reportedly increased incidence of intracranial aneurysms found in patients with acromegaly.

Methods: Case study of three patients with acromegaly and intracranial aneurysms, one of them ruptured, who were treated within the last 3 years in our neurosurgical department.

Results: 2 out of 13 patients with clinically and biochemically proven acromegaly admitted to our department for pituitary surgery since 2014 presented with chance findings of intracranial aneurysms, one located at the pericallosal artery (5,6 x 6,6 mm) and one located at the anterior communicating artery (5 x 8 x 9 mm). A further patient operated in 2008 for a GH producing pituitary adenoma and still active acromegaly due to medication incompliance was admitted to our neurosurgical intensive care ward with subarachnoid hemorrhage (SAH) and intracerebral hemorrhage due to a ruptured anterior communicating artery aneurysm. Additionally, he harbored an unruptured middle cerebral artery aneurysm. The ruptured aneurysm was coiled successfully, but the further clinical course was complicated by vasospasm and development of hydrocephalus necessitating shunt insertion.

Conclusion: Our small case series shows a high number of unruptured aneurysms in patients with acromegaly as well as a case of SAH with severe clinical consequences. This observation is in line with two cross-sectional studies: the first having found that 26/152 acromegaly patients (17.3%) investigated by means of MRI imaging of intracranial vessels harbored 40 newly diagnosed aneurysms, and the second describing a with 6.9% increased prevalence of intracranial aneurysms in male acromegaly patients in comparison to 1.6% in the control group. Considering the fact that patients with acromegaly have comorbidities that are risk factors for aneurysm rupture, neurosurgeons should take into account the potentially increased prevalence of aneurysms in this patient group, especially against the background that MRI screening for intracranial aneurysms can be effected during routine presurgical work-up.

The unruptured intracranial aneurysm and subarachnoid hemorrhage common data elements project: results from the unruptured intracranial aneurysms subcommittee

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Objective: One major limitation for pooling of data from previous studies on unruptured intracranial aneurysms or aneurysmal subarachnoid hemorrhage remains the lack of homogenous data definitions. Homogenous data definitions would facilitate pooling and thereby enable more robust estimation of effect sizes or risk ratios. The Common Data Elements (CDE) project was therefore initiated under the auspices of The National Institute of Neurological Disorders and Stroke (NINDS) to develop standardized or common data elements definitions (CDEs) for future studies on unruptured cerebral aneurysms and aneurysmal subarachnoid hemorrhage. We here present the final CDEs of the Unruptured intracranial aneurysm (UIA) subcommittee.

Methods: The total CDE group comprised 64 international and multidisciplinary cerebrovascular clinicians and scientists, 10 of which were responsible to identify or develop CDEs on UIAs. Following a systemic review of previous cohort studies on UIAs and existing CDEs, additional and potentially relevant data elements were identified, compiled and defined by means of telephone conferences, emails and face-to-face meetings. The CDEs were all defined based on existing evidence and classified into four categories: 1. core elements, which should be employed in future studies, 2. supplemental highly recommended – strongly advised to use, 3. supplemental – relevance depends on study, 4. exploratory – reasonable to use, validity is limited.

Results: A total of 92 CDEs on UIAs were compiled, 70 of which were newly created and 22 CDE were reused from the ischemic stroke CDEs. The CDE were demographics (n=3), radiological findings (n=27), clinical symptoms and assessment at baseline (n=8), risk factors (n=13), concomitant medications (n=10), concomitant diseases (n=24), reason of medical consult and diagnosis (1) as well as management (n=6) of unruptured aneurysms. Eight CDEs were defined as core, 24 as supplemental highly recommended, 25 as supplemental and 35 exploratory elements. Robust definitions of risk factors for aneurysm growth or rupture and all aneurysm locations could be established. Lastly, the working group developed a formal classification for aneurysm morphology (Type I indicates regular; Type II indicates a bleb and Type III indicates a daughter-sac or multi-lobed aneurysm).

Conclusion: The UIA CDEs developed serve to globally standardize and optimize data for future cohort studies, to ultimately facilitate pooling and comparison of different study populations.

Interrater Agreement in the radiological characterization of ruptured intracranial aneurysms based on CT-angiography

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Objective: Radiological assessment of ruptured intracranial aneurysms is subject to rater dependent differences. The objective of this study was to determine interrater agreement in the initial radiological characterization of ruptured intracranial aneurysms based on CTA with special emphasis on the rater's level of experience.

Methods: Out of five high volume neurovascular tertiary centers, one junior and senior rater, evaluated anonymized CTA images of 30 consecutive aneurysmal SAH patients from one selected institution. Each rater described location, side and morphology, the presence of multiple aneurysms as well as maximum diameter, dome and neck diameter of the ruptured intracranial aneurysm in a standardized manner. Interrater variability was analyzed using intraclass correlation and Fleiss'kappa analysis.

Results: There was a substantial to almost perfect agreement for location ($\kappa = 0,76$, 95% confidence interval (CI) 0,74 - 0,79), side ($\kappa = 0,95$, CI 0,91 - 0,99), maximum diameter (Intraclass Correlation Coefficient (ICC) = 0,81, CI 0,70 - 0,90) and dome (ICC = 0,78, CI 0,66 - 0,88) of ruptured intracranial aneurysm. In contrast only poor to moderate agreement was observed for aneurysms neck diameter (ICC = 0,39, CI 0,28 - 0,58), presence of multiple aneurysms ($\kappa = 0,35$, CI 0,30 - 0,40) and aneurysm morphology (blister $\kappa=0,11$, CI -0,050 - 0,072; fusiform $\kappa=0,54$, CI 0,479 - 0,601; multilobular, $\kappa=0,39$ $\kappa = 0,330 - 0,451$). We found a generally higher interrater agreement in the senior rater group (median of 12 years of experience) than in the junior rater group (median of 3,5 years of experience).

Conclusion: Interrater agreement confirms the benefit of CTA as initial diagnostic imaging in ruptured intracranial aneurysms but not for aneurysm morphology and presence of multiple aneurysms. A trend towards higher interrater agreement between more experienced raters was noticed.

Size of aneurysm matters in subarachnoid hemorrhage

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Objective: The Hunt&Hess (H&H) grade is still one of the best scores to assess disease severity and neurological outcome in subarachnoid hemorrhage (SAH). However, the question remains, which biological factors determine the severity of SAH. Previous studies analyzing the amount of blood and the size of the ruptured aneurysm showed inhomogeneous results. Here, we present an analysis of a large prospective database. We hypothesize that the H&H grade at presentation correlates with preexisting biological factors such as aneurysm size.

Methods: All patients from 10/2010 to 03/2016 with proven aneurysmal SAH were included in this study. Detailed clinical characteristics were compared with regard to the assessed H&H grade using a multivariate regression analysis. Outcome was measured via the Glasgow Outcome Scale (GOS) at discharge. Analyses were calculated using SPSS v.23 and MATLAB R2014b. Probability values of $p < 0.05$ were considered significant.

Results: 371 patients (240 females, 64.7%) with a mean age of 54.6 ± 13.6 years (range 18-88) were analyzed in this study. The mean H&H grade was 2.75 ± 1.4 (median=2). The diameter of the symptomatic aneurysm ranged from 0.7 mm to 37.0 mm with a mean of 7.3 ± 5.4 mm. At discharge, 196 patients (52.8%) showed a favorable outcome (GOS 4-5), which was predicted by the H&H grade at presentation ($p < 0.001$). Multivariate analysis revealed aneurysm size ($p < 0.001$), age ($p = 0.001$), a preexisting neurological disease ($p = 0.002$) and abuse of alcohol ($p = 0.039$) to differ significantly among the H&H grades. Among these parameters, aneurysm size had the strongest effect with a partial eta squared (η_p^2) of 0.118 followed by age ($\eta_p^2 = 0.053$). Sex, number and location of aneurysms, hypertension, diabetes, body mass index, use of platelet inhibitors, anticoagulation and smoking showed no difference regarding the H&H grade at presentation.

Conclusion: We could identify preexisting biological and life style conditions, which were associated with disease severity in SAH. The size of the aneurysm and age seemed to have the strongest impact on the risk of a higher H&H grade. Since age is an immutable parameter, further functional analyses of the biological characteristics of aneurysm size seem a promising tool to understand the clinical severity of SAH.

Systemic HMGB1, a novel predictive biomarker for cerebral vasospasm in patients with aneurysmal subarachnoid hemorrhage

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Objective: HMGB1 is a non-histone DNA binding nuclear protein expressed in almost all eukaryotic cells. Translocation of HMGB1 out of the nucleus up-regulates inflammatory response in different diseases including subarachnoid hemorrhage. Pro-inflammatory molecules have been suggested to play an important role during early brain injury and cerebral vasospasm (CVS) after subarachnoid hemorrhage. Systemic release of HMGB1 after SAH and its association with development of CVS has not yet been investigated in detail. This study was aimed to investigate the release of HMGB1 in serum of patients after subarachnoid hemorrhage and its association with cerebral vasospasm.

Methods: We enrolled 53 patients with Hunt and Hess grade I-V that were admitted to our hospital between 2012 and 2015. The peripheral venous blood was withdrawn on days 1,3,5,7,9,11, and on day 13 from SAH patients, whereas once from the controls. The blood was centrifuged to obtain the serum that was immediately frozen at -80 °C. HMGB1 was quantified with standard ELISA. Plasma IL-6 and peripheral blood leukocytes were also determined over the first 2 weeks after SAH. Patients' data and post hemorrhagic complication were recorded prospectively.

Results: HMGB1 was significantly elevated in plasma of patients after SAH from day 1 to day 13 as compared to non-SAH patients. Patients with CVS (n=31) showed significantly higher HMGB1 starting from day1 till day 13 as compared to patients without CVS (n=22). HMGB1 serum concentration in patients treated with endovascular coiling did not differ from patients who underwent surgical clipping excluding the effect of craniotomy on HMGB1 elevation. Furthermore, systemic infection did not influence HMGB1 levels significantly. Cumulative levels of HMGB1 showed significant correlation with peripheral blood leukocytes and IL-6 levels (p<0.05). ROC curves showed that serum HMGB1 levels on admission is a fair predictive biomarker for CVS with sensitivity of 77 % and specificity of 59 % at a cutoff value of 5.5 ng/ ml.

Conclusion: Serum HMGB1 is differentially elevated after SAH. Serum HMGB1 levels were elevated early after SAH and were significantly high until day 13 in patients who developed CVS. Our data suggests that serum HMGB1 is a predictive biomarker for the detection of CVS with a fair sensitivity and specificity

Serum markers in aneurysmal and non-aneurysmal subarachnoid hemorrhage - A prospective comparative study

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Objective: Non-aneurysmal subarachnoid hemorrhage (naSAH) is characterised by milder clinical presentation and course compared to aneurysmal subarachnoid hemorrhage (aSAH), despite comparable blood distribution on admission CT scanning. A fundamental difference in the underlying etiology (venous tearing vs. aneurysmal rupture) is generally assumed, implying also that a different pathophysiological cascade is triggered in the very acute phase; this assumption, however, lacks further characterisation.

The objective of this study was to evaluate selected, systemic biomarkers in the acute phase of aneurysmal and non-aneurysmal SAH in order to further clarify pathophysiological discrepancies.

Methods: A total of 41 patients with verified aSAH (mean age 56.1 ± 12.3 years; aSAH_{HH°1-3}, n=21; aSAH_{HH°4-5}, n=20) and 14 patients with naSAH (mean age 55.3 ± 12.8 years; all HH°1-3) were prospectively recruited for this study. Blood samples were obtained within the first 48hrs after hemorrhage and analyzed for the following parameters: glucose, lactate, bilirubin, urea, CRP, procalcitonin, leukocyte count, S100, TNF-alpha, IL-6.

Results: Serum markers were comparable without statistically significant difference for naSAH patients and patients of lower HH-grade (aSAH_{HH°1-3}). Glucose level, leukocyte count and S100 were significantly higher in patients with higher HH-grade (aSAH_{HH°4-5}) when compared to patients with naSAH ($p < 0.01$, $p < 0.01$, $p < 0.001$) and aSAH_{HH°1-3} ($p < 0.01$, $p < 0.05$, $p < 0.01$). IL-6 was significantly lower in patients with naSAH compared to aSAH_{HH°4-5} patients ($p < 0.01$), while comparison with aSAH_{HH°1-3} patients failed to reach statistical significance for both naSAH and aSAH_{HH°4-5} patients ($p < 0.1$). Lactate, bilirubin, urea, CRP, TNF-alpha and broader inflammatory markers (CRP, procalcitonin) were comparable in all groups.

Conclusion: In low-grade aSAH patients (aSAH_{HH°1-3}), systemic parameters are comparable to those in non-aneurysmal SAH patients, implying a comparable severity of the initial insult despite an assumed difference in underlying etiology. Severely affected patients (aSAH_{HH°4-5}) feature pronounced hyperglycemia, leukocytosis and elevation of S100 and IL-6 in the very acute phase after hemorrhage, attributable to the severity of the initial insult.

MI.12 Vaskuläre Neurochirurgie 11

Mittwoch *Wednesday*, 17.05.2017, 11.00 – 12.30 Uhr *hrs*

- MI.12.01 *Role of endothelial NO-synthase in early brain injury after experimental subarachnoid hemorrhage*
I. Westermayer, S. Katzdobler, N. Plesnila, N. Terpolilli* (München, Deutschland)
-
- MI.12.02 *Effect of blood metabolites and degradation products (BMDP) on neuronal tissue – The isolated murine retina as a new ex-vivo SAH model?*
W. Albanna* (Aachen, Deutschland), F. Neumeier, C. Conzen, H. Clusmann, A. Höllig, T. Schneider, G. Schubert
-
- MI.12.03 *Transcranial direct current stimulation leads to polarity-specific astrocyte activity in an experimental subarachnoid hemorrhage model in rats*
K. Bleuel* (Göttingen, Deutschland), V. Malinova, B. Iliev, W. Schulz-Schaeffer, V. Rohde, D. Mielke
-
- MI.12.04 *Transcranial Doppler sonography enhances fibrinolysis of rtPA in an in vitro model of intracerebral hemorrhage*
J. Masomi-Bornwasser* (Mainz, Deutschland), P. Winter, A. Neulen, J. König, O. Kempfski, N. Keric
-
- MI.12.05 *Transcranial direct current stimulation influences the extent of neuronal injury after experimental subarachnoid hemorrhage in rats*
V. Malinova* (Göttingen, Deutschland), K. Bleuel, B. Iliev, W. Schulz-Schaeffer, V. Rohde, D. Mielke
-
- MI.12.06 *Grading of experimental subarachnoid hemorrhage - definition of a SAH severity score*
D. Mielke* (Göttingen, Deutschland), K. Bleuel, B. Iliev, W. Schulz-Schaeffer, V. Rohde, V. Malinova
-
- MI.12.07 *Crosstalk between the angiotensin- and endothelin-system in the cerebrovasculature after experimental induced subarachnoid haemorrhage*
S. Wanderer* (Aarau, Switzerland), J. Mrosek, F. Gessler, H. Vatter, V. Seifert, J. Konczalla
-
- MI.12.08 *A systematic and meta-analysis of mortality in experimental mouse models analyzing delayed cerebral ischemia after subarachnoid hemorrhage*
J. Weber* (Düsseldorf, Deutschland), I. Fischer, J. v. Lieshout, T. Restin, H. Steiger, M. Kamp
-
- MI.12.09 *Evaluation of hemodynamic changes after extracranial-intracranial bypass using dynamic perfusion CT imaging with acetazolamide challenge.*
A. Tortora* (Düsseldorf, Deutschland), H. Sadat, H. Steiger, B. Turowski, J. Cornelius, A. Petridis
-

Role of endothelial NO-synthase in early brain injury after experimental subarachnoid hemorrhage

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Objective: Despite advances in neurointensive care and surgical/ endovascular aneurysm occlusion techniques subarachnoid hemorrhage (SAH) remains a disease with high mortality and morbidity. Experimental and clinical studies indicate that pathological changes in the early phase (72 hours) after SAH, summarized as early brain injury (EBI), determine the extent of brain damage and, thus, neurological outcome. A main characteristic of EBI is microcirculatory dysfunction. Potential mechanisms for this include microvascular constriction (microvasospasms) and impaired CO₂-reactivity of cerebral microvessels. Both pathophysiological phenomena have been linked to nitric oxide (NO) depletion after SAH. Endothelial NO-synthase (eNOS) – the main source of cerebrovascular under physiological conditions - is dysfunctional early after SAH but it is unclear how eNOS function/ dysfunction is linked with early brain injury and posthemorrhagic brain damage. In the current study we evaluated parameters of EBI in mice lacking eNOS and respective wildtype controls.

Methods: SAH was induced in male eNOS^{-/-} mice and wildtype (WT) mice using the MCA-perforation model under continuous control of ICP, CBF, and MAP. Three hours after SAH, the cerebral microcirculation was directly visualized using *in vivo*-2-photon-microscopy (IV-2PM). CO₂ vessel reactivity was directly studied via IV-2PM before, during, and after induction of hypercapnia (7.5%); exogenous NO was supplied by inhalation (50 ppm) before CO₂ challenge.

Results: eNOS^{-/-} mice had significantly increased pathology after SAH with more severe intracranial hypertension and hypoperfusion starting immediately after induction of SAH ($p < 0.05$ vs. control until 30 min post SAH), significantly more re-bleedings (eNOS^{-/-} 4.2/h, WT 0.7/h, $p < 0.05$) which translated into massively increased post-SAH mortality: while 50% (10/20) of eNOS^{-/-} animals did not survive until IVM 3 hours post SAH no control animal (0/10) died. The cerebral microcirculation was significantly impaired 3 hours after SAH, there was significant microarteriolar narrowing and formation of microvasospasm; the extent of microcirculatory dysfunction was comparable in both groups. Exogenous NO increased CBF in WT animals compared to baseline but not in eNOS^{-/-} mice. While CO₂-reactivity is abolished after SAH in the MCA perforation model, hypercapnia led to significant vasodilatation and CBF increase in WT and eNOS transgenic mice after NO application via inhalation; the effect was more pronounced in WT animals.

Conclusion: eNOS^{-/-} mice have significantly more severe SAH and, subsequently, posthemorrhagic mortality and brain damage. Early microcirculatory changes were more pronounced in transgenic animals. These findings indicate a key role for eNOS produced NO in the pathophysiology of early brain injury after SAH. Further evaluation of the mechanisms is in planning.

Effect of blood metabolites and degradation products (BMDP) on neuronal tissue – The isolated murine retina as a new ex-vivo SAH model?

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Objective: Metabolites and degradation products of hemoglobin - such as bilirubin and its oxidation end products (BOXes) - may be involved in the development of cerebral vasospasm after aSAH. Vascular smooth muscle cells in the brain are activated, possibly via stimulation of different voltage-gated calcium channels (VGCCs). VGCCs are also present in the retina playing a major role for signal transduction. Their interaction during transretinal excitation can be recorded as an electroretinogram (ERG). The retina as an embryological part of the brain and currently subject of clinical pilot studies may allow for direct visualization of the interactions from blood degradation products on acute signaling and thus also on pathways for vascular tone regulation. The present investigation analyses the effect of bilirubin on an isolated and superfused murine retina to determine the suitability of this new experimental ex-vivo model for SAH.

Methods: Murine retinas were isolated from wildtype (n=16) and knock-out mice (Ca_v2.3, R-Type; n=7), transferred to a recording chamber and superfused with nutrient solution for 45min. From the dark-adapted retina, ERGs in response to a single white flash were recorded in 3min intervals. Reactivity was tested for different pH settings. After reaching an equilibrium for the characteristic b-wave amplitude, retinas were superfused with 10µM albumin, followed by 5µM bilirubin+10µM albumin and again with 10µM albumin (bilirubin wash-out), each for 45min.

Results: In 17 separate retinæ, the b-wave amplitude, as a response of the inner retina, was increased by the pH-shift (pH 7.4 to pH 7.7) from 22.9±8µV to 37.5±10.3µV (p<0.001). After optimization, in 16 wild type retinas, the b-wave amplitude decreased significantly during bilirubin superfusion by 24,9±3.9% (p<0.001). After washout of bilirubin, the amplitude returned to the baseline. Knock-out animals showed a comparable response to bilirubin superfusion. However, b-wave amplitude increased significantly during washout (12.3±4.5%; p<0.05). No significant changes of the implicit time (latency until maximum of amplitude) were found.

Conclusion: The isolated and superfused murine retina as a new ex-vivo model shows a characteristic and reproducible response to selected degradation products such as bilirubin, in this case reduction of b-wave amplitude after electrical stimulus. The described experimental setup may be used as a new neuronal model to examine BMDP effects, mimicking the alterations after SAH and utilizing BOXes and selected knock-out animals to shed more light into the underlying pathophysiology of cerebral vasospasm.

Transcranial direct current stimulation leads to polarity-specific astrocyte activity in an experimental subarachnoid hemorrhage model in rats

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Objective: Transcranial direct current stimulation (tDCS) is a noninvasive neuromodulation technique with therapeutic use in different neurological disorders including stroke. Subarachnoid hemorrhage (SAH) is often complicated by the occurrence of vasospasm-induced ischemia. The tDCS can provoke changes of the cortical activity and of the cerebral blood flow. The aim of this study was to investigate the effect of tDCS on the astrocyte activity in an experimental SAH model in rats.

Methods: SAH was induced using the double-hemorrhage model in Sprague Dawley rats. For this purpose autologous arterial blood was injected into the cisterna magna on day 1 and day 2. The sham group got a saline solution injection instead of blood. tDCS (cathodal or anodal) with an intensity of 408 μ A and a duration of 15 minutes was performed on day 3 and day 4. The control group and the sham group received no stimulation. The animals were sacrificed on day 5 and histological analyses of the brains were performed. A blinded evaluation of the astrocyte activity was performed using immunohistochemical staining against Glial Fibrillary Acidic Protein (GFAP).

Results: The brains of 28 animals were analyzed. In the anodal group 84% (10/12) of the animals showed an asymmetric astrocytic reaction. In contrast to that in 56% (5/9) of the animals in the cathodal group a symmetric astrocytic reaction was observed. In the control group (n=5) a symmetric astrocytic reaction was seen in all 5 animals. In the sham group (n=2) no astrocytic reaction could be detected.

Conclusion: The tDCS induces polarity-specific astrocytic reactions (symmetric and asymmetric) in an experimental SAH model in rats. Additional experiments are necessary to evaluate if tDCS has a neuroprotective effect in SAH.

Transcranial Doppler sonography enhances fibrinolysis of rtPA in an *in vitro* model of intracerebral hemorrhage

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Objective: Several studies have demonstrated the potential of transcranial Doppler with common 2 MHz probes (TCD) to enhance intravascular fibrinolysis through sonothrombolysis in ischemic stroke. Other studies have shown that catheter-based administration of rtPA induces lysis of the hematoma and reduces blood clot size in patients with intracerebral hemorrhage (ICH). However, the effect of TCD-induced sonothrombolysis has not been investigated in ICH.

The aim of this study was to investigate possible fibrinolytic effects of Doppler-sonography in an established *in vitro* model of ICH. Furthermore we examined whether insonation with 2 TCD probes placed vis-à-vis enhances the effect of sonothrombolysis.

Methods: Experiments were performed with standardized human blood clots of 25 ml in a water bath at 37°C. A silicone catheter for drug administration and drainage was placed in the clot core. Clot weight was assessed before and after 60 min treatment in the water bath. To assess acoustic peak rarefaction pressure (APRP) a brain phantom was created consisting of 3.5 l agarose gel. Temperature and APRP were measured in the field of view of a single and of both probes. APRP measurement was also performed through a temporal squama to simulate the situation *in vivo*. We investigated rtPA- and TCD-induced lysis in 6 groups (each n=6): (i) 1 TCD probe, (ii) 1 mg rtPA, (iii) combination of 1 TCD probe and 1 mg rtPA, (iv) 2 TCD probes placed vis-à-vis, (v) combination of 2 TCD probes and 1 mg rtPA, and (vi) control group.

Results: Clot weight was reduced in all groups after treatment in the water bath. The control group had a relative end weight of 71.43±6.23%. Weight reduction was significantly enhanced in clots treated with 1 TCD probe (relative weight: 55.2±3.42%) or with rtPA (52.59±5.56%) compared to the control group (p<0.0001). Combination of 1 TCD probe and rtPA as well as insonation with 2 TCD probes induced a further significant weight reduction (relative weight: 46.1±4.67%; 45.09±4.26%; p<0,0001) compared to control. Most efficient clot lysis was achieved using 2 TCD probes and rtPA (36.31±4.42; p<0,0001). Application of 1 TCD probe leads to an APRP of 1609±112.6 kPa, while 2 probes showed a significantly higher APRP value (3113±173.3 kPa p<0.0001). Application through bone leads to an APRP attenuation by 70% (443.7±22.07kPa), 2 probes through bone significantly increased APRP values to 731.6±79.55 kPa, which is significant above lysis threshold.

Conclusion: TCD-induced sonothrombolysis significantly enhances rtPA-induced lysis of blood clots, and the effect of TCD-induced sonothrombolysis is amplified by using multiple TCD probes. Our results indicate that bitemporal insonation of the hematoma using image-guided 2 MHz TCD probes could be a new promising approach to enhance fibrinolysis and hematoma reduction respectively of ICH's treated with intralesional catheter and rtPA application.

Transcranial direct current stimulation influences the extent of neuronal injury after experimental subarachnoid hemorrhage in rats

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Objective: Cerebral hypoperfusion is a frequent condition after subarachnoid hemorrhage (SAH), increasing the risk for neuronal injury. In previous experiments transcranial direct current stimulation (tDCS) induced alterations of cerebral blood flow (CBF) in an experimental SAH-model in rats, which again could influence the extent of neuronal injury. In this study a possible correlation between the tDCS and the neuronal injury was evaluated in a SAH-model in rats.

Methods: SAH was induced in 31 Sprague Dawley male rats using the double-hemorrhage SAH-model. The rats were then assigned to the tDCS-group (anodal/cathodal) or to the control-group (no tDCS). The tDCS was applied on day 3 and 4 after the SAH-induction via an epicranial electrode placed over the right hemisphere. Histological analysis with neurons count within the hippocampus formation was performed in all rats. Five rats without SAH were analyzed to establish a reference of normal neurons count within the hippocampus. A correlation analysis of tDCS with neurons loss (NL), as a measure for neuronal injury, was then performed.

Results: 27 rats were assigned to the tDCS-group (15 anodal and 12 cathodal) and 4 rats to the control-group. The cut-off for significant NL was < 720 neurons/mm² (ROC, AUC 0.93, 95%CI 0.83-1.02, $p=0.0003$). A significant NL (mean 651 neurons/mm²) was detected in all SAH rats compared to the rats without SAH (mean 840 neurons/mm²). In the control-group a significant NL was observed in 70% (3/4) equally affecting both hemispheres. The cathodal-tDCS correlated with a significant lower rate of NL ipsilateral to the tDCS-application compared to the anodal-tDCS (OR 3.0 95%CI 1.5-5.9, $p=0.001$). There was no significant difference in the NL in the cathodal-tDCS-group compared to the control-group (OR 0.7 95%CI 0.4-1.4, $p=0.54$). The anodal-tDCS was associated with a significant higher rate of NL ipsilateral to the tDCS-application in comparison to the control-group (OR 2.4 95%CI 1.1-4.8, $p=0.01$).

Conclusion: The tDCS can influence the extent of neuronal injury ipsilateral to the applied stimulation in an experimental SAH-model in rats. Future experiments will show if a possible neuroprotective effect of the cathodal-tDCS can be established with a more frequent stimulation.

Grading of experimental subarachnoid hemorrhage - definition of a SAH severity score

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Objective: Animal models are essential for the research on pathophysiological processes following subarachnoid hemorrhage (SAH). The amount of extravasated blood is an established surrogate marker for the SAH severity, which varies comparing different experimental SAH models. A comprehensive grading system of experimental SAH (eSAH) would allow a more reliable correlation of outcome parameters with the SAH severity and a better comparability of experimental SAH models. The aim of this study was to define a severity score for eSAH.

Methods: SAH was induced in 31 Sprague Dawley male rats using the double hemorrhage model. A sham group included 5 rats, in which saline solution instead of autologous arterial blood was injected. After perfusion-fixation a histological analysis with HE(hematoxylin-eosin)-staining for visualization of blood was performed in all rats. The amount and distribution of blood within the subarachnoid space and ventricular system were analyzed.

Results: In all SAH rats blood was visible within the subarachnoid space. As expected, no blood was visible in the sham group. The following severity score was defined: 0 = no visible blood, 1 = local small amount of blood, 2 = diffuse small amount of blood, 3 = diffuse high amount of blood and 4 = additional intraventricular hemorrhage. Grade 1 SAH was detected in 4% (1/31), grade 2 SAH in 10% (3/31), grade 3 SAH in 23% (7/31) and grade 4 SAH in 63% (20/31) of the rats with SAH.

Conclusion: The double hemorrhage model allows the induction of a high grade SAH, subsequently making it especially suitable for evaluation of outcome parameters in severe SAH. We recommend a validation of the SAH severity score in other experimental SAH models.

Crosstalk between the angiotensin- and endothelin-system in the cerebrovasculature after experimental induced subarachnoid haemorrhage

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In a recent study losartan (LOS) shows a dose-dependent antagonistic effect to the endothelin-1 (ET-1) induced vasoconstriction, which could be abolished after preincubation with an endothelin B₁ receptor (ET(B₁)-receptor) antagonist. Also under LOS an increased ET(B₁)-receptor-dependent relaxation to the ET(B)-receptor agonist Sarafotoxin S6c (S6c) was detected. Though, investigations under pathological conditions – like after experimental induced subarachnoid hemorrhage (SAH) – are still missing.

Therefore experimental cerebral vasospasm (CVS) was induced by a modified double hemorrhage model. Rats were sacrificed on day 3 and isometric force of basilar artery ring segments was measured.

Like under physiological conditions after experimental SAH the ET-1 induced vasoconstriction is decreased under LOS. Interestingly, this reduced vasoconstriction is abolished after preincubation with BQ-788, an ET(B₁)-receptor antagonist. Additionally, in precontracted vessels with BQ-123, an endothelin A-receptor (ET(A)-receptor) antagonist, and LOS ET-1 induced a higher vasorelaxation.

After experimental induced SAH LOS causes a modulatory effect in ET(B₁)-receptor-dependent vasorelaxation. LOS further induces an upregulation of the NO-pathway. The formerly known loss of the ET(B₁)-receptor function after SAH was abolished under LOS and a significantly increased relaxation, accompanied with an enhanced sensitivity of the ET(B₁)-receptor, was detected. Also the dose-dependent antagonistic effect to the ET-1 induced contraction can be effected by angiotensin II type 1-receptor (AT₁-receptor) antagonism due to LOS via the ET(B₁)-receptor.

A systematic and meta-analysis of mortality in experimental mouse models analyzing delayed cerebral ischemia after subarachnoid hemorrhage

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Objective: Mouse models are established models to study pathophysiological changes following subarachnoid hemorrhage (SAH) and remodel the human situation. The aim of the present systematic analysis was to determine the mortality rate in mouse SAH models of delayed cerebral ischemia (DCI), to identify factors influencing mouse mortality and to compare mouse mortality to the case fatality in human SAH patients.

Methods: A systematic search of the PubMed database was performed to identify all studies that assessed mouse DCI models. Mortality rates and predictor variables were extracted and compared to previously reported human case fatality after SAH. The Kruskal-Wallis test was used for all questions including more than two classes and the Wilcoxon rank sum test with continuity correction was used to compare mortality between mouse DCI models and SAH patients. As multiple statistical testing was performed, a level of less than 0.0021 was considered to be significant according to Šidák's correction.

Results: Forty-eight studies were included in the quantitative analysis. The mean overall mortality rate was 21% in mouse DCI models. The time period between induction of SAH and evaluation of mortality rates is a significant variable influencing the mortality rate in mouse SAH models. Furthermore, the mouse mortality after 48 hours rate was significantly influenced by the used SAH model (injection vs. endovascular perforation model). In contrast, neither the genetic background nor the anesthetic had a significant effect on the case fatality rate. Mouse mortality after experimental SAH in DCI models was significantly lower than human case fatality following aneurysmal SAH.

Conclusion: The mean overall mortality rate in mouse DCI models is significantly lower than human case fatality following aneurysmal SAH. However, time between SAH induction and evaluation is a significant variable influencing the mortality rate in mouse SAH models. Further analyses will be required to establish whether and to which extent different DCI models affect mortality and reflect human pathophysiology.

Evaluation of hemodynamic changes after extracranial-intracranial bypass using dynamic perfusion CT imaging with acetazolamide challenge

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Objective: Since the failure of the extracranial-intracranial (EC-IC) bypass study and COSS study in showing the usefulness of cerebral revascularization to decrease stroke risk in patients with chronic cerebrovascular insufficiency great effort was made to identify a subgroup of high-risk patients who might benefit of bypass surgery. CT perfusion (CTP) imaging with Acetazolamide (ACZ) challenge gained an increasing role in detecting patients with impaired autoregulatory reserves. Little is known about hemodynamic changes in CTP imaging before and after surgery, in particular if impaired cerebral reactivity improves after revascularization.

Methods: 33 patients undergoing 37 EC-IC bypasses were studied with CTP including ACZ challenge before and on average 3 months after surgery. 22 patients were treated for moyamoya disease, 13 for carotid occlusion and 2 for stenosis of the middle cerebral artery. Cerebral blood flow (CBF), mean transit time (MTT) time-to-maximum (Tmax) were assessed in the affected hemispheres before and after ACZ and a CBF reactivity index (RI) was calculated for the ACZ challenge.

Results: Baseline Tmax and ACZ Tmax in the affected hemisphere decreased after surgery by 4.5 and 7.5 arbitrary units (approximately corresponding to deci-seconds). The postoperative reduction of Tmax after ACZ challenge was statistically highly significant ($p=0.003$). Baseline CBF improved by 5.6 arbitrary units (corresponding approximately to ml/100g tissue) and ACZ CBF improved by 5.2 units. Baseline MTT and ACZ MTT were unchanged after surgery, as well as the RI.

Conclusion: EC-IC bypass resulted in a reduction of Tmax values and improvement of CBF. These parameters should be used for the CTP assessment of bypass function. Our study did not confirm improvement of ACZ CBF reactivity by EC-IC bypass.

MI.13 Tumor 12 - In-vitro C

Mittwoch *Wednesday*, 17.05.2017, 11.00 – 12.20 Uhr *hrs*

- MI.13.01 *Human organotypic glioblastoma tissue slices for therapy improvement can be analyzed by transcriptome-wide next-generation sequencing, whole slice immunochemical analysis and immunoblotting*
S. Haehnel* (Leipzig, Deutschland), K. Reiche, H. Oppermann, K. Winter, J. Meixensberger, I. Bechmann, F. Gaunitz
-
- MI.13.02 *Influence of chronic low dose Orlistat on de novo fatty acid metabolism in primary human glioblastoma cell cultures*
N. Kaube* (Jena, Deutschland), S. Grube, J. Walter, R. Kalff, C. Ewald
-
- MI.13.03 *Inhibition efficacy of extracellular carbonic anhydrases in glioblastoma depends on the glycolytic phenotype*
M. Proescholdt* (Regensburg, Deutschland), E. Stoerr, A. Lohmeier, A. Brawanski
-
- MI.13.04 *Inhibition of apelin signaling blocks glioma angiogenesis and reduces invasive glioma growth*
V. Stöcklein* (München, Deutschland), G. Mastrella, M. Hou, U. Schüller, J. Tonn, R. Glaß, R. Kälin
-
- MI.13.05 *Inhibition of MutT homolog 1 (MTH1) in glioblastoma multiforme results in impaired cell migration and tumor growth*
M. Timmer* (Köln, Deutschland), S. Kannampuzha, G. Röhn, B. Krischek, R. Goldbrunner
-
- MI.13.06 *Local HSV-TK suicide gene therapy in the orthotopic U87 glioblastoma model using human bone-marrow derived mesenchymal stem cells*
L. Dührsen* (Hamburg, Deutschland), S. Montag, S. Zapf, D. Hirsch, J. Sedlacik, M. Westphal, F. Hermann, N. Schmidt
-
- MI.13.07 *New pericytes in glioblastoma blood-vessels originate from a previously unrecognized, pericyte progenitor-like cell and promote glioma progression*
R. Kälin* (München, Deutschland), Y. Li, Y. Wu, K. Eisenhut, S. Siller, J. Tonn, R. Glaß
-
- MI.13.08 *CCR2-CCL2 axis represents a key pathway for macrophage recruitment to gliomas*
A. Bungert* (Berlin, Deutschland), S. Brandenburg, M. Felsenstein, R. Urbantat, A. Mueller, P. Vajkoczy
-

Human organotypic glioblastoma tissue slices for therapy improvement can be analyzed by transcriptome-wide next-generation sequencing, whole slice immunochemical analysis and immunoblotting

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Objective: The individual treatment of brain tumor patients requires experimental models that can be used to propose the outcome of a certain treatment strategy. Today, cell culture or mouse models are frequently used for the development of test systems that poorly reflect the tumor's biology. Hence, we asked whether organotypic slice cultures can be used for an in depth analysis of tumor response to treatment. Here, we describe an automated analysis of whole slices subjected to immunochemistry and the isolation of proteins for immunoblotting. Most importantly, we demonstrate that transcriptome-wide next-generation sequencing of RNA isolated from slices can successfully be applied.

Methods: Tissue slices (~350 µm) were obtained from surgically removed glioblastoma and normal brain tissue using a tissue chopper. Slices were treated by irradiation (4 Gy) and Temozolomide (200 µM). Caspase-3 and Ki-67 expression within the tissue were determined from whole slices using an automated scanning technology. In addition, protein was isolated for immunoblot analysis and RNA was processed for strand-specific transcriptome-wide NGS sequencing.

Results: Normal brain tissue that had to be removed to get access to the tumor and corresponding glioblastoma tissue from the same patient were used for organotypic slice cultures. Agilent BioAnalyzer quality control revealed high quality RNA and libraries could be established and subjected to transcriptome analysis. A total of ~10.000 genes were detected with at least 1 transcript per million in all samples at a moderate sequencing depth (5 to 8x10⁶ counts per sample). Principal component analysis of annotated genes revealed expression variance between normal and tumor tissue as well as between treated and untreated samples. Automated quantification of whole slices revealed a high correlation with data obtained by manually counting cells. Moreover, we could identify components of signal transduction pathways and their phosphorylation by immunoblotting.

Conclusion: Here we demonstrate that tissue slices obtained from surgically removed glioblastoma tissue can be analyzed by transcriptome-wide RNA sequencing after treatment in culture. In addition, automated quantification of immunohistochemistry is possible and proteins isolated from slices can be used for immunoblotting. This offers the opportunity for an in depth analysis of the response of individual patient-derived glioblastoma tissue to treatment, which is an important step towards personalized treatment of patients.

Influence of chronic low dose Orlistat on de novo fatty acid metabolism in primary human glioblastoma cell cultures

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Objective: We showed increased fatty acid synthase (FASN) expression level in glioblastoma (GBM) compared to astrocytoma WHO grade I to III. We revealed a dose and time dependent decrease in viability and proliferation rate of primary human GBM cell cultures under treatment of Orlistat. With regard to possible clinical use we investigated the effects of chronic exposure to low dose Orlistat (27.8 μ M) on viability, autophagy, and genes participating in fatty acid metabolism in GBM cell cultures.

Methods: Three primary human GBM cell cultures (G1145, G1273, G1319) were incubated with 24mM ethanol (vehicle control) or 27.8 μ M Orlistat for 96h in total. We analyzed cell viability by Prestoblu[®] staining after 0h, 24h, 48h, 72h, and 96h and induction of autophagy by monodansylcadaverine staining after 12h, 24h, and 48h. Furthermore we studied changes in expression levels of genes involved in fatty acid metabolism by quantitative PCR: ATP-citrate-lyase (ACLY), acetyl-CoA-carboxylase 1 (ACACA), FASN, and carnitine-palmitoyltransferase 1A (CPT1A).

Results: All results are in comparison to vehicle control. In all treated cultures we revealed a significant decrease of cell viability up to 79.0%, 96.6% and 253.2% after 96h (p=0.000) incubation with Orlistat with a positive significant correlation to time of exposure in G1319 (p=0.040, r=0.896). The higher the growth rate of the analyzed GBM cells, the more Orlistat affects cell viability negatively. In G1145 and G1273 Orlistat increased significantly autophagy up to 15.8% respectively 16.0% after 48h (p=0.000). The observed autophagic processes may represent an escape mechanism which follows fatty acid deprivation caused by low dose Orlistat. ACLY showed decreased (p=0.025), ACACA and FASN increased mRNA expression levels after 48h, and CPT1A decreased levels after 24h (p=0.004). A positive correlation exists between changes in expression level of ACLY and CPT1A (p=0.007, r=0.665) as well as FASN and CPT1A (p=0.013, r=0.625), both induced by Orlistat.

Conclusion: Orlistat influences the fatty acid metabolism in primary GBM cell cultures even at low concentration. To escape inhibition of Orlistat by binding at thioesterase of FASN, its mRNA is upregulated. This functional inhibition results in malonyl-CoA accumulation and palmitate deprivation so CPT1A for fatty acid transport is needed less. Malonyl-CoA upregulates FASN and inhibits ACLY. Therefore less acetyl-CoA is produced. Furthermore ACACA is upregulated to use the little acetyl-CoA as effectively as possible to synthesize malonyl-CoA which should be used by FASN to produce palmitate. Direct inhibition of FASN by Orlistat is able to down- and upregulate genes taking part in fatty acid metabolism but not in a constant manner. GBM cells may counter these metabolic changes so inhibition of fatty acid metabolism should be performed in more than one way in future.

Inhibition efficacy of extracellular carbonic anhydrases in glioblastoma depends on the glycolytic phenotype

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Objective: Malignant gliomas metabolize glucose preferably by glycolysis which is in accordance to the Warburg effect. This induces a high demand of glucose combined with a significant lactic acid load. Surprisingly, the intracellular pH has been demonstrated to be slightly alkaline in these tumors. The hypoxia – inducible, extracellular carbonic anhydrase IX (CAIX) is highly overexpressed in malignant gliomas and plays an important role in their acid management and cell survival. Recently, specific inhibitors of this enzyme have been developed and may provide an innovative strategy for adjuvant treatment. The goal of our study was to test several of these compounds for their efficacy in glioblastoma cells in vitro compared to normal astrocytes.

Methods: Two established rat and two established human glioblastoma (GBM) cell lines and 4 primary GBM cell lines (2 with mesenchymal transcriptional profile and 2 with proneural profile) were exposed to CAIX inhibitors in different concentrations. As control cells served normal rat astrocytes derived from p3 rat brains. Cell toxicity was measured by a colorimetric assay (AQ assay, Promega), apoptotic cell death was investigated by annexin V labeling. To investigate potential biomarker for treatment efficacy, a glycolytic profile of all cell lines was established by measuring lactate production, activity of glycolytic key enzymes, the extracellular acidification rate in addition to the oxygen consumption rate.

Results: Normal astrocytes did not show any toxic reaction to CAIX inhibition even at high dosages. In contrast, several GBM cell lines were highly susceptible to CAIX inhibition, whereas others were rather refractory. The glycolytic profiling revealed that a highly glycolytic phenotype correlates with profound efficacy of CAIX inhibition, whereas a lower glycolytic activity was associated with significantly reduced efficacy of this approach. Glycolytic enzyme activity was established as a reliable marker for the response rate of GBM cells to CAIX inhibition.

Conclusion: Our data demonstrate that CAIX inhibition can be an effective treatment strategy in GBM with a high glycolytic potential resulting in a significant acid load requiring the function of this enzyme complex.

Inhibition of apelin signaling blocks glioma angiogenesis and reduces invasive glioma growth

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Objective: Glioblastoma (GBM) present with an abundant and aberrant neo-vasculature and a high degree of invasion. We have previously established the neuroendocrine hormone apelin as an angiogenic factor during embryonic development and described its upregulation in GBM patient samples. Here, we investigated whether apelin signaling has a role in angiogenesis and invasive GBM growth as well as its therapeutic potential.

Methods: Towards this aim, we investigated expression of apelin and its receptor in GBM stereotactic biopsies using in situ hybridization and qPCR, screened 19 patient-derived GBM stem cell cultures performing RNAseq and compared the expression pattern to the TCGA (the cancer genome atlas) data set. Furthermore, we performed orthotopic implantation of human patient-derived and mouse subtype-specific GBM cells and employed genetic and pharmacological blockade of apelin signaling complemented by in vitro invasion assays. To study the specific contribution of glioma-derived apelin, we implanted human glioma cells expressing lentiviral control- or apelin-shRNA. For vascular apelin expression Apelin-KO mice were used.

Results: In a serial implantation model of invasive human GBM in mice we found that upregulation of apelin and its receptor correlated with induction of the angiogenic switch. Interrogating the TCGA data set for apelin, co-expressed genes showed that angiogenesis signature genes were more than 64 times over-represented. We then screened patient-derived GBM stem cell cultures and detected expression of apelin and its receptor in all described genetic GBM subtypes. We found that depletion of apelin expression (reduction by over 90%) in patient-derived GBM cells massively reduced the glioma vascular network (reduction by 71%). Additionally, blockage of the endothelial apelin signal using Apelin-KO mice led to a complete loss of glioma angiogenesis, a reduction of glioma volume by 69% and a significant increase in survival of the mice by 42%. Moreover, direct infusion of the peptide apelin-13 rescued the vascular loss-of-function phenotype. RNAseq confirmed enrichment for angiogenesis but also for invasion-related human and mouse gene signatures in apelin-depleted xenografts. Consistently, we found that apelin is not only able to attract endothelial cells to the brain tumor site but also enhances invasion of primary GBM cells by more than 2 times *in vitro* as well as in patient-derived xenografts *in vivo*. Finally, therapeutic application of an apelin receptor antagonist (Apelin-F13A) blocked tumor angiogenesis to normal levels, reduced GBM cell invasion by 46% and led to an overall attenuation of tumor size by 47%.

Conclusion: In summary, we found that apelin regulates glioma angiogenesis and directly mediates primary GBM cell invasion. Consequently, we propose apelin and its receptor as novel targets for GBM therapy.

Inhibition of MutT homolog 1 (MTH1) in glioblastoma multiforme results in impaired cell migration and tumor growth

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Objective: MutT homolog1 (MTH1) is required for survival of cancer cells. These have irregular redox formations resulting in the production of reactive oxygen species which damage the deoxynucleoside triphosphate pool and subsequent the DNA. MTH1 plays a crucial role by inhibiting the incorporation of oxidized bases into the DNA that avoid apoptosis of cancer cells. Our aim was to analyze the pathophysiological role of MTH1 in glioma.

Methods: MTH1 expression was analyzed in human glioma specimens by quantitative RT-PCR, immunohistochemistry and Western Blot. U87 proliferation, cell migration *in vitro* and tumor growth in an orthotopic rat model was monitored after knock-down of MTH1 by siRNA or inhibition by crizotinib. In addition, progression free- and overall survival of patients was correlated to the MTH1 level using both, own data and the TCGA dataset.

Results: Higher expression of MTH1 was observed in glioblastoma than in lower grade astrocytomas and peritumoral tissue, both, on the gene and protein level. Quantitative RT-PCR resulted in a threefold MTH1 mRNA increase in GBM (6.93 ± 1.38) compared to diffuse astrocytoma (2.35 ± 0.27). Immunohistochemistry and Western blot analysis revealed a highly significant grade dependent upregulation of MTH1 in gliomas: control tissue 0.19 ± 0.07 ; astrocytoma WHO°II 1.42 ± 0.74 ; astrocytoma WHO°III 2.20 ± 0.55 ; glioblastoma 5.97 ± 2.68 ($p < 0.001$). MTH1 siRNA transfected U87 cells showed slower migration compared to control U87 cells. Furthermore, treatment with crizotinib, an inhibitor of MTH1, also lowered cell migration (gap distance difference after 24h $994 \mu\text{m} \pm 49$; $p < 0.01$). In rats, tumor growth was significantly impaired in MTH1 siRNA U87 grafts. Additionally, the data indicate an inverse correlation between the progression free- and overall survival of patients and the expression level of MTH1 ($p < 0.05$).

Conclusion: These results show that MTH1 plays an essential role in both, malignization of glioma and disease progression in recurrent glioblastoma. Moreover, the MTH1 level in patients seems to influence tumor growth and patient survival and could be targeted by crizotinib indicating a putative role for potential future therapies.

Local HSV-TK suicide gene therapy in the orthotopic U87 glioblastoma model using human bone-marrow derived mesenchymal stem cells

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Objective: Mesenchymal stem cells (MSC) show an inherent brain tumor cell tropism that can be exploited for targeted delivery of therapeutic genes to invasive gliomas. Here, we describe the dynamics of human MSC migration and demonstrate that the injection of tumor-targeting MSC is able to deliver a suicide gene to intracerebral growing human glioblastoma xenografts.

Methods: Human MSC from healthy donors were genetically modified to stably express the herpes simplex virus thymidine kinase (TK). The biological activity of MSC and MSC-mediated TK/ganciclovir (GCV) system was assessed in cell migration, survival and bystander assays. The dynamics of Fe- and DiI-labeled MSC migration in time and distribution were tested in the intracranial U87 human glioblastoma model in nude mice and analyses were performed by histology and 7T MR imaging. Therapeutic effects of intratumoral (0.4×10^6 cells) application was tested likewise. Control groups received either NaCl instead of GCV or MSC containing the empty vector (MSC-control). Therapeutic efficiency was determined by assessment of tumor size by 7T MR-imaging at day 20 and by establishment of Kaplan-Meier survival curves (n=30).

Results: MSCs showed a high tumor tropism with 4.9 times more MSCs migrating towards U87 compared to controls. The MSCs were mainly detected at the peritumoral border compared to the intratumoral distribution and showed an early peak accumulation after 48 hours. Cell survival and bystander assays using different glioma cell lines confirmed the GCV catalytic activity of MSC expressed TK in a GCV dose dependent manner and a significant bystander effect. Intratumoral application of MSC-TK followed by systemic prodrug application of GCV lead to a significant tumor growth inhibition of 86% versus the control groups ($p < 0.05$) which translated in a significant prolonged survival time ($p < 0.05$).

Conclusion: Our data demonstrates that MSC show a rapid targeted migration to intracerebral glioma and accumulate predominately peritumorally within in short time. We demonstrate that these genetically modified human MSC generated under GCP conform conditions are able to target and provide a significant growth inhibition in a glioma mouse model. Our data support the concept of an autologous stem cell-based therapy for glioblastoma using bone marrow derived MSC.

New pericytes in glioblastoma blood-vessels originate from a previously unrecognized, pericyte progenitor-like cell and promote glioma progression

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Objective: Pericytes have an important role in controlling angiogenic mechanisms in the developing brain and in primary brain tumours (gliomas). Previous studies suggested that newly generated pericytes derive from mitotically active, mature pericytes, which can be identified by the expression of marker molecules and their close association with endothelial cells. Using a newly established lineage-tracing model we show that mature pericytes largely originate from marker-negative cells that are not attached to endothelia. The tumour-supportive role of these pericyte progenitor-like cells (pericyte-PLC) is shown in transgenic mouse models.

Methods: In our mouse model stable fluorescence-reporter activity was obtained after tamoxifen (TAM) inducible genetic recombination controlled by a modified nestin-promoter element (nestin-creER2). To study neoangiogenesis in the brain we orthotopically inoculated mice with syngeneic glioma cells and observed pericyte expansion during tumourigenesis. The identity of these cells was further verified by electron microscopy. To study if these cells are resident to the brain or originate from the periphery we produced bone-marrow (BM) chimeric mice. And finally, in a functional experiment we crossed our nestin-reporter mice to inducible Diphtheria Toxin A (DTA) mice to specifically ablate these cells.

Results: Throughout tumour growth recombined cells expanded in the tumour mass and labelling-experiments with different thymidine-analogues revealed their continuous proliferation. Strikingly, the vast majority of recombined cells in early gliomagenesis was negative for all pericyte-markers investigated (78% of all recombined cells), but they acquired pericyte markers at later stages of tumour expansion (81% PDGFR-B-, 76% NG2-, 74% desmin- and 84% CD146-positive recombined cells). Combinatorial immunofluorescence labelling showed that mature pericytes simultaneously express multiple markers. Few new pericytes were generated in the tumour-periphery or in normal brain. Using this model we were able to lineage-trace in average 34% of all intra-tumoural pericytes. This suggests that a very large part of newly generated pericytes derive from nestin-positive, PDGFR-B-, NG2-, desmin-, CD146-negative cells. Lineage-tracing experiments in bone-marrow chimeric glioma models indicated that pericyte-PLCs are endogenous to the brain. In a functional experiment with DTA-induced cell death under the nestin-promotor we observed a 50% decrease of pericyte-PLCs leading to a 34% decreased tumor vessel density and a reduced glioma volume by 33%.

Conclusion: All in all, our data indicate that newly generated pericytes origin, to a large extent, from a previously unrecognized (pericyte-marker negative) brain-resident precursor cell and that depletion of this pericyte progenitor can be exploited as a novel therapy against glioma.

CCR2-CCL2 axis represents a key pathway for macrophage recruitment to gliomas

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Objective: CCR2-CCL2 signaling is involved in myeloid cell recruitment to tumors and is considered as being a crucial axis for new therapeutic strategies. In glioma, we observed that CCR2ko mice showed 30% less infiltration of myeloid cells within the glioma tissue. Myeloid cells in glioma are composed of microglia and macrophages that both express CD11b and CD45. Glioma-bearing wildtype mice show an upregulation of CD45 expression (CD45^{high}) as a sign of activation. In CCR2ko mice, we found significantly reduced amounts of CD11b⁺CD45^{high} cells. In our study, we aimed to characterize the contribution of microglia and macrophages to the CD45^{high} population, and their specific behavior in reaction to the CCR2-CCL2 signal and the impact on tumor progression. Therefore, we generated bone marrow chimeras to distinguish between microglia and macrophages by GFP-labeling.

Methods: Chimeras were generated using lethal irradiation with head protection. CX3CR1-GFP mice were used as recipient or bone marrow donor allowing the identification of microglia and macrophages. We established chimeras with CCR2ko of either microglia (ko/wt) or macrophages (wt/ko) and with ubiquitous functional CCR2 (wt/wt) as control. After reconstitution, tumor cells were implanted. On day 21 of tumor growth, glioma volumes were measured by MRI. Flow cytometric analyses and immunofluorescence staining were performed.

Results: Flow cytometry revealed that influx of peripheral macrophages into glioma tissues was similar in wt/wt and ko/wt chimeras (26-31%), and the percentage of CD45^{high} cells was comparable (about 40%). In contrast, the group of wt/ko chimeras showed minor infiltration of macrophages within the CD11b⁺CD45⁺ population (approx. 2%) accompanied by a reduced proportion of CD45^{high} cells. Interestingly, the contribution of macrophages to CD45^{high} cells differed extremely. In controls, macrophages accounted for 55% of the CD45^{high} population. The CD45^{high} fraction in wt/ko chimeras consisted of below 7% of macrophages. Indeed, we detected mainly microglia on tumor sections. The ko/wt group showed up to 83% of macrophages within the CD45^{high} population. Nevertheless, brain sections indicated accumulation of macrophages and microglia in glioma. Wt/ko as well as ko/wt chimeras tended to have larger tumor volumes than the control group.

Conclusion: For the first time, we report a recruitment mechanism for macrophages in gliomas. We demonstrate a strictly CCR2-dependent infiltration of macrophages. In contrast, microglia accumulate independently of CCR2. Chimeras with CCR2ko of either microglia or macrophages show larger tumor volumes than control group, confirming the importance of the CCR2-CCL2 signaling in glioma growth. Finally, the predominance of microglia in wt/ko chimeric mice offer a great tool for analyzing the specific behavior of microglia during tumor progression.

MI.14 Tumor 13 - Gliome - Low-grade

Mittwoch *Wednesday*, 17.05.2017, 11.00 – 12.20 Uhr *hrs*

- MI.14.01 *Intraoperative diagnostics of low grade vs high grade gliomas using confocal laserendomicroscopy*
D. Breuskin* (Homburg, Deutschland), J. Oertel
-
- MI.14.02 *Surgical treatment of Lower-Grade Gliomas in the Spotlight of the 2016 WHO-Classification*
D. Delev* (Freiburg, Deutschland), D. Heiland, B. Mercas, G. Petrova, G. Haaker, O. Schnell
-
- MI.14.03 *Clinical and molecular factors impacting progression and survival in IDH1 mutant glioma patients*
F. Löbel* (Berlin, Deutschland), T. Juratli, G. Shankar, D. Mordes, N. Lelic, T. Batchelor, A. Iafrate, F. Barker II, A. Chi, D. Cahill
-
- MI.14.04 *Diffusion-Weighted Imaging Based Probabilistic Quantification of Residual Tumor on Early Postoperative MRI in Low-Grade Glioma*
M. Scherer* (Heidelberg, Deutschland), M. Götz, C. Jungk, K. Maier-Hein, A. Unterberg
-
- MI.14.05 *Identification of 18FET-PET time-to-peak as a prognostic marker specifically in IDH1/2 mutant diffuse astrocytoma*
B. Suchorska* (München, Deutschland), A. Giese, A. Biczok, M. Unterrainer, M. Weller, P. Bartenstein, U. Schüller, N. Albert, J. Tonn
-
- MI.14.06 *Prognostic value of contrast enhancement and histopathological grading in diffuse glioma depends on IDH1/2 mutation*
B. Suchorska* (München, Deutschland), A. Biczok, M. Lenski, N. Albert, A. Giese, C. Schmid-Tannwald, U. Schüller, J. Tonn
-
- MI.14.07 *Recurrent low-grade gliomas: hit hard after malignant transformation?*
S. Kellermann* (Köln, Deutschland), J. Hampl, A. Kohl, I. Duval, R. Goldbrunner, S. Grau
-
- MI.14.08 *The malignant transformation rate of surgically treated low-grade gliomas has not changed during the last four decades*
S. Siller* (München, Deutschland), A. Romagna, S. Nachbichler, J. Tonn, O. Schnell, F. Kreth
-

Intraoperative diagnostics of low grade vs high grade gliomas using confocal laserendomicroscopy

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Objective: Intraoperative distinctions of brain tumors as well as determining the extent of resection are some of the most challenging factors during neurooncological surgery. Confocal laser endomicroscope (CLE) findings of removed tumour tissue were directly compared with intraoperative instantaneous sections by the neuropathologist in a blinded study. Here we present an update concerning low-grade and high-grade glioma differentiation with the CLE.

Methods: in total 42 tumour samples of 42 patients were examined. Of these 32 were diagnosed as high grade gliomas and 10 as low grade gliomas by final neuropathologist report. The imaging device comprises of a rigid endoscope with Hopkins-Rod lenses. The outer diameter is 5 mm and the length amounts 323 mm. The size of the circular scanning field covers 300 µm x 300 µm and the highest achievable resolution is 2 µm. The wavelength of the laser signal is red and scanning depth in 3D-mode is approximately 80 µm. The detected signal consists of reflection and scattering. The frame rate (2D) is almost 40 frames per second (real-time).

Results: Of the 32 high grade gliomas, 26 were diagnosed as such using CLE (81,2%), 30 by conventional intraoperative instantaneous sections (93,75). Of the 10 low grade gliomas 9 were diagnosed as such using CLE (90%), 10 by conventional intraoperative instantaneous sections (100%).

Conclusion: Our results prove that whilst CLE is a new and evolving technology, intraoperative differentiation between low-grade and high-grade gliomas is possible, making CLE an effective tool for quick intraoperative diagnostics.

Surgical treatment of Lower-Grade Gliomas in the Spotlight of the 2016 WHO-Classification

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Objective: According to the new WHO classification lower-grade gliomas are divided into three groups: *IDH1/2* mutated and 1p/19q co-deleted, *IDH1/2* mutated and *IDH1/2* wildtype. The better knowledge of the molecular background enabled a diagnostic classification, improving the prediction of the clinical course and oncological outcome. The aim of this study was to evaluate the impact of different therapeutic strategies for lower-grade gliomas with a particular focus on the revised WHO-classification.

Methods: This is a single-center retrospective analysis including 183 patients, who underwent treatment for lower-grade tumors. All tumors were re-classified according to the 2016 WHO classification. Comprehensive data concerning overall survival, progression free survival, different treatment modalities, functional outcome and Karnofsky Performance score have been collected and analyzed. All patients underwent a molecular profiling. Functional outcome was measured by NANO-Score (where NANO=0 means no neurological deficit).

Results: The stratification according to the molecular subtype showed that the longest OS was achieved in the *IDH1/2* and 1p/19q mutated group (median OS 269 months), followed by the group of IDH mutated (median OS 167.6 months) and wildtype gliomas (median OS 32.5 months).

In the *IDH1/2* mutated subgroup reoperations ($n > 3$ surgeries) for recurrent disease was significantly associated with longer OS (HR=0.3, $p=0.029$), while partial resection (HR=3.5, $p=0.003$) and chemo- or radiotherapy alone (HR=3.7, $p=0.04$) were significantly associated with poor clinical course. Longest OS was achieved in the group of the patients with most surgical interventions (HR=0.3, $p < 0.03$). Insular (HR=3.9, $p=0.01$) and corpus callosum (HR=4.1, $p=0.003$) localization showed shorter OS compared to other tumor localizations. Patients with IDH wildtype gliomas, who underwent only stereotactic biopsy, had a shorter OS (HR 2.1 $p=0.04$) compared to those, who underwent a surgical resection.

Analysis of the functional outcome in the *IDH1/2* mutated group revealed that the risk for development of neurological deficits remained low during the first three surgeries (NANO mean 0.3-0.6). Any further operation increased the risk for functional impairment (NANO mean 1.6-3) significantly. In the *IDH1/2* wildtype subgroup the risk for functional deficit increased significantly even after the second surgery ($p < 0.05$).

Conclusion: The impact of different treatment modalities in lower-grade gliomas is highly dependable on the molecular subtype of the tumors. Less aggressive tumors (*IDH1/2* mutated) seem to profit from more aggressive treatment like gross total resection as well as multiple resections. Reoperations in *IDH1/2* wildtype tumors should be carefully discussed as the risk for neurological impairment increases rapidly, while the impact on the overall survival remains controversial.

Clinical and molecular factors impacting progression and survival in IDH1 mutant glioma patients

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Background: Isocitrate dehydrogenase 1 (*IDH1*) mutant tumors represent a distinct subtype among diffuse gliomas, with improved prognosis compared to histological grade-matched *IDH1* wild-type tumors. Here, we sought to identify factors associated with outcome exclusively within the glioma subgroup defined by *IDH1* mutation.

Methods: We retrospectively analyzed 214 *IDH1* mutant glioma patients (112 WHO grade II, 76 grade III, 26 grade IV) treated at our institution to determine clinical and molecular factors associated with time-to-treatment-failure (TTF) and overall survival (OS). TERT promotor mutation analysis was performed to identify molecular subgroups in our population.

Results: At median follow-up in survivors of 8.38 years, 58 deaths (27.1%) were recorded in the cohort. Median TTF was 5.0 years (95% CI 4.6–5.8) and median OS was 14.6 years (95% CI 12.1–17.4). Adjuvant radiation (median 6.2 versus 4.5 years, $p=.019$) and more-extensive resection (MER) (median 6.7 versus 4.5 years, $p<.001$) were associated with prolonged TTF. Both remained significant predictive factors in a multivariate model of TTF including age and histological grade (HR=.395 for radiation, $p=.0011$ and HR=.520 for MER, $p=.0062$).

MER was also significantly associated with prolonged OS (median 19.01 versus 13.23 years, $p=.0119$).

In the TERT wild-type subgroup, both TTF (median 7.8 versus 3.8 years; $p<.0001$) and OS (median 19.0 versus 11.5 years; $p=.0133$) were significantly prolonged in patients that received a MER. Additionally, adjuvant radiation (median 6.2 versus 3.8 years; $p=.0019$) and adjuvant chemotherapy (median 6.2 versus 3.8 years; $p=.0025$) significantly improved TTF, but not OS. Interestingly, in the TERT mutated subgroup we did not observe a significant benefit from MER ($p=.534$), adjuvant radiation ($p=.08$) or chemotherapy ($p=.88$) for TTF.

Conclusion: Within *IDH1* mutant gliomas, adjuvant radiation therapy and more-extensive resection are independently associated with improved TTF and OS. TERT wild-type patients seem to benefit from MER and adjuvant radiation or chemotherapy.

Diffusion-Weighted Imaging Based Probabilistic Quantification of Residual Tumor on Early Postoperative MRI in Low-Grade Glioma

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Objective: In low-grade gliomas (LGG), early postoperative MRI (epMRI) has been shown to frequently overestimate the amount of residual tumor on fluid-attenuated inversion recovery (FLAIR) sequences. Therefore, residual tumor is usually defined according to follow-up MRI 3 months after surgery (fuMRI). This study sought to evaluate if integration of apparent diffusion coefficient (ADC)-maps permits an accurate estimation of residual tumor also on epMRI.

Methods: Since 2004, 28 consecutive cases with primary surgery for WHO^{II} astrocytomas and complete epMRI and fuMRI including ADC-maps were retrospectively identified. To account for imaging confounders, histology was adjusted and cases with previous radiation therapy were excluded. Residual FLAIR hyperintense tumor was manually segmented on epMRI. After co-registration with corresponding ADC-maps, residual tumor segments were probabilistically clustered into areas of either low-ADC (edema, ischemia), high-ADC (residual tumor) or partial volume. Clustering was based on an expectation maximization (EM) algorithm fitting a mixture model of three respective Gaussians to the normalized ADC histogram. EpMRI residual tumor and results from ADC-clustering were compared with respective residual tumor on fuMRI.

Results: Median residual FLAIR tumor was significantly greater on epMRI compared to intMRI (17.0ccm, range 1.6-122.7ccm vs. 1.8ccm, range 0-168.0ccm, $p < 0.001$). ADC-clustering of epMRI subclassified FLAIR-hyperintense segments into proportions of: $27 \pm 23\%$ residual tumor (median volume 1.7ccm, range 0.2-79.2ccm), $45 \pm 20\%$ ischemia (6.2ccm, range 0.4-47.2ccm) and $28 \pm 20\%$ partial volume (2.9ccm, range 0.2-64.9ccm). After ADC-clustering, the amount of residual tumor on epMRI was comparable to fuMRI ($p = 0.45$) and showed significant correlation (Spearman $r = 0.65$, $p < 0.0001$). The amount of low-ADC clusters on epMRI suggestive for surgical trauma strongly correlated with the difference in FLAIR-hyperintensity between epMRI and fuMRI (Spearman $r = 0.86$, $p < 0.0001$).

Conclusion: With additional information conveyed in ADC-maps, an accurate quantification of residual tumor could already be achieved on epMRI in this series of low-grade astrocytomas. Probabilistic segmentation of ADC-maps helped to reassess the amount of residual tumor under suppression of signal alterations caused by surgical trauma which was the driving force for bias on epMRI. Reliability of ADC-clustering results based on the proportional partial volume has to be evaluated in the future. Larger case-series are needed to evaluate the prognostic impact of ADC-clustering in LGG.

Identification of ^{18}F FET-PET time-to-peak as a prognostic marker specifically in IDH1/2 mutant diffuse astrocytoma

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Objective: Stratification of glial tumors according to IDH1/2 mutation and 1p/19q co-deletion status has gained major importance in the new WHO classification and guides current clinical decision making. Parameters derived from ^{18}F FET-PET uptake dynamics such as minimal time-to-peak (TTP_{min}) analysis allow discrimination between different prognostic glioma subgroups, too. The present study aimed at exploring whether TTP_{min} analysis provides prognostic information beyond the new WHO classification.

Methods: Three-hundred patients with newly diagnosed WHO 2007 grade II-IV gliomas with ^{18}F FET-PET imaging at diagnosis were grouped according to IDH1/2 mutation and 1p/19q co-deletion status into 3 subgroups (IDH1/2 mut/1p/19q co-del; IDH1/2 mut/1p/19q non co-del and IDH1/2 wildtype). Clinical and imaging factors such as age, Karnofsky performance score, treatment, TTP analysis, biological tumor volume (BTV) and tumor-to-brain ratio (TBR) were analyzed with regard to progression-free and overall survival (PFS and OS) via univariate and multivariate regression analysis.

Results: PFS and OS were longest in the IDH1/2 mut/1p/19q co-del subgroup followed by IDH1/2 mut/1p/19q non co-del and IDH1/2 wt patients ($p < 0.0001$). Further, outcome stratified by TTP_{min} with a cut-off of 17.5 minutes revealed significantly longer PFS and OS in patients with $\text{TTP}_{\text{min}} > 17.5$ minutes ($p < 0.0001$ for PFS and OS). Lower TBR_{max} values or the absence of ^{18}F FET-uptake were also associated with favorable outcome in the entire group. Longer median TTP_{min} times were associated with improved outcome specifically in the IDH1/2 mut/1p/19q non co-del group, but neither in the IDH1/2 mut/1p/19q co-del nor in the IDH1/2 wt group.

Conclusion: ^{18}F FET-PET-derived dynamic analysis defines prognostically distinct sub-groups of IDH1/2 mutant/1p/19q-non-co-deleted gliomas which cannot be distinguished as yet by molecular marker analysis.

Prognostic value of contrast enhancement and histopathological grading in diffuse glioma depends on IDH1/2 mutation

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Objective: Contrast enhancement (CE) and anaplasia have been reported to indicate poor outcome in diffuse glioma. Recently, mutational status of the *IDH1/2* gene and co-deletion of on chromosome 1p/19q (co-del 1p/19q) have gained relevance for the evaluation of clinical outcome. Thus, we aimed at re-assessing the value of CE and histopathological grading within this framework of these molecular markers.

Methods: 332 patients with grade II (n=189) or grade III diffuse glioma (n=143) were stratified into 3 groups: *IDH1/2* wild type (n=118), *IDH1/2* mutated with (n=123) and without (n=91) co-del 1p/19q. Preoperative magnetic resonance (MR) imaging was reviewed and volumetrical analyses of CE and T₂ volumes were performed. Univariate and multivariate analyses were conducted using molecular and imaging factors as well as age, Karnofsky performance status, surgical procedure and adjuvant therapy.

Results: In the multivariate analysis, histopathological grading had a strong independent prognostic value on OS in *IDH1/2* wild type tumors (p=0.001). Conversely, CE is not associated with overall survival in *IDH1/2* wild type tumors. In gliomas with *IDH1/2* mutation, presence of CE is an independent prognostic factor for survival independently of its magnitude (p=0.04) while larger T₂ volume is associated with shorter progression-free survival. This effect is especially pronounced in *IDH1/2* mutated tumors without co-del 1p/19q.

Conclusion: In patients with diffuse *IDH1/2* wildtype gliomas WHO grade II/III, CE is not associated with survival. In tumors with an *IDH1/2* mutation, presence of CE on initial MRI is linked to inferior survival, but grading is not.

Recurrent low-grade gliomas: hit hard after malignant transformation?

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Objective: While numerous studies address the impact of extent of resection and different forms of adjuvant therapy in WHO grade II gliomas, the gap in knowledge concerning treatment options after malignant transformation is striking.

Methods: In a retrospective single-center study all adult patients with initial diagnosis of low-grade glioma between 1998 and 2015 undergoing tumor resection after malignant progression were identified. Besides demographic values, we evaluated preoperative Karnofsky performance score (KPS), histology, extent of resection and adjuvant treatment. Outcome measure was post-progression survival (PPS). For statistical calculation Kaplan–Meier estimates were used.

Results: A total of 43 patients with progressed LGG that had undergone surgery were identified. At the time of progression, the median age was 45 years and the median preoperative KPS 90%. In 25 patients (58.1%) complete resection of contrast enhancing tissue could be achieved. Median survival after re-resection was 57 months and median overall survival 137 months. Complete removal of contrast enhancing tumor tissue, adjuvant concomitant radio-chemotherapy, prior radiotherapy and oligodendroglial subtype were significantly correlated with improved PPS.

Conclusion: Patients in good clinical status with malignant transformation of previously treated low grade gliomas should receive aggressive treatment including re-resection followed by radio-chemotherapy.

The malignant transformation rate of surgically treated low-grade gliomas has not changed during the last four decades

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Objective: The transition from WHO grade II to grade III/IV is detrimental for the prognosis of patients with low-grade gliomas. It remains unclear whether improvement of both imaging and surgical techniques has reduced the risk of malignant transformation (MT) over time. In this retrospective, two-institutional study, we estimated malignant transformation rates (MTRs) in 3 cohorts of adult patients with supratentorial WHO grade II gliomas covering a time span of 37 years (1979-2009). All patients received surgically based highly localized initial treatment.

Methods: Study populations referred to 3 distinct treatment epochs, i.e. epoch I (1979-1992; 239 patients undergoing initial brachytherapy), II (1991-1998; 159 patients undergoing tumor resection), and III (1998-2009; 71 patients treated with brachytherapy and/or resection). Median follow-up for the survivors in the respective treatment epochs was >120 months. Adjuvant treatment was always withheld until tumor progression occurred. Reference point was the date of initial treatment. Endpoint was the date of MT which was considered to have occurred in case of i) histologically verified WHO Grade III/IV disease and/or ii) multilobar tumor appearance and/or iii) contrast enhancement of an initially non-enhancing lesion in combination with rapid tumor growth. Secondary endpoint was survival after MT. For survival analyses the Kaplan-Meier method was used. Prognostic factors were assessed with proportional hazards models. Patients' informed consent and approval by the local ethical review board was obtained.

Results: Patients of the respective treatment epochs did not differ in terms of age and Karnofsky score. Tumors were smaller ($p < 0.001$) and more often left-sided ($p = 0.002$) in epoch I; lobarly located tumors were most often seen in epoch II ($p < 0.001$). 5- (10-) year MTRs ranged from as low as 30.3% (47.1%) to as high as 34% (61%) with no significant difference between the 3 treatment epochs ($p = 0.4$). Kaplan-Meier curves did not level-off even ten years after treatment in either of the cohorts. A larger tumor volume ($> 25\text{ml}$; $p = 0.002$) was a risk factor for MT in each of the cohorts and overall. Neither treatment mode nor extent of resection affected the risk of MT. 1- (2-) year survival after MT ranged from as low as 51.1% (25.5%) to as high as 75.6% (40.1%); it was shortest in epoch I ($p = 0.02$).

Conclusion: Despite advances in imaging and surgical techniques, the risk of MT after localized initial treatment still seems to be predominantly determined by the natural course of the disease.

MI.15 Joint Meeting Session 10 – Cervical Spine 2

Mittwoch Wednesday, 17.05.2017, 11.00 – 12.20 Uhr hrs

- MI.15.01 *Disease severity does not reduce time to neurosurgical assessment in degenerative cervical myelopathy*
B. Hilton* (Cambridge, United Kingdom), B. Davies, A. Komashie, M. Kotter
-
- MI.15.02 *Spinal degenerative changes correlate with the development of degenerative cervical myelopathy*
B. Hilton* (Cambridge, United Kingdom), B. Davies, M. Kotter
-
- MI.15.03 *Diagnostic yield of cervical spine MRI scans – an insight into the incidence of degenerative cervical myelopathy*
B. Hilton* (Cambridge, United Kingdom), B. Davies, M. Kotter
-
- MI.15.04 *Reversible reorganization of motor area and excitability in cervical spondylotic myelopathy: The Corticospinal Reserve*
A. Zdunczyk* (Berlin, Deutschland), V. Schwarzer, I. Bährend, T. Picht, P. Vajkoczy
-
- MI.15.05 *Endogenous inflammatory and angiogenic response in cervical spondylotic myelopathy – a pilot series*
C. Blume* (Aachen, Deutschland), H. Clusmann, L. Brandenburg, M. Schmeisser, C. Müller
-
- MI.15.06 *Radiographic Findings after Anterior Cervical Discectomy and Fusion with Translational and Rotational Plating System*
B. Burkhardt* (Homburg, Deutschland), M. Kerolus, V. Traynelis, R. Fessler
-
- MI.15.07 *Parvovirus B19 infection in intervertebral disc*
A. Reinke* (Donauwörth, Deutschland), M. Sailer, M. Behr, B. Meyer, J. Lehmborg
-
- MI.15.08 *Antibiotic therapy in surgically treated pyogenic vertebral discitis: is a 6 weeks therapy accessible?*
J. Scorzin* (Bonn, Deutschland), A. Boström, H. Vatter
-

Disease severity does not reduce time to neurosurgical assessment in degenerative cervical myelopathy

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Objective: Degenerative cervical myelopathy (DCM) is spinal cord compression due to degenerative changes in the surrounding spine. DCM causes progressive spinal cord damage which can be arrested by surgical decompression. This study examines DCM patient flow through a healthcare system.

Methods: A retrospective cohort of 12 cases of DCM. Patients were identified by screening 3 months of cervical MRI scans at a tertiary neurosciences centre. Electronic records were used to document patient interactions (e.g. investigations or consultations) and disease severity (by inferring their modified Japanese Orthopaedic Assessment score based on documented findings) with respect to time since disease onset. Analysis was performed using linear regression and Chi-Squared tests. Averages expressed as medians \pm interquartile range.

Results: Disease severity increased from 16 ± 1.5 at primary care referral to 15 ± 3.75 at neurosurgical assessment. Time from symptom onset to MRI scan was 8.6 ± 7.7 months and a further 3 ± 3 months to neurosurgical assessment. DCM progressed between MRI scan and neurosurgical assessment (-0.5 ± 1.75). Disease severity did not correlate with referral times; from primary to secondary care ($R^2=0.03$, $p=0.65$) or MRI scan to neurosurgical assessment ($R^2=0.06$, $p=0.48$).

Conclusion: Delays in diagnosis and specialist assessment of DCM exist, even amongst the more severely affected patients. Patients with proven cord compression deteriorated waiting to see a spinal surgeon. A larger scale multivariate model is required to identify components of the healthcare system which influence management to optimise the patient pathway and improve outcomes

Spinal degenerative changes correlate with the development of degenerative cervical myelopathy

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Objective: Degenerative cervical myelopathy (DCM) is spinal cord compression due to degenerative changes in the surrounding spine. The study examines the prevalence of key pathological changes in the cervical spine that increase the likelihood of a patient being clinically myelopathic

Methods: A retrospective cohort of 281 patients receiving a cervical spine MRI scan in a 3 month period at a tertiary neurosciences centre. All cervical spine MRI scans were examined for reported pathological features. A comparison was made between myelopathic patients with cord compression, non-myelopathic patients with cord compression, and non-myelopathic patients without cord compression. Chi squared analysis was conducted to identify statistically significant pathological differences between groups.

Results: DCM MRI scans showed significantly higher rates of osteophytosis, ligamentous pathology, and T2 hyperintensity than the spines of non-myelopathic patients ($p < 0.01$). DCM patients averaged 3.25 key degenerative changes whereas non-myelopathic patients with cord compression averaged 1.8 ($Z = -5.6$, $p < 0.05$). 69% of DCM had cord "compression". The remaining 31% had other terminology used to describe their cord compromise. Number of degenerative changes did not correlate with disease severity at time of scan ($R^2 = 0.08$, $p = 0.36$) or at surgical assessment ($R^2 = 0.28$, $p = 0.11$).

Conclusion: In patients with MRI confirmed cervical cord compression, clinical myelopathy was associated with more degenerative spinal changes. The number of changes did not correlate with myelopathy severity.

Diagnostic yield of cervical spine MRI scans – an insight into the incidence of degenerative cervical myelopathy

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Objective: Degenerative cervical myelopathy (DCM) is spinal cord compression due to degenerative changes in the surrounding spine. The epidemiology of DCM is poorly understood. The aim of this study was to estimate its incidence by considering 3 months of MRI scans at a tertiary neurosciences centre.

Methods: A retrospective cohort of 281 patients receiving a cervical spine MRI scan in a 3 month period at a tertiary neurosciences centre. All cervical spine MRI scans were examined for the clinical indication for the scan and the pathology reported.

Results: Neural compression (39%) and trauma (27%) were the predominant indication for cervical MRI imaging. Other indications included: treatment planning (11%), inflammation (10%), malignancy (6%), other (7%). Number of scans triggered by symptom: upper limb paraesthesia/weakness (25%), neck pain (21%), numb hands (7%), lower limb paraesthesia/weakness (7%). DCM and inflammatory disease triggered 23 and 19 MRI scans respectively. New DCM findings were 2.6 times more common than new onset inflammatory lesions.

Conclusion: Suspected neural compression was the largest cause for cervical MRI investigation. New onset DCM was more common than new onset inflammatory lesions.

Reversible reorganization of motor area and excitability in cervical spondylotic myelopathy: The Corticospinal Reserve

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Objective: We have recently shown a compensatory reorganization of the corticospinal network in patients with cervical spondylotic myelopathy which led to the concept of the 'corticospinal reserve capacity'. In patients with mild symptoms (JOA>12) and preserved reserve an increased motor area due to a higher recruitment of supplementary motor areas was observed. In contrast, severely symptomatic patients (JOA<12) with an exhausted reserve presented with a restricted motor area, reduced recruitment curve and increased inhibition. Here we present the 9 months follow up in order to study how the status of the reserve impacts on the outcome after decompression and whether these plastic changes are reversible

Methods: 9 patients with a cervical myelopathy due to cervical spinal canal stenosis were examined preoperatively and in a 9 months follow up with nTMS. On the basis of the initial JOA score two patient groups were established (JOA<12/>12). We determined the resting motor threshold, recruitment curve, cortical silent period and motor area for the FDI muscle bilaterally.

Results: The RMT showed no difference in the follow up measurement for both groups (preoperative/ follow up RMT JOA<12 p=.069/ JOA>12 p=.060) Operative decompression led to a reconstitution of motor area size in the severely symptomatic patient group (motor area left / right hemisphere mean \pm SD preoperative JOA<12: 194,4 \pm 121,3 mm²/ follow up 430,1 \pm 253,4 mm² p=.034). These patients presented with a good clinical recovery (JOA<12 group: JOA preoperative 9,0 \pm 0,5/ follow up 12,4 \pm 2,5). In patients with preoperatively few symptoms (JOA>12) and preserved corticospinal reserve no significant change in motor area size was detected. However the compensatory increased recruitment of supplementary motor areas and disinhibition diminished after 9 months (JOA>12 M2 area preoperative 59,4 \pm 91,8 mm² / follow-up 2,1 \pm 4,2 mm² p=.023; CSP preoperative 147.5 \pm 37.8 ms/ follow up 164.3 \pm 41.8 ms p=.03) These patients remained clinically stable during follow-up (JOA preoperative 14,2 \pm 1,3/ follow up 13,8 \pm 1,9)

Conclusion: Based on these results, we could detect reversible adaptive mechanisms on the cortical and spinal level, i.e. corticospinal reserve capacity. This functional reorganization appears to be reversible following surgical decompression. Furthermore, operative decompression led to a reconstitution of motor area size in patients with an exhausted reserve. This was also reflected in a good clinical recovery. These changes in nTMS parameters might serve as a valuable prognostic factor in these patients in the future.

Endogenous inflammatory and angiogenic response in cervical spondylotic myelopathy – a pilot series

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Objective: The aim of this prospective study was to evaluate the different alterations of inflammatory angiogenic mediators in cerebrospinal fluid (CSF) and blood serum (BS) in patients with cervical spondylotic myelopathy (CSM).

Methods: In patients with CSM who underwent lumbar myelography CSF and BS were sampled. Patients were monitored for neurological symptoms including NDI and mJOA. Clinical follow up with examination, BS sampling for protein concentrations, and questionnaires were performed preoperatively (preop) and 5 days, 6 weeks, 3, 6, 9, 12 and 18 months postoperatively (postop). A control group with preop CSF and BS samples was formed from patients with abdominal aortic aneurysm surgery (AAA-group), who had a lumbar drain for intradural pressure monitoring. The control group was monitored to exclude neurological signs of CSM (mJOA). The samples were evaluated with ELISA. Following angiogenic protein-concentrations were measured in CSF and BS in pg/ml: PDGF-BB (Platelet-derived growth factor), RANTES (regulated on activation, normal T cell expressed and secreted), Endoglin, Angiopoietin-2, Endothelin-1, VEGF-A, C, D (Vascular Endothelial Growth Factor), FGF-1 and 2 (Fibroblast Growth Factor), EGF (Epidermal Growth Factor and Interleukins (IL-1, 6, 8, 10, 17)

Results: Overall 26 patients were included. CSM-group 14 patients (mean age 64 years), AAA-group 12 patients (mean age 58 years ($p=0.178$)). Mean preop scores: mJOA CSM-group 9.2, AAA-group 17.0 ($p<0.001$); NDI CSM-group 49.7, AAA-group 1.2 ($p<0.001$). We identified significant differences in the CSF preop: Angiopoietin-2 CSM-group 243.6 vs AAA-group 388.2 ($p=0.022$); VEGF-A CSM-group 12.3 vs AAA-group 5.0 ($p=0.019$); IL-1alpha CSM-group 100.3 ± 86.5 vs AAA-group 38.3 ± 52.1 ($p=0.047$); IL-1beta CSM-group 20.9 ± 25.9 vs AAA-group 0.9 ± 0.6 ($p=0.031$). In BS, only Endoglin was different in CSM-group 1526.9 vs AAA-group 975.4 ($p=0.024$). In the clinical follow up examinations of the CSM-group mJOA and NDI showed significant improvement from the third month postop.

Conclusion: The groups are clearly distinguished regarding the clinical signs of myelopathy. Higher concentrations of some angiogenic factors in the CSF are associated with the diagnosis of CSM. Thus, they could contribute to an increased induction of angiogenesis (VEGF-A, Endoglin) and a dysregulation of microvascular permeability (Angiopoietin-2) in patients with CSM. These factors may serve as tools for further research on prognosis and pathophysiology. A limitation is the non-availability of postoperative CSF, in general.

Radiographic Findings after Anterior Cervical Discectomy and Fusion with Translational and Rotational Plating System

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Objective: Anterior cervical discectomy and fusion (ACDF) with a cervical plate allows for decompression of neural structures and maintenance or correction of cervical alignment. Cervical lordosis has been correlated with good clinical outcomes and it is clear that segmental kyphosis is detrimental to clinical outcome and predisposes patients to adjacent segment degeneration. The radiographic change in cervical alignment using lordotic and non-lordotic grafts for ACDF has already been reported. The role of the anterior cervical plating on these postoperative radiographic parameters has yet to be assessed.

Methods: A retrospective review of 59 consecutive patients were separated into two groups depending on the allograft and the cervical plating system that was used. All patients underwent a 1, 2 or 3 level ACDF for cervical spondylosis using either a translational plating system with a 2-3° lordotic allograft or a rotational plating system with a 6° lordotic allograft. Plain neutral radiographs were assessed preoperatively, immediately after surgery and at the most recent follow-up. The measured radiographic parameters included C2-7 lordosis, segmental sagittal alignment (SSA), sagittal vertical alignment (SVA), adjacent SSA, disc height, adjacent segment ossification, plate to disc space distance (PDS), height of fusion, fusion rate and implant migration.

Results: There were thirty patients in group 1 and twenty-nine patients in group 2. A 1-level ACDF was performed in 10 and 9 patients respectively, a 2-level ACDF was performed in 14 and 15 patients respectively, and 3-level ACDF was performed in 6 and 5 patients respectively. The mean follow-up was 14.8 and 13.1 month, respectively. The immediate postoperative and most recent follow-up radiographs revealed improvement of C2-7 lordosis, SSA, and adjacent SSA in both groups. Further, a worsening of the SVA, a decrease in fusion height, an increase in adjacent segment ossification, and a loss of PDS were seen in both groups. After initial improvement on the first postoperative radiograph, the trend favored deterioration on the most recent radiograph in both groups. There was no significant difference in the improvement or worsening of these radiographic parameters between both groups. A higher rate of screw pull out was seen using a rotational construct. The fusion rate was 98.2% and 92.6%, respectively.

Conclusion: Performing an ACDF with allograft and either a dynamic translational or rotational plating systems provides adequate correction of cervical alignment. There is no significant difference in improvement or worsening of radiographic parameters in either group. In both groups, these parameters worsened at the time of the second postoperative radiograph; however, these changes were still an improvement from the preoperative radiographs.

Parvovirus B19 infection in intervertebral disc

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Objective: Virus are known as origin for various diseases. Vaccination against human papilloma virus is established for avoiding cervix carcinoma. Furthermore, Parvovirus B19 seems to play a role in appearance of cardiomyopathy and rheumatoid arthritis. Disc herniation is generally considered as a degenerative disease. But can we explain a disc herniation in youth and young adults to be degenerative? For evaluation the pathogenicity of parvovirus B19 related to the onset of disc herniation the present study was designed.

Methods: Out of 47 patients with lumbar or cervical disc herniation that underwent spinal surgery, the disc herniation was tested for Parvovirus by PCR (cervical prolapse n=16; lumbar prolapse n=31). After surgical excision of the herniated disc the sample tissue was placed in RNA-later and stored at -20°C until the virological analysis was made. Initially samples of the patients' blood serum were screened with ELISA for IgG antibodies. After the mechanical comminution of the disc material the nucleic acid was automatically extracted. Subsequently the viral nucleic acid was detected with quantitative polymerase chain reaction. Prion Protein DNA was added to the lysis buffer before the extraction as a combined extraction and inhibition control. The validity of the PCR tests was assured through positive controls and standards, which need to be in a certain target range

Results: In 21 samples we could detect positive PCR-results for Parvovirus, while the internal control is in the expected normal range. The serological testing of our patient collective showed a 76.6 % IgG-positive result (n=36), corresponding to the available data in literature for the spread of infection in the average population. Consequently 58.3% of serological positive patients and 44.9% of all patients showed an infection with Parvovirus B19 in herniated disc.

Conclusion: The results of Parvovirus in herniated disc are surprising. This evidence suggests a possible correlation between the Parvovirus and the appearance of a disc herniation.

Antibiotic therapy in surgically treated pyogenic vertebral discitis: is a 6 weeks therapy accessible?

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Objective: There are no guidelines according to antibiotic treatment duration (ATD) for surgically treated patients with pyogenic vertebral discitis. Although recently there is evidence that a 6 weeks antibiotic treatment is not inferior to a 12 weeks treatment in conservatively treated patients. Since then, we liberalized our former rigid 12 weeks treatment to a feasible 6 weeks treatment. Most surgeons end the antibiotic treatment according to clinical appearance, normalized infection parameters like C-reactive protein (CRP) and radiological survey in the follow-up.

We retrospectively investigated our surgically treated patients with pyogenic vertebral discitis (PVD) since 2015 for the difference in ATD.

Methods: We searched our local database for patients who matched the criteria for PVD. 50 patients were surgically treated to reduce the infection mass and to fuse the affected segments over a period of 20 months.

In cases with identification of the pathogen targeted antibiotic therapy was performed. Otherwise an empirical antibiotic therapy was started. The patient's surgeon decided about the intended ATD before discharge. In the follow-up the patients' clinical appearance, CRP measurements and MRI findings were collected to decide about the termination of antibiotic therapy. Intended follow-up was after 6 and 12 weeks.

Results: In 25 cases (m : f = 16 : 9; mean age 73 yrs) the acquired follow-up visits (at least one follow-up), CRP measurements and MRI were available for further investigation. In 14/25 cases (56%) we intended to treat < 12 weeks. In 5/14 patients (36%) the ATD was < 12 weeks and as intended. 9/14 patients (64%) had ATD longer than intended, 2 patients (14%) remained still below 12 weeks and the other 7 patients exceeded 12 weeks of ATD. Overall 50% of cases, which were intended to treat < 12 weeks, effectively received antibiotic therapy for less than 12 weeks.

Conclusion: There is lack of evidence regarding the optimal duration of antibiotic treatment as well as regarding the appropriate follow-up parameters in surgically treated patients with PVD. In our collective at least 50 % of patients could receive antibiotic therapy shorter than 12 weeks when initially intended so. We think a antibiotic treatment duration less than 12 weeks in surgically treated PVD is possible in a considerable number of cases and needs to be discussed further.

MI.16 Funktionelle Neurochirurgie 4

Mittwoch *Wednesday*, 17.05.2017, 11.00 – 12.10 Uhr *hrs*

- MI.16.01 *Keynote Lecture - Neurochirurgische Therapie bei Gesichtsschmerzen*
Dirk Rasche (Lübeck, Deutschland)
-
- MI.16.02 *Operative findings and outcome of microvascular decompression for trigeminal neuralgia in patients with multiple sclerosis*
G. Hatipoglu Majernik* (Hannover, Deutschland), J. Krauss
-
- MI.16.03 *Role of macrostimulation on clinical outcome (UDPRS-III) in subthalamic deep brain stimulation procedure for Parkinson's disease*
A. Pinter, K. von Eckardstein* (Göttingen, Deutschland), F. Sixel-Döring, T. Behm, V. Rohde, C. Trenkwalder
-
- MI.16.04 *Spinal cord stimulation and MRI-compatibility*
D. Rasche* (Lübeck, Deutschland), V. Tronnier
-
- MI.16.05 *Spinal cord stimulation for the treatment of Complex Regional Pain Syndrom (CRPS): a retrospective case series with 24 months follow-up*
F. Schwarm* (Gießen, Deutschland), K. Graf, M. Stein, M. Reinges, E. Uhl, M. Kolodziej
-
- MI.16.06 *Technical aspects and outcome in Sphenopalatine ganglion stimulation (SPG) for Cluster headache*
J. Vesper, J. Maciaczyk, P. Slotty, P. Slotty* (Düsseldorf, Deutschland)
-
- MI.16.07 *The Centromedian-Parafascicular Complex may signal behaviorally relevant events*
A. Beck* (Hannover, Deutschland), K. Schwabe, M. Abdallat, P. Sandmann, R. Dengler, J. Krauss
-

Operative findings and outcome of microvascular decompression for trigeminal neuralgia in patients with multiple sclerosis

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Objective: Trigeminal neuralgia (TN) might occur in patients with multiple sclerosis (MS). Although these patients have typical attacks they are often not considered as candidates for microvascular decompression (MVD). Optimal treatment in this group patients is unclear. Here we examine surgical findings and the results of MVD in multiple sclerosis.

Methods: Thirteen patients with MS affected by trigeminal neuralgia underwent MVD. All patients had a magnetic resonance imaging (MRI), which showed radiological findings of MS, before surgery. Results were assessed by clinical follow-up and periodic phone surveys. Mean follow-up was 34 months.

Results: There was no surgery related morbidity or mortality. All patients became refractory to medication preoperatively. Intraoperative findings indicated scar tissue at the trigeminal entry zone (11 patients), arterial contact (6 patients) and venous contact (7 patients). Initial postoperative pain relief was observed in 10 out of 11 patients. One patient had partial pain relief. In the follow-up 7 patients had pain relief, 3 had partial relief which were controlled with medication and 3 had recurrence. Two patients underwent a second MVD because of tefloma. One patient had 2 MVDs and afterwards percutaneous radiofrequency rhizotomy (PRR) because of pain persistence.

Conclusion: MVD initially provides good pain relief and in the long term follow up complete and partial pain relief was achieved in the 10 of 13 patients. Moreover, the intraoperative findings show neurovascular compression in all patients which was not determined by all patients in preoperative MRIs. Therefore, we suggest that although the success rate in this patients group is relatively lower compared to idiopathic TN patients group, MVD should be a seriously considered treatment option for TN in patients with MS.

Role of macrostimulation on clinical outcome (UDPRS-III) in subthalamic deep brain stimulation procedure for Parkinson's disease

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Objective: Subthalamic (STN) lead placement for Parkinson's disease typically involves MR-based target planning, microelectrode recording (MER), and macrostimulation. Macrostimulation in the awake patient is used to test for clinical responses as well as stimulation induced side effects and is thought to optimize lead position. Little is known of the impact of intraoperative macrostimulation on clinical long-term results.

Methods: We performed a review of prospectively collected data of clinical outcome scores of patients undergoing bilateral placement of non-segmented leads in the STN and compared patients in respect to consistency of results of MER and macrostimulation. Group A consisted of patients where trajectory selection for final lead placement followed consistent MER and macrostimulation results; group B included patients where trajectory selection for final lead placement followed macrostimulation results that were different from MER unilaterally; group C included patients in which there was a mismatch between MER and intraoperative macrostimulation bilaterally and lead placement hence followed macrostimulation results. We hypothesized that UPDRS-III scores at one year do not differ in those patient groups.

Results: We included 47 patients with 94 leads (42.6% female; mean age 60 ± 7.2 years). In 21 patients with consistent MER and macrostimulation results bilaterally (group A), UPDRS-III score at one year was 11.6 ± 8.5 stim ON and 39.0 ± 11.6 stim OFF. In 14 patients with unilaterally inconsistent MER and macrostimulation (group B), the score reading was 14.6 ± 11.0 stim ON and 40.0 ± 11.1 stim OFF. In group C (bilaterally inconsistent MER and macrostimulation results, 12 patients), patients showed a UPDRS-III score at one year of 15.6 ± 6.5 stim ON and 45.8 ± 12.9 stim OFF. The UPDRS-III score between groups is of no significant difference (ANOVA test).

Conclusion: Macrostimulation may alter trajectory preselection based on MER. As motor outcomes do not differ in those cases where macrostimulation overrules MER tract selection we assume that with non-segmented electrodes macrostimulation provides important information for optimal tract selection.

Spinal cord stimulation and MRI-compatibility

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Objective: Spinal cord stimulation (SCS) is an invasive treatment option for various chronic neuropathic pain syndromes. An estimated number of 1500 implants per year are performed in Germany. Because of the expanding indications and increasing number of magnetic resonance imaging-examinations it is of most importance that implanted materials are MRI-conditional. In detail, the MRI-scan with the body-coil is the significant problem for all ferromagnetic implants. A recent overview of the available SCS implants with respect to the MRI-conditional and the clinical experience will be presented.

Methods: Different stimulation devices of at least four companies are available for SCS in Germany. Usually, a SCS implantable system mostly consists of a lead, an extension and a stimulation device. The main risk of MRI-scanning with ferromagnetic implants is the heating and thus tissue damage around the devices, in first instance the lead. Since January 2013 a neurostimulation device with a new designed lead and a modified impulse generator is approved for SCS and 1.5 Tesla MRI-scanning with the body-coil. In 2016 another SCS device received the approval for MRI full-body-scan with the body coil in 1.5 Tesla scanners.

Results: In more than 70 patients a MRI-conditional SCS device was implanted. In each case the stimulation lead were directly connected to the stimulation device and no extensions were used. Prior to the MRI-scanning an impedance measurement was carried out and, in case of normality, the device was switched off to an MRI-safety mode. Different MRI-scans with adapted scan parameters were performed in the implanted patient sample, e. g. lumbar spine, heart, breast etc. No adverse events or technical failures of the implanted materials were noted. Also no complaints or discomfort were reported by the patients during or following the MRI-scans. Only local distortion or minor artifacts were seen on the MRI-scans at the site of the implanted materials, but these did not influence the image quality and evaluation.

Conclusion: In all de novo SCS procedures the use of MRI-conditional implants is recommended. Therefore all companies should make the effort that future devices for SCS achieve the approval for full-body MRI-scanning with a body-coil, at least in 1.5 Tesla scanners. Additionally detailed patient information and a standardized safety protocol for radiologists conducting MRI-examinations in patients with SCS should be easily available and strictly followed.

Spinal cord stimulation for the treatment of Complex Regional Pain Syndrome (CRPS): a retrospective case series with 24 months follow-up

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Objective: Complex regional pain syndrome (CRPS) is a common pain condition which usually occurs after trauma or operation on a limb. It is characterized by pain, functional impairment, and trophic changes. Neurosurgical treatment is not widely offered. In this study the treatment with spinal cord stimulation (SCS) was evaluated over 24 months follow up.

Methods: A retrospective case analysis of 6 patients with CRPS was performed. Pain chronicity was recorded with the Mainz Pain Staging System (MPSS). Pain intensity (VAS), activity level and health-related quality of life (EQ-5D-5L), the actual mood state (ASTS), and treatment satisfaction (CSQ-8) were assessed. All patients received conventional pharmacological treatments including multimodal pain therapy through their local pain therapist or in specialized centers as well as physical therapy. A SCS electrode was implanted for trial stimulation. After successful trial a neurostimulator was implanted and connected to the electrode. Patients were retrospectively analyzed before implantation, and 6, 12 and 24 months postoperatively. Statistical analysis was performed using Mann-Whitney U and Wilcoxon rank-sum test.

Results: Patients median age was 43 years (range 36-54 years). The median MPSS Score was 3 of 3 indicating a very high pain chronicity. Median VAS before implantation of the neurostimulator was 8.8. A reduction to 7.8 after 6 months, 6.5 after 1 year, and 6.8 after 2 years was achieved ($p=0.32$). Median EQ-5D-5L index value before treatment was 0.27 (range 0.24-0.47) indicating a severely lowered quality of life. A significant improvement to 0.53 (range 0.26-0.76) after 6 months, 0.58 (range 0.26-1) after 1 year as well as after 2 years was seen ($p=0.03$). ASTS scale showed an increase of values for positive mood, and a reduction in values for sorrow, fatigue, anger, and desperation during the whole follow up period after implantation of the neurostimulator. The treatment satisfaction in the whole cohort with a median CSQ-8 value of 29.5 of 32 was very high.

Conclusion: The results of this small case series showed a significant improvement of the EQ-5D-5L after implantation of a neurostimulator. VAS reduction was not significant but a tendency towards reduced values was observed. We therefore conclude that SCS is an alternative option to relieve chronic pain and psychological distress originating from complex regional pain syndrome (CRPS) if conservative treatment modalities fail. The preoperative selection plays a crucial role for good results.

Technical aspects and outcome in Sphenopalatine ganglion stimulation (SPG) for Cluster headache

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Objective: Cluster headache (CH) is a debilitating, severe form of headache. A novel non-systemic therapy has been developed that produces therapeutic electrical stimulation to the sphenopalatine ganglion (SPG). Our experiences with a transoral surgical technique for inserting the Pulsante SPG Microstimulator into the pterygopalatine fossa (PPF) are presented herein.

Methods: We implanted 5 CH pats so far, 3 females, 2 male. 2 out the total already received an ONS device with partial (30% seizure reduction) long-term effect. Technical aspects include detailed descriptions of the preoperative planning using computed tomography scans, 3D printouts of the individual skull base for presurgical digital microstimulator insertion into the patient-specific anatomy and intraoperative verification of microstimulator placement. Surgical aspects will be presented including techniques to insert the microstimulator into the proper midface location atraumatically

Results: 4 weeks after implantation stimulation was switched on, patients are asked to stimulate 15 minutes during the attacks. All patients benefit from surgery so far. The 2 combined ONS/SPG patients were almost free of attacks. The further 3 patients reported (preliminary 6- 8 weeks after OR) already an improvement including a reduction of attack duration and severity. One surgical complication occurred with misplacement of the electrode into the ethmoidal sinus. By using intraoperative CT this was immediately revised and ended in an accurate final electrode position. During the Pathway CH-1 and Pathway R-1 studies, 99 CH patients received an SPG microstimulator. Ninety-six had a microstimulator placed within the PPF during their initial procedure. Perioperative surgical sequelae included sensory disturbances, pain, and swelling. Follow-up procedures included placement of a second microstimulator on the opposite side (n=2), adjustment of the microstimulator lead location (n=13), re-placement after initial unsuccessful placement (n=1), and removal (n=5). This SPG microstimulator insertion procedure has sequelae comparable to other oral cavity procedures including tooth extractions, sinus surgery, and dental implant placement. Twenty-five of 29 subjects (86%) completing a self-assessment questionnaire indicated that the surgical effects were tolerable and 90% would make the same decision again.

Conclusion: SPG is safe and feasible. We hereby present the technique and preliminary personal results of this new approach for a debilitating disease. With an interdisciplinary team technical limits can easily be solved. Further studies are required regarding long-term efficacy of this promising method.

The Centromedian-Parafascicular Complex may signal behaviorally relevant events

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Objective: The centromedian-parafascicular complex (CM-Pf) of the intralaminar thalamus was shown to be activated during attentional orienting and processing of behaviorally relevant stimuli. Therefore, the CM-Pf was suggested to be a part of a subcortical cognitive control loop. Here, we investigated the human CM-Pf and its involvement in processing of task relevant information during an auditory three-class oddball paradigm with simultaneous cortical recordings.

Methods: Simultaneous intracranial local field potentials (LFPs) and scalp electroencephalographic (EEG) recordings were obtained in 6 patients (2 woman; mean age=48±12 years) who received deep brain stimulation (DBS) electrodes in the CM-Pf for the treatment of their pain syndromes. Within 2 days after surgery, they performed an auditory three-class oddball paradigm with externalized DBS electrodes. Subcortical and cortical event-related potentials (ERPs) were analyzed upon presentation of one frequent standard stimulus (900Hz; 72%) and two infrequent stimuli (600Hz and 1200Hz; 14%), either being a relevant or a distractor stimulus.

Results: Analysis revealed high accuracy (>70%) for all participants. As expected, the rare relevant stimuli elicited a P3 response over parietal regions in the EEG. The P3 component of an ERP is known to reflect attentional processes in tasks requiring stimulus detection and discrimination. Recordings in the CM-Pf revealed highest amplitudes to the relevant stimuli as well. Interestingly, peak latencies of the CM-Pf precede the cortical P3 response.

Conclusion: The CM-Pf seems to be involved in goal-oriented action selection and attentional mechanisms. Importantly, subcortical responses in the CM-Pf precede cortical responses, suggesting that auditory information is labelled as behavioral relevant from subcortical circuits and is then distributed to cortical areas; possibly via thalamo-striatal loop mechanisms.

MI.17 OP-Techniken 5

Mittwoch *Wednesday*, 17.05.2017, 11.00 – 12.20 Uhr *hrs*

- MI.17.01 *Endoscopic endonasal surgery for removal of pituitary adenomas - treatment results using different two- and three-dimensional visualization systems*
S. Hajdari* (Erfurt, Deutschland), C. Jacobi, C. Schönfelder, G. Kellner, A. Meyer, S. Rosahl, R. Gerlach
-
- MI.17.02 *Simpson grading revisited: Surgeon's estimation of meningioma removal vs. postoperative 68GA-DOTATATE PET/CT*
M. Ueberschaer* (München, Deutschland), F. Vettermann, P. Bartenstein, J. Tonn, N. Albert, C. Schichor
-
- MI.17.03 *Complications in vestibular schwannoma resections via the retrosigmoid approach*
M. Hummel* (Würzburg, Deutschland), R. Nickl, J. Perez, R. Hagen, R. Ernestus, C. Matthies
-
- MI.17.04 *The Endoscopic Treatment of Colloid Cysts with Focus on Intraoperative Complications*
S. Senger* (Homburg/Beeden, Deutschland), S. Linsler, J. Oertel
-
- MI.17.05 *Cranial and spinal robot-guided surgery without computed tomography scan – analysis of accuracy*
A. Spyranitis* (Frankfurt, Deutschland), M. Setzer, A. Cattani, J. Quick-Weller, A. Strzelcyk, V. Seifert, T. Freiman
-
- MI.17.06 *Transsphenoidal pituitary surgery: the effect of seller reconstruction techniques on postoperative cerebrospinal fluid leakage - a single-center series and multivariate analysis*
P. Schuss* (Bonn, Deutschland), A. Hadjiathanasiou, D. Klingmüller, Á. Güresir, H. Vatter, E. Güresir
-
- MI.17.07 *Twist drill procedure for chronic subdural hematoma evacuation- an analysis of predictors for treatment success*
F. Jablawi* (Aachen, Deutschland), H. Kweider, O. Nikoubashman, H. Clusmann, G. Schubert
-
- MI.17.08 *"Two are never enough"- Impact of the number of tissue samples taken in stereotactic biopsy*
J. Quick* (Frankfurt, Deutschland), J. Tichy, P. Harter, S. Tritt, N. Dinc, V. Seifert, G. Marquardt
-

Endoscopic endonasal surgery for removal of pituitary adenomas - treatment results using different two- and three-dimensional visualization systems

Shefqet Hajdari¹, Christoph Jacobi¹, Christian Schönfelder¹, Geralf Kellner¹, Almuth Meyer¹, Steffen Rosahl¹, Rüdiger Gerlach¹

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Objective: Endoscopic endonasal transsphenoidal surgery (EETSS) is the treatment of choice for patients with pituitary adenomas (PA). Three-dimensional high definition (3D-HD) visualization offers stereoscopic depth perception (SDP) compared to two-dimensional (2D-HD) and three-dimensional standard definition (3D-SD) endoscopy techniques. However, it is undisclosed, if this perception improvement for surgeons is accompanied with better outcomes for operated patients with PA. In this regard, we intend to compare the effectiveness of 3 different system 2D-HD, 3D-SD and 3D-HD.

Methods: A database of patients treated with EETSS is established. Between 12/2008 and 11/2016, 238 patients were identified. Using SPSS software, collected data, those with primary PA in particular, were analyzed for pre- and post-OP characterization and EETSS efficiency. Correspondingly, non-parametric statistical tests (Mann-Whitney, Kruskal-Wallis and Wilcoxon) were performed, in order to compare three different EETSS-techniques.

Results: 151 (63.5%) of 238 patient had surgery for primary PA using the following systems 2D-HD (Storz, Germany; 54 patients), 3D-SD (VisionSense vsii; 76 patients) and 3D-HD (VisionSense vsiii; 21 patients). Preoperatively no statistical differences were found for tumor size, extension, endocrine and ophthalmologic status. Complete tumor resection was achieved in 39 (72%), 54 (71%) and 17 (81%) patients in 2D HD, 3D SD and 3D-HD groups, respectively. The better resection rate in the 3D-HD group was due to better resection of parasellar tumor parts ($p = .025$). The number of complications, such as postoperative bleeding, CSF leaks and meningitis was not different between visualization systems ($p = .211$). Ophthalmological outcome did not differ between EETSS techniques. The number of cases with new pituitary insufficiency is smaller in patients operated with 3D-HD (4.8%) vs. 2D-HD (16.6%) and 3D-SD (9.2%). Concerning endocrinological remission, no difference for was found between 3 EETSS groups.

Conclusion: Although primary PA patients had the same pre-OP characterization, application 3D-HD operative technique leads to less residual tumor and fewer new postoperative endocrine deficit.

Simpson grading revisited: Surgeon's estimation of meningioma removal vs. postoperative ⁶⁸Ga-DOTATATE PET/CT

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Objective: The intraoperatively assessed Simpson-Score (SimS) has been used as a predictor for meningioma recurrence for decades. Nevertheless the validity of the scoring system in contemporary neurosurgical practice has recently been called into question. Therefore we investigated the congruence of the surgeon's estimated SimS with postoperative ⁶⁸Ga-DOTATATE PET/CT Scans that are known to be more sensitive in diagnosis of meningioma tissue than MRI.

Methods: In this retrospective study 37 adult patients with primary or recurrent WHO^oI meningioma and surgical resection between January 2011 and July 2016 were investigated. Inclusion criteria were the documented Simpson Score and a postoperative ⁶⁸Ga-DOTATATE PET/CT scan, obtained shortly after tumour resection (median time between resection and PET scan: 20 days). The PET parameters SUV_{max}, SUV_{mean} and threshold-based biological tumor volume (BTV; SUV>2.3) were assessed by an experienced rater from nuclear medicine being blinded for MRI results and the intraoperatively estimated SimS (complete removal with resection (I) or coagulation (II) of dural attachment, III: complete removal without coagulation or resection of dural attachment, IV: subtotal resection, V: decompression/biopsy only).

Results: There were 4 SimS I, 4 SimS II, 4 SimS III and 25 SimS IV resections according to surgeon's estimate. Among the cases with SimS I and II, only 3/8 showed no pathological uptake, while 5/8 presented with high tracer uptake typical for meningioma tissue (3/4 SimS I: median SUV_{max}=14.7; SUV_{mean}=5.06; BTV=11.5 cm³, and 2/4 SimS II: median SUV_{max}=8.0; SUV_{mean}=3.8; BTV=5.4 cm³). Of the SimS III cases, all 4 showed pathological ⁶⁸Ga-DOTATATE uptake, but 2/4 with relatively low uptake intensity and volumes (SUV_{max}=2.6 and 2.4; BTV=0.03 and 0.02 cm³). All 25 SimS IV tumours had high uptake of ⁶⁸Ga-DOTATATE (median SUV_{max}=23.2; SUV_{mean}=6.4) with a wide range of remaining BTV (median 21.6 cm³; range 2.7-101.2 cm³).

Conclusion: ⁶⁸Ga-DOTATATE-PET/CT seems to provide more sensitive information to delineate postoperative remaining meningioma tissue compared to surgeon's estimated SimS, especially in cases with Simpson I and II resections. This should be taken into account for follow-up management.

Complications in vestibular schwannoma resections via the retrosigmoid approach

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Complications in vestibular schwannoma resections via the retro-sigmoid approach

Objective: Surgery is one of the treatment options for vestibular schwannomas (VS), and results have improved enormously during the last decades. But alternative options like observation and radiosurgery have been evolved for VS and a shift towards fewer and later surgery at more advanced stages has occurred. Faced with larger tumors in patients with higher incidences of co-morbidities, surgical sequels and complications need further continuous consideration and were the focus of this study.

Methods: Over the past 11 years 502 tumour resections were performed in 483 patients (14% Neurofibromatosis Type 2, 227 male, 256 female) under continuous neuro-monitoring via a retro-sigmoid approach, 97% in the semi-sitting position by an interdisciplinary oto-neuro-surgical team. Standardized documentation of auditory and facial functions before and after surgery, of intra- and postoperative sequels and complications were analysed.

Results: 182 (36%) patients had small tumours (T1 to T3A; Hannover Classification) and 320 (64%) large tumours (T3B or T4). Some residual hearing (Hannover Classification I to IV), was documented in 367 patients (73%) before and in 116 patients after surgery with more favourable preservation rates in small tumours (39%). Facial palsy was present in 25 patients (HB°3-6) before and in 186 patients after surgery (77 HB°3, 65 HB°4, 44 HB°5-°6). Auditory and facial nerves outcome correlated significantly with tumour size ($p < 0.001/p < 0.05$). Intra-operative complications included air embolism in 45 cases (9%) and sinus injury in 3, without further sequels. Post-operative cerebrospinal fluid leakage occurred in 46 (9%), some local haemorrhage in 19 (4%), and surgical revision for either cause was indicated in 22 cases (4%). There were two deaths due to stroke, after total resection of an extensive tumour in patients with complex co-morbidity.

Conclusion: Thorough counselling to the patient leading to individual decision on the adequate treatment option and timing is ideally performed by an interdisciplinary team offering the complete spectrum of consideration. Tumour size and individual co-morbidity remain the most important risk factors in VS surgery. Functional cranial nerve preservation could be achieved at 32% for the auditory and 80% for the facial nerve (HB° 1-3) in this series. So in order to prevent a disadvantage course, surgery at late tumour stages may be avoided by adequate timing of treatment to optimise outcome.

The Endoscopic Treatment of Colloid Cysts with Focus on Intraoperative Complications

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Objective: Colloid cysts are cystic or solid lesions at the anterior part of the third ventricle close to the foramen of Monro. Due to this location surgical treatment bears the risk of venous bleedings and/or fornix lesions. Endoscopic treatment strategies and complication management are presented by the authors.

Methods: This study retrospectively analyses data of 19 cases with colloid cysts. Off-line video analysis of the neuroendoscopic procedures, MRI analysis and clinical follow-up were performed.

Results: Twenty patients (11 male, 9 female) underwent endoscopic cyst fenestration or resection in our department between 2011 and 2016. In three cases of cyst fenestration a second procedure was necessary. Heavy venous hemorrhages occurred in four cases. The hemorrhages were either stopped by constant irrigation or by dry-field technique. Distorted surface or loss of ependymal integrity at the foramen of Monro was observed in five cases (20%). Only in one case those findings were related to postoperative memory disturbances. Shunt independency was achieved in all cases.

Conclusion: The surgical treatment of colloid cysts is recommended due to the potential life-threatening course. However, surgeons have to be aware of the potential intraoperative risk of hemorrhages due to the anatomic location. Different options of bleeding management are feasible. Intraoperative lesions at the foramen are common, but obviously clinical correlation is rare.

Cranial and spinal robot-guided surgery without computed tomography scan – analysis of accuracy

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Objective: Most cranial stereotactic- and spinal navigation- or robotic procedures use computed tomography (CT) for referencing. However, young patients could profit from reduced radiation. Therefore, we established a cranial robot-guided stereotactic biopsy and implantation protocol, based on MR-scans, only. For robot-guided pedicle screw implantation 3D-fluoroscopy was established for referencing. We will provide accuracy studies for the cranial- and spinal robotic surgery protocol.

Methods: In the cranial part of the study, robot-guided implantation of sEEG electrodes by the cranial robotic surgery assistant (ROSA-brain, MedTech/Zimmer-Biomet, Montpellier, France) were analyzed. Planning was performed on preoperative MRIs with the ROSA-software. Patients heads were fixed in a sharp clamp, referencing was performed by laser-scan of the face. During surgery the robotic arm steered the probe. After surgery the final position of the electrodes was identified on a postoperative CT scan, which was merged with the preoperative planning MRI scan. The accuracy was determined by calculating the target point error (TPE) and the entry point error (EPE) applying the Euclidian distance. In the spinal part of the study, three fresh-frozen cadaver were used. Preoperatively 3D-fluoroscopy (Ziehm Vision RD Vario 3D, Nuernberg, Germany) was performed and referenced to a tracker, fixed on the processus spinosus. Screw trajectories were planned with the ROSA-software. A total of 12 pedicle screws (Viper, Depuy Synthes, Zuchwil, Switzerland) were percutaneously implanted through a probe, steered by spine-robot (ROSA-spine, MedTech/Zimmer-Biomet). The final position of the pedicle screws was identified with 3D-fluoroscopy and compared to the preoperatively planned trajectories with the ROSA-software.

Results: A total of 40 sEEG electrodes were implanted in five patients. The mean TPE was 2.96 mm, the mean EPE 2.53 mm. We observed a difference in accuracy depending on the MRI field strength. The mean TPE (1.72 mm) in one patient who received a 1.5 Tesla MRI was better than the average TPE we achieved in our patients. No complications related were observed. In the spinal study, we observed accurate navigation and facilitated real time virtual visualization of the surgical procedure. The depth and position of the screw could be monitored by the surgeon during the placement procedure. All screws were placed in a correct transpedicular position, no major medial or lateral deviations or breaches of the pedicle wall were observed.

Conclusions: The cranial MR-based robotic protocol, as well as the spinal 3D-fluoroscopy-based robotic protocol, have shown equal accuracy compared with studies using CT for referencing. Both protocols are suitable to reduce radiation exposure of patients.

Transsphenoidal pituitary surgery: the effect of sellar reconstruction techniques on postoperative cerebrospinal fluid leakage - a single-center series and multivariate analysis

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Objective: Transsphenoidal surgery is a common procedure in patients suffering from pituitary adenomas. Several techniques have been previously postulated to achieve sufficient postoperative sellar reconstruction to avoid cerebrospinal fluid (CSF) leakage. We analyzed our institutional database concerning two techniques of sellar reconstruction and the postoperative development of CSF leakage.

Methods: From 2009 to 2015, 255 patients with pituitary adenoma were treated via transsphenoidal approach at our institution. Information, including patient characteristics, treatment modality, radiological and endocrinological features, length of hospital stay, modality of sellar reconstruction, and presence of postoperative CSF leak were collected and further analyzed. According to the technique used for sellar reconstruction, patients were divided into two groups: 1) with fibrin glue alone and 2) with additional autologous muscle patch.

Results: Overall, postoperative CSF leakage occurred in 7% of the patients. However, occurrence of postoperative CSF leakage did not differ significantly between both sellar reconstruction techniques ($p=0.2$). Nevertheless, patients who underwent sellar reconstruction with fibrin glue alone had a significantly shorter length of hospital stay ($p=0.01$) as well as significantly shorter duration of the surgical procedure ($p<0.0001$). On multivariate analysis, occurrence of intraoperative CSF leakage was the only predictor for postoperative CSF leakage ($p<0.0001$).

Conclusion: The present data suggest that sellar reconstruction after transsphenoidal pituitary surgery seems to be equally effective in preventing postoperative CSF leakage. However, the use of fibrin glue alone as sellar reconstruction results in shorter hospital stay and operating time without exposing patients to more frequent CSF leakage.

Twist drill procedure for chronic subdural hematoma evacuation- an analysis of predictors for treatment success

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Objective: Twist drill craniostomy (TDC) is a “minimally invasive” and cost-effective technique to treat chronic subdural hematomas (CSDH). Predictors for treatment sufficiency such as imaging characteristics, hematoma volume, and drainage volume - are not established so and are purpose of this analysis.

Methods: We retrospectively evaluated all data of CSDH patients undergoing TDC in our institution between January 2010 and December 2013. We analyzed imaging characteristics (extension and composition), volumetrically calculated pre- and postoperative hematoma volume, measured drainage volume, and clinical course. As volumetric analysis, we evaluated the hematoma volume on the available pre- and post-treatment CT via Osirix 7.0 (Advanced open-source PACS Workstation, ©Pixmeo SARL, Berne, Switzerland). For volumetric assessment, we transferred the respective DICOM data of all included patients into the Osirix Workstation and identified the hematoma on each axial image. Finally, a 3D image of individual hematoma was calculated to define its extension and volume.

Treatment was defined as sufficient if definitive treatment was achieved via a single TDC (TDC-1) and insufficient if more than one TDC was needed (TDC-X). The need for open surgical evacuation was defined as treatment failure.

Results: Data of 233 patients undergoing 387 TDCs were available for our study. Treatment was sufficient in 124 (32%), insufficient in 136 (35%), and failed in 127 (33%) procedures. Using the median-split-method, sufficient treatment was achieved more frequently in smaller hematomas ($p < 0.05$). Treatment sufficiency was neither correlated with hematoma image characteristics (presence of membranes: $p = 0.11$, extent of chronification: $p = 0.55$), nor with the respective drainage volume ($p = 0.95$). Residual hematoma volume was consistently higher than expected by drainage calculation ($p < 0.05$).

Conclusion: TDC is an effective treatment option for CSDH. Sufficient treatment was more common in smaller hematomas with an associated smaller residual hematoma. Failure of brain re-expansion after TDC may increase the treatment failure rates. In these cases, an open surgical evacuation might accelerate treatment and clinical recovery.

"Two are never enough"- Impact of the number of tissue samples taken in stereotactic biopsy

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Objective: Stereotactic procedures are performed in many neurosurgical departments in order to obtain tumor tissues from brain lesions for histopathological evaluation. It is still unclear how many tissue samples have to be taken to establish a final diagnosis based on histopathological and genetic examinations. Only histopathological diagnosis results in adequate therapy.

Methods: We included 43 consecutive patients who underwent stereotactic biopsy of a suspected glioblastoma between 02/2013 and 07/2015. All patients showed contrast enhancing tumors in the MRI. The patients underwent stereotactic biopsy with the Leksell frame attached to their head. Target and Entry Points were calculated with BrainLab iplan software (BrainLab iplan 1.0, Feldkirchen, Germany). First the two samples 5mm before the Target (pre-target) and the "Targetpoint" itself were analyzed (group 1), then a histopathological evaluation of all samples was performed (group 2).

Results: Regarding all patients, a median of 14 samples were taken. Using hematoxylin-eosin staining a correct histopathological diagnosis was made in only 30 cases of group 1. In detail a correct diagnosis was made in 73% of the glioblastoma patients, in none of the anaplastic astrocytoma patients, in 100% of diffuse glioma patients, and in 100% of the carcinoma patients. In 3 cases of group 1 only necrosis was found. Contrariwise a final diagnosis was made in 100% of the patients of group 2.

Conclusion: For patients with suspected glioblastoma, a minimum sample number of ten (4-6 samples for hematoxylin-eosin staining and 4 for molecular diagnosis) should be taken for histopathologic and genetic examination in order to establish a final diagnosis.

MI.18

Mapping / Elektrophysiologie 2

Mittwoch *Wednesday*, 17.05.2017, 11.00 – 12.20 Uhr *hrs*

- MI.18.01 *Intraoperative Monitoring of visual evoked potentials during anterior skull base surgery: feasibility, benefits and limitations*
H. Andrade-Barazarte* (Mannheim, Deutschland), D. Kefalas, A. Abdulazim, J. Perrin, D. Haenggi, N. Etmianan
-
- MI.18.02 *A comparison between threshold criterion and amplitude criterion in transcranial motor evoked potentials during surgery for supratentorial lesions*
T. Abboud* (Hamburg, Deutschland), C. Schwarz, M. Westphal, T. Martens
-
- MI.18.03 *High-resolution language mapping with transcranial magnetic stimulation: Impact of hemispheric dominance for language and stimulation intensity*
K. Sakreida* (Aachen, Deutschland), J. Blume-Schnitzler, G. Frankemölle, H. Clusmann, G. Neuloh
-
- MI.18.04 *Connectivity-based structural parcellation of Broca's region correlates with high-resolution language mapping by use of transcranial magnetic stimulation*
K. Sakreida* (Aachen, Deutschland), C. Werner, V. Kumar, H. Clusmann, G. Neuloh
-
- MI.18.05 *Electrophysiological predictors of hearing deterioration based on AEP-monitoring during posterior fossa approach for petroclival meningiomas*
G. Lepski, A. Arevalo, C. Almeida* (São Paulo, Brazil), B. Alencar Pires Barbosa, F. Roser, M. Liebsch, M. Tatagiba
-
- MI.18.06 *Non invasive mapping of categorization function by navigated transcranial magnetic stimulation*
S. Maurer* (München, Deutschland), T. Boeckh-Behrens, B. Meyer, S. Krieg
-
- MI.18.07 *Predictive value of transcranial motor-evoked potentials and electromyography for postoperative facial motor function after vestibular schwannoma surgery*
G. Naros* (Tübingen, Deutschland), L. Trakolis, M. Liebsch, M. Tatagiba
-
- MI.18.08 *The influence of brain tumor location on functional reorganisatory processes of the language system*
K. Rosengarth* (Regensburg, Deutschland), F. Dodoo-Schittko, C. Doenitz, L. Forster, M. Greenlee, A. Brawanski
-

Intraoperative Monitoring of visual evoked potentials during anterior skull base surgery: feasibility, benefits and limitations

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Objective: Intraoperative monitoring (IOM) of visual evoked potentials (VEP) during anterior skull base surgery may be challenging, predominately due to varying methodological approaches or technical difficulties. This results in heterogeneous data regarding the ultimate sensitivity and surgical benefit of intraoperative monitoring of VEP. We aimed to demonstrate the feasibility of intraoperative monitoring of VEPs and to identify its clinical benefits and limitations.

Methods: From October 2015 to September 2016, 12 patients (9 women and 3 men) underwent optic nerve decompression for sphenoid wing meningiomas which compromised or compressed the anterior visual pathway (optic nerve and/or chiasm) at our department. Following total intravenous anesthesia, VEP recordings were obtained through flash light stimuli delivered directly over a closed eyelid during surgery. Additionally, we performed electroretinography (ERG) recordings to confirm successful retinal activation during stimuli. We collected data on the surgical procedure, preoperative and postoperative visual function, VEP P100 features, and changes of VEP and ERG before, during and at the end of the surgery.

Results: All patients underwent optic nerve decompression and/or radiologically complete tumor resection in case of unilateral location or ipsilateral complete resection in case of bilateral presentation. One patient underwent a redo craniotomy due to early tumor recurrence in a grade 2 meningioma. VEP recordings were feasible and reliable in 20 (77%) out of 26 examined eyes. VEP recordings of the remaining six (23%) eyes were not possible due to severe preoperative visual impairment. All patients had recordable ERG. After frontal scalp-flap reflection, of the nine ipsilateral eyes with recordable VEP, five (56%) experienced complete disappearance and four (44%) had significant changes. All previously lost or significantly altered VEP and ERG responses except one returned to baseline during skin-flap closure.

Conclusion: Intraoperative VEP monitoring is sensitive to detect intraoperative deterioration of visual function due to surgical dissection but it also correlates with preoperative visual function, which limits the additive value of VEP monitoring in severely impaired patients. However, ERG monitoring is a useful tool to distinguish technical (light axis deviation) from functional VEP variances. Skin-flap mobilization and reflection is a common cause of technical VEP lost due light axis deviation requiring a more reliable method to fix and ensure VEP monitoring.

A comparison between threshold criterion and amplitude criterion in transcranial motor evoked potentials during surgery for supratentorial lesions

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Objective: Different warning criteria have been described to prevent and predict postoperative neurological deficits during monitoring of motor evoked potentials (MEP) using transcranial electrical stimulation (TES) in cranial surgery. This study was undertaken prospectively to compare sensitivity and specificity between threshold criterion and amplitude criterion in the same patient cohort.

Methods: Between 11/2015 and 10/2016, TES-MEP were performed in 125 patients during surgery for unilateral supratentorial lesions in motor-eloquent brain areas. MEP were recorded from abductor pollicis brevis (APB), and from orbicularis oris and/or tibialis anterior and were evaluated bilaterally to assess the percentage increase in threshold-level, which was considered significant if it exceeded 20% on the contralateral side beyond the percentage increase on the ipsilateral side. MEP amplitude was measured with a stimulus intensity of 150% of the threshold level, at the baseline and at closure. We studied the relationship between recorded changes in threshold level and amplitude and postoperative motor function.

Results: 16 of 125 patients showed a significant change in threshold level as well as an amplitude reduction over 50% in the MEP recorded from APB and 12 of them had a postoperative arm paresis, while one patient with no MEP changes had a postoperative arm paresis. Recording from tibialis anterior was performed in 64 patients and 3 of them developed a postoperative leg paresis, all showed a significant change in threshold level while an amplitude reduction over 50% took place in one of them. Amplitude reduction over 50% occurred in further 7 patients who had no significant change in threshold level and did not develop a postoperative leg paresis. Recording from orbicularis oris was performed in 57 patients, one of them developed a postoperative facial paresis and had a significant change in threshold level as well as an amplitude reduction over 50%. Another 6 patients had an amplitude reduction over 50% but had no significant change in threshold level and did not develop a postoperative facial paresis.

Sensitivity and specificity of threshold criterion and of amplitude criterion were 92% and 97%, respectively, when MEP were recorded from APB. Recording from the leg and face muscles, threshold criterion had a 100% sensitivity and specificity, while amplitude criterion had a specificity of 89% (leg and face) and a sensitivity of 33% from the leg and 100% from the face.

Conclusion: Sensitivity and specificity of threshold criterion was comparable to the amplitude criterion with a stimulus intensity set at 150% of threshold level, when recording MEP from APB and superior to it when recording MEP from the leg or the face.

High-resolution language mapping with transcranial magnetic stimulation: Impact of hemispheric dominance for language and stimulation intensity

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Objective: Language mapping by transcranial magnetic stimulation (TMS) is commonly applied over the left language-dominant hemisphere to indicate language-related cortex at stimulation intensities close to the resting motor threshold (rMT). High-resolution mapping in immediate vicinity to the premotor cortex by use of higher stimulation intensities for more efficient language inhibition may raise concern about confounding unspecific effects. In this study, we performed inter-hemispheric comparisons in order to delineate unspecific premotor effects from true language inhibition by TMS. Likewise, we investigated the effects of stimulation intensities above the rMT on naming errors, latencies, and stimulation discomfort.

Methods: Fifteen healthy, right-handed German speakers underwent two language mapping sessions with a naming protocol adapted for high-resolution mapping purposes. In the first experiment, we applied navigated TMS over a left- and right-hemispheric target array covering the left inferior frontal junction (IFJ) area. Six mapping repetitions were conducted per hemisphere with pseudo-randomized sequence between participants. Stimulation intensity was determined according to the individual speech inhibition threshold. In the second experiment, TMS was applied over the same left-hemispheric target array with pseudo-randomized intensities of 110, 120, 130, and 140 % of rMT. Three mapping repetitions were conducted per intensity. In both experiments, participants rated the unspecific interference of TMS with speech due to facial twitching, discomfort, and pain on a 4-level Likert scale (1 = none, 4 = strong) after each stimulation/naming.

Results: In the first experiment, we found a minor, statistically significant preponderance of stimulation discomfort on the left side: Stimulation of left IFJ was elicited slight discomfort more frequently as compared to right IFJ, whereas no discomfort at all was reported more frequently after stimulation of right IFJ as compared to left IFJ. More severe discomfort ratings did not differ between hemispheres. Naming errors were observed significantly more frequently during stimulation of the left IFJ, although some participants showed comparable effects during right-hemispheric stimulation. In the second experiment, there was no increase in both naming latencies and discomfort ratings with increased stimulation intensities, except for a small number of subjects. It is important to note that the individual speech inhibition threshold, i.e. the stimulation strength which reliably elicits language errors during random test stimulations within the target area, was not reached in all subjects.

Conclusion: During high-resolution TMS language mapping over the IFJ area, only slight discomfort is marginally more frequent in the left hemisphere, whereas more severe interferences are equally distributed between hemispheres. A major contribution of not language-specific effects to TMS language mapping results in this area is therefore unlikely. Our findings also support the determination of the individual speech inhibition threshold even at higher stimulation intensities, prior to high-resolution TMS language mapping in a distinct cortical target area. Within the moderate range of intensities tested here, raised stimulation strength does not increase discomfort in most subjects.

Connectivity-based structural parcellation of Broca's region correlates with high-resolution language mapping by use of transcranial magnetic stimulation

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Objective: Microstructural mapping indicates multiple sub-areas within Broca's region which constitutes a core node in the language network. Connectivity based parcellations of white matter fiber tractograms have been shown to correlate with cytoarchitectonic mapping. More recently, navigated transcranial magnetic stimulation (TMS) language mapping at high spatial resolution revealed a focus of TMS impact close to the inferior frontal junction area. Here, we correlate a novel connectivity-based structural parcellation approach with TMS language mapping results.

Methods: Twelve healthy, left-dominant native German speakers underwent both diffusion tensor magnetic resonance imaging and high-resolution TMS language mapping with a previously described focus of TMS susceptibility in the inferior frontal junction area. Diffusion-weighted images were acquired at 3 Tesla and were isotropic distributed along 64 directions (b-value = 1000 s/mm²). Data were analyzed using the FMRIB Software Library (FSL) Diffusion Toolbox FDT with standard preprocessing. Probabilistic tractography was performed based on 30 seed volumes originating from TMS stimulation sites systematically covering Broca's region. Linear registration to the MNI template was performed for normalization. A multi-session temporal concatenation independent component analysis (ICA; FSL Toolbox MELODIC) was applied to the series of tractograms. Four independent components and thus four clusters of stimulation sites were specified. This parcellation of Broca's area was correlated to TMS results and probabilistic cytoarchitectonic maps.

Results: The dorso-posterior cluster corresponded clearly to the inferior frontal junction area and the focus of TMS susceptibility in naming. Medial clusters were arranged along the border of cytoarchitectonic areas 44 and 45, while the anterior cluster was restricted to area 45.

Conclusion: Parcellation of Broca's region according to an ICA of structural connectivity data appears to converge with functional clustering of high-resolution TMS language mapping. This correspondence will lead to a more detailed understanding of the structure-function relationships within the language network and might have clinical impact in pre-surgical planning.

Electrophysiological predictors of hearing deterioration based on AEP-monitoring during posterior fossa approach for petroclival meningiomas

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Objective: To evaluate the risk of hearing deterioration as a function of amplitude and latency changes of the most stable components of the AEPs during surgery

Methods: We performed a retrospective study enrolling 40 consecutive patients harbouring petroclival meningiomas operated through retrosigmoid route at the University Clinic in Tübingen, Germany, from 2005 until 2011. clinical assessment was based on examination of the electronic medical files, image findings and electrophysiological data; tumour classification was reviewed through careful analysis of the preoperative MRIs. Radicality of the surgical resection was defined based on interpretation of post-operative MRIs. Neurological assessment immediate postoperatively, at the 5 th postoperative day, and late postoperatively, 3, 6 and 12 months after surgery, was documented. Amplitude and latency of the electrophysiological recordings were documented at many stages during surgery. For mathematical processing, we considered as initial values the waves before surgical incision and as final values those after suture of the dura-mater.

Results: In the 6 years time-window mentioned, we operated totally 78 cases of meningiomas in the cerebello-pontine angle. Among these, 40 cases of primary petroclival without previous treatment, excluding neurofibromatosis. The mean age was 59 ± 10 years, 31 female and only 9 male patients. As related to hearing, 12 patients out of 40 presented preoperatively with clinically detectable hearing impairment. Eight patients presented in the first assessment (prior to hospital discharge after surgery), deterioration of the hearing function; four of them reported subjective improvement. Among those 8 who reported initial deterioration, 4 recovered until the last assessment, and 4 remained stable. Next, we based on the constructed model to infer levels of wave parameters related to 10%, 20%, 50%, 80%, and 90% of hearing deterioration.

Conclusion: Our data indicate that latency measurements have high specificities (>92%, with advantage in favour of wave III), but relatively low sensitivities (71%). It means that latency is excellent in ruling out the chance of deficit (few false negatives, low type II error). Nevertheless, latency was more associated with false positives (false alarm, type I error). The amplitude of wave V, however, has a very high sensitivity (100%, no false positive), and low specificity (associated with some false negatives). Combining a very specific measurement like latency of the wave III, and a very sensitive measurement like amplitude of wave V seems to be the best strategy to predict precisely the chance of hearing deterioration in the immediate post-operative period.

Non invasive mapping of categorization function by navigated transcranial magnetic stimulation

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Objective: Over the past years navigated transcranial magnetic stimulation (rTMS) had become increasingly important for the preoperative examination and mapping of eloquent brain areas. Among other things it was demonstrated that the detection of neuropsychological function, like calculation or face recognition, seems feasible with rTMS. Since the avoidance of postoperative impairment are of broad interest in neurosurgery and neuroscience this study now aims on the investigation of the cortical mapping of categorization function via rTMS.

Methods: 20 volunteers (11 female, 9 male) purely right-handed and without any medical deficiency underwent rTMS mapping for cortical categorization function using 5 Hz/10 pulses. 52 cortical spots spread over the whole hemispheres were stimulated. Both hemispheres were examined randomly with 2 weeks delay between both mappings. The task consisted of 80 pictures of living and non-living images, which the volunteers were instructed to categorize while rTMS pulses were applied.

Results: The highest error rates for all errors of all subjects were observed in the left hemisphere's posterior middle frontal gyrus (pMFG) with an error rate of 60%, as well as in the right hemisphere's pMFG and posterior supramarginal gyrus with a 45% error rate each. In total the categorization of non-living objects elicited more errors over both hemispheres than the recognition of living objects.

Conclusion: rTMS seems feasible for the detection of categorization function. Moreover, the observed bihemispheric representation, as well as the higher error incidence for the categorization of non-living objects is well in accordance with current literature. Clinical applicability for preoperative mapping in brain tumor patients has to be evaluated as the next step.

Predictive value of transcranial motor-evoked potentials and electromyography for postoperative facial motor function after vestibular schwannoma surgery

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Objective: Maintaining facial nerve function is a major concern in vestibular schwannoma surgery. Still, tumor size is one of the most important factors predicting postoperative facial palsy (PFP). On the other side, continuous intraoperative neuromonitoring (INM) of transcranial facial motor-evoked potentials (fMEP) and free-running facial electromyography (fEMG) is applied routinely to prevent PFP. While fMEP amplitude reduction of 50% and the occurrence of spontaneous high-frequency fEMG activity (A-trains, AT) are accepted to indicate facial nerve distress, there is only limited data concerning the predictive value of these measures in the background of different tumor sizes.

Methods: This retrospective study includes 507 consecutive patients (age 49.1 ± 12.9 , 52.3% female) without any preoperative facial deficit undergoing surgical removal of a vestibular schwannoma under continuous INM (fMEP and fEMG). We evaluated the sensitivity (SENS) and specificity (SPEC) of fMEP amplitude reduction (>50%) and AT for the occurrence of a significant PFP on the House & Brackman Scale (H&B) ≥ 3 . Tumor size was graded preoperatively by the Hannover classification T1-4 (T1/2: 26.9%, T3: 39.8%, T4: 33.3%).

Results: fMEPs were measurable in 480/507 patients (94.7%). AT showed an overall SENS 46.7%, SPEC 58.0% while fMEP had an overall SENS 45.2%, SPEC 88.6%. Combining fMEP and AT increased SENS while reducing SPEC (76,3 % and 52,8 %, respectively). For both fMEP and fEMG there was an increase of SENS in larger tumors while SPEC decreased.

Conclusion: INM of facial nerve function based on fMEPs showed higher sensitivity and specificity than INM based on AT. However, while fMEPs show a good specificity, we found a rather low sensitivity. The combination fMEP and fEMG revealed the best predictive value for the occurrence of postoperative facial palsy after vestibular schwannoma surgery.

The influence of brain tumor location on functional reorganisatory processes of the language system

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Objective: Lesions caused by brain tumors in language critical areas may lead to changes in the functional networks associated with language function. Since the language network is widely spread over several brain areas in both hemispheres there might be an influence of the specific tumor location on those reorganisatory changes. Therefore this study aims to investigate a possible relationship of brain tumor location and reorganisatory processes of the language system.

Methods: To assess the influence of brain tumor location on language associated brain activation a total sample of 60 patients with brain tumors in language critical areas of the left hemisphere was stratified in a group with tumors in the inferior frontal gyrus (N=28), a group with tumors in posterior language areas encompassing the supramarginal and angular gyrus and the posterior lateral part of the superior temporal gyrus and sulcus (N=16; named as "posterior-temporal group") while the last group showed tumors in the lateral anterior portion of the temporal lobe (N=16; (named as "anterior-temporal" group). Additionally data of 34 healthy subjects were included in the study. Functional magnetic resonance imaging was performed at a 3T Siemens Allegra Scanner. During the language fMRI paradigm subjects had to perform covertly a verb and a syntactic generation task. Data analysis was done by using SPM 12 including the Marsbar toolbox and the Automated Anatomical Labeling Atlas for region of interest (ROI) definition and analysis.

Results: The whole brain analysis reveals a significant enhancement in language associated activation in the right inferior frontal cortex for the whole patient group compared to controls, while controls show increased activation in right supramarginal and angular gyrus compared to tumor patients. Focusing on the further group differences, there is the finding that patients with posterior-temporal tumors show an increase in activation of the right supramarginal gyrus during the performing of language tasks compared with healthy controls and patients with anterior-temporal tumors. According to the ROI analysis the posterior-temporal group exhibits a significant decrease in activation in the left inferior frontal gyrus in contrast to healthy controls and the anterior-temporal patients group. All differences were apparent in both linguistic tasks (verb and sentence generation).

Conclusion: In line with the literature, the results of this study suggest a strong incorporation of the right hemisphere in language processing in patients with tumors in language critical areas. Furthermore we observed also left lateral reorganisatory processes in language critical areas which are not affected by the tumor. Thereby tumor location seems to be a predictor due to tumor induced neuroplastic changes of the language network.

MI.19 Intensivmedizin 5

Mittwoch *Wednesday*, 17.05.2017, 11.00 – 12.10 Uhr *hrs*

- MI.19.01 *Prevalence of patients decreases in a neurosurgical unit - a survey study*
D. Müller* (Essen, Deutschland), N. El Hindy, B. Kleist, U. Sure, O. Müller
-
- MI.19.02 *Sedation of patients with acute aneurysmal subarachnoid haemorrhage with Ketamine is safe and might influence the occurrence of delayed cerebral ischemia*
C. von der Brölie* (Göttingen, Deutschland), M. Seifert, S. Rot, A. Tittel, V. Rohde, U. Meier, J. Lemcke
-
- MI.19.03 *Vasospasm as a life threatening complication after pituitary surgery*
K. Osterhage* (Hamburg, Deutschland), T. Burkhardt, P. Czorlich, R. Rotermund, U. Grzyska, M. Westphal, J. Flitsch
-
- MI.19.04 *Prophylaxis, diagnosis, and therapy of delayed cerebral ischemia in patients with aneurysmal subarachnoid hemorrhage in Germany: a nation-wide survey*
S. Hernandez Duran* (Göttingen, Deutschland), D. Mielke, V. Rohde, V. Malinova
-
- MI.19.05 *Complications and Shunt-Dependency following Placement of an External Ventricular Drainage - a Single-Center Experience*
M. Herbolzheimer, H. Sitoci-Ficici, M. Dengl* (Dresden, Deutschland), A. Zolal, D. Podlesek, M. Kirsch, G. Schackert
-
- MI.19.06 *Venous air embolism and related intra- and postoperative complications in semi-sitting position for posterior cranial fossa surgery.*
N. Jarc* (Freiburg, Deutschland), C. Scheiwe, J. Grauvogel
-
- MI.19.07 *Repetitive measurement of cerebral ventricular dimensions in patients with decompressive craniectomy: bedside sonographic duplex technique compared to cranial computed tomography*
H. Bendella* (Köln, Deutschland), A. Hartmann, J. Spreer, A. Igressa, M. Nakamura
-

Prevalence of patients' decrees in a neurosurgical unit - a survey study

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²Essen, Deutschland

Objective: The patient's autonomy is of utmost importance among the four principles of ethics in medicine according to Beauchamp and Childress. The public interest has focused on this topic in recent years. This study is to assess the prevalence of decrees in patients admitted to a single neurosurgical unit and, furthermore, to evaluate the patients' understanding of the content of their decrees.

Methods: All patients admitted to the neurosurgical department were asked for their participation in the survey between November 2014 and September 2015. A total of 500 patients approved and was included for study reasons. 482 completed surveys could be evaluated for further analysis. Approval from the local ethics research committee was obtained prior to inclusion.

Results: Of 482 patients, 210 had a written decree (43.6%). The prevalence increased with higher age of life (significant correlation with age >65years; $\chi^2(1)=49.46$; $p<0.001$). The likelihood that patients completed a decree was significantly higher in patients older than 65y (OR 3.86). Patients that had a decree were most likely to have a medical power of attorney as well (86.2%). The underlying diagnosis did not influence the prevalence of a decree. 30% of the patients were either not informed about the content of their decree or had transferred the responsibility for medical decisions onto the treating physicians or their relatives, respectively. 49.3% refused life supporting treatments, but only 10% specified these restrictions in regard of ventilation and resuscitation.

Conclusion: The importance of patient decrees has been intensely debated in the media and the public, and the incidence especially in older patients is higher than expected in our cohort. Compared to the frequency of a completed organ donor cards (28%) the incidence is twice as high. Yet, only the minority of patients has declared their will in detail that will be sufficient for therapeutic decision making. Therefore, we may suggest from our data that a better explanation about the meaning and content of a patient decree is needed for the public. here insert your text.

Sedation of patients with acute aneurysmal subarachnoid haemorrhage with Ketamine is safe and might influence the occurrence of delayed cerebral ischemia

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Objective: Ketamine has neuroprotective characteristics as well as beneficial cardiocirculatory properties and may thus reduce vasopressor consumption. In contrast, sedation with Ketamine (like any other sedative drug) has side effects. This study should assess the influence of Ketamine on the ICP, on the consumption of vasopressors in induced hypertension therapy as well as on the occurrence of DCI associated cerebral infarctions with particular focus on the complications of sedation in patients with aneurysmal subarachnoid haemorrhage (SAH).

Methods: This is a retrospective, observational study. Sixty-five patients with SAH who underwent a period of sedation were included. The clinical course variables (RASS score, ICP values, consumption of vasopressors, complications of sedation, outcome and other clinical parameters) were analyzed. Cranial CT scan imaging results were analyzed.

Results: Forty-one patients underwent sedation including Ketamine (63.1%).

Ketamine lowered the ICP in 92.7% of the cases. Vasopressors could be

reduced in 53.6%. DCI associated cerebral infarctions occurred

significantly less often in the patient cohort being treated with

sedation including Ketamine (7.3% versus 25% in the non - Ketamine group; $p = 0.04$). The rate of major complications was not higher in the Ketamine group. Outcome was not different regarding the groups either if they were sedated with or without Ketamine.

Conclusion: Ketamine lowers the intracranial pressure while it was not associated with a higher rate of complications. The rate of DCI associated cerebral infarctions was lower in the Ketamine group. Ketamine administration lead to a reduction of vasopressors used for induced hypertension.

Vasospasm as a life threatening complication after pituitary surgery

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⁶University Hospital Hamburg-Eppendorf, Neurosurgery, Hamburg, Deutschland

Objective: To identify clinically relevant vasospasms as a rare complication after pituitary surgery with emphasis on management and outcome.

Methods: In a retrospective design, 1900 patient charts undergoing transsphenoidal pituitary surgery from January 2008 through October 2016 were retrospectively analyzed regarding postoperative, vasospasmic events, its' management and neurological outcome.

Results: Four patients (0,2%) who developed neurological deficits in the postoperative phase caused by vasospasms – as identified by neuroradiological means - were identified. Patients were treated according to current state-of-the-art recommendations for SAH triggered vasospasms, including intra-arterial spasmolysis. Nevertheless multilobar ischemic infarctions developed in all 4 patients. Three patients recovered with no or only slight neurological deficit. (Glasgow Outcome Score 5 twice, 4 once), one patient deceased due to large bihemispherical infarction.

Conclusion: Although a rare complication, vasospasms after pituitary surgery can lead to severe ischemic infarctions and thus neurological impairment. In case of unexpected postoperative neurological deficit following transsphenoidal pituitary surgery, this rare complication should be considered and adequate and immediate imaging should be performed. MR imaging and (contrast-enhanced) MR angiography are an appropriate diagnostic tool, treatment of vasospasms including local intra-arterial spasmolysis, if necessary, should not be delayed.

Prophylaxis, diagnosis, and therapy of delayed cerebral ischemia in patients with aneurysmal subarachnoid hemorrhage in Germany: a nation-wide survey

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Objective: Aneurysmal subarachnoid hemorrhage (aSAH) is associated with high morbidity and mortality. Delayed cerebral ischemia (DCI) is one of the main contributors to poor outcome after aSAH. While several studies have assessed the use of nimodipine and other medications in aSAH, no consensus standard currently exists for the prophylaxis, diagnosis or treatment for DCI in the clinical setting.

Methods: We conducted a nation-wide, Internet-based survey of German tertiary centers treating patients with aSAH. Our goal was to assess how DCI is prevented, diagnosed, and treated in Germany in patients with aSAH.

Results: A total of 40 tertiary centers were included in the analysis. All of them (40/40, 100%) use nimodipine for DCI prophylaxis in aSAH. The majority of these centers administer nimodipine for 21 days (19/40, 47.5%), through both oral and intravenous routes (24/40, 60%). In 27/40 centers (67.5%), nimodipine is interrupted when high catecholamine doses are needed. Specific cut-off values of catecholamine doses for nimodipine interruption were heterogeneous. The majority of centers (39/40, 97.5%) use transcranial Doppler (TCD) to monitor vasospasm. Other methods employed include CT-angiography (CTA) (20/40, 50%), CT-perfusion (CTP) (24/40, 60%), digital subtraction angiography (DSA) (24/40, 60%), and brain tissue oxygenation (17/40, 42.5%). However, there is no homogeneous parameter dictating when these diagnostic tools are used. Pathological TCD-values and clinical deterioration were the most common criteria that indicated further DCI work-up; in 37.5%, these criteria lead to CTP, while in 45% to CTA, and in 37.5% to DSA. Treatment of DCI/vasospasm included Triple-H (37/40, 92.5%), medical dilation (28/40, 70%), and mechanical dilation (24/40, 60%).

Conclusion: Our survey reveals a large heterogeneity in the prophylaxis, diagnosis, and therapy of DCI in patients with aSAH in Germany. This illustrates the need for an established standard of care in the management of this complex condition.

Complications and Shunt-Dependency following Placement of an External Ventricular Drainage - a Single-Center Experience

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¹Klinik und Poliklinik für Neurochirurgie, Universitätsklinikum Carl Gustav Carus, Technische Universität Dresden, Dresden, Deutschland

Objective: Placement and postoperative management of external ventricular drainage differs significantly in different neurosurgical units due to lacking of nationwide or international guidelines. We examined the management and complications in our institution for the years 2009 till 2015 to identify problems and possibilities for improvement.

Methods: We conducted a retrospective analysis of external ventricular drainages performed between 2009 and 2015 on adult patients in our institution. Points of interest were, among others, the underlying disease, patient demographics, duration of external drainage, measured liquor dynamics and chemistry, usage of prophylactic antibiotics (which was changed in our institution in 2014).

Results: 573 patients were treated with an external ventricular drainage receiving 961 interventions. The far most prominent underlying diseases were aneurysmal subarachnoid hemorrhage (29.7 %) and intracerebral hemorrhage (27.2 %).

51.5 % of the patients received a permanent drainage system (shunt). There was a high dependence on the underlying disease for shunt placement, e.g. patients with subarachnoid hemorrhage received in 67.3 % of the cases a permanent liquor shunt after an external drainage.

The over-all infection rate in our institution was 8.52 % per patient. Since we changed our management and abandoned prophylactic antibiotic usage in 2014, we could correlate historically the infection rates with or without prophylactic antibiotics, which were similar (8.54 % vs. 8.46 % for patients receiving prophylaxis vs. no prophylaxis).

Conclusion: Although external ventricular drainage is a frequent neurosurgical intervention, it is still haunted by a high complication rate, infection being the most prominent.

The infection rates in our institution were consistent within the range of various reports from other institutions. Antibiotic prophylaxis could not provide a significant lower infection rate and was thus rightfully abandoned and should be one recommendation in a future guideline for external ventricular drainages.

We had a high rate for shunt placement compared to other reports, especially in patients with subarachnoid hemorrhage; the reasons for this will be discussed.

Venous air embolism and related intra- and postoperative complications in semi-sitting position for posterior cranial fossa surgery

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Objective: The semi-sitting position during posterior fossa surgery is known to ensure significant advantages, yet due to the danger of venous air embolism (VAE) it remains controversial and is not exclusively used. In our center we tend to operate almost all complex lesions of the posterior fossa in a semi-sitting position, therefore a retrospective analysis of the incidence of VAE and related complications in the semi-sitting position was performed.

Methods: Data from 45 patients (Pt.) who underwent surgery for complex posterior fossa lesions in the semi-sitting position from October 2015 until November 2016 were retrospectively analyzed. All patient data including patient information, clinical details, intraoperative anesthesiological details, postoperative course and follow-up information were collected and statistically analyzed.

Results: Tumor entities in our series comprised acoustic neurinomas (30 Pt., 67%), petrous bone or petroclival meningiomas (5 Pt., 11,1%), Epidermoid cysts (2 Pt., 4,4%), and Ependymomas (2 Pt., 4,4%). 29 Pt. (64%) were females and 16 Pt. were males (36%) with a mean age of 53 Years. 27 Pt. (60%) had BMI larger than 25. Preoperatively determined ASA (American Society of Anaesthesiologists) classification revealed ASA I in 7 Pt. (15,5%), ASA II in 28 Pt. (62,2%), ASA III in 10 Pt. (22,2%). Preoperative transthoracic echocardiography (TTE) to rule out patent foramen ovale (PFO) was proven positive in 3 Pt. (6,6 %), negative in 38 Pt. and could not be determined in 4 Pt. (8,9%). Intraoperatively performed transesophageal echocardiography (TEE) proved PFO existence in 2 Pt. (4,4%), one of them was falsely negative in preoperative TTE. Mean operation time was 4 hours 58 minutes. VAE was detected using an intraoperative continuous TEE in 3 Pt. (6,6%) once and in 2 of those Pt. twice. (4,4%) One of these Pt. also had a corresponding decrease in end tidal CO₂ of 7mm Hg, while none of the Pt. with detected intraoperative VAE had a timely corresponding drop of systolic blood pressure or an increase of heart rate. Postoperative complaints consisted of nausea and vomiting (26 Pt., 58%) , headache (23 Pt., 51%), vertigo (12 Pt., 26,7%). 6 Pt. (13,2%) suffered from perioperative complications such as pneumonia (2 Pt., 4,4%), subdural hematoma (2 Pt., 4,4%), local wound infection (1 Pt., 2,2 %), subcutaneous collection of CSF (1 Pt., 2,2%).

Conclusion: In a 1 – year overview of our Pt. operated in a semi-sitting position intraoperative VAE occurred only in 3 Pt. without paradox embolism and any neurological sequelae. Intraoperative and postoperative pulmonary function was also not compromised. The semi-sitting position can therefore safely be used in the neurosurgical treatment of complex posterior fossa lesions even in selected cases with PFO. However, in our opinion intraoperative continuous TEE and standardized perioperative management is mandatory.

Repetitive measurement of cerebral ventricular dimensions in patients with decompressive craniectomy: bedside sonographic duplex technique compared to cranial computed tomography

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Objective: Recently we have shown the reliable evaluation of all four cerebral ventricles via SDT and the high correlation of the measurements with sonographic duplex technique (SDT) and CCT in patients after decompressive craniectomy (DC). The objective of this study was to assess the reliability of the values by repetitive measurements in a patient.

Methods: 20 consecutive patients after DC following trauma, brain infarct and bleeding were examined by SDT and CCT. If clinically indicated, for example in cases with persisting ICP or neuroworsening in the postinterventional sequelae, craniectomized patients underwent a CCT control. In timely context within 24 hours after CCT exam SDT (Hitachi-Aloka Arietta V70, Convex probe 5-2, mechanical Index 0.8 to 1.2) was performed. In these patients repetitive measurements were done.

Results: The dimensions of all four ventricles, midline shifts and differential cerebral anatomy could be visualized in SDT corresponding to CCT in each repeated measurement. For instance structures like the cerebellum, the basal cisterns and other parts of the brainstem were adequately identified in SDT every time. In repetitive measuring the diameters of all four ventricles the values obtained with SDT and CCT show a high and significant correlation. Even minimal changes of the diameters of the ventricles could be recorded with SDT as well as with CCT ($p < 0.001$).

Conclusion: In addition repetitive measurements of the dimensions of all four ventricles by using SDT in the same individual after DC deliver reliable values and show a high correlation to CCT. Therefore SDT may be a valid option as a bedside tool to supplement CCT scans after DC especially for follow-ups in patients risky for CCT transports.

MI.20

Trauma 2

Mittwoch *Wednesday*, 17.05.2017, 13.30 – 14.20 Uhr *hrs*

- MI.20.01 *Acute Subdural Hematoma (aSDH)- Does Age really contribute to unfavourable Outcome?*
S. Bele* (Regensburg, Deutschland), J. Scheitzach, K. Schebesch, A. Brawanski
-
- MI.20.02 *Spinal cord injury in the axolotl: A promising model to monitor therapeutic hydrogels*
J. Bendig* (Dresden, Deutschland), O. Uckermann, G. Schackert, E. Tanaka, M. Gelinsky,
G. Steiner, M. Kirsch
-
- MI.20.03 *Multiple injuries in comatose patients - A multicenter study of early interdisciplinary management*
M. Luchtman* (Magdeburg, Deutschland), A. Rashidi, R. König, I. Bondar, R. Firsching
-
- MI.20.04 *The effect of S100B on synaptogenesis and inflammatory processes in the hippocampus following experimental traumatic brain injury*
T. Sehm, J. Baecker, A. Ghoochani, M. Buchfelder, A. Kleindienst* (Erlangen, Deutschland)
-
- MI.20.05 *A systematic review and retrospective analysis of epileptic seizures in adults with subdural haematomas: GATE 24-score for prophylactic antiepileptic treatment*
S. Won* (Frankfurt, Deutschland), J. Konczalla, D. Dubinski, A. Cattani, C. Cuca, V. Seifert,
F. Rosenow, A. Strzelczyk, T. Freiman
-

Acute Subdural Hematoma (aSDH) – Does Age really contribute to unfavourable Outcome?

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Objective: Acute subdural hemorrhage (aSDH) is often associated with bad outcome after traumatic brain injury. Since society is continuously aging, we were interested to find out if age > 65 years is a significant factor for bad outcome or if other factors in this aging society are influencing outcome.

Methods: We retrospectively analyzed data of patients with the ICD code S06.5 from the last 11 years. Ct scans and charts were checked for aSDH, age, mass lesion, midline shift, coagulopathy or intake of anticoagulants, GOS at discharge and GCS on admission.

Results: So far we analyzed 130 data sets. 60 patients had to be excluded due to wrong use of code S06.5, missing data or missing ct scans. Mean age was 66 years with a median of 70 years. 37 patients were in the group of 65 and older, 33 were younger. Median outcome in the former group was 3 compared to 4 in the latter. In the group > 65 years 26 patients were in the GOS group 1-3 ($p=0.074$), 16 of those had an additional coagulopathy. In addition 16 older patients had a midline shift > 10 mm, 15 of which had bad outcome.

Conclusion: From our data so far we conclude that patients older than 65 years are at high risk for adverse outcome, especially if they are on anticoagulants or have another form of coagulopathy. If in addition to age > 65 years a midline shift of more than 10 mm is present at time of admission the risk for adverse outcome is significantly increased compared to patients < 65 years independent if surgery is performed or not. .

Spinal cord injury in the axolotl: A promising model to monitor therapeutic hydrogels

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Objective: The axolotl salamander exhibits an unusual regenerative capacity even after spinal cord injuries (SCI). Since various experimental approaches to treat SCI involve the application of modified biodegradable matrices, we investigated whether the frequently used substrate component alginate-hydrogel will be included in the regenerative process. The effect of the implant was analysed by **label-free multiphoton microscopy (MPM)**.

Methods: A one millimetre long section of the spinal cord was resected and the resulting gap filled with alginate-hydrogel or left void (control). Cryosections of the injured area were prepared after 0, 2, 7, 14, 28, 56 d (n=10 per time point) and analyzed with MPM. Specifically, coherent anti-stokes Raman scattering (CARS) probed lipid-rich myelin via visualization of CH₂ vibrations, while two photon excited fluorescence (TPEF) and second harmonic generation (SHG) displayed endogenous fluorophores and collagen, respectively. Immunostaining for myelin basic protein, neurofilament and ionized calcium binding adaptor molecule 1 (Iba1) served as histological reference. If not stated otherwise, P-values were calculated with Welch's t-test.

Results: MPM visualized tissue components including myelin ensheathed axons (CARS) and meninges (SHG). Upon lesioning we found profound changes within the area of injury that were characterized by an increased number of TPEF-positive cells. The Iba1 staining identified these cells as activated microglia and macrophages

The alginate-treated group showed a significantly higher number of TPEF-positive cells in all time points except for 56 d (e.g. 7 d: P<0.0001, mean: 77 and 179 cells). At 7 d post-lesioning, the formation and outgrowth of axons and meninges was significantly hindered compared to the control (P<0.0001 for both, difference of mean: 567 µm and 658 µm respectively). Growth of cells, axons or meninges into the alginate-hydrogel was not observed at any time point. However, the reconnection in the alginate-hydrogel treated animals occurred outside of the transplant and the spinal cord was successfully restored in both groups. After 56 d there were no significant differences regarding myelination (P=0.85), inflammation (P=0.24) or meningeal continuity (all values 0 µm in both groups).

Conclusion: The axolotl proved to be a promising model to evaluate the impact of novel implants on spinal cord regeneration. Through MPM meningeal, axonal and cellular behavior (e.g. inflammation or myelination) become easily assessable in unstained tissue and thus potentially *in vivo*. Consecutively, we will investigate novel hydrogels/implants for spinal cord regeneration and further advance our combined approach for *in vivo* situations.

Multiple injuries in comatose patients - A multicenter study of early interdisciplinary management

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Objective: As a patient in posttraumatic coma cannot choose the treatment he needs, a multidisciplinary team of specialists has the responsibility to determine what is urgent in a collision of priorities. In a prospective multicenter cohort study we tried to analyse the timing of initial diagnostic and curative measures.

Methods: 1003 patients admitted in posttraumatic coma were followed in 16 hospitals. The timing of surgical management and outcome was analysed in the early phase - within 48 hours - and late phase - until 6 months -. Statistical analysis included chi-square and NANOVA tests.

Results: Vital operations within 48h of the injury were 348 cases of craniotomy, 78 cases of abdominal and 84 thoracic operations. Non-vital operations included 220 intracranial catheters for ICP recording, 160 definitive or provisional stabilizations of fractures extremities, 55 maxillofacial operations and 35 spinal operations. In 5 cases the cranial operation was performed prior to the abdominal operation. In 2 cases the abdominal operation preceded the craniotomy, in 5 cases the thoracic intervention preceded the craniotomy. In 7 cases craniotomy was performed simultaneously with either abdominal or thoracic surgery. Mortality correlated highly significantly with the duration of coma and additional neurological disorders.

Conclusion: The most frequent vital surgical procedure of comatose patients within 8 hours of the accident was a craniotomy (68.2%). Vital surgery of the thorax or abdomen was necessary in 31.8%. Based on the mortality of specific neurological findings, secondary non vital surgery should be delayed, until the condition of the patient is stable and survival appears likely. When the patient is in a coma, the most frequent type of surgery performed is a neurosurgical procedure.

The effect of S100B on synaptogenesis and inflammatory processes in the hippocampus following experimental traumatic brain injury

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Objective: The stimulated release of the neurotrophic protein S100B is known to enhance hippocampal progenitor cell proliferation, neuronal differentiation and cognitive recovery following traumatic brain injury (TBI). However, the effect of S100B on synaptogenesis and inflammatory has not been elucidated yet. In the present study, we investigate the effect of S100B on the microglial activation and the synaptic density in the hippocampus following experimental TBI.

Methods: Male Sprague-Dawley rats were subjected to lateral fluid percussion or sham injury, and S100B (50ng/hr) or PBS was infused into the lateral ventricle for 7 days using osmotic micro-pumps. The animals were sacrificed on day 5 or 34 post-injury, and 5µm sections (distance 100µm, bregma -3.3 to -5.6mm) were analyzed histologically. The hippocampal microglial activation and synaptic density were quantified by immunostaining applying marker against CD68 (ED1) – a single chain membrane bound glycoprotein and synaptophysin (SYN) – a synaptic vesicle glycoproteine.

Results: S100B attenuated bilateral the SYN expression in the hippocampus (week 5: CA1 region, $p < 0.001$; CA3 region, $p \leq 0.001$; GCL, $p < 0.001$) both in uninjured animals and following TBI. This effect was present on day 5 and after 5 weeks. The stimulated CD68 expression displayed a similar spatial profile (week 5: CA3 region, $p = 0.008$; GCL, $p < 0.001$).

Conclusion: Our results demonstrate that S100B attenuates the hippocampal SYN expression and induces a microglial activation in non-injured and in injured animals. This effect is not limited to the lesion side, but also comprises a long-term effect in the contralateral hemisphere. Whether the reduction of synaptic density is directly caused by S100B or is mediated through the triggered neuroinflammatory response remains unclear. However, since we demonstrated earlier in the same animals that S100B augments significantly hippocampal neurogenesis and improves cognitive function, the S100B induced microglial activation does not counteract neuroregeneration within the first five weeks post-injury. Further studies are required to elucidate the respective cellular signalling and possible long-term effects.

A systematic review and retrospective analysis of epileptic seizures in adults with subdural haematomas: GATE 24-score for prophylactic antiepileptic treatment

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Objective: Posttraumatic epileptic seizures (PTS) are a serious complication in patients with subdural haematoma (SDH). However, to date, several studies have shown discordances about SDH-associated seizures in terms of incidence, risk factors and prophylactic antiepileptic treatment. The aim of this study was first to perform a systematic literature review of PTS in SDH and secondly to analyse incidence, risk factors of PTS and establish a guideline in patients with acute SDH (aSDH) to standardize the decision for prophylactic antiepileptic treatment.

Methods: A systematic literature review examining PTS in patients with SDH was performed using PubMed gateway, Cochrane Central Register of Controlled Trials, and Excerpta Medica dataBASE between September 1961 and February 2016. Search terms included subdural haematoma, seizure, epilepsy, prophylactic antiepileptic drugs, anticonvulsive medication, and risk factors. PRISMA statements were used for assessing data quality. Two independent reviewers extracted data from included studies and disagreement was solved by consensus. Furthermore a retrospective study with 139 aSDH patients treated from 2007 until 2015 were analysed. Baseline characteristics and clinical findings including Glasgow coma scale (GCS) at admission, 24 hours after operation, timing of operation, anticoagulation, Glasgow outcome scale (GOS) at hospital discharge and after 3 months were examined. Multivariate logistic regression analysis was performed to detect independent predictors of epileptic seizures and a scoring system was developed.

Results: In total, twenty-four studies were included into the study. Overall incidence of early PTS (ePTS) and late PTS (IPTS)/2years was 28% and 43% in aSDH whereas the incidence of e- and IPTS was lower in chronic SDH (cSDH; 5.3% vs. 10%). Similar incidence of ePTS in aSDH was found in our cohorts with 38%, preoperatively 15% and postoperatively 25%. 90% of patients with preoperative epileptic seizures were seizure-free after operation. Overall risk factors for PTS in patients with aSDH were: 24 hours postoperative Glasgow Coma Score (GCS) score below 9 (OR 10.5), craniotomy (OR 3.9), preoperative GCS below 8 (OR 3.1). In the retrospective study, independent predictors of PTS were also low GCS (<9; OR 3.3) 24 hours after operation and anticoagulation (OR 2.2). In patients with cSDH the risk factors were alcohol abuse (OR 14.3), change of mental status (OR 7.2), previous stroke (OR 5.3) and density of haematoma in computer tomography (OR 3.8). Age, sex, haematoma size/side and midline shifts were not significant risk factors for PTS in both types of SDH. In prevention of PTS phenytoin and levetiracetam showed similar efficacy (OR 1.3), whereas levetiracetam was associated with significantly lower adverse effects (OR 0.1). Additionally, a score system (GATE 24) was developed; cut-off was measured at 24 points. Patients with less than GCS 14, a prophylactic antiepileptic treatment is recommended.

Conclusion: PTS are a serious complication in patients with SDH, particularly in aSDH. Based on GATE 24-score, seizure prophylaxis should be considered in high-risked patient to promote better clinical outcome.

MI.21 Wirbelsäule – Tumor

Mittwoch *Wednesday*, 17.05.2017, 13.30 – 14.50 Uhr *hrs*

- MI.21.01 *Treatment of cervico-spinal giant cell tumors - case report and systematic review*
M. Mütter* (Münster, Deutschland), M. Schwake, H. Berssenbrügge, W. Stummer,
E. Christian
-
- MI.21.02 *Impact of decompressive laminectomy on the functional outcome of 28 patients with spinal metastases and complete motor paralysis*
A. Younsi* (Heidelberg, Deutschland), S. Brenner, K. Zweckberger, A. Unterberg
-
- MI.21.03 *Radiofrequency Ablation of spinal metastasis and temperature distribution at neural structures*
S. Jadik* (Kiel, Deutschland), M. Synowitz
-
- MI.21.04 *Primary cancer determines the extent of impairment as well as surgical treatment for metastatic spinal cord compression without affecting the patients' functional outcome*
S. Ridwan* (Bielefeld, Deutschland), A. Grote, K. Gousias, M. Simon
-
- MI.21.05 *Surgical treatment of spinal metastases - predictors of neurological outcome*
C. Hohenberger* (Regensburg, Deutschland), C. Schmidt, J. Höhne, A. Brawanski,
K. Schebesch
-
- MI.21.06 *Polyetheretherketone cages patients with spinal metastases: impact on postoperative radiation therapy*
M. Mütter* (Münster, Deutschland), J. Löbbecke, U. Haverkamp, H. Eich, W. Stummer,
C. Ewelt
-
- MI.21.07 *Accuracy of robot-assisted versus fluoroscopy guided pedicle screw insertion for metastatic spinal disease: A matched cohort comparison*
V. Solomiichuk* (Göttingen, Deutschland), V. Rohde, J. Fleischhammer, J. Warda, A. Alaid,
K. von Eckardstein, B. Schatlo
-
- MI.21.08 *Spinal cord hemangioblastomas - Significance of intraoperative neurophysiological monitoring for surgical resection and long-term outcome*
S. Siller* (München, Deutschland), A. Szelényi, L. Herlitz, J. Tonn, S. Zausinger
-

Treatment of cervico-spinal giant cell tumors - case report and systematic review

Michael Mütter¹, Michael Schwake², Hendrik Berssenbrügge², Walter Stummer², Ewelt Christian²

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Objective: Giant Cell Tumors (GCT) account for 5% of bone tumors, spinal GCT again form 5% of all GCT. Generally considered benign, local aggressiveness and metastatic growth have been described. Because of low prevalence mostly small clinical series have been published on GCT in the cervical spine. In this work we present a case of a GCT in the second cervical vertebra and put our treatment in context of current literature.

Methods: We report the surgical treatment of a GCT in the second cervical vertebra. Literature search on pubmed.gov was performed using the following headings: giant cell tumor AND cervical spine, osteoclastoma AND cervical spine. 161 abstracts were analyzed according to the PRISMA-protocol.

Results: A 35-year-old male presented with a six week history of headache and neck pain. CT and MRI showed an osteolytic lesion of the second cervical vertebra and signs of atlanto-axial instability. In a first step fusion of the first four cervical vertebrae was performed. After a needle biopsy through one of the screw canals an aneurysmal bone cyst was found to be the most likely diagnosis. Accordingly transoral resection of the dentoid process, local tumor curettage and interposition of an autologous bone graft was performed. At this point GCT was diagnosed. Whole body FDG-PET staging showed no signs of metastases. During follow-up the patient remained asymptomatic, the cervical fusion remained stable.

Conclusion: In terms of best oncologic treatment an aggressive surgical strategy should be considered in GCT. However, radical excision of an affected cervical vertebra is mostly not feasible due to anatomical and functional complexity. In cases of spinal instability an initial posterior fusion and biopsy appears to be a reasonable first step. As pathology may be wrong initially as in this case, local surgical control via an anterior approach should be a major treatment goal. If negative surgical margins cannot be achieved adjuvant treatment such as radiotherapy, Zolendronic Acid or Denosumab must be considered.

Impact of decompressive laminectomy on the functional outcome of 28 patients with spinal metastases and complete motor paralysis

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Objective: Malignant spinal cord compression (MSCC) is a frequent phenomenon in advanced tumor diseases with varying, but often severe neurological impairments. Decompressive laminectomy is frequently used for surgical treatment of MSCC. Our study aims to analyze the impact of this procedure on the functional outcome of patients with complete motor paralysis.

Methods: A single center retrospective analysis of MSCC-patients with complete motor palsy (Frankel grade A+B) treated with decompressive laminectomy between 2004-2014 was performed. Demographic as well as clinical data were collected from the patients' hospital records. On imaging, the epidural spinal cord compression scale (ESCC) was calculated. Frankel grade (FG) was used to assess the patients' functional outcome at discharge, the Spinal instability neoplastic score (SINS) was evaluated to determine spinal stability and the ASA score was documented to define the patients' overall health. Statistical analysis for possible correlations of various clinical parameters with the patients' functional outcome was performed.

Results: 28 patients (9 female / 19 male; age 65±11 years) were identified. Lung (39%) and prostate (28%) were the most common primary tumor sites and progressive disease was present in 75% of cases. Paresis was the first symptom in 75% of patients with a median duration of 2 days (IQR 1-6). On admission, 61% of patients had no motor or sensory function below the lesion level (FG A) and the remaining 39% had complete motor paralysis (FG B). Patients were unable to walk for a median duration of 24 hrs. (IQR 24-48). Imaging revealed prevalently cervical or thoracic MSCC (93%) with an ESCC scale of 3 in 75% and a SINS score < 12 in 100% of cases. Emergency surgery (<24 hrs.) was performed in 96% of patients. Median time to surgery was 8 hrs. (IQR 6-13). Median ASA score was 3 and rates of complications and revision surgery were 11% and 4%, respectively. On discharge, FG had improved in 61% of patients and 25% had regained ambulation (FG D+E). Univariate predictors for a favorable outcome (FG D+E) were female sex (p=0.0326) and a higher Karnofsky performance index (KPI) (p=0.0146). Interestingly, shorter duration of symptoms and the exact time of emergency surgery within 24 hrs. after admission showed no significant impact.

Conclusion: Decompressive laminectomy used as an emergency surgical treatment for MSCC with a stable spine has beneficial effects on severely ill cancer patients with complete motor palsy: Ambulation is regained in 25% of cases. A higher KPI prior to surgery (> 30) may be a positive predictor for a favorable outcome.

Radiofrequency Ablation of spinal metastasis and temperature distribution at neural structures

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Objective: Radiofrequency ablation (RFA) is an interventional method to treat metastases of the spine. RFA leads to a heat build-up to 75 °C in the tumor, which rapidly drops to normal body temperature in the periphery. But nevertheless heating of the nerves and the spinal cord could lead to their damage. In this study temperature distribution is shown directly at the dura and demonstrated with some examples.

Methods: RFA was performed in 12 patients with metastases involving the spinal canal. The ablation probe is equipped with a distal and a proximal Temperature-probe. The temperature directly at the nerve and the spinal cord was measured with a third T-Probe. In an overheating of more than 38.5 °C, the nerve was cooled by flushing with saline.

Results: The maximum reached temperature in the tumor center was 71.33 °C (+/- 1.53). In the periphery of the ablation probe, the heat generation was always 50 °C. At the nerve and the spinal cord temperatures were measured on average 37.17 °C (+/- 2.03). Peaks of 38.5 °C up to 40 °C have been successfully reduced to normal of 36 °C by flushing. In all cases an effective ablation temperature in the center of the tumors are achieved. At the nerve and the spinal cord temperatures rose up to 40 °C. It could be cooled by flushing with saline. Without cooling the heat can rise to critical values and cause damage to the nerve or the spinal cord.

Conclusion: The heat distribution distally and proximally of the ablation can be tracked well and is effective. The heat in the vicinity of neural structures is moderate. T-peaks can be intercepted by flushing and thus further increase with potential damage to the nerve and the spinal cord can be prevented.

Primary cancer determines the extent of impairment as well as surgical treatment for metastatic spinal cord compression without affecting the patients' functional outcome

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Objective: Epidural metastatic cancer in spine can result in malignant spinal cord compression (MSCC) with neurological symptoms of variable extent. Here we have analyzed our institutional experience with surgical treatment for MSCC in order to characterize the impact of primary cancer on surgical management and the patients' functional outcomes.

Methods: Pertinent data from 209 patients treated in our Department from 2001 through 2011 were collected from the patients' clinical records. Primary cancer site, the neurological status (Frankel grade, FG), the Karnofsky performance index (KPI) as well as the ambulatory status (AS; ambulatory: 1, assistance required: 2, wheelchair: 3, bedridden: 4) were documented. Surgical, neurological and systemic complications were recorded. The various clinical parameters were tested for possible correlations with the patients' functional outcomes. Statistical analysis was performed using standard methods.

Results: Primary cancer site was lung in 23.4%, prostate 18.7%, breast 17.7% and other in 40.2%. On admission 55% of patients were ambulatory (AS 1 & 2) compared to 72.2% at discharge. 60.4% of patients presenting with AS 3, and 32.5% of cases in AS 4 became ambulatory after surgery (AS 1 & 2). Extracting patients with lung, breast and prostate cancer, significant differences in clinical presentation were found. Primary site was majorly untreated in lung cancer ($p < 0.0001$). Prostate showed less pathological fracture ($p = 0.024$). Whereas paravertebral growth was higher in lung ($p = 0.009$). Breast patients presented with better Frankel grades ($p = 0.043$). Interestingly axial pain was less in prostate patients ($p = 0.004$) as well as using internal fixation as surgical strategy ($p = 0.007$). Lung patients suffered more severe adverse events ($p = 0.016$). Primary cancer had no impact on the functional outcome at discharge.

Conclusion: Surgery for MSCC has a significant beneficial impact on the patients' postoperative functional status, and many patients regain ambulation. Primary cancer site determines clinical presentation and surgical strategies but doesn't affect the functional outcome on discharge.

Surgical treatment of spinal metastases - predictors of neurological outcome

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Objective: Space-occupying spinal metastases are commonly diagnosed due to acute neurological deterioration and consequently, immediate decompression with tumor removal or reduction is performed. Here, we report our experience and analysis of our series of patients with surgically treated spinal metastases. We explicitly sought to determine individual predictors of functional outcome.

Methods: 95 consecutive patients (27 women, 68 men; mean age 64.0 years) with spinal metastases were included retrospectively. All patients were treated surgically in our department. We reviewed the charts, surgical reports and radiographic data for demographics, duration of symptoms, histopathology, stage of systemic disease, co-morbidities, radiographic extension, surgical strategy and neurological performance pre- and postoperative. The median follow-up was 1.4 months..

Results: Prostate carcinoma (29.5%) and breast carcinoma (11.6%) were the most common histopathologies. KPI was < 70 % in more than 50% of the cases at admission and improved significantly until discharge. Emergency surgery (<24 hrs) was performed in 38%. Rates of complications and revision were 9.4% and 4.2%, resp. From admission to discharge we encountered significant pain reduction ($p=0.019$) and significant improvement motor deficits ($p=0.003$). The ASIA Impairment Scale and the Brice McKissock Score showed a significant improvement during in hospital treatment ($p=0.05$; $p=0.049$). In the multivariate analysis emergency surgery was a significant predictor for persisting neurological deficits at time of discharge, whereas a solitaire metastasis was a predictor for improved.

Conclusion: Decompression with tumor removal or reduction in patients with space-occupying spinal metastases led to a good functional neurological outcome and had a beneficial impact on pain and impairment. However, patients with acute severe onset of neurological deficits due to multiple spinal metastases had a higher risk poor neurological outcome.

Polyetheretherketone cages patients with spinal metastases: impact on postoperative radiation therapy

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Objective: Titan cages are widely used in the surgical treatment of spinal metastases. In most cases adjuvant radiotherapy is an essential part of treatment. Radiation target volumes are defined from postoperative imaging. However, titan cages lead to metal-related artifacts in CT imaging. Large PEEK polymer cages have recently been introduced to the market as parts of corporectomy systems. PEEK does not cause imaging artifacts and may be superior to titan cages in terms of more exact radiation planning. Our study evaluates the use of titan and PEEK cages implanted after corporectomy.

Methods: We retrospectively analyzed all cage implantations performed in our center on patients with metastatic spinal tumors between 2011 and 2015. Strong emphasis was put on the evaluation of radiation therapy concepts. Results were stratified by demographic data, tumor histology, tumor localization, prae- and postoperative Karnofsky Performance Status, oncologic concept and follow up radiographic findings.

Results: 24 patients were included into the study comparing 11 cases of PEEK and 13 cases of titan cage implantation. Tumor localization is 10% lumbar, 40% thoracic and 50% cervical spine. Dose homogeneity is higher with PEEK cages, possibly hazardous dose maxima are lower in this group. Each group shows similar distributions of demographic and oncologic features. All patients underwent radiotherapy 4-6 weeks post to surgery. No case of implant failures was observed.

Conclusion: To our best knowledge this is the first study comparing the use of PEEK and titan after corporectomy in the metastatic spine. Due to decreased imaging artifacts radiotherapy planning is easier and a focused radiotherapy meaning a decrease in dose maxima and possibly associated side effects is more feasible. We do feel there is a benefit towards the use of PEEK cages in spinal metastases.

Accuracy of robot-assisted versus fluoroscopy guided pedicle screw insertion for metastatic spinal disease: A matched cohort comparison

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Objective: Studies validating robotic technology in the spine have hitherto focused on degenerative disease and therefore overrepresent lumbosacral instrumentation where pedicles are relatively large. The aim of the present study is to compare the accuracy of the Mazor/SpineAssist system to conventional fluoroscopy-guided pedicle screw placement for metastatic spinal disease.

Methods: Seventy (n=70) patients suffering from metastatic spinal disease requiring instrumentation were included in the study. Robot-guidance was based on preoperative planning and intraoperative fluoroscopic matching. In the "conventional" group, pedicle screws were placed based on anatomical landmarks and antero-posterior and lateral fluoroscopy. The primary outcome measure was accuracy of screw placement as assessed using the Gertzbein-Robbins scale. Screw grades A and B (less than 2mm pedicle breach) on postoperative coronal and axial CT imaging were considered clinically acceptable, while all other grades were considered misplacements.

Results: A total of 406 screws were placed on 204 levels. The upper thoracic spine (Th1-Th6) accounted for 61 operated levels (29.6%), the lower thoracic spine for 35.9% (74/206), while the remaining (71/206) (34.4%) were lumbosacral. In the robot group (n=35, 192 screws), trajectories were graded A or B in 162 instances (84.4%). The misplacement rate was 15.6% (30/192 screws). In the conventional group (n=35, 214 screws), acceptable trajectories made up 83.6% of screws (179/214) with a misplacement rate of 16.3% (35/214). There was no difference in screw accuracy between groups (Chi2, p=0.89). There was no difference in infection rates between the two groups (5 patients with conventional (14.3%) vs. 8 patients (22.8%) with robotic technique). Moreover, radiation exposure did not differ between groups (p>0.05).

Conclusion: Our initial experience with robotic instrumentation of the thoracic spine is encouraging in that results were comparable to the gold-standard conventional technique. Registration and screw placement were not hampered by osteolytic vertebrae or small thoracic pedicles. On the other hand, radiation exposure and the incidence of wound breakdown were comparable between groups, raising the question whether the added cost and effort justifies robotic surgery for metastatic spinal disease.

Spinal cord hemangioblastomas - Significance of intraoperative neurophysiological monitoring for surgical resection and long-term outcome

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Objective: Spinal cord hemangioblastomas are rare tumors, developing sporadically or as part of von Hippel-Lindau disease (VHL). Although surgical resection is generally referred to be the treatment of choice, significance of intraoperative neurophysiological monitoring (IONM) for resection and postoperative outcome has hardly been evaluated before.

Methods: We retrospectively analyzed clinical, imaging and operative findings of 24 patients (m/f=1:1, sporadic/VHL=2.4:1) with 26 operations for resection of 27 spinal cord hemangioblastomas. Resection was performed under continuous IONM of somatosensory and transcranial motor evoked potentials (SSEPs and TcMEPs) and electromyography. Outcome parameters included short- and long-term neurological/functional status and a questionnaire evaluation of general performance and Oswestry Disability Index (ODI) at the end of follow-up. The correlation between IONM findings and postoperative deficits resp. outcome parameters was statistically assessed. Patients' informed consent and approval by the local ethical review board was obtained.

Results: Preoperative symptoms included sensory changes (100.0%), pain (66.7%), and motor deficits (41.7%) with a median McCormick grade of II. Most tumors were located dorsally (92.6%), cervically (77.8%), and completely intramedullary (77.8%). Gross-total resection was achieved for 26 tumors (96.3%). IONM was non-pathological in 11 and pathological in 15 operations. Patients with non-pathological IONM had significantly less new or worsened postoperative sensorimotor deficits ($p=0.005$). Long-term follow-up (mean 7.9yrs, 7 patients lost) revealed a satisfying outcome with 88.2% of the patients having a stable/improved McCormick grade and 70.6% a Barthel Index (BI) of 100%, while mean ODI ($11.4\pm 12.5\%$) indicated only minimal disability. There was a significant correlation of pathological IONM findings and worse long-term BI resp. ODI ($p=0.011$ resp. $p=0.024$). VHL was identified as a risk factor for worse functional long-term prognosis ($p=0.044$).

Conclusion: Resection of spinal cord hemangioblastomas with IONM facilitates a satisfying long-term outcome. Non-pathological IONM is associated with a lower risk of new deficits and correlates with a better long-term BI and ODI. VHL is a risk factor for worse prognosis.

MI.22 Tumor 14 - gemischt B

Mittwoch Wednesday, 17.05.2017, 13.30 – 15.00 Uhr hrs

- MI.22.01 *Reclassification of oligoastrocytoma by applying molecular markers and the 2016 classification of CNS tumors displays a better correlation with clinical outcome*
F. Geßler* (Frankfurt am Main, Deutschland), P. Baumgarten, P. Harter, O. Bähr, J. Konczall, V. Seifert, C. Senft
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- MI.22.02 *Assessment of psychosocial burden in brain tumor patients: application of the "Basic Documentation for Psycho-Oncology Short Form" (Po-BADO-SF) and the "Patient Health Questionnaire for Depression and Anxiety" (PHQ-4) –a longitudinal prospective observational study with regard to clinical application*
H. Tsakmaklis, S. Soebianto, M. Nadji-Ohl, O. Ganslandt, F. Ringel, A. Hickmann, M. Renovanz* (Mainz, Deutschland)
-
- MI.22.03 *Assessment of psychosocial support and unmet needs in glioma patients using the patients' perspective questionnaire - Results of 232 patients as part of the prospective multicenter "ERASMUS II" study.*
H. Lahr, S. Singer, E. Weimann, F. Ringel, C. Wirtz, M. Renovanz* (Mainz, Deutschland), J. Coburger
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M. Skardelly* (Tübingen, Deutschland), F. Behling, S. Noel, J. Schittenhelm, B. Bender, G. Tabatabai, M. Tatagiba
-

Reclassification of oligoastrocytoma by applying molecular markers and the 2016 classification of CNS tumors displays a better correlation with clinical outcome

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Objective: While astrocytoma and oligodendroglioma are histologically and genetically well-defined entities, oligoastrocytomas (OA) appear less clearly defined. As per the 2016 update of the classification of CNS tumors, we reclassified OA diagnosed histologically before addressing molecular markers IDH1r132H, TP53, ATRX and FUBP-1 loss and segregating OA into two groups, genetically matching oligodendroglioma or astrocytoma, respectively.

Methods: We included patients that had undergone cranial tumor removal within our neurosurgical department and were diagnosed with oligoastrocytoma. IDH1R132H-, TP53-, ATRX- and FUBP-1-status were assessed by immunohistochemistry. We further reviewed patient charts and correlated neuropathological findings with outcome.

Results: We identified 56 patients diagnosed with oligoastrocytoma. Median age was 41.1 years (IQR 34-47), 19 patients (33.9%) were suffering from recurrent tumor. Complete resection was achieved in 25 patients (44.6%), 28 patients (50%) underwent postoperative radiotherapy, 20 patients (35.7%) underwent postoperative chemotherapy and 8 patients underwent combined radio-/chemotherapy (14.3%). Of the patients, 15 patients (26.8%) were initially diagnosed with a WHO° II tumor and 41 patients (73.8%) were diagnosed with a WHO° III tumor. Between WHO°II and WHO°III oligoastrocytoma, no significant differences were observed regarding PFS ($p=0.17$) and OS ($p=0.39$). When considering molecular markers, and reapplying the updated classification of 2016, we diagnosed 2 patients (3.6%) with WHO° II Oligodendroglioma, 13 patients (23.2%) with WHO° II diffuse astrocytoma, 5 patients (8.9%) with WHO° III anaplastic oligodendroglioma and 36 patients (64.3%) with WHO° III anaplastic astrocytoma. Upon reclassification, a significant difference was observed regarding progression-free survival ($p=0.04$) and overall survival ($p=0.04$) between the abovementioned groups. In multivariate analysis, independent factors associated with progression-free survival were postoperative chemotherapy ($p=0.03$) and histology per the 2016 classification ($p=0.048$). Independent factors associated with overall survival were age ($p=0.01$), recurrent tumor ($p<0.01$) and neuropathological findings per the 2016 classification ($p=0.03$).

Conclusion: Reclassification of oligoastrocytoma per the updated 2016 classification of CNS tumors into two groups, genetically matching oligodendroglioma or astrocytoma allows for a better correlation with outcome. Moreover, this grouping is an independent factor associated with progression-free and overall survival.

Assessment of psychosocial burden in brain tumor patients: application of the "Basic Documentation for Psycho-Oncology Short Form" (Po-BADO-SF) and the "Patient Health Questionnaire for Depression and Anxiety" (PHQ-4) – a longitudinal prospective observational study with regard to clinical application

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Objective: Identification of brief, valid screening instruments is critical for providing neuro-oncological patients with appropriate psychosocial support. At the same time, due to patient's neurocognitive impairment and/or restricted ability to undergo screening procedures, physicians' estimation of need of support is inevitable. This is the first study applying the ultra-short 4-item version of the Patient Health Questionnaire for Depression and Anxiety (PHQ-4) in neuro-oncological patients. Consistency of physicians' perception (assessed by PO-Bado-SF) and patients' screening results during first six months of the disease was evaluated.

Method: Patients with primary diagnosis of intracranial tumors, MMST >26 and written informed consent were assessed after surgery (T1), 3 and 6 months (T2, T3). Health-related quality of life was evaluated with EORTC-QLQ-C30+BN20, psychosocial burden with PHQ-4, Distress Thermometer (DT) and Hornheide Screening instrument (HSI). Simultaneously, attending neuro-oncologists (n=3) completed the PO-Bado-SF assessment. PHQ-4 results were compared to the validated instruments (DT, HSI) and the physicians' perception.

Results: 140 patients were included (male: 46%; glioma: n=48, 34%; meningioma: n=43, 31%; metastases: n=30, 21%). The PO-Bado-SF questionnaire was completed in 139 participating patients at T1, 117 at T2 and 96 at T3 (patient drop outs: T2 n=23 and T3 n=20).

Using the suggested cut-off score (>6) for PHQ-4, it identified n=20 (39%) of n=51 DT-positive and n=16 (39%) of n=41 HSI-positive cases at T1; n=8 (28%) of n=29 DT-positive and n=8 (20%) of n=40 HSI-positive cases at T2; n=5 (23%) of n=22 DT-positive and n=8 (26%) of n=31 HSI-positive cases at T3 (sensitivity 33%, resp. 29%; specificity 93%, resp. 91%).

PO-Bado-SF agreement with screening results for patients in need of support was better with PHQ-4 and DT than with HSI without reaching significance (PHQ-4: 56% (T1), 58% (T2), 63% (T3) vs. DT: 51% (T1), 59% (T2), 64% (T3) vs. HSI: 56% (T1), 48% (T2), 42% (T3)). Neuro-oncologists observed fatigue/tiredness in n=113 patients (T1), in n=94 (T2) and in n=76 (T3). The number of patients suffering from anxiety/worries and/or tensions was analogous (T1: n=113, T2: n=89, T3: n=69). In n=246 of n=352 (70%) completed assessments (T1: n=93, T2: n=90, T3: n=63) physicians observed mood swings/uncertainty/helplessness, being unreported by the patients themselves at that time. In turn, at T1, n=34 patients longed for support, of whom only 19 (56%) were identified by physicians via PO-Bado-SF. After 3 resp. 6 months, n=12 resp. n=11 patients (10% resp. 11%) immediately asked for psychological help, the PO-Bado-SF detected n=8 (67%) resp. n=6 (54%) of these patients as in need for support.

Conclusion: Reliable identification of neuro-oncological patients suffering from psychological burden is limited using the PHQ-4 by cut-off: >6 alone. However, due to its construction patients cannot only be identified by a cut off score, but also by directly expressing a potential wish for support. Furthermore, the physicians' perception by PO-Bado-SF provides a different facet of the psychosocial burden. However, the physicians view does not completely reflect the patients' wishes. Thus, patient reported outcome measures are indispensable but should be accompanied by the assessment of the physicians.

Assessment of psychosocial support and unmet needs in glioma patients using the patients' perspective questionnaire- Results of 232 patients as part of the prospective multicenter "ERASMUS II" study.

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Objective: To assess unmet needs of glioma patients and to evaluate received and requested psychosocial support by the patient's perspective questionnaire (PPQ) a patient reported outcome measure, applied for the first time in glioma patients.

Methods: We used a multicentre prospective design. Neuro-oncological patients were assessed consecutively within their outpatient visits using the self-administered PPQ. The first 9 items assess psychosocial distress by 5 step Likert-scales and support requested by the patient. The next 10 items assess provided support and its subjective benefit. Last 7 items record support requested currently by the patients (caregivers, relatives, physician etc.). We performed descriptive statistics.

Results: We included 232 patients. 82% were high-grade gliomas. M:f ratio was 1.25:1. Mean age was 52 years (range 20-87yrs).

We observed that 38% (87) of patients felt depressed. 44% (103) showed signs of anxiety. 39% (91) reported to feel tense/nervous. 57% (133) were emotionally distressed by the disease at a higher level. 77% (180) of patients felt sufficiently supported. But only 59% (138) reported to be thoroughly informed about the disease and therapy options. Patients' reported support was highest among family (75%) and physicians (68%). Both were classified as helpful in 87%. Only 13% were supported by a psychologist and 5% by a dietitian. Desired support was highest from physicians (59%), psychologists (19%) and dietitians (15%).

Conclusion: Glioma patients report a high level of psychological distress and need for support. Physicians play a crucial role in these patients' care. While the majority of them seems sufficiently supported, it is our task to detect the remaining almost 20% that are not. The PPQ screening instrument allows to evaluating the psychosocial support perceived by the patients, to detect supportive care needs and provide this information to the caregiver at a glance.

The proxy's view: The Family Situation, Psychosocial Burden and Needs for Support in 95 Caregivers of Patients with Gliomas assessed in an outpatient Setting.

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Objective: The prognosis for high-grade glioma patients remains poor. Little is known about the situation of their caregivers. We surveyed patients' caregivers in an outpatient setting in order to assess their levels of distress and needs for support.

Methods: In a multicentre outpatient setting patients and their caregivers were assessed at the same time. A questionnaire developed for the study and focusing on quality of life, distress and supportive care needs, was completed by caregivers. Amongst others, the questionnaire assessed quality of life, level of distress and wish for support. Simultaneously, the glioma patients were assessed using questionnaires measuring quality of life (EORTC QLQ-C30+BN20), psycho-oncological distress (Distress Thermometer, DT, a score ≥ 6 indicates significant burden). Socio-demographic factors and clinical data were collected, and associations between situation of patients and their caregivers were performed.

Results: Of 123 included patients (92%, n=113 harboring a high-grade glioma), 95 caregivers completed the questionnaires. The patients' age was 56 years (SD +/- 14.8, range 19-84). Most of the caregivers (64%; n=61) were life partners. The caregivers' DT mean was higher than the DT mean of the patients (caregivers: DT=5.9, SD=2.5 vs. patients: DT mean=5.3, SD=2.4). Similarly, more caregivers (58%) reported significant distress (DT ≥ 6) than patients (47%, n=37). 28% (n=26) of caregivers supporting a patient with DT ≥ 6 or more are also stressed (n=26). However, 19% of those who care for a patient with DT <6, are burdened (DT ≥ 6 , n=17). In total, of 29 patients reporting family problems, 59% had a caregiver with a DT ≥ 6 (n=17). When patients were under chemotherapy, their caregivers indicated significantly more often DT ≥ 6 than the patients themselves (patients: 33%, n=13, vs. caregivers 59%, n=23, p=0.02, Fishers' exact). 28% (n=26) of the caregivers indicate a moderate and 14% (n=13) indicate a poor quality of life. Emotional problems are reported by 64% of the patients (n=61), 61% of their caregivers state a DT ≥ 6 (n=37). 29% of the caregivers wish for more support from their own relatives and 25% wish for more support from the doctor in charge.

Conclusion: Although these data reflect the caregivers' subjective views, it has to be taken into account that not only the needs of the glioma patients themselves but also those of their caregivers should be assessed and support provided adequately as the patients' needs and burden do not always reflect the caregivers situation. Especially caregivers of patients under chemotherapy are burdened.

Would you do it again? Therapy of malignant glioma patients from the caregiver's perspective

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Objective: Due to consequent and aggressive combination of resection, radio- and chemotherapy, survival of malignant brain tumor patients has been increased in the last years. Therapy decisions after tumor recurrence are mainly made individually depending on the clinical status as well as on the patients and their relatives will. Often side effects are accepted and possible gained life time outbalances reduction of quality of life. Finally patient's relatives have to cope with enormous burden during the course of therapy especially when adjuvant therapy is changed to palliative assistance. Therefore, we were interested if the caregivers would still support therapy decisions in the course of therapy with their background knowledge and different perspective they gain after the patients dead.

Methods: A questionnaire focusing on medical-, logistic-, support- and symptom control was sent to caregivers of malignant brain tumor patients after their death. Clinical data were retrospectively correlated with the caregiver appreciation expressed in the questionnaire.

Results: Between 2010 and 2016 183 brain tumor patients died, who were treated at the neurooncological department. Till now we received 87 (69 anaplastic glioma patients, 18 extra axial brain tumors) answered surveys. 56 patients (64.4%) died in a hospice, hospital or palliative ward and 28 patients (32.2%) died at home. Overall 52 caregivers were content with general support, 49 did not regret final therapy decisions. Regarding the last applied therapy schemes, most caregivers were content with resection (n=12, 92.3%) and chemotherapy (n=37, 71.2%) and would retry these therapies, whereas 58.3% (n=7) would refuse radiotherapy. 65 caregivers (77.4%) would deny further intensified therapy. False hopes were mainly raised by radiotherapy (53.8%) and chemotherapy (52.7%), compared to surgery (30.8%). 55.4% stated that all together therapy effects overweighed the side effects. 32.2% claimed that they would need further assistance for the patients as well as for the caregivers during palliative care.

Conclusion: As far as we can see the majority is content by the chosen therapies and would make the same decision again. Concerning the different therapeutic schemes radiotherapy seems to be associated with the highest subjective side effects.

Intraoperative MRI in brain tumor surgery: results of resection and histological assessment of glioblastoma surgery and safety of intraoperative MRI in dual use

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Objective: Extent of Resection (EoR) is a significant factor in the survival of glioblastoma (GBM) patients. Intraoperative MRI (IO-MRI) in dual use is a new concept to improve this. The aim of the study is to show the rate of Gross total resections (GTR), EoR and the histological results after IO-MRI in patients suffering from GBM. Furthermore, we evaluated the rate of surgical site infections (SSI) in a series of 197 patients.

Methods: We analysed 79 surgical procedures for GBM applying intraoperative 1.5T MRI. IO-MRI was performed in all cases and residual Gd-enhancing tissue was resected in 55 cases. Histological assessment concerning the presence of tumor tissue of the resections after IO-MRI was evaluated. GTR and EoR were evaluated by segmentation and volumetric analysis of the MR-images. Furthermore, we evaluated the rate of surgical site infections (SSI) in 197 patients. Surgical site infections were defined as superficial infections, meningitis, subdural empyema, brain abscess and cerebritis. SSI and the use of perioperative antibiotics was analysed in 195 patients using Pearson's chi-squared test. 118 of 195 patients received parenteral antibiotics and 77 of them additionally received intrathecal antibiotic injections composed of Vancomycin and Gentamicin. To ensure the sterility of this procedure, we used a covering consisting of various layers.

Results: GTR was achieved in 59 (74,68%) of the patients suffering from GBM. Mean EoR of all resections was 96,27%. In 45 (81,81%) of the 55 patients who underwent resections after IO-MRI tumor of astrocytic origin was confirmed by histopathological examinations. Overall SSI rate of the 197 patients operated in IO-MR suite was 4,06% (n=8). Rate of meningitis was 1,52 % (n=3) and the rate of brain abscess was 0,51 % (n=1). SSI of the group which received parenteral antibiotics was 5,1 %. Beyond, the other group with additional intrathecal antibiotic injections showed a SSI rate of 2,6%. Pearson's two-tailed chi-squared test showed no significance concerning the two types of perioperative antibiotics and SSI. (p=0,392)

Conclusion: We found an obvious increase of GTR and EoR by using IO-MRI guided GBM resection compared to the rates before IO-MRI or other concepts without the use of IO-MRI. The rate of infections is low and within the normal range of neurosurgical procedures. Consequently, sharing a high-field MRI for daily diagnostic use and intraoperative resection control is a safe and successful concept.

Where lies the threshold level of MGMT promotor hypermethylation in malignant gliomas

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Objective: Hypermethylation of the O6-methylguanine-DNA methyltransferase (MGMT) promotor is associated with improved treatment response and prolonged survival in glioma patients. Pyrosequencing is an approved method to determine MGMT promotor status, but still adequate threshold levels for clinical decision making need to be determined on the basis of a well-defined patient cohort.

Methods: This study included 263 newly diagnosed, previously untreated, IDH R132 wildtype malignant gliomas with the histopathological morphology of a glioblastoma multiforme WHO grade IV. IDH R132 Status was assessed with immunohistochemistry (IHC). The MGMT promoter methylation status was evaluated with methylation-specific polymerase chain reaction (MSP) and pyrosequencing (PSQ). Overall survival was correlated to percent MGMT promoter methylation.

Results: The patient population was well balanced in concerns of age, extend of surgical resection and adjuvant therapy. Patients with a KPS less than 70% were excluded from the study. The degree of MGMT promoter and GpG (GpG1-5) island methylation was independent of age and tumor localization. Statistical analysis revealed a threshold of 15-20% MGMT promoter methylation, which was associated with significant difference in survival (median survival 13 month vs. 25 month, $p^*=0.01$, HR 1.915, 95% confidence interval 1.162 to 3.155)

Conclusion: Here we report that a reasonable threshold level of MGMT promoter methylation lies above 15-20% predicting survival benefit and therapy response. Among the investigated CpG islands CpG3 and CpG5 are the main contributors to favorable outcome. Further RCT studies need to approve the cut-off value on the basis for future treatment decisions.

Glioblastoma as a second cancer - a retrospective analysis of 2164 patients

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Objective: Characterization of epidemiological, molecular and clinical features of patients being diagnosed with glioblastoma (GBM) as a second malignancy.

Methods: We utilized the cancer data management system at the Memorial Sloan Kettering Cancer Center, New York, to identify patients with a GBM diagnosis from 2007 to 2014. We collected baseline demographic, molecular and clinical data. Univariate analysis was performed to compare the cohort of GBM patients with and without prior cancer (PC) diagnosis. Survival differences were analyzed with Kaplan-Meier and log-rank testing. A Cox-proportional hazards model was fit for multivariable analysis.

Results: In total, 2164 patients harboring GBM were identified including 170 patients (7.9%) with a PC diagnosis. The median interval between diagnoses was 79 months. The most common pathologies were breast (18.8%) and prostate (18.8%) cancer followed by melanoma (10%) and lung cancer (6.5%). Only six of the PC patients had a documented history of cranial irradiation. 10% of PC patients had a history of multiple malignancies. Patients with a PC were older at the time of GBM diagnosis than those without PC (66 years vs. 59 years, $p < 0.001$). Patients with PC were more likely to harbor an EGFR (20% vs. 12.3%, $p < 0.001$) or MGMT mutation (17.6% vs. 11.6%, $p < 0.001$). Adjuvant therapy regimens were similar in both cohorts with 61% (PC) and 68% (without PC) of patients having been recommended combined radiochemotherapy. Median survival was 13 months in the PC cohort and 15 months in the cohort without PC ($p = \text{not significant}$). Median progression free survival was 6 months (PC) and 7 months (without PC) ($p = \text{not significant}$). Age, KPS, and diagnosis year were the only factors which influenced outcome in multivariable analysis.

Conclusion: More patients are surviving long-term following a cancer diagnosis and as such are at risk for second malignancies. In line with this, about 8% of patients diagnosed with GBM have a history of PC. Despite significant epidemiological and molecular differences there seems to be no influence of PC on overall prognosis and clinical course.

The role of resection on survival times in recurrent high grade glioma

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Objective: In newly diagnosed high-grade glioma (HGG) the role of resection is well explored. The median overall survival correlates with the extent of resection. In contrast, in recurrent HGG the role of recurrent resection is unresolved, so far. Only a few retrospective studies suggest a potential benefit for overall survival (OS) or post-progression survival (PPS) after resection but convincing evidence is still missing. We investigated the effect resection in the treatment of recurrent HGG on OS and PPS accounting for potential confounders.

Methods: We enclosed 331 patients >18 years of age who received treatment for first recurrent HGG in our clinic between 2006 and 2014 in a retrospective single cohort study. Clinical parameters included age, histology, *methylation of O6-methylguanine-DNA methyltransferase (MGMT)*, mutations of *isocitrate dehydrogenase*, extent of resection, tumor location, eloquence, Karnofsky performance status (KPS) and adjuvant therapy. Survival times were determined by Kaplan Meier analyses. After univariate regressions of potential covariates of survival times, all univariate significant predictors were included in multivariate analyses of OS and PPS for HGG and for the subgroup of glioblastoma (GBM).

Results: A total of 260/331 patients were eligible for Kaplan-Meier analyses and Cox regressions in HGG and 214/271 in GBM. Median PPS times in HGG were 12 months (95% CI 10-17) for patients with gross total resection (n=171), 8 months (95% CI 2-21) for subtotal resection (n=70) and 8 months (95% CI 7-9) for no resection or biopsy (n=19). In the subgroup of GBM, median OS times were 11 months (95% CI 8-15) for patients with gross total resection (n=148), 6 months (95% CI 2-10) for subtotal resection (n=53) and 8 months (95% CI 7-9) for no resection or biopsy (n=13). Multivariate Cox regression of PPS and OS were adjusted for age, KPS, MGMT status, prognostic group, therapy groups, relation to ventricle and location of the tumor. Cox regressions did not show a significant PPS benefit for patients with subtotal (RR 1.12; 95% CI 0.62-1.88; p=0.69) or gross total resection (RR 0.77; 95% CI 0.54-1.07; p=0.12) in HGG and also no survival benefit for patients with subtotal (RR 1.27; 95% CI 0.67-2.23; p=0.44) or gross total resection (RR 0.82; 95% CI 0.56-1.18; p=0.28) with GBM. Kaplan Meier and Cox regression for OS times showed the same findings.

Conclusion: Our data do not suggest a recommendation for re-resection in recurrent HGG in general.

MI.23 Bildgebung 3

Mittwoch Wednesday, 17.05.2017, 13.30 – 14.40 Uhr hrs

- MI.23.01 *DTI Fiber tracking of clear positive speech responses of the superior parietal lobe in nTMS language mapping*
G. Durner* (Günzburg, Deutschland), A. Ribenis, C. Wirtz, J. Coburger
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- MI.23.02 *Using templates for the identification of language related areas in tumor patients based on resting state fMRI*
C. Ott* (Regensburg, Deutschland), M. Goldhacker, K. Rosengarh, J. Höhne, E. Lang, M. Greenlee, A. Brawanski
-
- MI.23.03 *Safety, value and feasibility of continous intraoperative electrophysiological monitoring in 1.5T iMRI-guided surgery*
C. Roder* (Tübingen, Deutschland), M. Breitkopf, S. Bisdas, M. Liebsch, F. Behling, M. Tatagiba
-
- MI.23.04 *Probabilistic DTI based depiction of the facial nerve in vestibular schwannoma*
A. Zolal* (Dresden, Deutschland), W. Polanski, G. Schackert, S. Sobottka
-
- MI.23.05 *Functional mapping and DTI fiber tracking used in navigated surgery in the insula*
P. Grummich* (Erlangen, Deutschland), K. Rössler, M. Buchfelder
-
- MI.23.06 *Congruence of language-related areas identified by functional MRI and non-invasive brain stimulation*
C. Nettekoven* (Köln, Deutschland), N. Reck, J. Pieczewski, V. Neuschmelting, C. Grefkes, R. Goldbrunner, C. Weiß Lucas
-
- MI.23.07 *Preoperative navigated transcranial magnetic stimulation and tractography in transparietal approach to the trigone of the lateral ventricle*
P. Hendrix* (Homburg/Saar, Deutschland), S. Senger, C. Griessenauer, A. Simgen, S. Linsler, J. Oertel
-

DTI Fiber tracking of clear positive speech responses of the superior parietal lobe in nTMS language mapping

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Objective: Navigated transcranial magnetic stimulation (nTMS) has gained increasingly relevance for non-invasive language mapping in recent years. In our mappings, we recognized a high number of clear positive speech responses in parietal lobe, specifically in superior parietal lobe (SPL) which most authors would consider to be a non-eloquent region regarding language processing. In our current pilot study, we assessed positive nTMS responses using diffusion tensor imaging (DTI) fiber tracking.

Methods: We performed nTMS language mapping based on a standardized protocol covering both hemispheres and all superficial cortical gyri in 9 patients with left sided speech dominance using Nexstim NBS System. Positive speech responses were defined as a missing answer during the 1s stimulation interval of a picture naming task. Parietal responses were then used as a seed for DTI fiber tracking using Brainlab iPlan 3.0 software. Fractional anisotropy (FA) threshold was set to 0,2 and minimum length to 70mm.

Results: 7 out of 9 patients showed parietal nTMS responses in their dominant hemisphere. SPL responses were found in 4 patients, in 2 cases more than 1. In fMRI responses confirmed these answers in all 4 patients. When performing fiber tracking of all parietal seeds, we identified typical fibers of superior longitudinal fasciculus (SLF) in 5 patients, temporo-parietal (tp) SLF in 3 patients and 1 seed showed parieto-parietal commissural fibers. All 3 SLF-tp tracts were based on SPL seeds.

Conclusion: The detected tracts showed quite consistent results corresponding to fibers of SLF. SLF-tp fibers originated from SPL specifically. Thus, SPL should not per se be considered as a non-eloquent area in dominant hemisphere. Preoperative fMRI or nTMS testing with DTI fiber tracking seems to be valuable tools in assessment of involvement of language processing. However, future studies are needed to verify our results by awake mapping or detailed postoperative neuropsychological assessment after resection of parietal lesions.

Using templates for the identification of language related areas in tumor patients based on resting state fMRI

Christian Ott¹, Markus Goldhacker¹, Katharina Rosengarth¹, Julius Höhne¹, Elmar Lang¹, Mark Greenlee¹, Alexander Brawanski¹

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Objective: In contrast to the task-based-fMRI there is no need for an active participation of the patient in resting-state fMRI (rs-fMRI). The major question of our study is, whether it is possible to identify language related areas in patients suffering from a lesion close to those areas using rs-fMRI and a predefined template of the language related resting state network in the entirely absence of any patient participation

Methods: 15 patients suffering from lesions close to language related areas were included. All of the patients underwent rs-fMRI, which was analyzed by independent component analysis (ICA). ICA was performed in multiple runs for each patient. Correlation analyses between the predefined template of the language related resting state network and resting state components were conducted. For each patient the component - out of all ICA runs - highest correlating with the predefined template was selected as a candidate for representing language related areas.

Results: Preliminary results showed that the maximally correlating component of the ICAs of the rs-fMRI with the template was promising concerning the activation surrounding tumor areas and their appearance as being language related.

Conclusion: In patients who are not able to actively participate due to neurological impairment or sedation rs-fMRI could be an alternative tool for the identification of eloquent cortex. The major challenge is the identification of the correct component and thereby the correct network. In this study we could show that it is possible to identify language related areas in tumor patients using rs-fMRI solely.

Safety, value and feasibility of continuous intraoperative electrophysiological monitoring in 1.5T iMRI-guided surgery

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Objective: The combined use of intraoperative high-field MRI (iMRI) and electrophysiological monitoring (IOM) is often not applied on a routine basis due to concerns on possible side-effects. This is mainly based on sorrow to leave the skin-electrodes in-situ for intraoperative scanning, as burnings might occur and the magnetic field might disturb the fine electrical currents needed for proper neuromonitoring. However, if used together, both technologies might bring significant advantages for the treatment of patients. Therefore we have evaluated the safety and results of the combined use of both technologies.

Methods: The setup, surgical, imaging and clinical results of 110 patients with eloquent intracranial lesions with the combined use of 1.5T iMRI and IOM were analyzed.

Results: 187 iMRI scans were performed with straight Platinum/Iridium IOM needles in place, resulting in a total experience of using more than 4000 electrodes in the iMRI. No complication (ferromagnetic or relevant heating/burning of skin) was caused by the combined use of both technologies. MR imaging quality was not influenced by leaving the electrodes in situ. Surgically induced severe postoperative sensorimotor deficits were seen in 11.8%. The surgeon's intraoperative estimation of a "complete resection" proved to be true postoperatively in 90.3%. If the resection was stopped due to worsening of IOM, postoperative MRI revealed residual disease to be located in direct vicinity of eloquence in 27 of 28 cases, but not in other parts of the resection cavity. Of these patients, only 7% (2 of 28) had relevant new persisting neurological deficits after 3 months. In 82 (74.5%) of all patients the resection was continued after the iMRI scan, whereat in only 18 (16.4%) the resection was already completed at this point. In addition to proving safety and efficiency of both technologies, we have photo-documented special pitfalls in positioning of electrodes and cables to ensure a safe treatment.

Conclusion: The combined use of IOM and 1.5T iMRI is feasible and safe, if complications are avoided by careful preparation of each patient. The complementary use of both technologies might result in more radical resections at comparable surgically-induced neurological deficits. If available and indicated, the combined use of IOM and iMRI should be performed on a routine basis.

Probabilistic DTI based depiction of the facial nerve in vestibular schwannoma

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Objective: According to our previous results, probabilistic tractography might be more successful in depicting cranial nerves compared to the common deterministic method. We have examined the utility of this technique in patients harboring large vestibular schwannomas.

Methods: Data from fifteen patients harbouring Koos Grade 3 and 4 vestibular schwannomas were included in this study. Diffusion weighted and anatomic images were acquired. The probabilistic tracking was run preoperatively and the true position of the nerve was determined intraoperatively by the surgeon. Both positions were compared and the diffusion - based tracking depiction was checked for accuracy.

Results: The depiction of a fiber tract corresponding to the facial nerve was observed in 12 of the 15 cases (80%) as a connection between the brainstem and the internal acoustic meatus. However, in 9 of these 12 (75%) cases, one or more additional pathways were visible in the final depiction, making immediate identification of the true position of the facial nerve impossible. Moreover, in the three remaining subjects (20%), only pathways not corresponding to the facial nerve position were depicted.

Conclusion: Probabilistic tracking between the internal acoustic meatus and the brainstem results in multiple pathways in a majority of cases. Observer's judgement is necessary to identify the probable position of the facial nerve among the multiple connections.

Functional mapping and DTI fiber tracking used in navigated surgery in the insula

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Objective: Insular gliomas were considered a long time as inoperable, because of high morbidity rates. The reasons for these are adjacent eloquent cortices and white matter tracts as well as the branching middle cerebral artery. fMRI and DTI were used to receive information about these eloquent areas.

Methods: Preoperative functional imaging with fMRI was performed in 9 patients with insular tumors. For fMRI we used a 1.5T MR scanner with echo planar imaging (Sonata, Siemens Medical Solutions) and a block paradigm with 180 measurements in 6 blocks (rest alternating with activation, 25 slices, 3mm thickness & resolution TR=2470, TE=60). During the activation intervals patients had to perform language tasks, presented visually. Correlation maps were calculated and merged with 3D-MR maps.

DTI was used with 1.9 mm slices and 6 directions to reconstruct fibre connections of language areas and the pyramidal tract. Repeated language- and calculation tests were conducted pre- and postoperatively to rate the recovery of neurological function. Intraoperative MRI was used and registered to the functional images to show the extent of resection, the brain shift and an update of the relation to functional structures.

Results: Of the 9 patients 7 had surgery in the left and 2 in the right insula. One of the 7 with surgery in the left insula was right dominant. For all 6 left dominant patients language areas at the cranial border of the insula and in the frontal operculum of the inferior frontal gyrus were obtained.

None of the 9 patients had a permanent neurologic deficit. 3 patients had transitory language problems, which resolved during 2 weeks. No paresis was observed in any patient.

Conclusion: Functional MRI and DTI Fiber tracking together with functional neuronavigation are able to avoid permanent neurologic deficits like aphasia and paresis while maximizing the extant of resection.

Congruence of language-related areas identified by functional MRI and non-invasive brain stimulation

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Objective: Recently, repetitive transcranial magnetic stimulation (rTMS) has gained a lot of interest in preoperative planning of brain tumor resections for detection of cortical language-related areas. However, the right rTMS protocol is still a matter of debate since rTMS-evoked speech-errors appear relatively widespread over the brain and are rather poorly reliable, depending on the type of speech-errors. We, here, compared locations of rTMS-evoked speech-errors of distinct categories to language-related fMRI clusters (widely used standard for language mapping).

Methods: Thirteen right-handed, healthy volunteers were investigated by fMRI and navigated rTMS using the same picture naming-task. In fMRI a sparse-sampling design was used with the following parameters: TR = 11 000 ms, delay in TR = 9000 ms, TE = 30 ms, flip angle = 90°, voxel size 3x3x3 mm³, FoV = 192 mm², 79 images. After preprocessing, the clusters of the superior temporal gyrus (STG) and the inferior frontal gyrus (IFG) were extracted. In the rTMS sessions, 10, 30 and 50 Hz rTMS were applied in a randomized order over the left hemisphere, continuously covering facial (pre-) motor and language-related cortical areas. Bursts were triggered to picture presentation without delay. Errors were rated by two independent examiners using a post-hoc video analysis and categorized as follows: arrest, anomia, delayed term, complete delay, dysarthria, morphosyntactic errors, speech-motor disturbance, semantic and phonematic paraphasia. The coordinates of the sites corresponding to the speech-errors were extracted. Then the amount of rTMS-speech errors lying within the STG/IFG-clusters was calculated (relative to the total number of errors, "hit rate").

Results: Overall, 17 % of the rTMS-evoked speech-errors were located within the STG (10 Hz: 0.15 ± 0.05, 30 Hz: 0.19 ± 0.07, 50 Hz: 0.18 ± 0.07). Only 6% were located within the IFG (10 Hz: 0.06 ± 0.05, 30 Hz: 0.05 ± 0.02, 50 Hz: 0.07 ± 0.04). However, when corrected for the different cluster sizes (STG>IFG) this difference was not significant. Within the STG, a significantly higher rate of speech-errors was observed for 30 Hz as compared to 10 Hz (p<0.05). The rate of motor-speech associated errors increased along with higher rTMS-frequencies (30 & 50 Hz, p<0.05).

Conclusion: The rate of rTMS-induced language errors within the STG seems to increase with higher frequencies, especially for errors associated with motor-speech function. This finding suggests that higher rTMS frequencies may be more powerful to induce virtual lesions, i.e., to interfere with language processing via short-lasting cortico-cortical inhibition in the area of the STG.

Preoperative navigated transcranial magnetic stimulation and tractography in transparietal approach to the trigone of the lateral ventricle

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Objective: : Eloquent neural structures surround the trigone of the lateral ventricle. Therefore, surgical procedures in the vicinity of the trigone challenge the surgeon. Depending on tumor entity, size, location and extension, and size of the ventricles, various surgical approaches have been proposed. The transparietal approach is one established surgical corridor. Preoperative workup via tractography and nTMS mapping may facilitate identification of the optimal surgical route in the transparietal approach to the trigone.

Methods: The authors retrospectively reviewed all patients with trigonal tumors that underwent combined preoperative nTMS motor mapping, preoperative rTMS language mapping, nTMS-based corticospinal tract tractography, and optic radiation tractography for presurgical workup.

Results: Five patients underwent this combined workup. Preoperatively, the information supported fast and accurate selection of an optimal trajectory for a transparietal approach towards the trigone. Eventually, four patients underwent surgical resection guided by intraoperative a multimodal neuronavigation containing nTMS and tractography data. None of the four patients experienced a new permanent deficit.

Conclusion: Combination of preoperative nTMS and tractography facilitates the identification of the optimal parietal trajectory towards the trigone. Specifically, it allows for sparing of visual pathways as well as cortical language areas.

MI.24 Joint Meeting Session 11 – Various 3

Mittwoch *Wednesday*, 17.05.2017, 13.30 – 14.50 Uhr *hrs*

- MI.24.01 *Keynote lecture: EANO guidelines for the diagnosis and treatment of meningiomas*
Roland Goldbrunner (Köln, Deutschland)
-
- MI.24.02 *UK survey on parental leave among neurosurgeons: have we got the balance right?*
J. Cheserem* (London, United Kingdom), R. deSouza, J. Lam, M. Amarouche, S. Hettige, M. Crocker
-
- MI.24.03 *Females are poorly represented at the biannual meetings of the Society of British Neurological Surgeons*
A. Lawson McLean* (London, United Kingdom), A. Lawson McLean
-
- MI.24.04 *Are neurosurgeons too busy to do research?*
J. Jung* (London, United Kingdom), M. Amarouche, G. Grahovac, R. Selway
-
- MI.24.05 *Predictive factors of mortality for primary pontine haemorrhage in an Asian population*
T. Munusamy* (Singapore, Singapore), S. Suretheran, A. Nasir, B. Pang, E. Yang, R. Kirillos
-
- MI.24.06 *Different mossy fiber sprouting pattern in ILAE hippocampal sclerosis subtypes*
B. Schmeiser* (Freiburg, Deutschland), I. Blümcke, R. Coras, J. Zentner, A. Brandt, M. Prinz, T. Freiman
-
- MI.24.07 *Neurosurgery in octogenarians: a comparative study on perioperative morbidity and mortality in elderly patients*
N. Maldaner* (Zürich, Switzerland), M. Neidert, J. Sarnthein, L. Regli, O. Bozinov
-
- MI.24.08 *The dependence of the diameter of the optic nerve sheath on the intracerebral pressure in an animal model*
R. Preda* (Bern, Switzerland), I. Zubak, C. Fung, A. Bloch, A. Raabe, J. Beck, W. Z'Graggen
-

UK survey on parental leave among neurosurgeons: have we got the balance right?

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Objectives: Shared Parental Leave (SPL) policy allows parents to share up to 52 weeks of leave. Facilitation of return to work post-maternity and utilisation of paternity leave remain variable with no data published on parental leave amongst neurosurgical trainees in the UK

Methods: An online anonymised survey of neurosurgical doctors in the UK was performed. The questions established the stage of training at which parental leave was taken, available support upon return to work, consideration of job share or part time employment and suggestions to improve implementation of SPL policy within the demands of a neurosurgical career.

Results: 44/81 (54%) respondents were parents (8 female, 36 male) of which all mothers and 27/35 (77%) fathers took parental leave. 4/7 mothers and 10/27 fathers would consider shared parental leave in the future. 8/27 fathers and 2/7 mothers would job share. 6/7 mothers were offered no support for return to work. A recurring concern was decline in surgical skills

Conclusions: Our results suggest limited support is available for neurosurgeons taking parental leave. Potential improvements as suggested by respondents include cultural acceptance and facilitation of job sharing or part time work, staged return, mentorship, choice of rotation location and accrual of annual leave. Open discussion is needed in order to offer options that balance the rigorous standards required to become a competent neurosurgeon with the realities of family life in line with other surgical specialties and other countries.

Females are poorly represented at the biannual meetings of the Society of British Neurological Surgeons

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Objective: It is generally considered that female attendees and presenters are outnumbered by their male counterparts at neurosurgical conferences. The aim of our study was to investigate the proportion of female and male speakers and chairs at the Spring and Autumn meetings of one of the largest national neurosurgical societies in Europe, the Society of British Neurological Surgeons (SBNS).

Methods: We obtained programmes and proceedings for both the Spring and Autumn meetings of the SBNS in 2016 to assess gender representation at these meetings. Details of the presenters and chairs from these meetings were extracted and compared with data from the register of the British General Medical Council (GMC) and online bibliographic databases including Medline to determine gender. We recorded the presentation type (lifelong learning sessions, eponymous lectures, free papers or poster presentations) along with the planned duration of each presentation. In addition, we evaluated the number of female and male session chairs. Further, we obtained recent membership data from the SBNS, including gender distribution by membership status (full members, associate members, etc.).

Results: Overall, there were fewer female than male speakers across the study period (16.5% female at the Spring meeting and 21.4% at the Autumn meeting). Females had a total of 17.3% of the aggregate speaking time at the Spring meeting and 27.3% in the Autumn meeting. Lifelong learning sessions and eponymous lectures were delivered by females in 50.0% and 16.7% of cases in the Autumn meeting. In the Spring meeting, none of these talks were given by women. 16.6% (Spring) and 24.7% (Autumn) of free papers were presented by females. Posters were first-authored by women in 29.7% (Spring) and 25.0% (Autumn) of cases. Conference sessions were chaired by females in 5.6% of instances in the Spring meeting. In the Autumn meeting, no sessions were chaired by women.

Conclusion: Less than a quarter of all speakers at SBNS Spring and Autumn meetings are women. It is predominantly men who chair and deliver the programme. This correlates broadly with the low proportions of female members of the SBNS and female neurosurgeon specialists in the UK. Initiatives like European Women in Neurosurgery (EWIN) initiative of the EANS and the RCSEng's Women in Surgery project have the potential to help address the gender imbalance in neurosurgery over the next decade.

Are neurosurgeons too busy to do research?

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³King's College Hospital, London, United Kingdom

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Objectives: Does a busy clinical environment preclude conducting research? We aim to answer this question by identifying whether the volume of clinical activity at UK neurosurgical units correlates with their academic production.

Methods: Reviewing 15 years of SBNS programmes, data on abstract acceptance was recorded on all UK neurosurgical units. Sample-based analysis was used to confirm proportion of abstracts turned into peer-reviewed publications. The clinical activity was determined using the 2015 Neurosurgical National Audit Programme report.

Results: On average, units submitted 2 abstracts per SBNS conference (range 0-6.5). Total number of abstracts accepted over 15 years ranged between 12 and 208 with the top 5 scoring units being Addenbrooke's hospital (n=208), NHNN (n=167), King's College hospital (n=133), the Walton Centre (n=127) and Leeds General Infirmary (n=94). 0 to 40% of abstracts were turned into publications with Hope Hospital Salford having the best conversion rate. The median number of procedures performed in 2015 was 7114.5 (range 3588-12318) with the top 5 hospitals being Hope Hospital Salford, the Walton Centre, NHNN, Addenbrooke's Hospital and Queen Elizabeth Hospital Birmingham. Clinical activity correlated positively with SBNS abstract submission (Pearson test, $p=0.0169$) and abstracts publication ($p=0.0242$).

Conclusions: The availability of huge amounts of clinical material is the reason rather than the barrier to research publication. It therefore seems that we are never too busy to do research!

Predictive factors of mortality for primary pontine haemorrhage in an Asian population

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¹*Khoo Teck Puat Hospital, Department of Surgery, Division of Neurosurgery, Singapore, Singapore*

²*Cambridge University Hospitals NHS Foundation Trust, Department of Neurosurgery, Cambridge, United Kingdom*

Objective: Primary pontine haemorrhage is the most devastating form of haemorrhagic stroke accounting for about 10% of intracerebral haemorrhages with an overall mortality rate of 40-50% as reported in the literature. There are various factors reported to have an association with outcome such as Glasgow Coma Scale score, clot location, clot volume, age and history of hypertension. In our study, we analysed the correlation between outcome and clinical and radiological parameters to determine the predictive factors and prognosis in primary pontine haemorrhage.

Methods: We retrospectively reviewed the clinical data of 47 patients admitted to Khoo Teck Puat Hospital, Singapore with a confirmed radiological and clinical diagnosis of primary pontine haemorrhage from 2009 to 2015. Patient demographics, Glasgow Coma Scale scores, clinical and radiological parameters and outcomes were recorded. Subsequently, predictive factors of mortality were identified by statistical analyses. We also analysed the correlation between acute blood pressure lowering and mortality.

Results: Out of the 47 patients, 31 were men. Overall 30-day mortality rate was 25.5%. Positive predictive factor of 48-hour mortality was mean systolic blood pressure of 160 mmHg or above in the first 48 hours of admission (Grade 2 and 3 hypertension). Positive predictive factor of 30-day mortality was Glasgow Coma Scale score of 8 or less on arrival. Lowering of mean systolic blood pressure by 20% or more in the first 48 hours correlate with reduction in 48-hour and 30-day mortalities.

Conclusion: The overall 30-day mortality rate of 25.5% for patients with primary pontine haemorrhage in our study population is better than that reported in the literature. We attribute this to acute reduction of mean systolic blood pressure by 20% or more in the first 48 hours of admission. Persistently raised mean systolic blood pressure in the first 48 hours and Glasgow Coma Scale score of 8 or less on arrival are positive predictors of mortality in primary pontine haemorrhage.

Different mossy fiber sprouting pattern in ILAE hippocampal sclerosis subtypes

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⁶Universitätsklinikum Freiburg, Institut für Neuropathologie, Institut für Neuropathologie, Freiburg, Deutschland

⁷Goethe-Universität, Universitätsklinikum Frankfurt, Klinik und Poliklinik für Neurochirurgie, Frankfurt am Main, Deutschland

Objective: In temporal lobe epilepsy, hippocampal sclerosis is the most prevalent pathology, characterized by selective neuronal cell loss, migration and axonal reorganization of granule cells. The new ILAE classification identifies four subtypes of hippocampal sclerosis. Whereas the selective neuronal cell death was well described for these subtypes, the role of granule cell dispersion and mossy fiber sprouting was not examined so far.

Methods: 319 patients who had been included in this retrospective analysis. Hippocampal specimens were stained for neuronal loss, granular cell dispersion (Neu-N, HE) and mossy fiber sprouting (synaptoporin-immunohistochemistry). For seizure outcome Engel score I-IV was applied.

Results: In ILAE 0 (no sclerosis) there was no cell loss, no granule cell dispersion and mossy fibers were present in their normal projection: CA3 and CA4. In ILAE 1, cell loss was massive in CA1, CA4 and moderate in CA2, CA3 as well as GCL being dispersed. Mossy fibers showed massive supragranular sprouting and a loss of mossy fibers in CA4 and CA3. In ILAE 2, cell loss was restricted to CA1. Granule cells dispersed and mossy fibers showed supragranular sprouting, yet with fiber loss in CA4 and CA3 less than in ILAE 1. In ILAE 3, cell loss was abundant in CA3 and CA4 only. Granule cells were dispersed and mossy fibers showed sprouting as in ILAE 1 and 2. Fiber loss in CA4 and CA3 was lower than in ILAE 1 and 2, respectively.

Conclusion: Granule cell dispersion, mossy fiber sprouting and mossy fiber loss in CA4 and CA3 might develop independently of neuronal cell loss and affected region.

Neurosurgery in octogenarians: a comparative study on perioperative morbidity and mortality in elderly patients

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²Zürich, Switzerland

Objective: With patient care continuously improving over time, age limits for neurosurgical interventions shift towards ever older patients in modern western countries. We investigate whether octogenarians (> 80y) stand out in outcome and incidence of perioperative complications.

Methods: We included all consecutive patients >80y operated in our department between January 2013 and August 2016 from our prospective patient registry. As control group, we selected patients aged 55-75y matched by the indication for surgery. Status at admission, indication for surgery, early perioperative complications, functional outcome and mortality were assessed. Complications were graded by their severity in the therapy-oriented Clavien-Dindo-Grading system (CDG).

Results: We compared 183 octogenarians (mean age 84y, 110 men) to 155 controls (mean age 67y, 107 men). At admission, the degree of disability and dependence was indistinguishable between age groups (mRS 2 vs. 2, $p = 0.47$; Karnofsky 70 vs. 80, $p = 0.49$). Indications for surgery were trauma (42% vs 38%), tumor (20% vs 22%), vascular (14% vs 15% controls), hydrocephalus (14% vs 15%), spinal (11% vs 10%) and movement disorder (1% vs 1%). At discharge, the clinical and functional outcome significantly favored the younger cohort (mRS 2 vs. 1; Karnofsky 80 vs. 90, both $p < 0.001$). While complications were more frequent in octogenarians than in controls (34% vs. 25%), this difference did not reach statistical significance ($p = 0.073$). Octogenarians with spinal pathology showed the highest complication rate (50%). The majority of complications were low grade (CDG 1-2) in both groups (74% vs. 68%). There was no difference in mortality (3.3% vs. 3.2%).

Conclusion: Frequency of severe complications, dependency and mortality was equally low in both octogenarians and controls, which supports indication for neurosurgery in the elderly.

The dependence of the diameter of the optic nerve sheath on the intracerebral pressure in an animal model

Raluca Preda¹, Irena Zubak¹, Christian Fung¹, Andreas Bloch¹, Andreas Raabe¹, Jürgen Beck¹, Werner Z'graggen¹

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Objective: Several studies have shown that the diameter of the optic nerve sheath depend on the intracranial pressure and can be measured with transbulbar ultrasonography. The purpose of this study was to characterize the changes of the diameter of the different components of the optic nerve sheath (optic nerve, subarachnoid space, sheath) depending on the intracranial pressure in an animal model.

Methods: Eight pigs were intubated and sedated. An external ventricular drain was placed in the third ventricle through a burrhole. The intracranial pressure was progressively raised (20, 30, 40, 50 and 60mm Hg) by infusing saline. At each pressure level the diameter of the optic nerve and the inner as well as the outer nerve sheath was measured with means of transbulbar ultrasonography.

Results: The diameter of the optic nerve, as well as the diameter of the inner and outer nerve sheath increased in parallel to the intracranial pressure. The increase of the different diameters was mainly caused by an increase of the diameter of the optic nerve, whereas the size of the subarachnoid space and the nerve sheath did not change significantly.

Conclusion: The diameter of the optic nerve sheath depends on the intracranial pressure and can be measured by transbulbar ultrasonography. The increase of the diameter of the optic nerve sheath is mainly due to an increase of the diameter of the optic nerve itself, which might be caused by a reduction of the venous drainage.

MI.25 Intrazerebrale Blutung

Mittwoch *Wednesday*, 17.05.2017, 13.30 – 14.50 Uhr hrs

- MI.25.01 *Anticoagulation therapy is associated with higher volumes of delayed perihemorrhagic edema in patients with spontaneous intracerebral hemorrhage managed by fibrinolytic therapy*
B. Iliev* (Göttingen, Deutschland), D. Mielke, V. Rohde, V. Malinova
-
- MI.25.02 *ICH-Score allows a reliable prediction of mortality in patients with spontaneous intracerebral hemorrhage managed by fibrinolytic therapy*
B. Iliev* (Göttingen, Deutschland), D. Mielke, V. Rohde, V. Malinova
-
- MI.25.03 *Intrahematomal Sonothrombolysis enhances Fibrinolysis in a porcine Model of intracerebral Hemorrhage*
J. Masomi-Bornwasser* (Mainz, Deutschland), A. Heimann, C. Schneider, A. Kronfeld, K. Kreitner, F. Ringel, N. Keric
-
- MI.25.04 *Effect of irrigation on the fibrinolytic rtPA therapy in an in vitro model of intracerebral hemorrhage*
N. Keric* (Mainz, Deutschland), J. Masomi-Bornwasser, F. Freguia, H. Müller-Werkmeister, O. Kempfski, A. Giese, S. Kantelhardt
-
- MI.25.05 *The influence of medical data on the results of neurorehabilitation in intracranial bleedings*
V. Hagel* (Ulm), D. Woischneck, A. Pfaffenzeller, W. Christian Rainer, K. Thomas
-
- MI.25.06 *Decompressive craniectomy in patients suffering from spontaneous intracerebral hemorrhage: Influence of additional clot evacuation - a single-centre series.*
A. Hadjiathanasiou* (Bonn, Deutschland), P. Schuss, I. Ilic, V. Borger, H. Vatter, E. Güresir
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- MI.25.07 *Does the original intracerebral hemorrhage (ICH) score or early poor outcome predict patients `outcomes at 12 months? A single center prospective study*
M. Hamed* (Bonn, Deutschland), P. Schuss, C. Kaufhold, E. Güresir, M. Schneider, H. Vatter, A. Boström
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- MI.25.08 *Diagnostic accuracy of spontaneous intracerebral hemorrhage. Are there predictive factors for bleeding origins?*
N. Dinc* (Frankfurt, Deutschland), S. Won, N. Brawanski, J. Quick-Weller, J. Konczalla, V. Seifert, G. Marquardt
-

Anticoagulation therapy is associated with higher volumes of delayed perihemorrhagic edema in patients with spontaneous intracerebral hemorrhage managed by fibrinolytic therapy

Bogdan Iliev¹, Dorothee Mielke¹, Veit Rohde¹, Vesna Malinova¹

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Objective: Spontaneous intracerebral hemorrhage (ICH) is increasingly often related to anticoagulation therapy. Experimental studies suggest a better endogenous ICH clearance via the Virchow Robin spaces because anticoagulation prevented clotting, thereby possibly leading to less perihemorrhagic edema. It has been shown likewise in experimental studies that the fibrinolytic therapy with recombinant tissue Plasminogen Activator (rtPA) can increase the volume of the delayed perihemorrhagic edema. Putting the findings together, one might assume that patients with anticoagulation have a smaller edema than patients without anticoagulation. Thus, it was the aim of the study to evaluate the impact of running anticoagulation therapy on the initial and delayed perihemorrhagic edema in patients with supratentorial ICH managed by administration of rtPA and subsequent clot lysis.

Methods: A retrospective analysis concerning the presence of anticoagulation therapy at the moment of ICH diagnosis was performed in patients with supratentorial ICH treated by fibrinolytic therapy. Volumetric measurements of the perihemorrhagic edema were performed on the initial CT scan and on day 5 after ICH-onset. The correlation of anticoagulation with the perihemorrhagic edema initially and on day 5 was evaluated..

Results: A total of 114 patients were included in the study. The mean initial hematoma volume was 55ml. Anticoagulation therapy at bleeding was present in 36% (41/114) of all patients. An anticoagulation therapy showed a significant correlation with larger initial hematoma volume (linear regression $p=0.02$). There was no significant difference in the volume of the initial perihemorrhagic edema between the patients with and without anticoagulation. A significantly higher volume of the delayed edema was seen in the patients with anticoagulation compared to those without anticoagulation (Fisher's Exact test OR=5.65, 95%CI 1.54-20.4, $p=0.01$).

Conclusion: Patients with anticoagulation therapy at the moment of the spontaneous intracerebral hemorrhage have a significantly higher risk for a more extensive volume of the delayed perihemorrhagic edema, possibly counteracting the positive effect of hematoma volume reduction by the fibrinolytic therapy. Anticoagulation has no positive influence on the initial perihemorrhagic edema.

ICH-Score allows a reliable prediction of mortality in patients with spontaneous intracerebral hemorrhage managed by fibrinolytic therapy

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Objective: Intracerebral hemorrhage (ICH) is associated with high morbidity and mortality. An estimation of the prognosis would be helpful for the treatment decision-making in patients with ICH. The ICH-score was established in 2001 (Hemphill et al. Stroke) to estimate the 30-day mortality in conservatively treated patients with ICH based on known prognostic risk factors (age, poor clinical status, intraventricular hemorrhage and hematoma volume). We evaluated the reproducibility of the ICH-score for the estimation of the prognosis in ICH patients undergoing application of recombinant tissue Plasminogen Activator (rtPA) and subsequent clot lysis.

Methods: We performed a retrospective analysis of patients with supratentorial ICH managed by fibrinolytic therapy and evaluated the 30-day mortality. Then, the ICH-Score was applied to match the mortality in our patients with the mortality predicted by the ICH-Score. The ICH-Score (range 0-5) is based on parameters available at the time of diagnosis of ICH: age (<80=0 vs. >80=1), hematoma volume (<30ml=0 vs. >30ml=1), intraventricular expansion (no=0, yes=1) and initial clinical status according to the Glasgow Coma Scale (3-4=2, 5-12=1 and 13-15=0). The ICH-Score predicts the following mortality rates in conservatively treated patients with ICH: 0 = 0%, 1=13%, 2=26%, 3=72%, 4=97%, 5=100%.

Results: A total of 233 patients with ICH treated at our department by fibrinolytic therapy were analyzed. The mean age of the patients was 69 years (range 30-93) and the mean initial hematoma volume was 55ml. The 30-day mortality rate was 30% (70/233). We found a significant correlation of 30-day mortality with an initial hematoma volume >30ml (linear regression $p=0.001$), intraventricular hemorrhage (linear regression $p=0.003$) and age >80 years (linear regression $p=0.01$). The ICH-Score showed a significant correlation with 30-day mortality (linear regression $p<0.0001$). The ICH-Score estimated the following 30-day mortality rates in our cohort: 1=0% (0/13), 2=0% (0/51), 3=1.3% (1/82), 4=43% (13/31), 5=100% (56/56).

Conclusion: The ICH-Score not only allows a reliable estimation of the 30-day mortality in patients with supratentorial ICH treated conservatively but also treated by clot lysis. Compared to conservatively treated patients with supratentorial ICH the fibrinolytic therapy reduced the 30-day mortality in the patients with ICH-Score 1-4. Patients with ICH-Score 5 do not have a benefit of the fibrinolytic therapy and should no longer be considered to be surgical candidates.

Intrahematoma Sonothrombolysis enhances Fibrinolysis in a porcine Model of intracerebral Hemorrhage

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Objective: Catheter-based hematoma lysis with recombinant tissue plasminogen activator (rtPA) has emerged to a well-established therapy of spontaneous intracerebral hemorrhage (ICH). A small clinical trial showed effectiveness of intralesional sonothrombolysis in combination with rtPA. Previously we could show a significant increase of rtPA-based fibrinolysis by endosonography in an *in vitro* model of ICH. The aim of this study was to assess the potential of sonothrombolysis by an endosonography catheter *in vivo* (porcine ICH-model). We present preliminary results of an ongoing experimental work.

Methods: *Deutsche Landrasse* male pigs (30–35 kg) were sedated and intubated. Continuous intra-arterial blood pressure was recorded via an arterial femoral line. An intracranial pressure- (ICP) sensor was placed in the left frontal lobe through a twist drill burr hole for monitoring reasons. A right frontal ICH was produced by infusion of 10 ml arterial autologous blood via a continuous infusion (3ml/min). A cranial MRI was performed immediately after ICH placement and 2 h after treatment. The animals were randomized in 4 treatment groups: group 1 (drainage only n=2), group 2 (drainage+rtPA n=3), group 3 (drainage+endosonography, 10 MHz b-mode n=3), and group 4 (drainage+endosonography+rtPA n=3). Liquefied hematoma was drained by a gravity-based system for 1 hour. Hematoma volumes were assessed by segmentation using a neuronavigation planning software (iPlan, Brainlab®). Animals were euthanized 6 h after ictus. Brains were fixed in 4 % PFA, paraffin embedded and sliced for histological analysis. Perihematoma tissue was morphologically analyzed in HE-staining and further characterized by immunohistochemistry.

Results: Hematoma volume reduction in the group 1 was 2.95±3.36%, 40.71±2.758% in group 2, 34.7±6.39% in group 3 and 54.5± 6.91% in group 4. Compared to the control group the groups 2, 3 and 4 showed significant differences in overall hematoma volume reduction (group 1 vs. 2 P=0.0043; group 1 vs. 3 P=0.0139; group 1 vs. 4 P=0.0042). The combination treatment group achieved the greatest hematoma volume reduction and was significant different compared to group 3 (P=0.0132). Mean arterial blood pressure (MAP) and ICP values did not differ between the treatment groups. MAP ranged from 64.9 to 87.4 mmHg and mean preoperative ICP values from 8.1-11.4 mmHg. ICP increased at the time of ICH placement till 91 and decreased again in the following 15 min until 14 mmHg. The HE-staining showed no morphological differences in the perihematoma zone.

Conclusion: The combination of sonography and rtPA seems to be a more effective and safe fibrinolytic therapy compared to rtPA alone, while sonography serves as an accelerator for fibrinolysis. Additionally this endosonography catheter can be applied as a diagnostic imaging tool in b-mode and Doppler mode, which allows realtime intracranial monitoring.

Effect of irrigation on the fibrinolytic rtPA therapy in an *in vitro* model of intracerebral hemorrhage

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Objective: Hematoma lysis with recombinant tissue plasminogen activator (rtPA) represents a well-established therapy for spontaneous intracerebral hemorrhage (ICH). However some issues in clinical routine like optimal dose and timing, catheter flushing or CSF irrigation need to be answered. Previously we investigated optimal dosing and timing of this therapy in an *in vitro* clot model. In addition the aim of this study was to investigate a potential effect of CSF, irrigation and washout on hematoma lysis.

Methods: *In vitro* blood clots were produced from 25 ml of human blood by 1.5 h incubation at 37 °C. A silicone catheter connected to an irrigation-catheter-system (IRRAS CNS™), which flushes 1 ml of NaCl into the clot for 1 min with a following passive gravity drainage period was placed into the clots. Different drainage periods of 15, 30 and 60 min (n=3) were tested. Four different irrigation rates were examined for 60 min of 0, 15, 90, 180 ml/h (each n=5) and the additional effect of 1 mg rtPA was evaluated for these 4 irrigation rates (n=3). Further 6 clots were treated either with 5 ml healthy CSF (n=3), hemorrhagic CSF (n=3) and hemorrhagic CSF 1 h after 1 mg rtPA administration. Plasminogen values were measured at different time points during rtPA therapy. Clots were weighed before and after treatment. For statistical analysis ANOVA was used.

Results: The relative weight after 60 min drainage with the irrigation-catheter-system was 58.28%±8.41 for 0 ml/h, 46.33%±9.51 for 15 ml/h, 46.53%±7.06 for 90 ml/h, 53.26% ±4.06 for 180 ml/h. After 15 min incubation of 1 mg rtPA following relative end weights were found: 0 ml/h=42.89% ±5.34, 15 ml/h=32.14%±5.05, 90ml/h=36.66%±5.64, 180 ml/h=41.85%±6.72. Different drainage time with a low irrigation rate of 15ml/h was evaluated and showed a significantly lowest relative weight after 1 h (49.49%±4,592) compared to 15 (62.02%±4.312; p=0.016) and 30 min (62.90%±1.88; p=0.012) of drainage. No significant differences in the fibrinolysis and the relative clot end weights were observed between the healthy CSF (55.1%±4.9), hemorrhagic CSF (69.4%±4.7) and hemorrhagic CSF (66.38%±5.3) pretreated with rtPA could be identified. Plasminogen levels in the clots decreased from initially >82% at a not measureable level <10% after already 1 single dose of 1 mg rtPA.

Conclusions: The present study showed that irrigation in general does not lead to higher lysis-rates. Healthy or hemorrhagic CSF did not increase lysis rate. Likewise, in ICH patients a contact of the lysis catheter to the ventricular system may not increase the efficiency of ICH lysis due to lytic effects but rather due to a pressure gradient. The decrease of the rtPA binding partner Plasminogen after already 1 mg rtPA implies that higher doses of rtPA might be ineffective.

The influence of medical data on the results of neurorehabilitation in intracranial bleedings

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Objective: What quality of life could be achieved after intracranial hemorrhage and poor initial situation in correlation with parameters from rehabilitation therapy?

Methods: Data from 115 patients after intracranial haemorrhage (spontaneously and traumatic), all of which had been treated in the same clinic for neurological early rehabilitation were analysed. Patients were consecutively added. All had been initially intubated, ventilated and stayed in coma for at least 24 hours. Data of the early stages in the acute care clinic were compared in the context of a retrospective, descriptive exploratory survey with the coma regression scales and the quality of life measurements of rehabilitation. The study was carried out with the approval of an ethics committee.

Results: 1. The potential for improvement and ultimately reached, functional results declined with increasing age. A significant threshold towards the poorer is reported in multiple scores from an age of 60 years onwards.

2. Clinical parameters predicting a poor functional outcome were a anticoagulative premedication, the coma degree in acute care, the nature and location of the lesion (spontaneous bleeding worse than traumatic; bilateral lesions worst).

3. Similar to age, there was a critical point for the duration of artificial ventilation. From 400 hours upwards, the functional values were significantly worse.

4. The rehabilitation potential decreased after a prolonged rehabilitation period of more than 60 days. Initial poorer patients, however, showed a better recovery if the stay in the rehabilitation facility was longer.

Conclusion: Age, cause of bleeding, anticoagulative medication, initial coma grade, intubation, duration of artificial ventilation and length of hospital stay in acute hospital are important predictors of outcome after spontaneous and traumatic intracerebral haemorrhage. Patients with poor initial findings at the beginning of early rehabilitation benefit particularly by a rehabilitation period of more than 60 days.

Decompressive craniectomy in patients suffering from spontaneous intracerebral hemorrhage: Influence of additional clot evacuation - a single-centre series.

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Objective: Decompressive craniectomy (DC) may be performed in patients with intractably elevated intracranial pressure due to intracerebral hemorrhage (ICH). However, the benefit of additional surgical clot evacuation is still controversially discussed. We therefore analyzed our institutional data.

Methods: Between 2007 and 2015, 31 patients suffering from spontaneous, hypertensive ICH underwent DC with and without clot evacuation in our institution. Patients were stratified into two groups: 1) patients with ICH who underwent DC without clot evacuation and 2) patients with ICH who underwent DC with additional clot evacuation. Patient characteristics, radiological features, postoperative complications, signs of cerebral herniation, and presence of antiplatelet or anticoagulant premedication were assessed and analyzed. Outcome was assessed according to the modified Rankin Scale (mRS) after 6 months and stratified into favourable (mRS 0-4) versus unfavourable (mRS 5-6).

Results: Overall, 10 patients (32%) achieved favourable outcome. 19 (61%) patients with ICH underwent DC without clot evacuation, whereas 12 (39%) patients underwent DC with clot evacuation. Mean ICH volume was similar in both groups ($p=0.9$). Functional outcome did not differ between both groups ($p=0.4$). Furthermore, reduction of initial midline shift after DC did not significantly differ in patients who underwent DC without, and patients who underwent DC with additional clot evacuation ($p=0.8$).

Conclusion: DC is safe and feasible in treating patients with intractably elevated intracranial pressure due to ICH. However, the present series showed no benefit of additional clot evacuation after DC for ICH. Therefore, ICH evacuation as an invasive and potentially dangerous procedure might not be necessary and should therefore be omitted according to the present study.

Does the original intracerebral hemorrhage (ICH) score or early poor outcome predict patients`outcomes at 12 months? A single center prospective study

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Objective: To evaluate the prognosis of poor early outcome in patients with spontaneous intracerebral hemorrhage (ICH) and to analyze mortality rates according the original ICH (oICH) score by Hemphill et al.

Methods: In a prospective observational data base the authors analyzed the outcomes of 105 patients with spontaneous intracerebral hemorrhage. Clinical condition was classified by the modified Ranking scale (mRS) at discharge, after 6 and 12 months, respectively. Factors possibly influencing outcomes (age, Glasgow Coma Scale, volume of hematoma, surgical versus conservative treatment) were investigated by statistical analyses. Mortality rates were calculated by the oICH score by Hemphill. Only patients with a follow up of at least 12 months were included. Poor early outcome was defined by a mRS of 5 at discharge.

Results: There were 56% male patients, mean age 68 yrs (median 71, range 18-98). 49.5% were treated conservatively. Fifty-three patients were treated by surgery including insertion of external ventricular drainage for the treatment of intracranial high pressure. Surgical therapy consisting of hematoma evacuation by craniotomy or catheter drainage with or without decompressive hemicraniectomy (DC) was performed in 21/53 cases. Altogether, 15 patients were treated by DC, 8/15 by DC plus hematoma evacuation and 7/15 by DC alone. The surgically treated patients presented significantly with older age, less GCS at admission and larger hematoma volume than the conservative group ($p < 0.5$). At discharge 42 patients presented with mRS 5. 17/42 (40%) remained mRS 5 after 6 and 12 months, 33% had died, 12% of patients improved to mRS less than 4. Overall mortality at 12 months was 37%. According to the oICH, patients scored oICH5 showed 100% mortality, surprisingly, patients scored oICH2 and 3 had higher mortality rates than patients scored oICH4. Analysis of influencing factors showed a significantly higher proportion of conservatively treated patients in the oICH 2 group (3 surgical versus 16 conservative cases).

Conclusion: In this cohort, most patients with poor early outcome remain poor or die within the first 12 months (73%). This result may be helpful in decision making of aggressive therapy of this patient group according to patients will. Patients scored oICH 5 had 100% mortality, while oICH 2-4 cases had reciprocal mortality rates. This seems to be influenced most probably by aggressive treatment strategy.

Diagnostic accuracy of spontaneous intracerebral hemorrhage. Are there predictive factors for bleeding origins?

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Objective: Atypical intracerebral hemorrhage is a common form of primary manifestation of vascular malformations. Hematoma location (lobar, brain stem, cerebellar) can give a clue to the cause of the bleeding.

Methods: We retrospectively evaluated 279 consecutive patients with spontaneous intracerebral hemorrhage (ICH), who were admitted to our neurosurgical department between 2006 and 2016. Subarachnoid hemorrhage (SAH) bleeding pattern and basal ganglia hemorrhage were excluded from this study. We assessed image modality, location of hemorrhage, spot positivity, hematoma volumes and histological findings.

Results: We collected data of 279 patients. In 142 cases (50.9%) vascular malformations, such as AVMs, cavernomas, dural fistulas and aneurysms were the cause of bleeding. In 6 (2.2%) patients a tumor could be detected. 131 (47%) patients suffered from an intracerebral hemorrhage due to sinus vein thrombosis, amyloid angiopathy or long standing hypertension.

In patients with infratentorial hemorrhage a malformation was more frequently detected as in patients with supratentorial hemorrhage (41.5% vs. 21.2%, $p < 0.001$, OR 2.65). Infratentorial location, brain stem, frontal and occipital regions were predicting locations for malformation -caused bleedings. Among the malformations AVMs were most common (78.2%).

Hematoma expansion was less ($< 50\text{cm}^3$) in hemorrhage due to a vascular malformation than non-malformation caused bleeding (80.3% vs. 48.2%, $p < 0.001$, OR 4.38). In 6 (2.2%) cases diagnosis remained unclear.

Conclusion: Localization and bleeding patterns are predictive factors for origin of the hemorrhage. These predictive factors should quickly lead to appropriate vascular diagnostic measures. CT-Angiography and MR-Angiography are suitable modalities but cannot replace interventional angiography in all cases.

MI.26

OP-Techniken 6

Mittwoch *Wednesday*, 17.05.2017, 13.30 – 15.00 Uhr *hrs*

- MI.26.01 *Outcome and complications in early vs. late cranioplasty procedures after decompressive hemicraniectomy in patients suffering from traumatic brain injury, malignant media infarction and aneurysmatic subarachnoidal hemorrhage*
M. Schomacher* (Berlin, Deutschland), F. Kramer, J. Leibling, D. Moskopp
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- MI.26.02 *Implementation of an institutional coagulation management protocol significantly reduces transfusions of allogeneic blood products in patients with decompressive craniotomy*
V. Borger* (Bonn, Deutschland), T. Kern, P. Schuss, Á. Güresir, H. Vatter, E. Güresir
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- MI.26.03 *First Experience with a new 3D/HD 4mm Endoscope for Transnasal Procedures: A Laboratory and Clinical Investigation*
A. Hickmann* (Zürich, Switzerland), M. Eördögh, P. Prömmel, H. Briner, N. Hopf, R. Reisch
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- MI.26.04 *Cognitive function surrounding resection of nonfunctioning pituitary adenomas with suprasellar extension: a prospective matched-control study*
P. Hendrix, E. Hans* (Homburg/Saar, Deutschland), C. Griessenauer, A. Simgen, J. Oertel, J. Karbach
-
- MI.26.05 *Robot-guided positioning of a magnetic coil for therapeutic repetitive transcranial magnetic stimulation (rTMS) over the cortex in patients with cerebral lesions*
A. Hartmann* (Köln, Deutschland), J. Rühling, A. Baumann, M. Manu, M. Nakamura
-
- MI.26.06 *Patient specific implants for skull defects: universal algorithm for conceptual design*
D. Schoeni* (Bern, Switzerland), A. Nowacki, A. Raabe, P. Schucht
-
- MI.26.07 *The sino nasal outcome test for neurosurgery (SNOT-NC): Modified version of disease specific questionnaire for transnasal skull base surgery*
Y. Ahmadipour* (Essen, Deutschland), B. Hütter, N. El Hindy, O. Gembruch, I. Kreitschmann-Andermahr, U. Sure, O. Müller
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- MI.26.08 *Assessment of cranial defects after craniectomy: a proposal for classification*
F. Schwarz* (Jena, Deutschland), A. Waschke, M. Simon, R. Kalff
-
- MI.26.09 *Retroperitoneal peripheral nerve associated tumours - approaches and interdisciplinary management*
C. Heinen* (Oldenburg, Deutschland), T. Schmidt, R. Heinzel, N. Bagias, T. Kretschmer
-

Outcome and complications in early vs. late cranioplasty procedures after decompressive hemicraniectomy in patients suffering from traumatic brain injury, malignant media infarction and aneurysmatic subarachnoidal hemorrhage

Markus Schomacher¹, Felix Kramer¹, Jörn Leibling¹, Dag Moskopp¹

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Objective: Cranioplasty procedure (CP) is often performed after decompressive hemicraniectomy (DHC) in patients suffering from refractory ICP elevation caused by traumatic brain injury (TBI), malignant brain infarction (MBI) or aneurysmatic subarachnoid hemorrhage (SAH). However timing of CP and ventriculo-peritoneal shunt procedures (VPS) are controversial discussed as well as the kind of usage of cranioplastic material.

Methods: A retrospective chart analysis was performed of all patients at our institution admitted with TBI, MBI or SAH that underwent DHC and subsequent CP in the period from 01/2009 to 12/2015. Demographic data, diagnosis, timing of CP (early < 90 days vs. late > 90 days), type of cranioplastic material, VP-shunt procedures, CP related complications and patients outcome were analyzed. Data are given as mean values \pm SD.

Results: 41 patients after DHC caused by TBI were identified.

26 patients (20m, 6f) received early CP (procedure time 91 ± 43 min) all with autologous material (defect size 103 ± 23 cm²). Simultaneous shunt implantations were performed in 4 cases. In 5 cases a postoperative hematoma with revision surgery and 2 cases of bone osteolysis occurred.

In 15 patients (12m, 3f) late CP (procedure time 96 ± 42 min), in 5 cases with synthetic material, was performed (defect size was 92 ± 33 cm²). In 1 case concurrent VPS was done. 3 wound healing disorders and 1 hematoma developed.

16 patients after DHC caused by MBI were evaluated.

6 patients (3m, 3f) with early CP (procedure time 92 ± 33 min) all with autologous material was performed (defect size 103 ± 23 cm²). No VPS were necessary. 1 case of meningitis and hematoma occurred.

In 10 patients (8m, 2f) late CP (procedure time 104 ± 39 min) was performed. Synthetic material was used in 1 case. The mean defect size was 119 ± 32 cm². In 1 case lumbar drainage application and VPS were performed.

16 patients after DHC caused by SAH were worked out.

In 10 patients (2m, 8f) early CP (procedure time 69 ± 18 min) was done, in 2 cases with synthetic material. The mean defect size was 73 ± 31 cm². In 5 cases an early VPS was necessary before CP. In 1 case a postoperative hematoma occurred.

6 patients (2m, 4f) received late CP (mean procedure time 115 ± 57 min) and defect size was 94 ± 31 cm². Synthetic material was used in 1 case. In 2 cases VPS were performed concurrently with DHC.

Conclusion: Early and late CP procedures can be safely performed in nearly same surgery time after DHC in patients suffering from TBI and MBI. In the early CP group after TBI there was a trend towards more complications (hematoma/hygroma and bone osteolysis) compared to late CP patients.

Patients suffering from SAH need more often a VPS (before or concurrent with CP) than other groups (TBI and MBI). A second hospital stay has to be considered in the most cases of late CP for all (TBI, MBI and SAH) patients.

Implementation of an institutional coagulation management protocol significantly reduces transfusions of allogeneic blood products in patients with decompressive craniotomy

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Objective: Decompressive craniectomy (DC) is a life-saving procedure and performed in patients suffering from space-occupying lesions of various underlying pathologies. An effective coagulation management is essential for prevention of an excessive blood loss and surgical morbidity in these patients. Therefore we introduced an institutional coagulation management protocol (ICMP) focusing on the reduction of transfusions of allogeneic blood products. The aim of this study was to evaluate the utilization of blood products in patients with DC after implementation of ICMP.

Methods: In this study, we analyzed the data of patients who underwent DC from a prospective conducted DC-database from 2012 to 2015. The ICMP was introduced in 07/2014. The period from 03/2012 to 06/2014 (epoch A) included 157 patients with DC. The period from 07/2014 to 10/2015 (epoch B) included 100 patients who underwent DC. The number of red blood cells units (RBCU) and platelet units (PU) given perioperatively was analyzed in each epoch. Further analysis focused on the occurrence of bleeding complications. In evidence of intake of antiplatelet drugs (APD), the platelet testing was performed with PFA-100™ test or aggregometry on whole blood. In evidence of intake of vitamin K antagonists (VKA) or novel oral anticoagulants (NOAC), international normalized ratio (INR), anti-factor-Xa activity level or thrombin clotting time were analyzed. According to our ICMP we started the reversal of APD with intra-venous (i.v.) bolus application of 1 g tranexamic acid (TXA) followed by continuous i.v. application of TXA in a dosage of 20 mg/kg during 8 h. For procedures with a higher risk for bleeding, Minirin® (DDAVP) was administered with a dosage of 0.3 µg/kg as an i.v. bolus additionally. The reversal of VKA was managed by administration of prothrombin complex concentrates (PCC). The reversal of NOAC was started with i.v. bolus application of 1 g TXA followed by continuous i.v. application of TXA in a dosage of 20 mg/kg of body weight. Furthermore, PCC were administered with a dosage of 50 IE/kg.

Results: The overall proportion of patients who received transfusion of RBCU and/or PU was significantly reduced in epoch B compared to epoch A (25% vs. 46%, $p=0.0009$). Even in patients with a preexisting history for the use of antithrombotic drugs prior to DC, no transfusion of allogeneic blood products was necessary in 17 of 28 (epoch B) vs. 20 of 63 (epoch A, $p=0.01$) patients. There was no significant difference regarding the rate of bleeding complications between epoch A and epoch B (9.5% vs. 10%).

Conclusion: Our ICMP was highly efficient in reducing the transfusion of allogeneic blood products in patients who underwent DC.

First Experience with a new 3D/HD 4mm Endoscope for Transnasal Procedures: A Laboratory and Clinical Investigation

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Objective: The Endoscopic technique has revolutionized transnasal skull base surgery over the last decades. However, endoscopes are still missing stereoscopic vision or adequate resolution compared to the operating microscope. We evaluated a new 3D/HD endoscope for transnasal minimally invasive procedures and present our first laboratory as well as clinical experience.

Methods: The 3D/HD endoscope (Karl Storz, Tuttlingen/Germany) was evaluated for transnasal use on 5 dry skull specimens, 5 formaldehyde-fixed and 20 fresh cadavers. A variety of transnasal approaches (mono-nostril paraseptal, mono-nostril transethmoidal, combined mono-nostril and extended binostril) were carried out. Performance of the 3D/HD endoscope was compared to a standard 4 mm 2D/HD endoscope (Karl Storz, Tuttlingen/Germany) and rated as inferior, equal or superior. Handling, resolution of details and stereoscopic vision were systematically evaluated based on the following criteria: "Imaging": recognition of details, color brilliance, illumination, image distortion, size and depth of field, fogging, 3D effect; "Usability": handling, ergonomics, nausea, positioning, time for preparation, conflict with instruments. After evaluation in the laboratory, the endoscope was used intraoperatively as adjunct to the standard 2D/HD endoscope in 5 consecutive cases.

Results: The 3D/HD endoscope showed equal performance concerning size of field. 3D endoscope presented better recognition of details and color brilliance, less image distortion and larger depth of field. Stereoscopic 3D vision was found to be extremely helpful especially in deep seated regions. However, during the first nasal phase and in narrow anatomical situation, stereoscopic vision was partially disturbing because of inappropriate space or debris on the distal tip of the endoscope. Inferior performance was seen in fogging of the scope. Using the 3D endoscope resulted in reduced time of preparation and equal conflict with instruments, was associated with better handling and ergonomics. No fatigue or nausea was experienced. The results from the cadaveric studies were confirmed intraoperatively.

Conclusion: Overall, the new 4 mm 3D/HD endoscope was rated superior compared to the 2D/HD endoscope due to the stereoscopic vision, which was found to be extremely helpful especially in deep-seated locations. The pleasant stereoscopic vision might be especially helpful for neurosurgeons switching from microscopic to endoscopic surgery.

Cognitive function surrounding resection of nonfunctioning pituitary adenomas with suprasellar extension: a prospective matched-control study

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Objective: Cognitive dysfunction in patients suffering from pituitary adenomas may derive from hormonal imbalances or suprasellar tumor extension displacing adjacent neural structures. Symptomatic or progressively enlarging nonfunctioning pituitary adenomas with suprasellar extension generally are resected. The literature on neurocognitive performance surrounding resection of these lesions is sparse.

Methods: The performed a prospective matched-control study to investigate the preoperative and postoperative cognitive performance of patients suffering from nonfunctioning pituitary adenomas with suprasellar extension. Healthy controls were matched for the following criteria: age, sex, handedness, education, and profession. Extensive neurocognitive testing assessed: perceptual speed, executive function, visual-spatial and verbal working memory, short- and long-term memory, verbal fluency, fluid intelligence, anxiety, and depression.

Results: A total of 10 patients and 10 healthy controls underwent cognitive assessment. In all patients, the suprasellar tumor extension compressed adjacent neural structures. Median sagittal suprasellar tumor extension scored 8 mm. Median sagittal tumor diameter was 21 mm. Preoperatively, patients displayed worse performance in perceptual speed and short-term memory tasks. All patients underwent surgical therapy. Either through a transnasal, transsphenoidal approach or a supraorbital frontolateral keyhole approach. Postoperatively at day 7, the short-term memory deficit was not measurable anymore. Two months after surgery, the performance of perceptual speed tasks of patients and controls showed equal scores, demonstrating patient recovery in this cognitive domain. None of the patients experienced worsening of cognitive function. Routine postoperative imaging at six months revealed regular postoperative radiological conditions.

Conclusion: Nonfunctioning pituitary adenomas with suprasellar extension may cause neurocognitive impairments in specific cognitive domains. However, after surgical therapy these deficits appear to resolve within two months. The risk for cognitive deterioration with surgery seems to be low.

Robot-guided positioning of a magnetic coil for therapeutic repetitive transcranial magnetic stimulation (rTMS) over the cortex in patients with cerebral lesions

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Objective: rTMS with focussed coils is able to stimulate depolarization in circumscribed cerebral region of interest (ROI). During repetitive stimulations it is difficult to position the coil precisely above the target gyrus. Orientation on the 10-20-EEG system or calculation of bone markers by MRI imaging has been used to position the coil manually. We present a system which coordinates the MRI of the brain with an infrared camera system (ICS) guided robot to position the coil directly over the ROI.

Method: 25 patients with aphasia due to left hemispheric lesions stimulation of the homologous motor language area of the right hemisphere were included. A T1-MRI of the brain identified the ROI, here the gyrus frontal inferior (GFI). The patient was placed into a relaxing chair and head reference markers (HRM) were fixed to the head by a headband. HRM were tracked by an infrared camera system (ICS). The HRM were correlated to the cerebral MRI imaging. A robot system (Smart Move[®], ANT) with a 6 joint metal arm allowing positioning of the coil with 6 degrees of freedom (DoF) was placed beside the patient. The magnetic coil (8-shaped) was fixed to the robot arm. The ICS identified both the position of the magnetic coil by another set of HRM fixed to the coil and the patient's head by the HRM.

MRI data were coordinated with the position of the patient's skull and of the magnetic coil. By this technique, it was possible to identify the ROI of the cortex and to position precisely the coil over the underlying ROI.

Results: Correct position of the coil manoeuvred by the robot arm was successfully controlled in all patients by rTMS of the precentral hand knob and surface electromyography of 3 contralateral hand muscles. Movements of the head in all horizontal directions during therapeutic sessions (GFI in aphasia treatment, parietal lobe in pain treatment, handknob in central paresis) could be compensated with automatic roboter guided positioning of the coil. Compared to sham (vertex) 1-Hz-stimulation of the GFI for 20 min/day followed by speech therapy in a 14-days protocol resulted in significant speech improvement.

Conclusion: It is possible to manoeuvre precisely a magnetic coil for rTMS over brain tissue of interest by a robot arm. This allows both diagnostic tests like motoric mapping and speech mapping and therapeutic measures like treatment for aphasia, central paresis and pain. The robot arm is able to follow the head during limited movements.

Patient specific implants for skull defects: universal algorithm for conceptual design

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Objective: Cranioplasty after decompressive hemicraniectomy or large format craniotomies is a challenging procedure especially in cases when a patient's own cranial flap is unavailable. Recent advances in computer-aided design and 3-dimensional (3-D) printing have enabled fabrication of patient specific implants (PSI) from a variety of polymer, ceramic, or metal components. Good functional as well as satisfying cosmetic postoperative results have been reported. However, computer-aided design and manufacturing of PSI requires fundamental knowledge in 3-D-processing software and can be difficult and time-consuming in a variety of cases. We aim at presenting first results of a fully-automated computer-based algorithm for PSI design (CAPSID) requiring no manual operation of 3-D-processing software by the surgeon.

Methods: Based on the patient's defect skull computed tomography (CT) scan we developed an algorithm implementing about 20 computational steps including rigid-, non-rigid fusion algorithms, mirror function, fusion and subtraction functions to calculate a 3-D mould (CAPSID). The algorithm works fully-automated requiring no user's manual adaptations. CAPSID was applied retrospectively in 9 patients with different types and sizes of skull defects (left and right decompressive hemicraniectomy, craniotomies crossing the midline, skull defects containing a subgaleal drain and external ventricular drain) to test for correct feasibility of the algorithm.

Results: Application of CAPSID led to successful construction of the 3-D mould in every 9 patients. Mean running time of the algorithm was 09:32 0.45 min. The resulting 3-D mould was constructed with high accuracy in 7 of 9 patients. Acquisition of CT scans with 3 mm slice thickness and a subgaleal drain crossing the skull defect affected accurate 3-D-mould construction.

Conclusion: Application of CAPSID for conception of 3-D moulds for manufacturing of PSI seems feasible in every case. Improvement of the algorithm to achieve high accuracy is needed in cases of CT scan acquisition with thick slices and subgaleal drains crossing the skull defect. A prospective cohort study is currently under investigation to confirm our results and test clinical practicability and patient satisfaction (NCT02828306).

The sino nasal outcome test for neurosurgery (SNOT-NC): Modified version of disease specific questionnaire for transnasal skull base surgery

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Objective: The transnasal endoscopic approach to lesions of the skull base has been increasingly employed in recent years. Standardized questionnaires to assess the postoperative subjective nose-related discomfort are missing. Here, we present a modified version of the SNOT-22 questionnaire for the sino-nasal outcome test for neurosurgery (SNOT-NC).

Methods: The SNOT-NC is based on the German version modified from sino-nasal outcome test (SNOT-22) which is used for patients with rhino sinusitis. The SNOT-NC consists of 6 subscales containing 23 items covering different areas of oto-rhino-nasal symptoms, ocular discomforts and quality of life adapted to patients undergoing endoscopic operations for skull base lesions. The Short Form 36 health survey (SF-36) and a parallel version of nasal questionnaire were used for subscale correlations. The SNOT-NC was psychometrically verified using the data of 86 consecutive patients treated by the same surgeon.

Results: The internal consistency (Cronbach's alpha) for the subscales ranged from 0.64 to 0.89 for the subscales, while it was 0.90 for the whole instrument. Also indicating a high internal consistency, the Guttman's split half reliability coefficients was 0.84 for all items. Inter-item correlation with Friedman-test and T-quadrat test revealed a high significance ($p < 0.0001$). Examination of validity revealed substantial associations between the SNOT-NC and SF-36 and also a wide range of related nasal symptoms ($p < 0.01$).

Conclusion: With our data we could show that SNOT-NC appears to be a valid and, reliable method for assessing outcome parameters for patients undergoing transnasal skull base surgery. It may prove to be a valuable tool to assess the nasal-discomfort outcome of patients at follow up examinations. Further analyses including tests for retest reliability and sensitivity are needed for the future.

Assessment of cranial defects after craniectomy: a proposal for classification

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Objective: The assessment of cranial defects after craniectomy is a daily routine for neurosurgeons, not only in an intensive care unit setting. A classification to perform an objective grading is not implemented to date. The aim of our study was to categorize cranial defects after craniectomy and to devise a systematic comprehensible grading system for evaluation of these lesions.

Material and Methods: The examiner stands behind the patient and assesses the defect by observing and palpation. Clinical data were differentiated in means of 12 easily comprehensible items, taking into account particularly resiliency and elevation in comparison to the cranial bone. Every assessment was carried out by two different examiners on a daily basis prospectively. Testing conditions e.g. position of the patient and location of the examiner were standardized. Additionally, every investigator was urged to estimate the degree of difficulty to assess the cranial defect on the basis of the selected items.

Results: A total of 200 examinations were conducted in 12 patients (8 men; median age 64 years). Most frequently craniotomy was performed by reason of an acute subdural hematoma (n=88; 44%). The mean extension regarding the cranial defect was 63.49 cm². 100 per cent of examination results coincided among the different investigators. In 95% (n=190) of cases the degree of difficulty to assess the cranial lesion was evaluated as simple. In 12 cases (6%) an increased degree of hardness was evaluated. In 2 out of 12 cases (16.7%) imaging was reapplied with surgical revision following. In 4 cases (33.3%) the gained degree in hardness was desired before autologous cranioplasty.

Conclusion: By means of our selected items a simple, reproducible and objective assessment and hence reliable monitoring of cranial defects is feasible. Due to the high reliability the classification of the cranial defect is also simple to assess for diverse examiners. In case of an alteration in the degree of hardness a fast adjustment of the currently conducted therapy seems therefore possible.

Retroperitoneal peripheral nerve associated tumours - approaches and interdisciplinary management

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Objective: Nerve or nerve associated tumours of the retroperitoneal space are rare. Histological findings vary significantly and each entity requires different strategies reaching from open biopsy, function sparing tumour enucleation to radical resection. The tumors are frequently situated in- or in the vicinity the lumbosacral plexus. Depending on tumour extent and location appropriate treatment sometimes necessitates pluriportal approaches. A considerable portion are peripheral nerve sheath tumors (PNST). However, the majority of PNST are benign, and can be microsurgically removed without functional deficit. If they are treated like conventional soft-tissue tumours pain and functional loss are the consequences. If situated in the lumbosacral plexus results can be disastrous. Therefore, nerve surgical expertise is crucial. We present our series of patients with different types of tumours, treatment strategies and results.

Methods: Retrospectively our patients with retroperitoneal nerve-associated tumours were evaluated. We followed an interdisciplinary approach for assessment and surgery. Clinical and imaging findings, treatment strategies, surgical approaches, histological findings and outcome are presented.

Results: From January 2012 to September 2015 n= 12 patients were operated on. Of these n= 9 were female, n= 3 male. Histological findings included n= 5 schwannoma, n= 2 malignant peripheral nerve sheath tumours (MPNST), n= 1 sarcoma of unknown origin, n=1 perineurioma, n=1 intraneural ganglion cyst, n= 1 lymphoma, n= 1 paraganglioma. In n= 5 a monoportal retroperitoneal, in n= 2 patients a biportal (transabdominal+transgluteal), in n=3 a monoportal transabdomial and in n= 2 a dorsal approach was used. In n= 2 we performed an open biopsy (perineurioma/ paraganglioma), in n= 2 a tumour enucleation (schwannoma), in n= 3 a subtotal function-sparing resection (MPNST/ sarcomas/ lymphoma), in n= 1 intraneural decompression (intraneural ganglion cyst) and in n= 1 removal of remaining schwannoma after previous surgery ex domo and autologous nerve reconstruction. Both macroscopic and microscopic techniques were applied in all cases. We generally do not perform CT-guided needle biopsies. In n=1 patient motor weakness occurred. N= 4 patients required further radio-oncological treatment.

Conclusion: Retroperitoneal nerve or nerve associated tumours encompass a large variety of different entities. Each requires different treatment strategies, but any one of them benefits from nerve surgical expertise. Aside from tumour removal preservation of function should be one goal of surgery. In our experience, working in an interdisciplinary team patient's safety can be improved significantly.

MI.27 Pädiatrische Neurochirurgie 5

Mittwoch *Wednesday*, 17.05.2017, 13.30 – 14.30 Uhr *hrs*

- MI.27.01 *Tethered Cord Syndrome in children and young adults - functional outcome after microsurgical detethering*
N. Terpolilli* (München, Deutschland)
-
- MI.27.02 *Chiari I Malformations in Children*
J. Klekamp* (Quakenbrück, Deutschland)
-
- MI.27.03 *Endoscopic-controlled surgery in craniosynostosis*
L. Schreiber* (Duisburg, Deutschland), A. Alyeldien, J. Thissen, T. Rosenbaum, M. Scholz
-
- MI.27.04 *Long-term results of the surgical correction of craniosynostosis in children*
E. Roeder-Geyer* (Siegen, Deutschland), R. Buchal, H. Petri, V. Braun
-
- MI.27.05 *Ultrasound in Craniosynostosis*
L. Schreiber* (Duisburg, Deutschland), A. Alyeldien, C. Junghans, A. Feldkamp, M. Scholz
-
- MI.27.06 *Diagnosis, treatment and prognosis of brain tumors in infancy - a single center study*
S. Sarikaya-Seiwert* (Düsseldorf, Deutschland), T. Beez, J. Klasen-Sansone, H. Steiger
-

Tethered Cord Syndrome in children and young adults - functional outcome after microsurgical detethering

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Objective: Tethered Cord Syndrome (TCS) comprises a combination of neurological, musculoskeletal and urological disturbances caused by abnormal tension of the spinal cord. TCS is radiomorphologically characterized by a low lying conus, shortening of the filum and is associated with (open or occult) spinal dysraphisms, but can also occur in combination with other conditions such as Chiari malformation. Microsurgical detethering is the therapy of choice in symptomatic TCS, but ideal timing is still unclear. The aim of the current study was to analyze the outcome after surgical detethering with regard to age, preoperative symptomology, and neurological outcome.

Methods: Clinical records of all patients under the age of 20 years microsurgically treated at our department for tethered cord syndrome and presented to our outpatient clinic at least once for follow-up between 01/2003 and 10/2016 were retrospectively analyzed.

Results: 59 patients (27 male, 32 female) diagnosed with symptomatic tethered cord syndrome were included in the current study. Patients were postoperatively followed up for 2.6 years on average (0.2 – 9.7 years). Most common initial symptoms included bladder disturbances (89.8%), muscle weakness (83.1%), foot deformities (45.8%), and back pain (27.1%). Mean age at operation was 6.1 years (10 days – 20.0 years). 37 patients (62.7%) were diagnosed with myelomeningocele perinatally and had undergone repair within 4 months after birth; 7 of the remaining patients without open spinal dysraphism were diagnosed with occult spina bifida on MRI images performed for TCS related symptoms. All patients underwent microsurgical detethering under intraoperative electrophysiological monitoring. Intraoperatively, a spinal lipoma was resected in 10 cases, a dermal sinus excised in 3 cases. Perioperative morbidity was 11.8%: 3 cases of CSF leak, 4 cases of impaired wound healing requiring surgical revision. There was no postoperative worsening of symptoms. Bladder function improved in 67.3% of cases presenting with this symptom; recovery of urinary function tended to be more complete when patients were operated before the age of 4 years. Pain abated in 62.5% of patients. Motor function significantly improved in 67.3% of patients. Of note, while of the 17 patients that were too young to stand and walk at the time of operation (below the age of 12 months) 11 were ambulatory at the time of last check-up, only one of 9 patients with detethering after the age of 1 year regained the ability to ambulate.

Conclusion: Our results indicate that neurological outcome, especially recovery of urinary function, after microsurgical detethering, is more favourable when surgery is performed early in life and when symptoms are mild. Further and prospective analyses are needed in order to validate these findings.

Chiari I Malformations in Children

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Objective: For years treatment of Chiari I malformation in children and young adults is a matter of controversy regarding both the diagnosis and the details of decompression. In this paper, differences in clinical presentation and diagnosis between children and adults are reported and results of decompression analysed.

Methods: Since 1991 all patients with spinal cord pathologies were entered into a spinal cord data base. Between 1991 and 2015 a total of 725 patients with Chiari I malformation were encountered. Among these 60 children between 3 and 17 years presented (follow up 53.5±50.7 months). Patients were examined on admission, after surgery, 3 months after discharge and yearly thereafter. Clinical data were analyzed with a scoring system for individual symptoms. Long-term results were determined by Kaplan-Meier statistics to calculate rates for progression-free survival.

Results: By comparison to adults children complain significantly less about occipital headaches (55.9% vs. 79.1%, $p < 0.0001$), sensory disturbances (20.3% vs. 59.2%, $p < 0.0001$), dysesthesias (15.3% vs. 39.9%, $p = 0.002$), motor weakness (13.6% vs. 33.8%, $p = 0.04$) or gait ataxia (28.8% vs. 59.1%, $p = 0.0003$). Bony anomalies such as basilar invagination, however, tended to be more common in children (20.0% vs. 13.4%, $p = 0.06$). 45.0% of children and 52.0% of adults underwent foramen magnum decompression with duraplasty and inspection of the 4th ventricle. Foramen Magendie was found to be occluded in 29.6% of children and 36.9% of adults (not significant). Postoperatively, 74.1% of children and 77.3% of adults reported improvement. The remainder considered their condition unchanged except 4.8% of adults, whose condition had worsened related to previous attempts of decompression. Progression-free survival for 10 years was achieved for 88.8% of children and 80.4% of adults (not significant).

Conclusion: Diagnosis of Chiari I malformation in childhood has to account for the physiologic tonsillar descent and differences in clinical symptoms compared to adults. A decompression should only be advised in patients with unequivocal symptoms and imaging results. Short- and long-term results of decompression with opening of the arachnoid and duraplasty tend to be slightly better compared to adults.

Endoscopic-controlled surgery in craniosynostosis

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Objective: Craniosynostosis is a premature pathologic ossification of one or several sutures of the skull. A child with a premature ossification of the sutures suffers a pathologic growth of the skull with a restricted growth in some areas and compensatory bossing in other areas. An increasing intracranial pressure is another well-known but rare complication of craniosynostosis. A surgical treatment is necessary for functional as well as cosmetic reasons. In the last few years, a minimally invasive endoscopic procedure is invented, developed and more and more performed to treat a wide range of patients with craniosynostosis.

Methods: Since 2013, 46 children with craniosynostosis were admitted to our department of neurosurgery for a surgical repair. We followed the endoscopic technique as main line of therapy for the patients younger than 4 month. 25 children with different types of craniosynostosis where operated endoscopically. A postoperative helmet therapy is considered to be a part of the endoscopic technique in the management of these cases. The follow up assessments take place 6 weeks, 3 months and 6 months after the surgery. A photo session as well as a 3d-photo-scan are the main follow-up measures that take place in each follow up assessment, so we can detect the efficiency of the treatment volumetrically and are able to optimize the therapy through the fine adjustments of the helmet.

Results: The endoscopic-controlled technique is a minimally invasive technique which allows us to reach the optimal functional und cosmetic results with a very small scar. A blood transfusion may not be needed as a very little amount of blood is lost. Only 12 Children out of 25 children needed blood transfusion, 4 children had the blood transfusion only intraoperatively, 7 children had the blood transfusion only postoperatively and only one child got the blood transfusion both intra- and postoperatively. Only one case which was operated endoscopically had undergone a re-operation "Open surgery" 7th month later due to insufficient cosmetic result.

Conclusion: The endoscopic approach is a minimal invasive technique to treat craniosynostosis with a minimal risk of blood loss and low incidence of required intraoperative blood-transfusion. It is a fast surgery with a very small scar and optimal cosmetic and functional results for children younger than 4 months.

The results of the endoscopic technique are as good as the open-surgery-results.

The helmet therapy helps to optimize the results and to achieve the best skull-form. It is well-accepted and tolerated by the children. The duration of the helmet therapy is around one year but it can be shortened to 6 months in a lot of cases.

Further studies are necessary to find out, whether this endoscopic technique is also a possible treatment option for the children older than 4 months or not.

Long-term results of the surgical correction of craniosynostosis in children

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Objective: 27 consecutive operated children for craniosynostosis were primarily included in this study. 7 children were lost for follow up due to different reasons. The remaining children were operated on in 2010-2012. The aim of the study was to ascertain whether these children develop in the same way as children without craniosynostosis in respect of physical motor functions, hand movement, cognitive and language skills and in their social-emotive behaviour. Furthermore, parental satisfaction with the surgical outcome was assessed.

Methods: At time of surgery the age ranged from 6 to 24 M, (average 9.9 M). The follow up time ranged from 38 to 69 M (average 50.4 M). The children were examined using the development test ET6-6 R 2013, which allows an assessment of all the above-mentioned factors. It was standardized in 2011/12 in 5 German regions basing on the results of 1.053 children. The test was carried out by an independent pediatrician.

Parental satisfaction with the results of surgery regarding head shape, wound healing, development and medical after-care was assessed by a questionnaire using a scale of 1 (unsatisfactory) to 5 (very satisfactory). The parents were also asked if, retrospectively, they would have their child operated on.

Results: Overall 19/20 operated children had better results than the control group with an average of 71.7 %, compared to the average in the control group of 50%. Only one child was slightly worse with 47.8%. In detail, in social-emotive development our children reached 60.3 %, in symbol drawing 68.9 %, in physical motor function 69.4 %, hand movement 72.0 %, language skill 76.9 % and in the cognitive section 82.5 %.

The questionnaire on parental satisfaction yielded the following Results: satisfaction with surgery gained 4.7 points; shape of head 4.4 pts; wound healing 4.4 pts; positive .development 4.9 pts; satisfaction with medical after-care 4.7 pts.

The average of the results reached 4.6 on a scale of 5 pts. The question whether parents would retrospectively have their child operated on was answered positively with 91.3 %.

Conclusion: All except one of our surgically treated children showed better developmental results than normal children in the control group, subsequently, the parental satisfaction was good as well. Thus, the indication for surgery in the case of craniosynostosis can definitely be positively rated.

Ultrasound in Craniosynostosis

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Objective: Craniosynostosis is a premature pathologic ossification of one or several sutures of the skull. The timing of normal closure of the cranial sutures varies according to the anatomical place of the suture. This physiological process ends normally between the 6th and the 18th month of life. A child with a premature ossification of the sutures suffers a pathologic growth of the skull with a restricted growth in some areas and compensatory bossing in other areas. This pathological process leads to abnormal shapes of the skull depending upon the site and timing of the abnormally fused suture. An increasing intracranial pressure is another well-known but rare complication which is discussed in craniosynostosis. A surgical treatment is necessary for functional as well as cosmetic reasons.

In the past a CT-scan or an X-ray was mandatory and was considered to be the gold standard examination to establish the diagnosis of a craniosynostosis.

Methods: Since 2013 our standard examination to diagnose a craniosynostosis has been the Ultrasound with a high-frequency Linear Probe (15 MHz, GE Healthcare).

Since 2013, 46 children with craniosynostosis were operated in our department of neurosurgery. All the 46 cases underwent an ultrasound examination in the primary assessment of the cases in the out-patient clinic as well as one day preoperative to confirm the diagnosis of craniosynostosis.

Results: In comparison the diagnostic findings of ultrasonography and intraoperative findings, the ultrasonography yielded a very high accurate result.

Studying all the ultrasonographic findings of the 46 cases reveals that the ossification always starts at one "trigger-point" and after a while this pathologic ossification increases. It also shows that if there is a sharp angle of the suture the suture tends to be functionally insufficient and the risk of an early ossification is high.

Conclusion: In the pediatric neurosurgery craniosynostosis is a well-known diagnosis.

The high-resolution, high-frequency ultrasound is a safe, painless and fast tool that can be used in the primary assessment of the cases in the out-patient clinic. It is possible to establish a diagnosis of craniosynostosis with a high accuracy so it can replace the CT and the X-ray to spare an extra radiation exposure of the children.

Diagnosis, treatment and prognosis of brain tumors in infancy - a single center study

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Objective: Brain tumors in infants are rare and form a distinct subgroup of pediatric brain tumors. These tumors differ from tumors in older children with respect to histology and management and tend to have a poorer outcome. Malignant histology is common, with persistently poor outcomes evolving adjuvant therapy.

Methods: We reviewed retrospectively the charts and the images of all patients under the age of 12 months who underwent brain tumor surgery from 2006 to 2016 treated in our institute. The charts were analyzed according to the age of the onset of symptoms, location of tumors, surgical treatment, histological results and outcomes. Data of outcome were analyzed using Kaplan–Meier plots, chi-square test.

Results: 37 patients were included in the study (13 girls and 24 boys). Four cases were diagnosed in the last three weeks during pregnancy, 18 cases within 6 months and the remaining 15 patients up to the end of 1 year of age. In 29 cases the tumor were localized supratentorial and in 8 cases infratentorial. Low and high grade glial cell tumors (18) and embryonal tumors (12) were the most common histological subtype, followed by ependymomas (5) and choroid plexus tumors (2); 76% of patients underwent a gross total or near total excision of the tumor with one perioperative mortality; Increasing head size due to raised ICP was the most common presenting feature in more than 77% of infants followed by seizures. 81% of the patients developed persistent multifocal CSF diversion problems with the need of ventriculo-cysto-peritoneal shunt placement. The range of follow-up was 2–129 months with a median follow-up of 41 months. The overall survival was 78.4%.

Conclusion: Low and high grade glial cell tumors and embryonal tumors were the most common histological subtype. Surgeries for tumors in this age group were associated with lower rates of total excision and higher morbidity due to complex CSF diversion problems. Safe resection should be the goal of surgery. Low-grade lesions as expected are associated with longer survival; however, long-term outcomes are far from satisfactory.

MI.28 Tumor 15 – Immunologie

Mittwoch *Wednesday*, 17.05.2017, 13.30 – 14.30 Uhr *hrs*

- MI.28.01 *Dexamethasone-induced leukocytosis is associated with poor survival in newly diagnosed glioblastoma.*
D. Dubinski* (Frankfurt am Main, Deutschland), S. Won, F. Gessler, J. Quick-Weller, B. Behmanesh, K. Franz, V. Seifert, C. Senft
-
- MI.28.02 *Comprehensive analysis of immunology in recurrent glioblastoma multiforme*
D. Heiland* (Freiburg, Deutschland), S. Heynckes, A. Gäbelein, G. Haaker, P. Franco Jimenez, I. Mader, D. Pfeifer, M. Prinz, D. Delev, O. Schnell
-
- MI.28.03 *Glioblastoma-derived extracellular vesicles dynamically carry PD-L1 and specifically inhibit CD4+ and CD8+ T-cell activation and proliferation*
F. Ricklefs* (Hamburg, Deutschland), M. Speranza, S. Lawler, M. Westphal, E. Chiocca
-
- MI.28.04 *Monitoring cell death and immune cell interactions in Glioblastoma with IncuCyteZOOM*
H. Mostafa, E. Dietrich, P. Sander* (Ulm, Deutschland), A. Soboh, A. Pala, A. Scheuerle, C. Wirtz, M. Georgieff, E. Schneider
-
- MI.28.05 *Tumor volume of glioblastoma correlates inverse with immunoglobulin-repertoires of tumor-associated macrophages*
S. Busch* (Mannheim, Deutschland), T. Fuchs, A. Abdulazim, D. Hänggi, M. Neumaier, M. Seiz-Rosenhagen
-
- MI.28.06 *The potential role of tumor necrosis resulting in an immunosuppressive microenvironment related to major immune suppression and highly detrimental outcome in GBM patients*
A. Pala* (Oberelchingen, Deutschland), H. Mostafa, A. Scheuerle, M. Hlavac, C. Wirtz, E. Schneider
-

Dexamethasone-induced leukocytosis is associated with poor survival in newly diagnosed glioblastoma.

Daniel Dubinski¹, Sae-Yeon Won², Florian Gessler¹, Johanna Quick-Weller², Bedjan Behmanesh², Kea Franz², Volker Seifert², Christian Senft²

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Objective: Despite its well-characterized side effects, dexamethasone is widely used in the pre- peri- and postoperative neurosurgical setting due to its fast and effective release of tumor side effects through the reduction of tumor-associated oedema. However, some patients show laboratory-defined dexamethasone induced elevation of white blood cell count without obvious clinical significance.

Methods: We retrospectively analyzed 113 patients with newly diagnosed glioblastoma to describe the incidence, risk factors and clinical features of dexamethasone-induced leucocytosis in primary GBM patients.

Results: Among all patients with preoperative dexamethasone administration, the presence of manifest dexamethasone-induced leucocytosis significantly decreased overall survival ($p=0.009$ HR: 2.25 KI: 1.15 , 4.38). Similar results were obtained for progression free survival. ($p=0.028$ HR: 2.23 KI: 1.09 – 4.59). We further detected patient's age as a positive prognostic factor for DIL development. ($p=0.033$)

Conclusion: We identified an early novel prognostic marker in GBM induced oedema management and characterized a subgroup, which would probably benefit from other oedema reducing substances in the course of GBM treatment.

Comprehensive analysis of immunology in recurrent glioblastoma multiforme

Dieter Henrik Heiland¹, Sabrina Heynckes², Annette Gäbelein², Gerrit Haaker³, Pamela Franco Jimenez⁴, Irina Mader⁵, Dietmar Pfeifer⁶, Marco Prinz⁷, Daniel Delev², Oliver Schnell²

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Objective: The biology of recurrent glioblastoma is a dynamic process influenced by selection pressure induced by different antitumoral therapies. The characteristics of these biological processes have been rarely explored, which complicates treatment. Checkpoint-inhibition (PD1/PD-L1 Inhibition) is a hallmark of immunotherapy, which is being investigated for recurrent GBM in ongoing clinical trials. The purpose of this study was to analyse the *PD-L1* expression in de-novo/recurrent glioblastoma multiforme and to explore associated genetic alterations.

Methods: 105 tissue samples of 56 glioblastoma patients were acquired by neuronavigation-guided resection between 2011 and 2014 in the Department of Neurosurgery, Medical Center University of Freiburg. Comprehensive transcriptional network analysis was performed by expression array data of 49 patients and validated by available data sets (TCGA and Bai et al.). Quantification of the PD-L1 level was performed by immunohistochemistry, immunofluorescence, western blot and qRT-PCR.

Results: Comprehensive transcriptional network analysis showed a strong connection between MAPK pathway activation and increased level of PD-L1. Additionally, PD-L1 expression was found to be associated with mesenchymal gene expression and immune response pathway up-regulation. However, the immune related pathways were down-regulated in recurrent glioblastoma. Recurrent GBM showed decreased mRNA expression-levels of PD-L1 in comparison to de-novo tumors. These findings were validated by additional immunostainings and western blot analysis. A multivariate regression model showed a significantly lower PD-L1-expression in recurrent glioblastoma associated with an extended temozolomide treatment.

Conclusion: We showed that PD-L1 expression and immune related pathway activation are reduced in recurrent GBM in comparison to de-novo GBM. Additionally, patients who received an extended dose of temozolomide chemotherapy showed a significantly lower level of PD-L1 expression in the recurred tumour stage. Our findings may therefore provide an explanation for reduced effectiveness of immunotherapy in recurrent GBM.

Glioblastoma-derived extracellular vesicles dynamically carry PD-L1 and specifically inhibit CD4+ and CD8+ T-cell activation and proliferation

Franz Ricklefs¹, Maria Speranza², Sean Lawler², Manfred Westphal³, Ennio Antonio Chiocca²

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Objective: Extracellular Vesicles (EVs) shed by tumor cells have recently been demonstrated to act a major conduits in cell-cell communication. However, knowledge of the effect of EVs on infiltrating lymphocytes within the tumor microenvironment is still rudimental. In this study we investigated the potential role of EVs in immune escape in heterogeneous glioblastoma.

Methods: Peripheral blood mononuclear cells (PBMCs) (n=8) were stimulated by IL-2 or anti-CD3±anti-CD28 treatment. Magnetic cell sorting was used to isolate CD3+ cells. Activation levels of CD3+CD4+ and CD3+CD8+ were monitored by flow cytometry of the T cell activation markers CD69 and CD25. Concurrent eFlour staining was used to measure proliferation. EVs derived from six different glioblastoma stem-like cell lines (GSCs) from either the mesenchymal (M) or proneural (P) subtype were used in this study. PDL1 expression was validated by immunoblotting and single EV analysis (SEA) and measured after IFN γ stimulation. EV binding was visualized by PALM-tomato positive EVs.

Results: EVs were able to bind to the outer surface of CD3+ cells. In whole PBMCs EV treatment led to a significant reduction of CD3+CD8+ and CD3+CD4+ T-cell activation as well as proliferation and IL-4 expression, especially in the M subtype. These effects were also observed in CD3+ sorted cells, indicating a direct effect of EVs on T cells. In contrast, increased IL-10 expression in PBMCs after EV treatment was lost on CD3+ sorted T-cells indicating that EVs also influence other CD3- cells in the PBMC population. PDL1 expression on EVs was inducible by IFN γ stimulation of GSCs.

Conclusion: Our findings demonstrate the immunosuppressive potential of GSC-derived EVs. Furthermore we identified PDL1 expression in EVs as a dynamic regulator that may be partially responsible for these effects.

Monitoring cell death and immune cell interactions in Glioblastoma with IncuCyteZOOM

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Objective: In an attempt to test allogeneic and autologous immune sensitization and vulnerability of established and new chemotherapeutic drugs, we established permanent cell lines from patients with glioblastoma multiforme (GBM).

Methods: Fresh tumor tissue was minced and trypsinized, then subjected to Ficoll-separation and culture using endotoxin-free fetal calf serum and Iscove's modified essential medium. Permanent cell lines were established 4-8 weeks after culture initiation. Blood-derived allogeneic and autologous mononuclear cells were activated with Interleukin- (IL-) 2 and IL-15 using standard protocols. GBM derived cell lines were characterized using flow cytometry and stem cell contents were determined by CD133 staining. For quantification of proliferation, cell death and the interaction with immune cells, we used the IncuCyteZOOM incubator microscope and software. Cells were seeded into 96well (flat-bottomed) microtiter plates and caspase 3/, Annexin-V and PI-staining were used for data analysis.

Results: Following IL-2/IL-15 activation protocols, we found active cell lysis of GBM cell lines in the presence of IL-2 alone. However, microscopical analysis demonstrated the renewal of malignant clones much faster than effective cell killing. Microscopical examination further demonstrated massive diminution of co-cultured T- and NK lymphocytes by a process likely to be due to macropinocytosis.

Conclusion: A novel mechanism identified in glioblastoma tumor cells appears to be due to macropinocytosis of immune effectors even in the presence of T- and NK cell growth factor.

Tumor volume of glioblastoma correlates inverse with immunoglobulin-repertoires of tumor-associated macrophages

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Objective: We have found that tumor-associated macrophages and blood monocytes obtained from glioblastoma patients are capable to recombine immunoglobulin genes and to express antibodies of different classes (IgM, IgG, IgK, IgL). The immunoglobulin-repertoires vary between patients and show a reduced complexity in the tumor as compared to the peripheral blood. The aim of the study was to examine the variations between the single repertoires.

Methods: Tumor-associated macrophages and monocytes were isolated from tumor tissue and peripheral blood of glioblastoma patients (n=15). They were purified to homogeneity using sequential affinity purifications (MACS-beads). Absence of lymphocytic cells was verified by high-sensitivity PCR assays. The expression of Igs in the cell preparations were investigated using repertoire-PCRs followed by TOPO-cloning and Sanger sequencing. Analyses of CDR3 regions and the V-, D- and J-chain usage of the Igs were performed using IgBLAST and VBASE2. The complexity of the Ig-repertoires was correlated to the individual tumor size of the patient as assessed by 3D volumetry in preoperative MR images.

Results: The evaluation of the Ig-repertoires from the myeloid cells showed significantly reduced complexity in the tumors when compared to the peripheral blood samples of the individual patients. Moreover, these repertoires are generally more restricted than the corresponding B-cell repertoires. Interestingly, the complexity of the myeloid antibody repertoires shows an inverse correlation to the individual tumor volumes in patients suffering from glioblastoma. Specifically, decrease of complexity in the repertoires can be found the larger the tumor is in size. This phenomenon can be detected in the tumor and in the blood for the heavy as well as for the light chains.

Conclusion: The Ig-repertoires in glioblastoma patients vary significantly between TAMs and circulating monocytes suggesting specific homing and/or immunosuppressive functions exerted by the tumor. This is further corroborated by the observation of a strong inverse correlation between the individual tumor size of the patient and the complexity of the Ig-repertoires expressed by tumor-associated macrophages and monocytes.

Further studies are needed to investigate potential functions of the myeloid antibody repertoires and their dynamics during the course of the disease.

The potential role of tumor necrosis resulting in an immunosuppressive microenvironment related to major immune suppression and highly detrimental outcome in GBM patients

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Objective: Current standard therapy of glioblastoma (GBM) patients offers dismal prognosis but individual patients differ in their prognosis. Immune phenotyping may constitute important predictive elements for survival. Generally, tumor-associated immune suppression is one of the major limitations in GBM therapy and T-cell exhaustion may be of highest relevance for immune insufficiency. Tumor necrosis seems to have a relevant influence on tumor microenvironment. We have evaluated the correlation between tumor necrosis volume and immunological characteristics of GBM patients in regard to patients' outcome.

Methods: Out of 90 analyzed GBM patients, 8 patients with poor and 6 patients with excellent outcome were selected on the basis of overall survival and Karnofsky performance scales (KFS). Tumors were characterized by analyzing their MGMT and IDH-1 mutation status. Volumetric analysis of enhanced T1 MRI images of tumor was assessed using Brainlab iPlan 3.0. Tumor and necrosis volume were evaluated separately. Additionally, necrotic tumor was assessed, questioning the possible contribution of an immunological response in the tumor area. We used antibodies recognizing: CD3, CD8, CD19, CD68, CD163 for flow-cytometry and immune histochemistry to characterize immune activation patterns in peripheral blood, and in the tumor, respectively.

Results: The mean necrotic core volume in patients with unfavourable outcome was 16.098 cm³ (0.428-34.820 cm³). Patients with favourable outcome presented a smaller necrotic tumor core with a mean volume of 2.912 cm³ (0.000 – 6.117 cm³, p=0.025, Mann-Whitney-U Test). Thus the volume/necrosis ratio has shown a significant difference between both cohorts (p=0.007, Mann-Whitney-U test). Remarkably, the high necrotic core ratio was related to a unique deficiency T-cell receptor positive T lymphocytes but preservation of CD19+ B cells. In tumor tissues, however, the infiltration of CD3+/CD8+ T lymphocytes appeared to be similar in dismal patients when compared to patients with a more favourable prognosis.

Conclusion: Patients with unfavourable outcome seem to present with tumors that exhibit large necrotic tumor core. The low tumor/necrosis volume index corresponds with an immunosuppressive environment and inferior survival in GBM patients. Furthermore, significantly decreased amounts of T cell receptor positive lymphocytes implies active immune suppression resulting in faster tumor progress and poor survival.

Posterbegehung *Poster presentation*

Montag *Monday*, 15.05.2017, 17.15 – 18.30 Uhr *hrs*

P 001	<i>The combined presigmoidal approach – own experience with the increasingly outmoded approach over the last seven years</i> S. Asgari* (Ingolstadt, Deutschland)
P 002	<i>Idiopathic pachymeningitis cervicalis hypertrophic: case report and critical review of the literature</i> M. Hijazi* (Dresden, Deutschland), M. Kirsch, D. Krex, D. Podlessek, B. Rieger, G. Schackert
P 003	<i>Smith-Robinson Procedure with and without Caspar Plating as a Treatment for Cervical Spondylotic Myelopathy: A 26 year follow-up of 23 patients</i> B. Burkhardt* (Homburg, Deutschland), M. Brielmaier, K. Schwerdtfeger, J. Oertel
P 004	<i>Radiation-induced meningioma (RIM) 54 years after radiotherapy for unilateral hereditary form of retinoblastoma - case report and critical review of the literature</i> M. Hijazi* (Dresden, Deutschland), G. Schackert, D. Krex, B. Rieger, D. Podlessek, M. Kirsch
P 005	<i>Intramedullary lesions of the spinal cord - experiences from 426 cases</i> C. Mende* (Hamburg, Deutschland), M. Westphal, S. Eicker
P 007	<i>Visualization in tubular assisted spinal surgery. Is there a difference between HD-endoscopy and microscopy?</i> B. Burkhardt* (Homburg, Deutschland), M. Wilmes, S. Sharif, J. Oertel
P 008	<i>Pathophysiological concepts for posttraumatic anisocoria in and after the thirties</i> V. Hagel* (Ulm), D. Woischneck, T. Kapapa
P 009	<i>Historical review of sciatica prior to the era of lumbar disc herniation</i> V. Hagel* (Ulm), T. Kapapa, D. Woischneck
P 010	<i>Intraoperative MRI for Resection Guidance in Neurosurgery - A Report from the German Study Group of Intraoperative MRI (GeSGIM)</i> M. Scherer* (Heidelberg, Deutschland), A. Merkel, J. Coburger, H. Ahmeti, C. Roder, T. Scholz, M. Banat, C. Senft, C. Wirtz, A. Unterberg
P 011	<i>Anticoagulants that block von Willebrand factor fiber formation prevent thrombotic complications associated with intracranial metastases</i> M. Seiz-Rosenhagen* (Mannheim, Deutschland), J. Robador, T. Mayer, S. Brehmer, D. Hänggi, S. Schneider, A. Bauer
P 012	<i>Resting state functional MRI in the Setting of the intraoperative MRI: Early Experience</i> H. Metwali* (Hannover, Deutschland), A. Akbarian, U. Kabelitz, B. Mohammadi, M. Samii, A. Samii
P 013	<i>Cognitive and neuropsychological outcome after awake surgery for left frontal and temporal tumor resection</i> A. Noack* (Frankfurt am Main, Deutschland), S. Frisch, C. Kell, V. Seifert, M. Forster
P 014	<i>Tumor-Treating-Fields treatment for Glioblastoma multiforme in daily praxis</i> S. May* (Dresden, Deutschland), A. Kirchner, J. Göbel, D. Krex, R. Gerlach
P 015	<i>Radio frequency ablation as a minimally invasive Treatment in patients with spinal metastases</i> J. Kohl* (Magdeburg, Deutschland), B. Jöllenbeck, D. Class, A. Donitza, R. Firsching
P 016	<i>The history of cerebral vasospasm - diagnostics and treatment over the past 80 years</i> D. Dubinski* (Frankfurt am Main, Deutschland), V. Seifert
P 017	<i>eLearning resources to supplement postgraduate neurosurgery training</i> M. Stienen* (Zürich, Switzerland), K. Schaller, H. Cock, V. Lisnic, L. Regli, S. Thomson

P 018	<i>Progress of neuroendoscopy in the last 80 years</i> F. Ebner* (Tübingen, Deutschland), M. Tatagiba
P 019	<i>The impact of Robot-assisted spine surgery - shown on the example of our center</i> A. Haj* (Regensburg, Deutschland), C. doenitz, A. brawanski
P 020	<i>Intradural nodular fasciitis mimicking spinal glioblastoma metastasis.</i> F. Behling* (Tübingen, Deutschland), C. Zipser, R. Beschorner, L. Füllbier, M. Skardelly, U. Ziehmann, M. Tatagiba
P 021	<i>Primary Gliosarcoma in adults: Clinical characteristics, Management and Outcomes in a series from a single German institution</i> V. Kuhna* (Oldenburg, Deutschland), J. Viñas-Rios, T. Kretschmer, T. Schmidt
P 022	<i>Pupillary dilation in flurane sedation – report of two cases</i> S. Nowak* (Greifswald, Deutschland), S. Rehberg, H. Schroeder, S. Fleck
P 023	<i>An antibody-guided poly-propylene-imine (PPI)-based polyplex-system for siRNA-treatment of EGFRvIII-positive tumors</i> S. Michen* (Dresden, Deutschland), S. Tietze, F. Ennen, A. Janke, G. Schackert, D. Appelhans, A. Temme
P 024	<i>Fluorescein Sodium and YELLOW 560 nm filter for improved visualization of brain abscesses</i> K. Schebesch* (Regensburg, Deutschland), A. Brawanski, J. Höhne
P 025	<i>Gamma Knife radiosurgery for radiation resistant brain metastases</i> F. Fitschek* (Wien, Austria), B. Gatterbauer, J. Frischer
P 026	<i>Quality Indicators in Neurosurgery- Which are presently substantiated? A systematic review.</i> S. Schipmann* (Münster, Deutschland), M. Schwake, E. Suero Molina, N. Roeder, W. Steudel, N. Warneke, W. Stummer
P 027	<i>Electromagnetic navigation for intracranial neuroendoscopic operations</i> F. Hertel* (Luxemburg, Luxembourg), C. Berthold, L. Schröder, N. Gunness, M. Raket
P 028	<i>Hyperthermia increases temozolomide induced cell death in MGMT-unmethylated human glioblastoma specimens in vitro.</i> A. Beher* (Gießen, Deutschland), M. Kolodziej, C. Koch, F. Schwarm, E. Uhl, M. Stein
P 029	<i>Deletion of chromosome 17q as an important step in the clonal cytogenetic evolution of recurrent meningiomas</i> S. Hemmer* (Homburg/Saar, Deutschland), R. Ketter, S. Urbschat, J. Oertel
P 030	<i>The transfalcine interhemispheric approach to contralateral paramedian, parafalcin lesions</i> J. Baldauf* (Greifswald, Deutschland), H. Schroeder
P 031	<i>Critique of approximate entropy as complexity measure of intracranial pressure</i> H. Heissler* (Hannover, Deutschland), M. Alam, J. Krauss
P 032	<i>Precursors of ICP changes: The analysis of causal relationships</i> H. Heissler* (Hannover, Deutschland), M. Alam, J. Krauss
P 033	<i>Repurposing of the old sulfone antibiotic dapsone for the treatment of gliomas</i> G. Karpel-Massler* (Ulm, Deutschland), R. Kast, X. Chen, C. Wirtz, M. Halatsch, C. Bolm
P 034	<i>Time-course of plasma chemokine and cytokine increases in a rat model of brain death</i> M. Esmailzadeh* (Hannover, Deutschland), M. Sadeghi, R. Galmbacher, V. Daniel, A. Mehrabi, J. Krauss
P 035	<i>Pathology of Pituicytoma - Indicators for treatment alternatives?</i> C. Mende* (Hamburg, Deutschland), J. Matschke, R. Buslei, W. Saeger, R. Fahlbusch, M. Buchfelder, M. Westphal, J. Flitsch

P 036	<i>The influence of brain tumor localisation and isocitrate dehydrogenase 1 (IDH1) on reorganisatory processes of the language system</i> K. Rosengarth* (Regensburg, Deutschland), F. Dodoo-Schittko, C. Doenitz, T. Popp, A. Brawanski
P 037	<i>Restless legs syndrome as a first indicator of a meningioma-induced compression of brainstem and cervical spinal cord: a case report.</i> M. Tatagiba* (Tübingen, Deutschland), J. Liepert
P 038	<i>Carnosine's anti-neoplastic effect on glioblastoma cell growth is independent of its cleavage</i> K. Purcz* (Leipzig, Deutschland), C. Seidel, C. Birkemeyer, J. Dietterle, J. Meixensberger, F. Gaunitz, H. Oppermann
P 039	<i>Diverse effect of acetazolamide administration in murine Close Head Injury with versus without surgical decompression.</i> J. Szczygielski* (Homburg / Saar, Deutschland), V. Hubertus, E. Kruchten, A. Müller, J. Oertel
P 040	<i>Neuroendoscopic biopsy of paraventricular intraparenchymal tumors</i> D. Keiner* (Homburg, Deutschland), J. Oertel
P 041	<i>Experimental 5-ALA Photodynamic Therapy of a Human Chordoma Cell Line</i> L. Eismann* (Düsseldorf, Deutschland), B. Senger, H. Steiger, J. Cornelius
P 042	<i>Large cerebellopontine angle tumors: Long term follow-up of facial nerve function</i> Ö. Yildiz* (Magdeburg, Deutschland), D. Class, R. Firsching
P 043	<i>One year with Optune in Austria: First report on clinical experiences</i> C. Freyschlag* (Innsbruck, Austria), J. Kerschbaumer, D. Pinggera, C. Thomé
P 044	<i>Survival of patients undergoing resection of multiple lesions vs. one lesion in the presence of multiple metastases - a survival analysis based on the prospective Metasys-trial-data</i> C. Wolfert* (Göttingen, Deutschland), A. Hussein, I. Fiss, S. Hernandez Duran, A. Bleckmann, V. Rohde, B. Schatlo
P 045	<i>Interaction of nanoparticles with Neurons- a Liaison with potential?</i> J. Glumm* (Berlin, Deutschland), J. Neubert, S. Wagner, J. Kiwit
P 046	<i>Interneurons in the spotlight for recovery after spinal cord injury</i> J. Glumm* (Berlin, Deutschland), M. Pohland, J. Kiwit
P 047	<i>IVH Score for the prediction of shunt dependency in patients suffering from aneurysmal subarachnoid hemorrhage with intraventricular hemorrhage</i> B. Iliev* (Göttingen, Deutschland), T. Gasimov, D. Mielke, V. Rohde, V. Malinova
P 048	<i>Prophylactic spinal expansile duraplasty in patients with intramedullary tumors undergoing radiation therapy</i> I. Fiss* (Göttingen, Deutschland), C. Bettag, B. Schatlo, T. Behm, V. Rohde, K. von Eckardstein, C. von der Brelie
P 049	<i>Preoperative assessment of haemostasis in patients undergoing stereotactic brain biopsy</i> C. Beynon* (Heidelberg, Deutschland), S. Wei, A. Radbruch, D. Capper, A. Unterberg, K. Kiening
P 050	<i>Beneficial role of combination therapy on TFPI2 and cell viability in U87MG glioblastoma cell line</i> A. Sachkova, S. Sperling, M. Ninkovic, V. Rohde, A. Sachkova* (Göttingen, Deutschland)
P 051	<i>Visualization Needs in Brain Tumor Surgery - A Multicenter Observational Study</i> A. Roethe* (Berlin, Deutschland), P. Vajkoczy, T. Picht
P 052	<i>Characterization of an intracranial rat model for local treatment</i> Z. Wu* (Hannover, Deutschland), K. Schwabe, J. Krauss, M. Nakamura, N. John

P 053	<i>Iterative Analysis for the temporal decomposition of CVR dynamic Response in neurovascular patients</i> B. van Niftrik* (Zürich, Switzerland), M. Piccirelli, A. Pangalu, A. Valavanis, L. Regli, J. Fierstra, O. Bozinov
P 054	<i>Delayed malignant transformation of vestibular schwannoma after stereotactic radiation</i> S. Simmermacher* (Halle (Saale), Deutschland), D. Vordermark, T. Kegel, C. Strauss
P 055	<i>Hippocampal and cerebellar atrophy in patients with Cushings Disease</i> T. Burkhardt* (Hamburg, Deutschland), D. Lüdecke, L. Spiess, L. Wittmann, M. Westphal, J. Flitsch
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The combined presigmoidal approach – own experience with the increasingly outmoded approach over the last seven years

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Objective: The combined presigmoidal infra- and supratentorial approach was developed in the 70es and 80es of the last century to reach lesions of the petroclival region, mainly meningiomas. But in the last two decades, this approach was leaved in cause of its enormous time consumption and complication profile. Today, this approach still may have its eligibility in a very small group of patients.

Methods: Over the last 7 years, the senior surgeon used the combined presigmoidal approach in the modification according to Samii and Ammirati in 9 patients. The mean age of the patients was 56 years (38-73 years). 3 patients were female. The indications, clinical results and specific approach-related aspects were analyzed and presented.

Results: Indications were 5 tumors (meningioma, chondrosarcoma, epidermoid, trigeminal schwannoma) and 4 vascular lesions (DAVF, cavernoma). The mean intraoperative approach-related duration time was 150 min.. No approach-related complications occurred (e.g. venous infarction, CSF fistula, wound healing failure). All vascular lesions were resected completely. 2 tumors were resected totally, 2 were resected subtotally, and 1 tumor partially.

Conclusion: The combined presigmoidal approach means a milestone in skull-base surgery during the neurosurgical proceedings over the last 80 years. In experienced hands, this approach gives a safe and multidirectional access to difficult tumors and vascular lesions of the petroclival region and brainstem. Interestingly, in all presented patients alternative routes and concepts could be discussed.

Idiopathic pachymeningitis cervicalis hypertrophic: case report and critical review of the literature

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Objective: In clinical practice we are confronted with rare cervical processes, which can't be attributed to a clear etiology. Pachymeningitis cervicalis hypertrophica (PCH) is an extremely rare, chronic, nonspecific, idiopathic or secondary disease causing chronic granulomatous inflammatory and fibrotic hypertrophy of the dura characterised by radiculomyelopathy resulting from dural thickening. The etiology of the PCH is usually obscure, although idiopathic, infection, trauma, toxins, metabolic disease and rheumatoid arthritis have all been implicated. Pachymeningitis hypertrophica has been found intracranially as well as in all segments of the spinal cord. Until now, a definite diagnosis can be only made by biopsy. The treatment of choice is surgical decompression and/or immunosuppressive therapy. We are reporting a case of IPCH causing cervical radiculopathy and paralysis of the right arm, not responding to surgery, but well to immunosuppressive therapy.

Methods: A fifty-seven-year-old male presented with a five-day history of increasing pain in his upper back and the right arm, associated with paralysis and numbness of the right arm before hospitalization. On magnetic resonance imaging, these thickened dura showed homogeneous and strong enhancement in the right nerve roots between C3 and C6, especially neuroforamina C4/5. Cerebrospinal fluid (CSF) analysis and blood examination were normal.

Results: A cervical right laminectomy was performed in C4/5. After the operation, the patient had a complete paralysis of the right shoulder abduction and right elbow flexion. The histological examination of the dural thickening showed marked nonspecific chronic perivascularly inflammatory infiltration with numerous plasma cells and mixed-celled inflammation. After the histological examination the patient was subsequently treated with high dose prednisone for 3 weeks, which has been tapered in the further course. Cervical spine MRI with full contrast enhancement after 2 weeks revealed marked regression of nerve roots lesion; however, a remaining lesion is still seen. The arm pain resolved postoperatively and the right-sided paralysis resolved within 2 weeks. One month after surgery, his only neurological deficit was very mild weakness of the right shoulder abduction.

Conclusion: The thickening of the meninges in the MRI is indicative, but not proving for pachymeningitis. The majority of the reported biopsies of IPCH were taken mainly during surgery after frustrating diagnosis and therapy. The diagnosis and treatment regimens of IPCH are therefore based on empirical data and are not "evidence-based". In case of spinal forms of IPCH early surgery is recommended. In our case the surgery has not improved the paralysis, but it was necessary for the diagnosis. Laminoplasty should be preferred to laminectomy due to spine instability.

Radiation-induced meningioma (RIM) 54 years after radiotherapy for unilateral hereditary form of retinoblastoma - case report and critical review of the literature

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Objective: During the last few decades, a combination of surgery, chemotherapy and radiotherapy have improved survival rates in the retinoblastoma therapy. Radiation is considered to be one of the factors most strongly associated with an increased risk of meningioma formation. There is a latency period between the radiation exposure and development of meningiomas. It is significantly longer with low- than with high- dose irradiation. Reports on meningiomas following radiation therapy for retinoblastoma are rather scarce. There are no reports in the literature of meningioma development 54 years after the success of unilateral hereditary retinoblastoma's irradiation. The current case differs from those previously reported in having another histological subtype, hereditary unilateral retinoblastoma and a much longer latency period.

Methods: A 54-year-old woman developed a microcystic angiomatous meningioma in the radiation field 53 years after radiotherapy for the left retinoblastoma. She began to suffer from word finding disorder. Gadolinium-enhanced magnetic resonance imaging (MRI) scan revealed an extra-axial mass lesion in the left mid-cranial fossa, with homogeneous diffuse contrast enhancement and cyst formation.

Results: The lesion was totally removed. The patient's postoperative course was event-free. The tumor demonstrated positive results for epithelial membrane antigen (EMA) with growth in small bales and small to larger cysts and showed no expression of CD10. The mean proliferation index was under 5%. Four years post surgery the patient remains well without neurological deficits. Repeated MRI scans have revealed no indication of tumor recurrence.

Conclusion: Eleven cases of radiation-induced meningiomas after retinoblastoma therapy have been documented in the literature so far. In our case, the radiation path was centered on the bed of the left enucleated eye and meningioma developed behind the left irradiated orbit 54 years later. Meningotheliomatous, transitional, and fibroblastic histological subtypes are the most common in RIM; however, the histological examination in our case shows a microcystic angiomatous meningioma. The recurrence rates of non-radiation-induced meningiomas are lower than RIMs. Exposure to the potentially carcinogenic effects of radiotherapy should be reserved only for tumors that demonstrate subsequent progression.

Intramedullary lesions of the spinal cord - experiences from 426 cases

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Objective: Intramedullary spinal cord tumors are rare entities of the central nervous system. The treatment of choice is resection, sometimes followed by adjuvant radio- or chemotherapy. The feasibility of surgery as the primary treatment of choice is demonstrated within our study.

Methods: We retrospectively identified 426 cases of 398 patients who received surgery for intramedullary lesions. 53% were male, 47% female with a mean age of 42 ± 17 years, a minimum age of 1 and a maximum of 86 years. Cooper Epstein Grades were available pre-op for 91.5%, for 85% at follow up and for 6 months follow up for 47%. Tumor length measured in spinal segments, localization within the spinal column (cervical, thoracic, conus), singularity of the lesion and pre-op progression were recorded as well as the extent of resection and the operative approach. Crosstables and logistic regression were used for statistical evaluation.

Results: 154 (38.7%) patients presented with ependymoma, 71 (17.8%) with astrocytoma, 46 (11.6%) with cavernoma, 54 (13.6%) with hemangioblastoma, 11 (2.8%) with lipoma and ganglioglioma respectively, 7 (1.8%) were benign cysts, 4 (1.0%) presented with glioblastoma of the spinal cord and 3 (0.8%) with oligodendroglioma, 1 patient had spinal intramedullary teratoma (0.3%). In 3 cases (0.8%) inflammation was the cause of the tumorous lesion and in 10 cases (2.5%) no diagnosis was found. 51.1% of all tumors were found on a cervical level, 41.4% on a thoracic level and 7.5% at the conus medullaris. 89 patients were seen again for tumor recurrence, 24 of those were operated again.

Cooper and Epstein grades on discharge were good for the lower extremities (0-1) for 46%, 28% were able to walk using a cane or walker ($p < 0.001$). Regarding the upper extremities, 67.4% had intact neurology or only sensory symptoms (grade 0-1). 20.1% showed mild motor deficit at discharge and 12.6% had major neurologic deficit at discharge ($p < 0.001$). During follow up, 40.2% of all patients improved for their upper extremities, 24% improved regarding the lower extremities ($p < 0.001$). Concerning preoperative status 15.2% improved for the lower extremity and 26.2% for the upper extremity. If sorted by localization, 12.3% of all cervical tumors improved, only 3.9% of all thoracic tumors improved and no conus tumor improved but 16.7% deteriorated ($p = 0.002$) regarding neurologic function of the upper extremities. For the lower extremities 8.9% of all cervical tumors improved, 6.5% of all thoracic tumors improved and 12.5% of the conus tumors improved at discharge ($p = 0.005$).

Conclusion: Surgery is a relatively safe option for the variety of intramedullary lesions for a significant number of patients. Further restitution after discharge can be expected during the follow up and especially for cervical tumors, whereas neurologic dysfunction by thoracic lesions may tend to persist or aggravate in the course of surgery.

Females are poorly represented at the annual meetings of the DGNC

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Objective: It is generally considered that female attendees and presenters are outnumbered by their male counterparts at neurosurgical conferences. The aim of our study was to investigate the relation of female to male speakers at the annual conference of one of the largest national neurosurgical societies in Europe, the Deutsche Gesellschaft für Neurochirurgie (DGNC).

Methods: We analysed the number of female and male speakers at the annual conferences of the DGNC in 2015 and 2016. We recorded the presentation type (plenary session, keynote session, oral presentation or poster presentation) and the planned duration of each presentation. In addition, we evaluated the number of female and male members of the programme organising committee and the session chairs. Further, we obtained recent membership data from the DGNC, including gender distribution by membership status (full members, associate members, etc.).

Results: Overall, there were fewer female than male speakers across the study period (26.8% female in 2016 and 32.1% in 2015). Females had a total of 25.6% of the aggregate speaking time in 2016 and 30.0% in 2015. Plenary and keynote lectures were given by females in 13.3% and 15.0% of cases in 2016. In 2015, none of these talks were given by women. 26.3% (2016) and 29.7% (2015) of oral presentations were given by females. Posters were first-authored by women in 31.9% (2016) and 38.3% (2015) of cases. Conference sessions were chaired by females 6.8% of instances in 2016, and in 9.1% of instances in 2015. The programme organising committees consisted of 12.0% (2016) and 12.5% (2015) women. Overall, 13.2% of the members of the DGNC are female. German federal statistics show that in 2015 18.4% of neurosurgical specialists were female.

Conclusion: Less than a third of all speakers at DGNC annual meetings are women. It is predominantly men who organise and deliver the programme. This correlates with the low proportions of female members of the DGNC and female neurosurgeon specialists. Initiatives like the mentoring programme of the Deutscher Ärztinnenbund might help to address the gender imbalance in neurosurgery over the next decade.

Visualization in tubular assisted spinal surgery. Is there a difference between HD-endoscopy and microscopy?

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Objective: Expert spinal surgeons criticized endoscopic procedures for poor image quality, in comparison to microscopic visualization. The recent introduction of high definition (HD) digital cameras has shown good results in spinal endoscopy. The aim of this study was to assess endoscopic HD image quality in comparison with microscopic visualization.

Methods: All posterior lumbar and cervical spinal surgeries of this study were performed in HD resolution. For each comparison, anatomical structures were predefined intraoperatively. A junior resident was randomly required to enter the operating theatre and to identify those structures either using HD-endoscopic or microscopic visualization through the endoscopic working sheath.

Results: Thirteen lumbar and three cervical procedures were performed. Thirty-four comparisons with a total of 214 predefined anatomical structures were analyzed. The number of predefined structures ranged from 5 to 9 per surgical field. Out of 214 predefined structures, 124 structures (65.8%) were correctly identified under endoscopic view and 88 (41.1%) under microscopic view ($p < 0.001$). The view onto the surgical field via endoscopic visualization was assessed superior to microscopic visualization ($p < 0.001$).

Conclusion: When using a working trocar and live images, endoscopic HD camera imaging accounted for significantly more reliable identifications of anatomical structures compared to the microscopic view. The subjective impression of video quality is significantly better with HD-optics. The goal of further studies should be to evaluate if these findings results in improved surgical outcome.

Pathophysiological concepts for posttraumatic anisocoria in and after the thirties

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Objective: In Germany of the thirties, the posttraumatic anisocoria was mostly seen as a lesion of the sympathetic nerve system. The English literature presented the uncal herniation with direct injury of the oculomotor nerve in the same decade. The background of a major experimental work from a German lab is analysed.

The study of Schörcher (1936, *Zentralblatt für Chirurgie*) was a result of the criticism to the work of Hoessley, who by experiments reported a unilateral dilated pupil as a result of "local intracranial pressure". Schörcher developed a contrary hypothesis. The work was a product of the experimental laboratories at the university in Munich, founded by Sauerbruch.

Methods: In a complex experiment in dogs, the range of pupils under normal tension conditions and after induced hypertension was analysed. The sympathetic nerves and the oculomotor nerve had been disconnected, isolated and dissected. The induction of increased intracranial pressure was represented by administration of a mix of oil and zinc paste into the intracranial extra-cerebral space. The sympathetic trunk was disconnected beneath the Ggl. cervicale sup. The disconnection of the oculomotor nerve was performed after a temporal craniotomy.

Results: The historical Results: An epidural or subdural haematoma is able to cause an ipsilateral dilated pupil by central irritation of the sympathetic nerves. The meaning of the disconnected oculomotor nerve for the unilateral dilated pupil after an ipsilateral haematoma should be rated as low. The theory of a peripheral injured oculomotor nerve as major cause for a unilateral dilated pupil after ipsilateral haematoma has been rejected.

Conclusion: The technical imponderables were too great for his time. Nevertheless, the study gained positive resonance in German literature. The work was lauded as a greater advance in the understanding of the sympathetic nerve system. The reworking shows once more the fundamental impact of patients' observation as a scientific method. Results gained by animal experiments can lead to confusing results. There are increasing publications emphasising that this recognition has a special meaning in neuro-traumatological topics. This historical work warns the neuro-traumatologically working physician in interpretation of animal experiments that promise progress.

Historical review of sciatica prior to the era of lumbar disc herniation

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Objective: A historical method of exposure of the ischiadic nerve from the era prior to lumbar disc surgery is described. The outcome of treatment for sciatica was so astonishing that the reader today is compelled to doubt the literature reports of the success rates of such pain surgery.

Methods: We have analysed historical works by Professor Bernhard Heile, who, between 1914 and 1922, was one of the first to suggest decompression of the sciatic nerve in the sciatic foramen. We have summarised the results from his articles.

Results: Of the 300 patients presented to the surgeon, 20 underwent surgery. Using a strict diagnosis (therapeutic resistance, positive provocation tests), he achieved a pain-free status in 75% without surgical complications. 15% described a clear improvement in pain, 10% recurrent pain after an initial improvement.

Conclusions: From this work we can identify the attempt to break away from a concept of inflammation as a cause of sciatica in order to be able to use minimally invasive surgical techniques based on theories of mechanical genesis. With contemporary diagnosis and microsurgery, suitable patients can perhaps be recruited to undergo an historical surgical procedure. But perhaps the procedure will also suffer the fate to which it was once destined almost 100 years ago.

Intraoperative MRI for Resection Guidance in Neurosurgery - A Report from the German Study Group of Intraoperative MRI (GeSGIM)

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Background: First mentioned in 1996, intraoperative MRI (iMRI) has increasingly been used for resection guidance in brain tumor surgery over the last 20 years. A growing number of studies have illustrated benefits of iMRI-guided surgery for extent of resection (EOR) and patient survival. Recently, eight centers with iMRI in Germany formed a collaborative study group to investigate the impact of iMRI in neurosurgery on a multicenter basis, called the German Study Group of Intraoperative MRI (GeSGIM). This study sought give an overview about the development of the method and the contemporary use of iMRI in Germany.

Methods: A questionnaire exploring general iMRI setup, sequences used during surgery, amount of intraoperative scans performed per case, additional surgical tools used in combination with iMRI and overall number of iMRI-cases and their indication for iMRI surgery within the past 5-years was sent to eight german iMRI centers. Research interests of centers were pooled to initiate multicenter collaborations.

Results: Completed questionnaires were retrieved from all eight centers. Seven of them were academic university institutions. Mean time of active iMRI use was 12±6 years. Two centers had >20 years of iMRI experience. Currently, seven 1.5 tesla (T) magnets are used and one center uses a 0.15T magnet. Anatomic T1w and T2w/FLAIR sequences are acquired by every center in a routine protocol. Additional sequences acquired in selected cases include perfusion and diffusion-weighted imaging, diffusion tensor imaging, MR-spectroscopy, MR-angiography and resting-state functional MRI. Additional guidance-tools including 5-ALA, intraoperative ultrasound, electrophysiology as well as awake surgery were combined with iMRI at the discretion of the respective center. Over the last 5-years, GeSGIM centers performed a total of 4973 iMRI cases. The majority of iMRI-cases were gliomas (2482, 50%), followed by pituitary tumors (849, 17%) and other tumor entities (495, 10%). iMRI was also used for planning of stereotactic procedures or epilepsy surgery (968, 20%). The GeSGIM published one retrospective multicenter study in 2016. A prospective study evaluating iMRI for glioblastoma and a prospective registry for low grade glioma are recruiting since 2015.

Conclusion: German iMRI centers have gathered extensive expertise in the field of iMRI-surgery over the last 20 years. The collaboration of eight iMRI centers within the GeSGIM formed a unique and powerful study group producing high annual iMRI case numbers for multicenter research. Among centers, there is consensus to use anatomic imaging for resection guidance and control of EOR in glioma surgery. However, there is great variation concerning additional iMRI-sequences used which depends on the research interest of respective centers. Future studies should aim to confirm the benefit of those additional iMRI sequences on a multicenter basis.

Anticoagulants that block von Willebrand factor fiber formation prevent thrombotic complications associated with intracranial metastases

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Objective: Venous thromboembolism is a frequent complication in cancer patients with brain metastases. Although anticoagulation revealed therapeutic effects, the impact of the coagulation on brain metastasis formation remains elusive. Own studies based on a mouse model of hematogenous lung seeding in malignant melanoma identified hallmarks of tumor-associated thrombosis in lungs, including von Willebrand factor (VWF) fibers and thrombotic vessel occlusions. Treatment with low molecular weight heparins (LMWHs) inhibited VWF network formation and lung metastases. Thus, we postulate that VWF fibers contribute to cancer-associated hypercoagulation and the formation of metastatic lesions in the brain.

Methods: Cell-based assays were used to examine the molecular mechanisms of melanoma-mediated activation of brain microvascular endothelial cells (BMECs) with subsequent VWF release. Different anticoagulant heparins were screened for their capacities to block tumor-induced EC activation, permeability and transmigration of tumor cells using a model of the blood-brain-barrier (BBB). Mouse models and tissue samples from patients with cerebral metastases were used to evaluate whether VWF affects cancer-associated thrombosis in the brain. The study was approved by the local ethic committee and all patients participated voluntarily and gave their written consent.

Results: *In vitro* settings showed that microvascular ECs express VWF to lesser extent compared to macrovascular ECs, but are able to deposit VWF fibers on the luminal surface upon activation by tumor cells. In contrast to Fondaparinux additional inhibition of VEGF-A by the LMWH Tinzaparin blocked tumor cell-mediated EC activation, luminal VWF fiber formation, permeability and extravasation of tumour cells in an *in vitro* model of the BBB. Taken advantage of the ret transgenic mouse model, characterized by spontaneous formation of brain metastases, and human tissue sections confirmed the *in vivo* relevance of intraluminal VWF networks. Notably, intradermal melanoma cell injection was sufficient to induce VWF-platelet aggregates and thrombotic vessel occlusions distal from the primary tumor and thus revealed pre-metastatic niches in early tumour stages. Finally, inhibition of thrombin and VEGF-A with Tinzaparin inhibited VWF network formation and platelet aggregation in the microvasculature of ret mouse brains reflected by a survival benefit and a strong trend towards reduced brain metastases.

Conclusion: Our data support a critical role of VWF fibers in malignancy-associated thrombosis and intracranial metastases. Non-anticoagulant activities of LMWHs provide the basis for the development of innovative anti-metastatic strategies.

Restingstate functional MRI in the Setting of the intraoperative MRI: Early Experience

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Objective: in this study we test the feasibility of recording and identifying the resting networks in patients operated under intraoperative MRI control.

Methods: The resting state fMRI was performed intraoperatively before and after resection of different intracerebral lesions in diverse locations. Ten patients were included in this study. The images were preprocessed and then the resting networks were analyzed using two approaches: Seed region analysis and independent component analysis.

Results: The resting networks can be identified. The activities can be influenced by the tumor location and can be correlated- in some patients- with the clinical status

Conclusion: Monitoring and analysis of resting network could be a method for monitoring the neural functions during cranial surgery. It could be helpful for better functional preservation

Cognitive and neuropsychological outcome after awake surgery for left frontal and temporal tumor resection

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Objective: Although neuro-oncological surgery focuses on maximizing tumor resection while preserving neurological function, the effect of both, the tumor itself and the surgical procedure on patients' psychology and neurocognition has hitherto often been neglected. We therefore aimed at investigating the pre- and postoperative neuropsychological status in a homogeneous cohort of patients undergoing awake surgery.

Methods: Among 54 patients who underwent awake craniotomy from 01/2012 to 07/2016, 30 patients were operated on for lesions in the left inferior frontal gyrus (n=10), the left anterior temporal lobe (n=7) or the temporoparietal region (n=13). Preoperative baseline neuropsychological evaluation was performed in all patients, of whom a subset of 14 patients underwent further postoperative neuropsychological follow-up. For testing a neuropsychological battery including tests for language, memory, attention, alertness and depression was used.

Results: Before surgery, nearly all patients presented slight verbal working memory difficulties, and word fluency was reduced in 47% of patients. These functions as well as short-term memory and attention declined during the first months after surgery, but thereafter fully recovered in all but two patients, still suffering from very slight verbal memory deficits.

Conclusion: Our results underline the relevance of assessing neuropsychological deficits, both, pre- and postoperatively, which might indicate the importance of cognitive rehabilitation after surgery, resulting in full cognitive long-term recovery in most patients.

Tumor-Treating-Fields treatment for Glioblastoma multiforme in daily praxis

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Objective Recent studies showed a significant improvement in progression-free and overall survival for patients with primary diagnosis of glioblastoma multiforme after treatment with tumor- treating fields (TTFields) in combination with temozolomide after concomitant chemoradiotherapy. The aim of the current study is to prove the implementation of this new therapy approach in clinical practice and to analyze the experience with TTFields for the purpose of daily handling and side effects of the therapy.

Methods: Patients of two independent centers were included. According to the general recommendation the therapy was carried out continuously with a wearing time of more than 18 hours per day preferably via four transducer arrays, which were placed on the shaved scalp and which were connected with the portable alternating fields generator. Following technical introduction of the patients we asked them about their satisfaction and handling of the technique, and also side effects and limitations of the therapy were recorded. Additionally, we focused on the progression-free survival of the patients and correlated this with the compliance of the patient in wearing the system.

Results: At the time of abstract submission, TTFields treatment was prescribed to 25 patients with an observation period of 15 months. 21 patients started the treatment in the observation time. Twelve patients treated with TTFields took part in the survey. Asking these patients for supply and technical introduction all of them were very satisfied. Most of the patients described the everyday handling as easy (58.3%), the remaining patients were limited in everyday life because of the treatment. Side effects were limited to skin irritation in 50.0% of the patients, sleep disturbances and back pain in 25.0% of the patients. 62.5 percent of the patients wore the system according to the recommended wearing time. Two patients showed a progressive disease during TTFields treatment. Six of the 21 patients, who have started TTFields treatment, died in the observation period. The remaining patients showed a stable disease. Although most of the patients described limitations in everyday life 83.3% of them would undertake TTFields treatment again.

Conclusion: The survey of patients with actual ongoing TTFields treatment in two independent centers showed a largely satisfaction with the therapy. Although it is described as complicated in handling and some reported side effects like skin irritation, back pain and sleep disturbances most of the patients could integrate the therapy in their everyday life and would agree to the treatment again. In the period of investigation two patients showed a progression of disease, six of the 21 patients with started TTFields treatment died. The compliance for the treatment is good and the progression free survival tends to approach the published data.

Radio frequency ablation as a minimally invasive Treatment in patients with spinal metastases

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Objective: Radio frequency ablation is an established method to treat hepatic and pulmonary metastases. The method has been performed in our hospital to patients with vertebral metastases since 2006. We analysed the effect of radio frequency ablation (RFA) on patients with spinal metastases and report our findings in patients treated from 2013 til October 2016.

Methods: In a retrospective study we analysed 27 cases of patients we treated with RFA for spinal metastases between 2013 and October 2016. Three patients were under 50 and one patient was over 80 years old. Nearly 40% of patients were between 70 and 80 years old. 19 patients were men, 8 women. Fifth patients were treated on 2 locations. Mostly affected vertebra was the 3rd lumbar vertebra. The most frequent primary tumor was the carcinoma of the kidney (12 cases).

Results: In 11 patients an additional kyphoplasty was performed. 8 patients needed further stabilisation. In 9 patients spinal decompression was added at the index level. In 3 patients decompression of another level was performed.

22 patients reported a reduction of pain after RFA during hospital stay, one patient reported a complete resolution of pain. In two cases neurological improvement was noted. No patient suffered additional neurological deficits after RFA. One patient suffered a secondary neurological deterioration associated with recurrent tumor growth.

Conclusion: More than 80 per cent of the patients reported a reduction of pain after RFA. Nearly 70 per cent of the patients needed an additional method for stabilisation, in 11 patients a second minimal invasive operation was sufficient.

We concluded, RFA is an effective palliative adjunct to common operative strategies and a successful minimally invasive procedure to reduce pain in patients with spinal metastases.

The history of cerebral vasospasm - diagnostics and treatment over the past 80 years

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Objective: Since the first description of cerebral vasospasm by the English physician Sir William Gull in 1859 the pathophysiological mechanism underlying this post subarachnoid hemorrhage condition fascinated and frustrated physicians for decades. Here the achievements in diagnosis and treatment of cerebral vasospasm over the past eighty years are chronologically presented.

Methods: Comprehensive analysis of the available literature on subarachnoid hemorrhage in general and on cerebral vasospasm in particular was performed.

Results: In this study the various endeavours undertaken to treat cerebral vasospasm are presented. From the history of spasm identification to the numerous clinical trials including biomarker analysis, receptor antagonists, implants, intra-arterial infusions, artificial hibernation, clot removal to endovascular management are discussed.

Conclusion: Cerebral vasospasm remains a major risk factor for morbidity and mortality after a subarachnoid hemorrhage. Although attempts to control cerebral vasospasm traces back to more than 100 years, the significant breakthrough remains to be discovered. Therefore, knowledge of the already undertaken effort is crucial and may help to strike new paths in future treatments.

eLearning resources to supplement postgraduate neurosurgery training

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Objective: In an increasingly complex and competitive professional environment, improving methods to educate neurosurgical residents is key to ensure high quality patient care. Electronic (e)Learning resources promise interactive knowledge acquisition. We set out to give a comprehensive overview on available eLearning resources that aim to improve postgraduate neurosurgical training and review the available literature.

Methods: A MEDLINE query was performed, using the search term “electronic AND learning AND neurosurgery”. Only peer-reviewed English-language articles on the use of any means of eLearning to improve theoretical knowledge in postgraduate neurosurgical training were included. Reference lists were crosschecked for further relevant articles. Captured parameters were the year, country of origin, the method of eLearning reported, the type of article, as well as its conclusion. eLearning resources were additionally searched for using Google.

Results: Of n=301 identified articles by the MEDLINE search, n=43 articles were analysed in detail. Applying defined criteria, n=28 articles were excluded and n=15 included. Most articles were generated within this decade, with groups from the USA, the UK and India having a leadership role. The majority of articles reviewed existing eLearning resources, others reported on the concept, development, and use of generated eLearning resources. There was no article that scientifically assessed the effectiveness of eLearning resources (against traditional learning methods) in terms of efficacy or costs. Only one article reported on satisfaction rates with an eLearning tool. All authors of articles dealing with eLearning and the use of new media in neurosurgery uniformly agreed on its great potential and increasing future use, but most also highlighted some weaknesses and possible dangers.

Conclusion: This review found only a few articles dealing with the modern aspects of eLearning as an adjunct to postgraduate neurosurgery training. Comprehensive eLearning platforms offering didactic modules with clear learning objectives are rare. Two decades after the rise of eLearning in neurosurgery, some promising solutions are readily available, but the potential of eLearning has not yet been sufficiently exploited.

Progress of neuroendoscopy in the last 80 years

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Objective: To report about the technological development and the pioneers who sustainably influenced neuroendoscopy over the last 80 years.

Methods: Literature review with the key words “neuroendoscopy”, “ventricles”, “endoscopic neurosurgery”

Results: The roots of endoscopy are in internal medicine, general surgery and urology. Therefore it was not by chance that Walter Dandy received a thin endoscope from the “father of cystoscopy” Howard Kelly for coagulation of the choroid plexus in hydrocephalus patients. Dandy concluded rather disappointed that “the instruments, in their relatively primitive construction, were not quite adaptable” (WE Dandy, 1922). However, he recognized the potential of the technique and supported technological improvements. In 1923 Tracy Putnam performed the first endoscopic ventriculocisternostomy. Despite this success the devices were so limited that the method of ventriculo-peritoneal shunting completely put intraventricular endoscopy out to grass. Interestingly it was during exactly that time that fundamental technological advancements have been achieved. Hopkins developed, a lense with magnification, Karl Storz the cold light source and later Smith and Boyle the CCD-chip. In 1978 thanks to the the improved devices Vries re-introduced the endoscopic ventriculocisternostomy as an attractive and successful alternative treatment of hydrocephalus patients. ENT surgeons recognized the potential of the endoscope. Wolfgang Draf and Heinz Stammberger are two pioneers of the functional endoscopic sinus surgery (FESS). The FESS is the base of a further field of endoscopy, the interdisciplinary endoscopic transnasal skull base surgery. Axel Perneczky is considered the father of intracranial endoscopic microneurosurgery. He brought the endoscope-assisted and endoscope-controlled techniques to perfection. Meanwhile, endoscopy is applied to several fields in neurosurgery from pure endoscopic intraventricular procedures to skull base surgery, vascular, cerebello-pontine angle and peripheral nerve surgery.

Conclusion: Neuroendoscopy developed over the last 80 years due to an interaction between the pioneers in medical technology and surgery. Future progress depends on an intense cooperation between technology and medicine.

The impact of Robot-assisted spine surgery - shown on the example of our center

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Objective: In modern spinal surgery we aim to maximize the patient outcome and minimize trauma to the body during surgery through the use of minimally invasive techniques. Accuracy of pedicle screw fixation greatly affects clinical outcome which accelerates return to full life. Over the past years Intraoperative navigation has advanced and we see significant improvement of accuracy with less postoperative complications. We report here about our clinical experience using the robot-guided screw placement.

Methods: Data were recorded from medical records and CT-data for 101 patients between February 2014 and February 2016 were operated at our institution with a miniature robot (Renaissance, Fa. Mazor Robotics, Israel). The majority of patients had degenerative spinal disease. Others had spondylolisthesis vera, Tumor, Infection or trauma. Screw placement was performed percutaneously with fluoroscopic aid in all patients. Screw accuracy was evaluated by postoperative CT scans according to the Wiesner et al. scale. We assessed age, the American Society of Anesthesiologists Physical Status Classification System of patients (ASA), co-existing diseases, blood loss, radiation , hospital stay, indications, length of surgery and most importantly screw position accuracy.

Results: In two cases and due to referencing problems, we switched to conventional screw placement. 465 screws were inserted percutaneously. In the postoperative CT scans the robot-guided screws showed an ideal position in 97.8 % and an acceptable position in 1.1 % of cases. There was no need of intra- or postoperative screw replacement. There were no new neurological deficits. X-ray exposition and blood loss were reduced significantly compared to freehand technique. The number of older patients, patients with higher ASA and co existing diseases enrolled for spine surgery has increased; for example we report an increase in cement augmentation use due to increase number of patients with osteoporosis. Moreover we report shorter hospital stay, lower revision rate and less complications .There was a steep learning curve regarding operation time and x-ray reduction.

Conclusion: Robot-Guided spinal surgery offers many potential advantages to patients and surgeons including improving the safety of minimally invasive as well as complex surgical procedures, improving the accuracy of spinal instrumentation, and minimizing the use of radiation during surgery. Robot-guided spine surgery utilizes highly accurate, state-of-the-art technology for the treatment of many spinal conditions including degenerative spinal conditions, spine tumors and spinal deformities.

Intradural nodular fasciitis mimicking spinal glioblastoma metastasis.

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Objective: We report the case of a 78 year old male patient who was diagnosed with a rightsided temporal glioblastoma with extensive meningeal spread at the time of diagnosis. Two months later he developed sudden onset paraplegia. An MRI scan showed a ventral space occupying lesion within the spinal canal of the thoracic segment 8 and 9 with myelon compression. An emergency decompression and resection of the alleged intradural glioblastoma metastasis was done. Surprisingly, the histopathological analysis revealed a nodular fasciitis, a reactive benign lesion typically found in soft tissue.

Methods: A clinical and histopathological description of the case is done and compared with the current findings in the literature.

Results: Only one case of a spinal and one case of an intracranial nodular fasciitis have been reported. Both lesions were extradurally and diagnosed in otherwise young healthy individuals. This case report is the first description of an intradural nodular fasciitis. The spatio-temporal and histopathological correlation with meningeal spread of a glioblastoma are discussed.

Conclusion: This is the first description of a spinal intradural nodular fasciitis. The spatiotemporal correlation suggests that the lesion may have occurred as a reaction to the meningeal dissemination of glioblastoma cells.

Primary Gliosarcoma in adults: Clinical characteristics, Management and Outcomes in a series from a single German institution

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Objective: Primary gliosarcoma (PGS) is a malignant central nervous system tumor composed of glial and mesenchymal components. Comprising approximately 1-8% of all malignant gliomas, the incidence is exceedingly rare. Though being considered a variant of glioblastoma (GBM), gliosarcoma only comprise 2% of all GBMs but feature an even worse prognosis and cannot be distinguished clinically. Due to the limited knowledge about this entity and resultant lack of large monocentric studies, we performed a retrospective study analyzing clinical, radiological, histopathological data as well as treatment regimens from patients with PGS at a single institution in Germany.

Methods: Between 2000 and 2016, a total of 9 patients with primary gliosarcoma were diagnosed at our institution. Demographics, clinical presentation, radiological, features and treatment regimen were retrospectively reviewed and analyzed for these histologically proven cases with PGS.

Results: All patients were males with a mean age of 60,2 (range:38-72 years) at time of presentation. Initial presentation and symptoms correlated with the location of the intracranial lesion and included headache and psychomotor retardation (77,8% n=7), dizziness (55,6% n=5), paresis (33,3% n=3), aphasia and/or vision impairment (33,3% n=3) as well as seizures (11,1% n=1). Based upon neuroradiological imaging, average tumor size was 52,1mm x 49,25mm x 48,3mm though its mass effect was notably bigger as the tumor and its perivascular edema involved an average area of 83,5mm x 52,8mm x 60,1mm in MRI-T2 imaging causing an average midline shift of 7,2mm. The extent of brain involvement and proliferative index Ki-67 did not correlate significantly with the length of overall survival (OS). Low KPS did correlate with short OS. Furthermore, age at presentation and the extent of surgical resection was a significant predictor of OS. Contrary to GBM, OS was not associated with MGMT methylation status and adjuvant radiotherapy did not seem to influence OS.

Conclusion: Our data underline the therapeutic challenges associated with PGS. Though surgical resection combined with chemoradiation is significantly associated with GBM survival, applying similar treatment protocols for PGS should be reconsidered due to its more aggressive clinical behavior and worse prognosis. Although not statistically significant, patients receiving postsurgical chemoradiation did not show a better trend in OS than patients receiving chemotherapy with TMZ postsurgically only.

Pupillary dilation in flurane sedation – report of two cases

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Objective:

Pupillary examination in a sedated and intubated patient is a fast diagnostic tool for assessment of neurological status. In a neurosurgical setting changes in the pupillary status is nearly always associated with intracranial pathology and warrants further diagnostics. Often, to assess and control intracerebral pressure invasive monitoring will be used with corresponding elevation of morbidity. Experimental studies demonstrated that volatile anaesthetics can induce pupillary dilation. This effect will be reversible by changing the sedative regiment.

Methods: We present two cases of pupillary dilation in sedated and intubated patients after isoflurane/sevoflurane sedation without corresponding intracranial pathology. We retrospectively reviewed the medical records and radiological images and analyzed the corresponding literature.

Results: Case 1: Two days old newborn with an acute hydrocephalus.

We performed an ETV and implanted a Rickham-Reservoir uneventfully. The direct post-operative pupillary examination showed new observed bilateral wide pupils without light reaction. An emergency MRI showed no signs of intracranial hypertension. One hour before pupillary control the narcotics were switch from propofol to sevoflurane with following rapid elevation of end-tidal volume from 1.4% to 2.5%. The patient was extubated uneventfully. The pupils normalized within the next hour after stopping volatile administration.

Case 2:

19-years-old male patient who suffered a traffic accident. A CCT documented mild axonal damage without space taking intracranial lesion. Due to difficult airway, he had to be sedated and intubated. After switching the sedative regiment to isoflurane and elevation of dosage from 4 ml/h to 10ml/h in the following 20 hours he developed maximal wide pupils without light reaction.

An emergency CCT showed no corresponding intracerebral lesion. After stopping the isoflurane sedation the pupil size normalized within 2 hours.

In all cases there were no drugs in the medication which can induce pupillary dilation.

Conclusion: Pupillary dilation not only in the setting of neurotraumatology and neurosurgery but also in emergency medicine, intensive care and others can have serious diagnostic or even therapeutic consequences. Many of the neurotraumatological patients have a sedative therapy to protect the brain from further injury. Often the newer group of volatiles will be used as sedative agents. Some studies could demonstrate that these agents can induce a pupillary dilation. But the mechanism is not fully understood yet. Due to therapeutic consequences for the clinicians it is important to know that volatile anaesthetics may induce mydriasis. Monitoring of volatile anaesthetics are mandatory. Further studies should be conducted to fully understand the mechanisms involved and to establish guide-lines for safe volatile anaesthetics regiments.

An antibody-guided poly-propylene-imine (PPI)-based polyplex-system for siRNA-treatment of EGFRvIII-positive tumors

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Objective: Therapeutics based on small interfering RNAs (siRNAs) offer great potential to treat so far incurable diseases such as glioblastoma multiforme (GBM). However, the broad application of siRNAs using various non-viral carrier systems is hampered by unspecific toxic or immunogenic side effects, poor pharmacokinetics due to unwanted delivery of siRNA-loaded nanoparticles into non-target cells, as well as inefficient internalization into target cells. In order to overcome these obstacles, we have developed a single chain antibody fragment (scFv)-guided polyplex system for targeted delivery, based on transfection-disabled maltose-modified poly-propylene-imine siRNA carrier molecules. To achieve selective siRNA delivery into EGFRvIII-positive tumor cells, a specific anti-EGFRvIII single chain antibody (scFv(MR1.1)) was utilized and conjugated to polyplexes through a novel coupling strategy and evaluated *in vitro* and *in vivo* in tumor xenografts.

Methods: Polyplex formation was investigated by Western Blot analysis and atomic force microscopy. Targeted delivery of scFv(MR1.1)-P-BAP guided polyplexes to EGFRvIII-positive cells *in vitro* were analyzed by flow cytometry and confocal laser scanning microscopy. Subsequently, delivery of these polyplexes to EGFRvIII-positive tumors was tested in an *in vivo* setting using nude mice.

Results: The production of a scFv fused with a biotinylation acceptor peptide (P-BAP) sequence derived from *Propionibacterium shermanii* transcarboxylase in biotin ligase-expressing HEK293T cells led to functional mono-biotinylated scFv-P-BAPs. Polyplex formation was achieved by a sequential conjugation of scFv-P-BAP to NeutrAvidin and mono-biotinylated mal19-biotin at defined stoichiometry. Compared to polyplexes conjugated to an unspecific control scFv-P-BAP, the generated tumor-specific polyplexes were able to bind to EGFRvIII-positive target cells and to exclusively deliver siRNA by selective receptor-mediated endocytosis. Atomic force microscopy revealed stable polyplexes, with a mean diameter of 150 nm that circumvents fast renal excretion and therefore provided a further precondition for the specific accumulation of tumor-specific polyplexes in subcutaneous tumors of nude mice.

Conclusion: In our study, we established a novel biotin-NeutrAvidin-conjugation system for coupling scFvs or other genetically engineered antibodies/protein ligands to glycodendrimers. Furthermore our results suggest that receptor-mediated uptake of siRNA containing polyplexes are a promising approach to improve siRNA therapy of cancer, and introduce a novel strategy for treatment of GBM.

Fluorescein Sodium and YELLOW 560 nm filter for improved visualization of brain abscesses

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Objective: Brain abscesses (BA) are rare intracerebral lesions. However, surgical removal or puncture of BA is frequently considered due to the space-occupying effect and/or for diminishing the cerebral infectious focus. However, meticulous identification of a premature capsule or inflammatory tissue can be challenging. As most BA are accompanied by disruption of the blood brain barrier (BBB), thus, intensely depicted by Gadolinium-enhanced magnetic resonance imaging (MRI), we sought to evaluate the efficacy of 10% Fluorescein Sodium (FL, ALCON, Germany) in combination with the YELLOW 560 nm filter of the PENTERO 900 surgical microscope (ZEISS Meditec, Germany) for improved visualization of BA in small retrospective series.

Methods: Seven consecutive patients (3 men, 4 women; mean age 53.8 years) with intracranial BA were included. In all cases, the diagnoses were confirmed microbiologically. All of the patients gave written informed consent at least on the day before craniotomy as the administration of FL in neurosurgery still is off-label. 5 mg/kg bodyweight of FL were injected during induction of anesthesia via the central venous line. In all cases, the PENTERO 900 surgical microscope, equipped with the YELLOW 560 nm filter was used while approaching the lesion and during removal of the capsule and the pus.

Results: In all cases brilliant visualization and intense fluorescence of the BA capsules were achieved under the filtered light. However, the pus was never enhanced by FL. We encountered no adverse events or allergic reactions due to the administration of FL.

Conclusion: To the best of our knowledge, this is the first report about the use of fluorescence-guided resection of BA. Under the dedicated YELLOW 560 nm filter, FL broadly visualizes BA. This can be helpful in approaching and resecting contrast-enhancing inflammatory cerebral lesions.

Gamma Knife radiosurgery for radiation resistant brain metastases

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Objective: The aim of our study is to evaluate GKRS for BMs of gastrointestinal (GI) and genitourinary (GU) tumors. Gamma Knife radiosurgery (GKRS) is a safe and effective treatment option for patients with brain metastases (BM). The most common primary tumors are lung cancer and breast cancer. However, secondary lesions, which are considered as less sensitive to radiation, such as BMs of colorectal cancer or renal cell carcinoma, do exist albeit much less frequently.

Methods: This is a retrospective single center analysis of 62 patients with 206 BMs undergoing GKRS due BMs of GI (n=28) or GU (n=34). Patients were assessed using the Graded Prognostic Assessment, Recursive partitioning analysis, and Score Index for Radiosurgery. Treatment planning was mainly conducted on the 50% isodose line (range: 45 – 80%) and included the whole tumor volume as seen on T1 contrast-enhanced MRIs. Most patients (60%) underwent single GKRS. However, several patients (40%) were treated more than one time for newly diagnosed BMs or due to a two-fraction dose staged treatment concept. The median margin and central dose were 19 Gy (range: 17 Gy – 20 Gy) and 36 Gy (range: 23 Gy – 44 Gy) for single fraction GKRS which was applied on the majority of BMs (159/ 206, 77%). The median margin and central dose were 14Gy (range: 5 Gy – 17 Gy) and 28 Gy (range: 10 Gy – 36 Gy) for two-fraction GKRS or boost treatment in combination with WBRT.

Results: A majority of patients (89%) was rated as RPA class II; three patients (3%) were classified as RPA class I, and five patients (8%) were classified as RPA class III at time of BM diagnosis. At the time of first GKRS patients presented with a median KPS score of 80. At time of last follow-up the vast majority of patients presented without any post-treatment complications. In 16 patients a six-month-follow-up is not yet available. In the remaining patients 66% presented with stable or decreased lesions at six-month-follow-up after first GKRS1. Unfortunately, several patients had succumbed to their disease (17%) prior to the six-month- follow-up or were lost-to-follow-up (11%). A progression of treated BMs was diagnosed in 4% of patients at six-month-follow-up after GKRS1. However, pooling all radiosurgical treatments, a progression rate was diagnosed in 9% of patients at last follow-up. **Conclusion:** GKRS seems to be a reasonably safe and effective treatment option, even for BMs generally considered as radiation resistant. GKRS can be applied as sole treatment or as boost treatment in combination with WBRT depending on target volume and number of BMs.

Quality Indicators in Neurosurgery- Which are presently substantiated? A systematic review.

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Objective: Being a high-cost specialty due to the use of advanced technology, the field of neurosurgery – as many other medical specialties - has come under close scrutiny through health economists due to rising financial pressures. Consequently, policy makers and health care administrators have shifted the focus towards an analysis of the quality of delivered care and have begun applying quality measures that are easily available but may be inadequate and inaccurate for the speciality of neurosurgery.

Methods: To elucidate which quality indicators are scientifically founded and thus potentially justifiable as measures of quality, we performed a systematic literature review on indicators that are presently employed or that are being contemplated in the field of cranial neurosurgery. A total of eight quality indicators were found and studies were methodologically evaluated according to the AIRE (Appraisal of Indicators through Research and Evaluation) criteria.

Results: The mainly discussed quality indicators were length of hospital stay, all cause readmission rate and unplanned reoperation rate. Our review indicates that these presently used or proposed quality indicators for neurosurgery lack scientific rigour and are restricted to rudimentary measures and that further research is necessary.

Conclusion: Neurosurgeons need to define their own quality indicators and actively participate in the validation of these quality indicators to provide the best possible patient outcomes. More reliable clinical registries, obligatory for all neurosurgical services, should be introduced as a basis for the establishment of such indicators with risk-adjustment being an important element of any such indicators.

Electromagnetic navigation for intracranial neuroendoscopic operations

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Objective: Optical navigation has become a standard navigation technology for a broad range of neurosurgical cranial and spinal interventions. In contrary, electromagnetic navigation (EMN) bears some significant advantages for some kinds of neurosurgical cranial interventions. This is especially the kind for intraventricular or intracystic fenestrations, as well as for endoscopic intra- and parasellar surgery.

Methods: For the EMN, a small, disposable universal frame is attached to the patient's head (by screws or by glue). The referentiation is performed as for a routine optical navigation. The accuracy is comparable to that of optical navigation.

Results: We have used the EMN in more than 70 procedures. For intrasellar endoscopic interventions, the EMN has the advantage, that the patient's head has not to be fixed in a Mayfield fixation. Additionally, because of a limited space in transnasal approaches, the EMN bears advantages due to the fact that the EMN navigational pointers are very small and don't need much space in the nasal cavity. For intraventricular or intracystic endoscopic procedures, these probes can be inserted directly into the endoscope. Therefore, a direct and not only virtual navigation is possible.

Conclusion: EMN is especially useful for endoscopic transnasal and intraventricular – intracystic interventions. Additionally in neonatal interventions navigation is possible even in very young children, where fixations in a Mayfield clamp would not be possible.

Hyperthermia increases temozolomide induced cell death in MGMT-unmethylated human glioblastoma specimens *in vitro*

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Objective: Human glioblastoma multiforme (GBM) has a poor prognosis and several new target drugs were not able to improve survival. Drug resistance through the expression of O6-methylguanine methyltransferase (MGMT) is one mechanism that is associated with temozolomide (TMZ) resistance and poor outcome. For other tumor entities such as melanoma it has been shown that hyperthermia can increase TMZ sensitivity. The aim of this study was to evaluate the effects of additional hyperthermia on human GBM specimens *in vitro*.

Methods: Human GBM specimens from 18 patients were cultured and incubated with 150 µmol TMZ for 72 hours (h). Hyperthermia (43°) was induced after TMZ incubation for 1h. Cell proliferation was measured using an MTT assay. Viable cells were calculated for TMZ in combination with hyperthermia at 72h and compared to TMZ effects without hyperthermia. Gene expression of downstream pathways was quantified by real-time PCR.

Results: After 72h TMZ reduced viable cells to less than 69.6%% in MGMT-methylated GBM specimens and to 92.9% in MGMT-unmethylated GBM specimens (P<0.001). With additional hyperthermia viable cells for MGMT-methylated and MGMT-unmethylated GBM specimens were 70.8% and 80.9%, respectively. The total reduction in viable cells with additional hyperthermia compared to normothermia was +1.2% for MGMT-methylated and -12.0% (P=0.025) for MGMT-unmethylated GBM specimens. Downregulation of p53 expression was found in MGMT-unmethylated GBM specimens after hyperthermia and TMZ incubation (1.80; IQR 0.88-6.18) compared to TMZ incubation alone (4.82; IQR 1.86-105.78).

Conclusion: *In vitro* the addition of hyperthermia treatment increases TMZ-induced cell death in MGMT-unmethylated GBM specimens. Furthermore, the downregulation of p53 expression in MGMT-unmethylated specimens could support the hypothesis that hyperthermia increases TMZ induced apoptosis. No significant additional effect was seen in MGMT-methylated specimens.

Deletion of chromosome 17q as an important step in the clonal cytogenetic evolution of recurrent meningiomas

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Objective: Meningiomas are mostly benign tumors that originate from the coverings of the brain and spinal cord. Cytogenetically, most often they reveal a normal karyotype or monosomy of chromosome 22. However, progression of meningiomas is associated by a non-random pattern of secondary losses of other autosomes e.g. deletions of 17q. The aim of this study was to determine the role of chromosome 17q deletions in patients with recurrent meningiomas.

Methods: FISH for chromosome 17q was performed on 22 meningioma biopsies (1 WHO I-, 13 WHO II-, 8 WHO III-Tumors) out of 7 patients (4 males, 3 females, mean age: 45,43 years at the date of surgery) that underwent surgery from 1999 to 2015. At least two different tumors of each patient were examined by FISH to evaluate the clonal cytogenetic evolution of recurrent meningiomas. A comparison to former cytogenetic results revealed by CGH- or conventional karyotype analysis, in 10/22 cases, were done.

Results: In all but two cases, the tumor samples showed a significant loss of chromosome 17q (10%-68.5%). Only 1/10 (10%) CGH or karyotyping results showed a loss of chromosome 17. Despite our presumption of being a late event in tumor progression, loss of chromosome 17q was present also in the patients' early tumor specimens. The percentage of losses displays to first increase over time and then to decrease in the subsequent tumor samples.

Conclusion: Deletion of the long arm of chromosome 17 does not appear to be a late event in meningioma progression. However, we could show that the loss of chromosome 17 seems to be a potential marker for meningioma recurrence that is not detectable by the standard cytogenetic analyses.

The transfalcine interhemispheric approach to contralateral paramedian, parafalcin lesions

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Objective: Deep located lesions within the paramedian, parafalcin region are sometimes difficult to access. Ipsilateral approaches may contain a high risk of damaging eloquent areas or associated white matter tracts and can be limited due to venous anatomy of sinusoidal draining veins. Therefore, a transfalcine contralateral approach to these lesions may have some advantages. The authors report their recent experience regarding the approach.

Methods: Between 2014 and 2016 four patients received surgery via the transfalcine interhemispheric approach for contralateral lesions. To avoid retraction of the cortical surface of the ipsilateral hemisphere the patients head was rotated moderately with the upper body in supine position. The falx had to be located as parallel to the ground as possible to support the descent of both hemispheres with the contralateral side fixed by the falx. A lumbar drain was placed before surgery to release CSF to achieve more space for manipulation. The advantage and disadvantage of the approach was analyzed with respect to clinical outcome of the patients and pre- and postoperative MR imaging.

Results: Four patients underwent the approach with an average age of 35 years (range 21-48years; female-male: 3:1). Lesions included 2 glioblastomas, 1 cavernoma and 1 metastasis of a melanoma. Measurement of mean maximal lateral extension (falx to lateral tumor border) was 21mm. In all but one complete tumor removal was achieved during initial surgery. In one patient with a GBM a small tumor remnant was resected in a second attempt. There was no need of additional retraction using a spatula. There were no complications related to the approach. Postoperative MRI revealed no changes of the ipsilateral hemisphere regarding the approach. No functional deficits have been observed in any patient.

Conclusion: The transfalcine interhemispheric approach to contralateral paramedian, parafalcin lesions is safe but challenging. Excessive retraction of the cortical surface of the ipsilateral hemisphere can be avoided by proper positioning of the patient, lumbar drainage and simply using gravity. Lateral extension of a lesion can limit the approach as well as the presence of many or large ipsilateral sinusoidal draining veins. The latter has to be estimated before surgery.

Critique of approximate entropy as complexity measure of intracranial pressure

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Objective: Approximate entropy (ApEn) was recently introduced to extend the spectrum of cerebrospinal fluid pressure parameters. The algorithm was found to produce low values when intracranial pressure (ICP) was elevated and high values when ICP was at low levels. Applying ApEn to point processes (e.g. neural spike trains) ApEn's scale features the degree of signal regularity or roughness (ICP dynamics). The scale's cornerstones outline clear but trivial signal characteristics. The intriguing question is how to interpret ApEn beyond extremes?

Methods: To reveal midrange ApEn scale's meaning we studied the influence of intrinsic ApEn parameters (embedding and radius) on real-world ICP and simulation data. To mark off the interval ranging from regularity to irregularity in ICP time series, samples were evaluated from a mechanically ventilated patient (highly regular, non-stationary), from nocturnal readings (generally non-stationary) of a patient who underwent long-term ICP measurement for diagnostic reasons, and red/white noise random numbers (mainly irregular). Data were tested by fixing one of the ApEn parameters while the other was varied. A total of 24 parameter combinations were examined in detail.

Results: Variation of parameters influenced the results notably. All parameter combinations resulted in an almost uniform picture of ApEn: starting out from initially high values and converging toward zero with two exceptions. 1) nocturnal ICP showed a concave decay instead of a convex, indicating some stability over parameter variations, and 2) white noise depicted a family of curves covering the complete scale of ApEn. Initial values fitted best for noise data with high ApEn but only for a small numbers of parameter combinations. Paradox ApEn was found for the ventilated patient. A direct assignment of data specifications and corresponding ApEn was impossible.

Conclusion: ApEn did not clearly scale regularity or irregularity. Application of recommended parameter settings from literature and also variations in parameters led to confusing results. ICP data created the impression of a distorting influence of non-stationarity on ApEn. This is fatal for biomedical data is inherently non-stationary. Based on these computations ApEn seems not to be an appropriate candidate for explaining ICP dynamics.

Precursors of ICP changes: The analysis of causal relationships

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Objective: It is common practice in signal processing to use statistical methods to infer causal relations from data if the theoretical background is insufficient or experimentation impossible. A typical biomedical application is the calculation of Granger-causality from a set of precursors and the average ICP of long-term epidural ICP recordings in patients with idiopathic intracranial hypertension (IIH).

Methods: In five ICP episodes of 50 min from five different patients with marked ICP dynamics an offline beat-to-beat analysis of pulse pressure waveforms was carried out following the MOCAIP concept (DOI: 10.1109/TBME.2009.2037607). Nine precursors were chosen reflecting both the pulse pressure magnitude and time interval related metrics. Also, the waveform's curvature at discrete times was taken into account. The working hypothesis was that a precursor „Granger-causes“ mean ICP (mICP). Additionally, the inverse assumption, i.e. mICP Granger-causes precursors, was considered. To ensure results second order stationarity (DOI: 10.1111/rssb.12015) of the time series analysed was evaluated.

Results: Direct Granger-causality (accepted for significance levels $p < 0.01$, F-statistic) was computed in a total of 90 analyses. 22/45 analyses showed that precursors cause mICP, however, 38/45 proved that mICP causes precursors. Three precursors did not cause mICP in all patients, however mICP caused these precursors. Pronounced bidirectional causality was found in amplitude related precursors whereas time intervals and curvatures showed more variable results. Local stationarity was tested (accepted for significance levels $p < 0.01$). Non-stationarities were found in all data.

Conclusion: Results were dominated by bidirectional causality for precursors and mean ICP. The meaning and consequences of bidirectional causality are not quite understood. It appears reasonable to attribute this phenomenon, primarily, to the overall non-stationarity of real-world clinical/biomedical data. Moreover, common cause fallacy or insufficient sampling might be involved. Set against this background, the complexity of causal relationships should be considered when evaluating ICP predicting studies.

Repurposing of the old sulfone antibiotic dapsone for the treatment of gliomas

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Objective: Dapsone is an antibiotic used for the treatment of mycobacterial and protozoal infections. We previously hypothesized that dapsone could possess biological activity extending beyond its anti-infectious properties and that it potentially represents a candidate for repurposing in the setting of glioma therapy.

Methods: Established glioblastoma cell lines and primary cultured glioma cells were treated with dapsone or several different chemical analogues of dapsone which we previously synthesized (D2-D5) and examined effects on proliferation, anchorage-independent growth and migration.

Results: Dapsone and its synthetic analogues D2-D5 displayed only modest anti-proliferative activity. However, treatment with dapsone lead to a significant inhibition of important neoplastic features such as anchorage-independent growth and directed migration. Moreover, several dapsone analogues yielded even enhanced anti-glioma activity.

Conclusion: Dapsone has pronounced activity against glioma which can be further enhanced by its molecular modification. Overall, dapsone holds strong promise to serve as a supplementary therapeutic measure for glioma therapy in a repurposing approach.

Time-course of plasma chemokine and cytokine increases in a rat model of brain death

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Objective: Brain death (BD) is a donor-associated risk factor that negatively affects transplantation outcome. The inflammation associated with BD appears to have a negative effect on organ quality. It was shown that complement activation, apoptosis and pro-inflammatory cytokines and chemokines significantly increase after brain death. We determined plasma chemokine and cytokine responses over a period of eight hours after BD.

Methods: Thirteen healthy adult male Sprague Dawley rats were intubated and mechanically ventilated. After induction of BD, rats were kept hemodynamically stable over a period of eight hours. A panel of immune responses including cytokines and chemokines were measured at 1, 4 and 8 hours after BD by multiplex analyses.

Results: In the early phase after BD induction, an increase in heart rate and a decrease in mean arterial pressure (mMAP) were recorded. Only limited fluctuations in Pa O₂, O₂ saturation and HCO₃ were noted. Almost all monocyte-/macrophage- and lymphocyte-derived cytokines and immune cell products increased steadily during a period of eight hours.

Conclusion: Increase of chemokines, cytokines and particularly pro-inflammatory responses after BD is significantly time-dependent. Studies which measure donors' and recipients' cytokines and chemokines could provide useful information to improve outcome for organ recipients.

Pathology of Pituicytoma – Indicators for treatment alternatives?

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Objective: Pituicytoma is a rare neoplasm of the sellar region, believed to originate from neurohypophyseal cells. Tumor resection is the primary treatment option, but may remain incomplete due to excessive bleeding of the well vascularized tumor stroma. Therefore the search for alternative or additional treatment regimens is necessary. In a previous publication in 2012 the presence of VEGF-R was shown in one tumor sample, potentially opening the door for modern treatment options. However no series of pituicytomas was analyzed so far.

Methods: We analyzed pituicytoma samples collected from three institutions between 2006 and 2015. The tumor tissues were stained for VEGF, VEGFR, TTF1, SSTR 2, SSTR 3, SSTR 5; furthermore the Ki67 fraction was determined. The strength of the stainings were classified from 0 = no staining to +++ = strong staining. A complementary retrospective analysis of the patient charts regarding sex, age, and primary symptoms, pituitary function, and peri- or postoperative complications was performed.

Results: Ten samples were analyzed; mean patient age was 57.8 years ±16,3years. 7 samples were acquired from male patients (1 relapse) and 3 from female. All tumors stained strongly positive (+++) for VEGF-R. VEGF was unavailable in 6 samples, did not stain in 3 and was slightly positive (+) in 1 sample. Six samples stained positive for TTF1. As for somatostatin receptors, 3 samples were slightly positive for SSTR2; 7 were negative. SSTR3 was + in 1, 3 were ++, 3 were +++ and 3 were 0. SSTR 5 stained +++ in 1, ++ in 5, + in 1 and 0 in 3 patients. Ki67 was unavailable for 7 samples; it was 5% for 2 samples and 10% in one.

Conclusion: All pituicytomas stained strongly positive for the VEGF receptor presence thus indicating a possible treatment option through targeted therapies in cases where resection remains insufficient. Further research is necessary as to whether tumor growth can be inhibited using this pathway.

The influence of brain tumor localisation and isocitrate dehydrogenase 1 (IDH1) on reorganisatory processes of the language system

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Objective: Lesions caused by brain tumors in eloquent brain areas may trigger functional reorganization of language processing. A common finding is enhanced language-associated activation in contralesional homolog brain structures. There are indications in literature that contralesional activation might reflect a compensatory or dysfunctional process depending on the tumor localization (Thiel et al. 2006). The reasons for this are still unclear but certainly must be caused by processes in the microstructure. According to tumor localization there is the finding that frontal tumors more often express the isocitrate dehydrogenase 1 (IDH1) mutation than tumors in other brain areas (Lai et al. 2011). This might also effect aspects of brain activation patterns. Therefore, this study investigates a possible correlation of tumor localization and the IDH1 mutation.

Methods: 23 patients with left inferior frontal gyrus (including 13 patients with IDH1 mutation) and 28 patients with left temporoparietal (including 10 patients with IDH1 mutation) primary glial tumors in language critical areas and 34 healthy control subjects were included. Functional magnetic resonance imaging was performed at a 3T Siemens Allegra Scanner. During the language fMRI paradigm subjects had to perform covertly a verb generation task. Data analysis was done by using SPM 12 including the Marsbar toolbox and the Automated Anatomical Labeling Atlas for region of interest (ROI) definition and analysis.

Results: Patients with tumors in the left inferior frontal gyrus (IFG) and IDH1 mutation show increased activation in the left superior temporal gyrus and sulcus compared to patients without IDH1 mutation. In contrast these patients exhibit more activation in the left supramarginal gyrus and the right IFG compared to healthy controls. Patients with tumors in posterior language critical areas and IDH1 mutation revealed more activation in the right IFG compared to patients without mutation. At least patients with posterior tumors and no IDH1 mutation exhibit increased activation in the right and left IFG and the right supramarginal gyrus in contrast to healthy control subjects.

Conclusion: This preliminary data provides first indications for the correlation of molecular markers and hemodynamic processes associated with cognitive functions as language processing. There might be an interaction of molecular markers as IDH1 and tumor location associated with processes of functional reorganization.

Restless legs syndrome as a first indicator of a meningioma-induced compression of brainstem and cervical spinal cord: a case report.

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Objective: Restless legs syndrome (RLS) is one of the most common neurological diseases that affects up to 4,5 % of the general population. Symptoms mainly consist of abnormalities in sensation and motor activity. Diagnostic criteria include an urge to move, uncomfortable sensations, motor restlessness, worsening of symptoms during relaxation and in the evening. RLS occurs in association with other diseases and conditions, in particular iron deficit, pregnancy, uremia, severe liver dysfunction, thyroid dysfunction, peripheral polyneuropathy, multiple sclerosis, Parkinson's disease and rheumatoid arthritis. We present the case of a patient suffering from RLS for several years and being relieved from these symptoms after removal of a meningioma that had compressed lower brainstem and upper spinal cord.

Methods: This 52-year-old woman reported symptoms consistent with RLS for 10 years duration. Initially, she felt an urge to move her legs only during long car rides. Simultaneously, prickling and tingling sensations developed in her thighs. Subsequently, symptoms also developed when sitting on a chair and lying in her bed. The discomfort was pronounced during evening and in situations of physical inactivity. Family history was positive, her father as well as her identical twin suffered from RLS. As additional symptoms, the patient mentioned difficulty to empty the bladder. Blood analyses excluded iron deficit, liver, thyroid or kidney dysfunction. On the International RLS severity scale, she scored 37 (out of a maximum of 40) points. Approximately 3 months later, she developed additional impairments in co-ordination and strength, pain in the cervical spine and a paresis of her left sided toes. A magnetic resonance imaging of the brain was performed. It showed a large tumor located above and below the foramen magnum, compressing medulla oblongata and upper spinal cord.

Results: The tumor was successfully removed without side effects. Histologic analysis classified the tumor as an angiomatous meningioma. Immediately after surgery, RLS symptoms disappeared completely. Four weeks post-surgery she still scored 0 points on the International RLS severity scale.

Conclusion: To our knowledge, this is the second report on a tumor evoking RLS symptoms. RLS pathophysiology is still under discussion. Presumably, several mechanisms play a role. A central disorder of sensory-motor integration and a functional deficit of dopaminergic pathways are suspected. Interestingly, a recent study suggested microstructural alterations in the midbrain and in the upper spinal cord of RLS patients. Rarely, RLS symptoms might be the first indicator of a tumor located at the foramen magnum level. We speculate that susceptibility for RLS is a prerequisite since both patients had a positive family history. Possibly, compression by the tumor had affected dopaminergic descending pathways.

Carnosine's anti-neoplastic effect on glioblastoma cell growth is independent of its cleavage

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Objective: Carnosine (β -alanyl-L-histidine) is a naturally occurring dipeptide that inhibits the growth of cells derived from glioblastoma. Previous work demonstrated that the anti-neoplastic effect is mimicked by its component L-histidine. Here we investigated whether the release of L-histidine is required for the anti-neoplastic effect.

Methods: Glioblastoma cells from 10 different cell lines and from cell cultures derived from 21 patients were cultivated in medium with different concentrations of carnosine or L-histidine and viability was analyzed using cell based assays. Carnosinase expression was determined by immunoblotting and qRT-PCR. In addition, the intracellular amounts of carnosine and L-histidine of cells from 10 lines and 5 primary cultures which were exposed to medium containing either L-histidine or carnosine were determined by Liquid Chromatography coupled to Mass Spectrometry.

Results: A 48 hour exposure to carnosine (50 mM) significantly reduced viability in all tumor cells as determined by the amount of ATP in cell lysates to an average of $73.6 \pm 20.5\%$ compared to the untreated control, whereas L-histidine revealed a more pronounced effect ($49.8 \pm 18.6\%$ at 50 mM and $69.4 \pm 22.2\%$ at 25 mM). Analyzing the intracellular release of L-histidine under the influence of carnosine, we observed a significantly enhanced ($p < 0.05$) abundance of L-histidine in 9 of 10 cell lines and in 4 of 5 primary cell cultures. In the presence of 25 mM L-histidine, we detected a 37.4 fold higher abundance of L-histidine compared to carnosine (50 mM) treated cells. No correlation between the expression of carnosinases and the anti-neoplastic effect was observed. Furthermore, the aminopeptidase inhibitor bestatin (10 to 100 μ M) did neither attenuate nor enhance the effect of carnosine. These observations clearly indicate that the release of L-histidine from carnosine is not required for the anti-neoplastic effect of the dipeptide.

Conclusion: Carnosine and L-histidine inhibited the viability of all 31 tested tumor cell cultures. Although L-histidine revealed a more pronounced effect than carnosine the intracellular release of L-histidine is not required for the anti-neoplastic effect of the dipeptide. As L-histidine and most likely its imidazole ring appear to be responsible for growth-inhibition it should be considered whether this observation can be used for the design of drugs that are able to deliver therapeutic amounts of imidazole groups to tumor cells.

Diverse effect of acetazolamide administration in murine Close Head Injury with versus without surgical decompression.

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Objective: Acetazolamide, a carbonic anhydrase inhibitor, is widely used in neurosurgical practice for treatment of hydrocephalus and benign intracranial hypertension. However, its administration in head trauma patients is not recommended due to the vasodilatation properties of acetazolamide: according to Monro-Kellie doctrine, the subsequent increase in volume of intracranial blood may lead to uncontrolled raise of ICP. We hypothesized, that this potentially negative effect of acetazolamide after head injury will be reduced in the condition of surgically opened cranial vault (decompressive craniectomy). To test this hypothesis, a murine model of closed head injury has been used.

Methods: Anesthetized male CD-1 mice were randomly assigned into the one of the following experimental groups: sham procedure, decompressive craniectomy alone, closed head injury alone, closed head injury followed by craniectomy at 1h posttrauma and closed head injury with craniectomy followed by intraperitoneal administration of acetazolamide (n=10 each group). After the surgery, the neurological function was assessed according to Neurological Severity Score (NSS) and Beam Balance Score 24h and 72h after head injury. The neurological impairment scores were compared between groups using one-way ANOVA. Significance was set at $p < 0.05$.

Results: The neurological assessment revealed a significant impairment in animals treated with acetazolamide without decompressive craniectomy, according to NSS, BB and according to balancing time. This negative effect was present during the 24h posttrauma and partially improved at 72h posttrauma, as compared to the sham animals. In contrast, in animals treated by surgical decompression before administration of the acetazolamide, no significant difference in neurological performance (compared with sham animals) could be documented.

Conclusion: The action of acetazolamide on posttraumatic outcome differs between animals with and without craniectomy. Possibly, the removal of cranial vault enables the acetazolamide-induced increase in brain volume to expand outside the rigid cranium. This observation should be further investigated in both experimental and clinical condition, in order to test possible new indication for the use of acetazolamide.

Neuroendoscopic biopsy of paraventricular intraparenchymal tumors

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Objective: Frame-based stereotaxy has been the gold standard for biopsy of deep-seated intracranial pathologies for many years. However, direct visual control of the biopsy area is not possible. A direct endoscopic visualization of the biopsy site might harbor distinct advantages. Here, the authors present a series of endoscopic, neuronavigated fine-needle biopsies of paraventricular intraparenchymal tumors.

Methods: Endoscopic fine-needle sedan-probe biopsy of paraventricular pathologies was performed in 5 male and 3 female patients between 03/2013 and 09/2016. The patient age ranged from 18 to 82 years. All patients underwent a pure endoscopic procedure over a burr hole trepanation. The surgery was performed in supine position with fixed heads. As an addition to the direct visual control by using the endoscope camera system, the paraventricular position of the biopsy needle could be controlled by a passive neuronavigation tracking system that was fixed at the sedan-probe.

Results: Histological diagnoses were established in all biopsies. In all cases, a direct control of the biopsy area was feasible and hemostasis could be obtained. In 5 cases, endoscopic third ventriculostomy (ETV) was performed due to obstructive hydrocephalus. In case of ETV, the stoma was created prior to biopsy. In 7 cases, the postoperative course was uneventful. One patient with a large tumor of the left thalamus and tumor growth into the third ventricle suffered from persistent hydrocephalus and had to be treated with external ventricular drainage.

Conclusion: Endoscopically conducted biopsies with the aid of neuronavigated tracking of the probe represent a possible additional technique in selected paraventricular intraparenchymal pathologies. The endoscopic approach enables the direct visualization of the intraventricular surface and its vessels. In contrast to standard stereotactic biopsy, direct visual control of hemostasis can be obtained even in paraventricular tumors.

Experimental 5-ALA Photodynamic Therapy of a Human Chordoma Cell Line

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Objective: Chordomas are rare malignant tumors with infiltrating growth. Surgery and radiotherapy are the mainstay of therapy. However recurrences are very common. As chemotherapy is ineffective, other adjuvant modalities have to be explored. Recently, 5-aminolevulinic acid based photodynamic therapy (5-ALA PDT) has come into focus of anticancer treatment. The present study investigated the efficacy of 5-ALA PDT *in vitro* on a human cell line.

Methods: Experiments were performed on a human chordoma cell line (UCH-2). Preliminary FACS-analysis with different 5-ALA concentrations had been performed after 4h and 6h incubation time. In the main experiment, cultured cells were incubated for 6h with different 5-ALA concentrations (15; 30; 40; 50 microgr/ml) and subsequently irradiated by laser light (635nm, 625 sec, 18.75 J/ cm²). Cell viability was tested 24h after PDT by WST-1 assay. Negative control groups (5-ALA only and laser only) were realized.

Results: Preliminary FACS-analysis had suggested a higher accumulation of protoporphyrin IX (PpIX) after 6h in contrast to 4h incubation time. The UCH-2 cell line could be effectively destroyed by 5-ALA PDT. 5-ALA concentrations of 15; 30; 40; 50 microgr/ml showed a dose-dependent effect with cell survival rates of 86.9%; 54.2%; 22.4% and 12.8%, respectively. 5-ALA or laser irradiation alone did not result in significant cell death.

Conclusion: 5-ALA PDT effectively caused cell death in a human chordoma cell line *in vitro*. There was a dose-dependent effect. Preliminary FACS-analysis had shown a superior effect of 5-ALA PDT after 6h of incubation time. Further experiments to optimize treatment parameters and on different cell lines and tumor tissue are needed to confirm these experimental results.

Large cerebellopontine angle tumors: Long term follow-up of facial nerve function

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Objective: In large tumors of the cerebello-pontine angle the preservation of the facial nerve function remains to be a challenge. We report about a group of 71 consecutive patients with special focus on this topic describing our operative strategies and tools we used during the procedure.

Methods: Records of the patients who were operated because of cerebello-pontine angle tumors between 1996 and 2016 with tumors larger than 2.5 cm in diameter were retrospectively analyzed. Follow up reached from 2 months to 225 months.

Results: 133 patients were operated between 1996 and 2016 because of cerebello-pontine angle tumors. 71 patients had tumors larger than 2.5 cm. in diameter. 41 of them had schwannomas (57.7%), 20 patients had meningiomas (28.2%), 10 patients (14.1%) had other histologies including carcinoma metastasis, cholesteatoma, epidermoid cysts, malignant melanoma and lymphomas. Most common symptoms were coordination and ataxia of varying degree (78.9%); followed closely by hearing loss and tinnitus (77.5%), nonetheless 16 patients had facial nerve dysfunction prior to surgery (22.5%), 4 of them with House – Brackmann grade IV and V (4.6%). 5 patients needed placement of an external ventricular drain prior to tumor removal (7%). Median tumor-size was 3.3 cm. Retrosigmoid approach was used. 72.5% of the patients were operated in semi-sitting position, 14.5% in prone position and 8.7% in lateral position. No operation had to be interrupted due to an air embolism. Complications included intracranial hemorrhages needing a surgical removal (2.8%), ventriculo-peritoneal shunt dependency (4.2%) and impaired wound healing needing a revision (5.6%). There was no fatal case. Median postoperative hospital stay was 11 days. 17 patients were lost to follow up after discharge; the median follow up with 54 patients was 51 months, of these 1 (1.9%) had House – Brackmann grade VI, and 6 (11.1%) had House – Brackmann grade IV and V facial nerve dysfunction. The tumor size and the preoperative facial nerve function were variables that affected the facial nerve outcome. Operations were performed with microsurgical facial nerve stimulation tools and continuous recording of evoked potentials. Recurrent tumor growth needing another surgical removal was noted in 4 patients (3 months to 9.3 years after surgery).

Conclusion: In large tumors of the cerebello-pontine angle the likelihood of complete loss of facial nerve function in long term after operation was only 1.4%, good facial nerve function defined as House – Brackmann grade I-III was 87%. Facial nerve stimulation is a most practicable tool in this setting and air embolism in semi-sitting was not a problem in our group of patients.

One year with Optune in Austria: First report on clinical experiences

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Objective: Tumor Treating Fields (TTFs) consist of intermediate frequency alternating electric fields that are delivered through 4 transducer arrays, directly placed on the shaved scalp. Optune TTF treatment is an established, non-invasive antimitotic therapy for patients with newly diagnosed or recurrent glioblastoma (GBM). Treatment efficacy was evaluated in the EF-14 trial, showing significant improvement of both, overall and progression free survival. This is the first report on clinical experiences with Optune in Austria (Start: February 2016, N=11 patients). All patients received a prescription in our department, the only certified TTF treatment center in Austria.

Results: We treated newly diagnosed (N=8) and recurrent GBM patients (N=3). Our patient population included female (N=4) and male (N=7) patients with an mean age of 42 years (range 17-69 years) at the date of prescription. The mean treatment time was 3,4 months (range 2 weeks - 6 months). The disease was rated stable in 5 patients with an mean treatment time of 82,06% daily. Three patients (27 %) showed progressive disease, one with a surgically resectable recurrence, the other patient with a diffuse progression of the disease. With regards to the side effects we were faced with mild to moderate skin irritation (RTOG 0-1) in 2 patients, but those could be treated by the use of local steroid application and did not cause significant treatment interruption in all but one patient. We noticed that patients need approximately 4 weeks to get used to the therapy. We perform regular follow-up visits including evaluation of patient compliance. With regards to the compliance rate and due to the patient's feedback we were able to show that patients mostly accept this new treatment approach.

Conclusion: TTF is generally an accepted and efficacious treatment for GBM. The promising results of the preterm analysis of EF-14 were recently confirmed in the final analysis. Our experiences with TTF are widely positive with great acceptance by the patients, however, the short treatment time does not allow reliable outcome analysis.

Survival of patients undergoing resection of multiple lesions vs. one lesion in the presence of multiple metastases – a survival analysis based on the prospective Metasys-trial-data

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Objective: Resection of multiple brain metastases is indicated under certain conditions. However, there are no data available from large-scale prospective studies if the resection of multiple metastases may not rather be detrimental in the presence of disseminated disease.

Methods: We included consecutive cases who underwent surgical resection of brain metastases at our institution since June 2013 up until 11/2015 in the present analysis. A minimum follow-up of 1 year and two or more metastatic lesions visible on MRI were required for inclusion in this study. We compared whether survival is different if more than one metastasis is resected. Survival analysis was based on Kaplan Meier log rank testing.

Results: Out of 147 cases included in the prospective Metasys protocol, 65 fulfilled the inclusion criteria for the present analysis (49% female, mean age 63yrs (CI95%: 45-80yrs)). We dichotomized patients with multiple metastases as follows: In the single resection group (44/65 cases (68%)), and in the multiple resection group (21/65 cases (32%)). Metastases originated from a non small-cell lung cancer in 27%: Median overall survival was 4.5 (3.4-5.8) months in the single resection group and 5.4 (4.1-6.7) months in the multiple resection group. Kaplan-Meier Log rank testing revealed no difference between both groups ($p=0.64$).

Conclusion: We could not demonstrate a significant difference in survival between both groups. The generalizability of this finding is limited due to the individually-based decision process and the heterogenous underlying pathologies. The strength of the analysis is the prospective data collection, which was lacking in previous trials.

Interaction of nanoparticles with Neurons- a Liaison with potential?

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Objective: Superparamagnetic iron oxide nanoparticles (SPIOs) have been used as contrast agents in magnetic resonance imaging (MRI) and are of special interest for diagnostic and therapy of

central nervous system (CNS) diseases. Currently, particular focus lies on the use of SPIOs to specifically influence neuronal regeneration after injury due to their unique composition, including size, surface coating and charge. The resulting increased interaction with and accumulation by brain cells make them ideal tools to act at the molecular level. Therefore, we sought to investigate the activation of intracellular signaling pathways as well as the cytokine/chemokine secretion profile responsible for SPIO-induced neurite outgrowth, which we have reported before.

Methods: Microglia and astrocytes from C57Bl6/J pups (P0-P2) and hippocampal neurons from mice embryos (E18) were cultured separately and in a co-culture. Very Small Iron Oxide Particles (VSOP-R1/-R2), differing in size or the clinically proven polymer coated Resovist® (Bayer Schering Pharma AG) or Feraheme® (AMAG Pharmaceuticals, Inc.), were added at 0,5mM for 24 hours. We analyzed arrays to identify up- und down regulated cytokines and chemokines. We performed ELISA to identify proteins and factors that mediate SPIO actions to investigate the underlying signaling pathways. We localized SPIOs and evaluated the degree of cellular uptake. Western blotting was used to analyze intracellular signaling cascades.

Results: Previous results showed that SPIOs induce degeneration of primary neurons, but stimulate neurite outgrowth in neuroglia co-cultures in a particle- and concentration-dependent manner. SPIOs modify and activate growth promoting intracellular signaling pathways in primary neurons in different cell cultures, depending on the microglia surrounding.

Conclusion: VSOPs, Resovist® and Feraheme® have so far not been thoroughly reviewed in terms of interactions with CNS tissue and potential adverse effects. Our experiments show, that there are considerable interferences between primary murine CNS cells and applied SPIOs as well as differences for the evaluated SPIOs. We just start to shed light on the influence of SPIO's on intracellular signaling cascades. The analysis of particle interactions and subsequent effects substantially contribute to the assessment of chances of SPIOs for the regeneration of spinal cord injury and limits in applications of SPIOs for diagnostics (e.g. MRI) in humans.

Interneurons in the spotlight for recovery after spinal cord injuryJana Glumm¹, Martin Pohland², Jürgen Carl Walter Kiwit³¹Klinik für Neurochirurgie, Helios Klinikum Berlin Buch, Berlin, Deutschland²Berlin, Deutschland³Neurochirurgische Klinik, HELIOS Klinikum Berlin Buch, Berlin, Deutschland

Objective: A variety of SCI (spinal cord injury) models exists *in vivo*, but due to their complexity, comparability and clinical practicability is extremely difficult. During the last years we have established a new coculture method combining murine motor cortical (MC) and spinal cord (SC) slices. We have further investigated motor cortical regeneration and sprouting to the spinal cord and present here our data on interneurons. The impact of intraspinal networks of interneurons on recovery after incomplete sensory or motor SCI has long been known (Flynn et al., 2011). One of the major factors here is that damaged axons from the MC form new connections with the help of interneurons at the severed level with connections to sublesional level.

Methods: MC prepared from postnatal Bl/6.GFP P0-P3 pups was cut along the coronal axis. SC was dissected from postnatal C57Bl/6 P0-P3 pups and subsequently chopped along a sagittal longitudinal plane. Thereafter, the medial MC zone was oriented to the rostral end of the SC and incubated up to 28 days. Using different approaches, we monitored interneuron in our model. On the one hand, we used transgenic mice expressing enhanced GFP under the control of the parvalbumin promoter (Pvalb-EGFP) and monitored their migration. On the other hand, we verified those migrating interneurons with additional immunohistochemical stainings using GAD67 and GAD65/67. Besides we performed electrophysiological analyses and studied the $[Ca^{2+}]_i$ response.

Results: After seven days *in vitro* we detected, using fluorescent live imaging, Pvalb-EGFP interneurons that migrated up to 300 μm into the wild type tissue. We observed typical interneuronal soma and dendrites. We verified those migrating interneurons with additional immunohistochemical stainings and verified a high distribution of GAD67 in our slice model. While studying the $[Ca^{2+}]_i$ response, we observed a second, traveling $[Ca^{2+}]_i$ wave following the initial response after cortical stimulation.

Conclusion: We describe further our GFP cytoarchitecture-preserving slice coculture technique to analyse regeneration between MC and SC *ex vivo*. Propriospinal neurons contribute to plastic reorganisation of spinal circuits (Flynn et al., 2011). Since we can monitor in our model not only the regenerating corticospinal tract, but Pvalb positive interneurons as well, we can study their role too. If the observed interneurons can integrate themselves into the existing interneuronal network by forming functional connections, they can help to detour the lesion side by forming connections with neurons with branches to sublesional level, thus creating a neuronal circuit surrounding the scar and allowing the passage of information to segments beyond it (Tuszynski and Steward, 2012).

IVH Score for the prediction of shunt dependency in patients suffering from aneurysmal subarachnoid hemorrhage with intraventricular hemorrhage

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Objective: The presence of intraventricular hemorrhage (IVH) is a known risk factor for the development of hydrocephalus after aneurysmal subarachnoid hemorrhage (aSAH). The amount of intraventricular blood and the location within the third and fourth ventricles correlate with higher incidence of hydrocephalus and shunt dependency. A simple scoring system allowing an early identification of patients, who will need a ventriculoperitoneal (VP)-shunt is currently lacking. We evaluated the validity of a simple IVH score for the prediction of shunt dependency after aSAH.

Methods: Patients with aSAH admitted to our clinic from January 2012 to September 2016 were retrospectively analyzed for the need of VP-shunt placement. The volume of the intraventricular clot in every ventricle was estimated based on the initial CT scan. A blood volume filling more than 50% of the ventricle volume was considered significant. The following scoring system (range 0-8) was defined for the classification of the IVH extension: for every lateral ventricle 1 point and for the third and fourth ventricles 3 points were given, respectively. The predictive value of the IVH score for shunt dependency was assessed using the Fisher's exact test.

Results: A total of 191 patients were analyzed. The mean age was 55 years, 67% (128/191) were female and 33% (63/191) male. In 25% (47/191) a VP-shunt was implanted. In the patients with a VP-shunt a mean IVH score of 4.8 was found, while the patients without VP-shunt had a mean score of 1.6. Patients with a score ≥ 4 have a significantly higher risk to become shunt dependent compared to the patients with a score < 4 (OR 6.9 95% CI 3.2-14.5; $p < 0.0001$). A score ≥ 4 showed a high specificity of 84% with a sensitivity of 58%; the positive predictive value was 52% (95% CI 39-65%) and the negative predictive value was 87% (95% CI 80-91%).

Conclusion: The IVH score is a simple score allowing the identification of patients who are at higher risk to develop chronic hydrocephalus with the need of VP-shunt after aSAH with IVH. A more aggressive management with intraventricular thrombolysis should be considered in patients with high IVH-Score.

Prophylactic spinal expansile duraplasty in patients with intramedullary tumors undergoing radiation therapy

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Objective: Malignant intramedullary tumors usually require radiation therapy which might lead to cord edema with severe neurological decline. Spinal expansile duraplasty enlarges the intradural space and might thus inhibit radiation-induced neurological deficits. The aim of this study is to evaluate the indications and the clinical course of patients undergoing expansile duraplasty.

Methods: In this retrospective observational analysis (2007 – 2016), we included all patients with primary and secondary intramedullary tumors who underwent spinal expansile duraplasty with either autologous or allogenic material. To analyze the degree of preoperative edema and the relative space occupying effect we formed the ratio of the diameter of the spinal cord adjacent to the tumor (median of a.p. diameter one level apical and a.p. diameter one level caudal to tumor) divided by the diameter measured at the level of the tumor (ratio > 0.8 was regarded as a significant swelling). The presence of CSF fringe around the medulla was analyzed. Postoperative course was analyzed with special emphasis on neurological deficits, wound breakdown and CSF fistula.

Results: We screened records from 985 patients, identified by the surgical procedural codes of 5-036.8 and 5-021.3. Thirty-one patients suffered from primary or secondary intramedullary tumors. Fifteen patients were excluded since a tumor debulking was carried out simultaneously, thus, 16 patients met the inclusion criteria. Twelve patients suffered from an intramedullary metastasis, four from an intramedullary glioma. Main localization was thoracic spine (6 patients; 5 cervical, 4 lumbar, 1 craniocervical junction). Mean craniocaudal tumor extension measured on the sagittal T1 contrast enhanced image was 24.6 mm (SD 8.2mm), the mean extension of intramedullary edema measured 116.2 mm (SD 48.7mm). A diameter ratio > 0.8 representing a significant preoperative intramedullary swelling was seen in 87.5%. Allogenic material for expansile duraplasty (Goretex®) was used in 81.3%. A CSF fringe surrounding the medulla at the level of the tumor was detected on the postoperative images of all patients, demonstrating successful decompression. Median length of follow-up was 3 months after the surgery. Postoperative course was uneventful in 87.5%, 1 patient developed wound infection, one patient died in the course because of ongoing primary bronchial carcinoma. All but one patient (93.8%) remained clinically stable during the course of radiotherapy.

Conclusion: Spinal expansile duraplasty for unresectable intramedullary tumor prior to radiation therapy is a previously undescribed method and a safe and feasible procedure. Wound breakdown or CSF fistula due to radiation associated wound healing disturbance was not observed. In selected cases the procedure seems to effectively prevent neurological decline due to radiation induce cord swelling.

Preoperative assessment of haemostasis in patients undergoing stereotactic brain biopsy

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Objective: Parenchymal hemorrhage is considered the main risk of stereotactic brain biopsy. Impaired haemostasis may increase the risk of haemorrhage and therefore, appropriate measures should be undertaken to minimize this risk. The role of standard laboratory evaluation of haemostatic parameters is unclear and subject to intense debate. While results from series on patients undergoing surgical procedures have suggested that evaluation of prothrombin time (PT) and activated partial thromboplastin time (aPTT) is of limited value in regard to prevention of haemorrhagic complications, this issue has not yet been addressed in patients undergoing stereotactic biopsy of intracranial lesions.

Methods: We retrospectively analysed the medical records of 189 consecutive patients undergoing stereotactic biopsy of supratentorial intracranial lesions during a three-year period (single-center/single-surgeon: senior author). Laboratory values (PT, aPTT), platelets) were reviewed as well as clinical characteristics, modalities of surgical treatment, histopathological results and the postoperative course of patients. Furthermore, laboratory values and their correlation with postoperative haemorrhage were analysed.

Results: The overall diagnostic yield was 92.5%. Histopathological examination revealed glioma (WHO[°]I: 5, WHO[°]II: 25, WHO[°]III: 23, WHO[°]IV: 65), lymphoma (n=14), inflammation (n=8) and other entities (n=7). Surgery-associated neurological deficits occurred in 7 patients (3.7%) and completely resolved in 6 of these patients. CT-confirmed intracranial hemorrhage occurred in 3 patients (1.9%) and in all cases, histopathological examination revealed glioblastoma. Results of hemostatic parameters (PT: 99±13%, aPTT: 24±3s, platelet count: 274±87 10³/μL) were within normal range values and did not correlate with postsurgical morbidity.

Conclusion: Standard assessment of haemostasis seems to be of limited value in patients with intracranial lesions undergoing stereotactic biopsy. The intratumoural vasculature may have a major impact on biopsy-related risk of haemorrhage. Further studies on this issue are needed, but improvement of preoperative imaging may reduce surgical morbidity in stereotactic brain biopsy.

Beneficial role of combination therapy on TFPI2 and cell viability in U87MG glioblastoma cell line

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Objective: Standard treatment of patients diagnosed with glioblastoma includes surgical resection and adjuvant radiochemotherapy. Molecular heterogeneity of glioblastoma is one of the reasons for its high resistance to standard treatment. This could be overcome by simultaneous targeting of several signaling pathways and epigenetic mechanisms. Here we examine the effect of approved drugs; tranilcypromine hydrochloride (2-PCPA), riluzole and valproic acid on the survival and proliferation of U87MG glioblastoma cell lines and on gene expression.

Methods: We measured the effect of tranilcypromine, riluzole and valproic acid and their combinations with temozolomide and radiation on the cell viability of U87MG glioblastoma cells using MTT assay. The effect on proliferation was studied by immunostaining with Ki67 antibody. Changes in gene expression were determined by qPCR.

Results: Riluzole (25, 50, 75 µM), tranilcypromine (250, 500, 1000 µM) and valproic acid (5, 10 mM) alone and in combinations with standard treatment caused significant reduction in the viability of U87MG cells. The best additive effect was achieved by the combinations of valproic acid and riluzole (76%) and valproic acid and tranilcypromine (63,5%). The co-treatment with temozolomide and radiation further increased the effect. The application of valproic acid and tranilcypromine caused significant reduction (3.39%; $p < 0.05$) in cell proliferation. Further on, we observed the upregulation in the mRNA expression of tissue factor pathway inhibitor 2 (TFPI2; x2,5-x4,7) under the treatment of various combinations of the study drugs.

Conclusion: Combinations of tranilcypromine, valproic acid and riluzole alone and in combination with standard treatment increased cell death and inhibited proliferation of U87MG glioblastoma cells. Combination of these drugs also upregulated TFPI2 expression. TFPI2 is a known inhibitor of tumor cell invasion and is downregulated by hypermethylation in various tumors including glioblastoma. Since TFPI2 is a potential inhibitor of invasiveness investigation of tumor progression under these treatments *in vivo* is required. Moreover, tranilcypromine and valproic acid are known to intervene in the epigenetic regulation mechanisms, which could be a new approach in the treatment of brain tumor.

Visualization Needs in Brain Tumor Surgery - A Multicenter Observational Study

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Objective: Image-guided technology supporting brain tumor interventions has become standard in most neurosurgical centers in Europe and the US. Yet there has been no structured qualitative assessment of the practical, context-sensitive demand in neurosurgical visualization so far. In order to improve not only the intraoperative setup and technical workflow but also the quality of information visualization and display during surgery, the study assesses systematically the use of structural and functional imaging in relation to intrasurgical decision-making and operative key events.

Methods: Over 24 months, 30 supra- and infratentorial lesion interventions in two different surgical centers have been observed, documented and analyzed. The main focus has been on pre- and intraoperative image acquisition, screen arrangement and direct versus delegated image interaction. After surgery, brief user feedback interviews with attending surgeons and staff helped to clarify observed events such as technical issues, workflow delays or additional visualization requests.

Results: As opposed to standard employment of (structural) neuronavigation and, if available, intraoperative imaging (US, MRI) to control the extent of resection (EOR), no standardized connection has been found between confirmed relevance and visualization/display mode of surgical information. This includes resolution, size, color, dimensionality, complexity and distance of guiding information to the surgical site as well as instant availability and minimal or aseptic interaction of surgeon and screen. Visual support («guidance») other than resection control continually decreases over the course of intervention whereas particularly functional information is not well integrated visually neither during craniotomy nor during resection. Intra-departmental discrepancies in visualization requests have been more significant than inter-institutional differences.

Conclusion: In the observed surgical environments, most surgeons adjust to intraoperative setup conventions dictated by non-surgical conditions (e.g. ceiling-mounted infrastructure, anesthesia and nursing management). As in many image-guided modalities default settings are trained and used as standard settings, the potential of more tailored and evidence-based visualizations remains unexplored to date. Based on the study results, sequential explorations and micro-interventions in surgical visualization can be tested and evaluated in different operating environments.

Characterization of an intracranial rat model for local treatment

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Objective: Glioblastoma multiforme (GBM) is the most frequent malignant primary brain tumor. Despite advances in microsurgical techniques and concomitant radiochemotherapy, the overall prognosis for patients is still poor. In this study we characterized a syngeneic, orthotopic glioblastoma rat model based on the BT4Ca cell line for its use to test local treatment, either by direct injection into the tumor or after tumor resection into the resection cavity.

Methods: BT4Ca cells were stereotactically implanted into the prefrontal cortex of BDIX rats. In the first group (n= 22 rats) a guiding cannula was implanted aiming at the implantation site, followed by microinjection of vehicle (here 10% dimethylsulfoxid in phosphate buffered saline) every three days via the implanted guiding cannula. In the second group (n= 18 rats) the tumor was resected 8 days after cell injection and vehicle given into the resection cavity. A third group (n= 12 rats) with implanted tumor cells but without further manipulation served as control. Postoperatively the survival time and health conditions were scored for humane endpoint criterion. The tumor growth was histologically verified.

Results: Implantation of BT4Ca cells reliably induced fast growing tumors with a mean survival time of 16 days and a tumor induction rate of 94.2%. In all groups the health score and body weight only deteriorated 1-2 days before humane endpoint criterion. Implantation of a guide cannula and microinjection of vehicle did not affect the survival time. The survival time after tumor resection with concomitant local application of vehicle was similar to that of the control group (i.e., in mean 16 days after resection). The tumor histology was similar in all groups.

Conclusion: We here present a fast and robust intracranial rat glioblastoma model that could be used to test the anti-tumor effects of local therapeutic strategies aiming directly into the tumor or applied locally after tumor resection under standardized experimental conditions.

Iterative Analysis for the temporal decomposition of CVR dynamic Response in neurovascular patients

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Objective: The BOLD CVR response to a CO₂ challenge of neurovascular patients is clinically relevant and has a complex temporal dynamic. This neurovascular response-function differs greatly from the commonly used canonical HRF. Therefore, we present here a novel model-free iterative analysis for evaluating transient phase duration parameters describing BOLD fMRI signal dynamics during a monitored CO₂ pseudo-square wave challenge. We aim to optimize the CO₂ arrival time to increase sensitivity and reliability of cerebrovascular reactivity analysis, test for its clinical relevance on patient data and gain further pathophysiological insight.

Methods: The algorithm was done using datasets of patients with unilateral internal carotid occlusion and healthy Controls. BOLD-fMRI derived normalized maps of 25 healthy subjects in MNI standard space are combined for reference atlases of all BOLD-derived parameters to better assess alterations within a single subject. All subjects underwent a standardized CO₂ pseudo square wave increase of ± 10 mmHg of PetCO₂ from a calibrated baseline of ± 40 mmHg PetCO₂. The iterative algorithm was then applied to the data to calculate both the transient phase durations, temporal delay maps and dynamic and static CVR maps. We compared our algorithm to the state-of-heart methods used in the literature: maximum correlation method.

Results: BOLD time series vs CO₂ time series are presented with different CO₂ arrival times applied to the data. We determined the most optimal CO₂ arrival time and found that the parametric decomposition resulted in the best description of the physiological data for white and grey matter. The linear fit of the BOLD vs. CO₂ scatter plot shows that only our algorithm removes the transition phases between the two static states correctly. Our algorithm corrected the too long CVR response delay obtained with the maximum correlation method: WM: 40 s, GM: 10 s; to the more realistic delay of WM 18 s, GM: 2 s. The CVR maps obtained with our algorithm differs significantly from previous CVR maps obtained with not correct delays. The new parametric maps obtained have a good SNR and clinically plausible.

Conclusion: We determined the most optimal CO₂ arrival time and found that the parametric decomposition resulted in a better description of the physiological data for white and grey matter. The linear fit of the BOLD vs. CO₂ scatter plot shows clearly that only our algorithm removes the transition phases between the two static states correctly. Our algorithm corrected the too long CVR response delay obtained with the maximum correlation method: WM: 40 s, GM: 10 s; to the more realistic delay of WM 18 s, GM: 2 s. The CVR maps obtained with our algorithm differed significantly from previous CVR maps obtained with not correct delays. The new parametric maps obtained: DTP, DTB have a good SNR and clinically plausible.

Delayed malignant transformation of vestibular schwannoma after stereotactic radiation

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Objective: Casereport of delayed malignant transformation of a vestibular schwannoma 13 years after stereotactic radiation.

Methods: 13 years after stereotactic radiation of a left sided vestibular schwannoma (VS) (Koos II) a female patient showed acute clinical signs of increased intracranial pressure. Recurrence of VS was initially suspected as the cause of occlusive hydrocephalus.

Results: After stereotactic radiation in 2002 a stable disease was documented on regular MRI controls up to 2013. Since march 2015, the patient developed a left sided facial nerve paresis (HB°V) and vestibular dysfunction. MRI (04/2015) showed an increase in tumor size. A tumor resection was scheduled. The patient then rapidly developed signs of elevated intracranial pressure and brainstem herniation. cCT (06/2015) showed a dramatic increase in tumor size as compared to april 2015. Emergency tumor resection was necessary. Histopathology revealed a malignant peripheral nerve sheath tumor. The patient was scheduled for adjuvant therapy after 10 weeks of rehabilitation. MRI on readmission showed progressive residual tumor, necessitating a second surgery. Systemic chemotherapy (EVAIA protocol) in combination with radiation followed. The latest MRI follow up (08/2016) showed only residual contrast enhancement within the CPA and the petrosal bone, indicating stable disease.

Conclusion: Malignant transformation is an uncommon, but critical problem after radiation therapy. Several cases of malignant transformation of VS after radiotherapy have been reported and Seferis et al. (2014) calculated a 10 times elevated risk of malignant transformation of VS after radiation over a 20 year course. Although typical is a late incidence of the malignant transformation. Therefore and especially in younger patients who received stereotactic radiation of VS lifelong MRI follow up is necessary.

Hippocampal and cerebellar atrophy in patients with Cushings Disease

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Objective: Cushing's disease (CD) may cause atrophy of different regions of the human brain, mostly affecting the hippocampus and the cerebellum. This study evaluates the use of 3-T MRI of newly diagnosed patients with CD to detect atrophic degeneration with voxel-based volumetry

Methods: Subjects with newly diagnosed, untreated CD were included and underwent 3-T MRI. Images were analyzed using a voxelwise statistical test to detect reduction of brain parenchyma. In addition, an atlas-based volumetric study for regions likely to be affected by CD was performed.

Results: Nineteen patients with a mean disease duration of 24 months were included. Tumor markers included adrenocorticotropic hormone (median 17.5 pmol/L), cortisol (949.4 nmol/L), and dehydroepiandrosterone sulfate (5.4 µmol/L). The following values are expressed as the mean ± SD. The voxelwise statistical test revealed clusters of significantly reduced gray matter in the hippocampus and cerebellum, with volumes of 2.90 ± 0.26 ml (right hippocampus), 2.89 ± 0.28 ml (left hippocampus), 41.95 ± 4.67 ml (right cerebellar hemisphere), and 42.11 ± 4.59 ml (left cerebellar hemisphere). Healthy control volunteers showed volumes of 3.22 ± 0.25 ml for the right hippocampus, 3.23 ± 0.25 ml for the left hippocampus, 50.87 ± 4.23 ml for the right cerebellar hemisphere, and 50.42 ± 3.97 ml for the left cerebellar hemisphere.

Conclusion: Patients with untreated CD show significant reduction of gray matter in the cerebellum and hippocampus. These changes can be analyzed and objectified with the quantitative voxel-based method described in this study.

Extended Surgical Therapy of Glioblastoma multiforme in Elderly Patients

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Objective: Glioblastoma multiforme (GBM) is the most common and aggressive primary brain tumor. Demographic development has increased the rate of newly diagnosed glioblastoma multiforme in elderly patients (>65 years). The standard therapy of GBM includes surgical resection followed by a MGMT-promoter stratified adjuvant radio- or chemotherapy. The aim of this study was evaluate the functional and oncological outcome in elderly patients treated by different therapy strategies included surgical re-resection in the case of tumor recurrence.

Methods: This is a single-center retrospective analysis including all surgically treated GBM patients older than 65 years. Comprehensive data concerning overall survival, progression free survival, different treatment modalities, functional outcome (NANO) and Karnofsky index (KPI) have been collected and analyzed. Survival analysis was performed by Cox-regression model included a 10-fold cross-validation. The alpha-level was determined to 5% to achieve statistical significance with a power of 80%. Cut-off values for age depended deficits were calculated by ROC analysis and a logit regression model.

Results: A total of 128 elderly patients with glioblastoma multiforme have been evaluated. The median overall survival (OS) was 6.8 months with a median progression free survival 5.5 months. Mean age at diagnosis was 73.5 years and the mean postoperative KPI was 75. A total of 96 patients underwent surgical resection, whereas the remaining 32 cases had a stereotactic biopsy. The postoperative treatment included combined radiochemotherapy in 36 patients, chemotherapy alone in 10, radiotherapy alone 23 patients. The patients with combined radiochemotherapy had longer overall survival compared to those with either radio or chemotherapy alone (HR 0.1 p<0.01). Patients (n=28), who underwent more than one resection because of recurrent disease, had a significant longer overall survival compared to those, who had only one surgical treatment (HR 0.5 p=0.016). Multivariate analysis revealed gross total resection and combined radiochemotherapy as independent prognostic factors associated with significant longer OS. A logit regression model showed a significant increase of postoperative neurological impairment (NANO > 2) beyond the age of 78 years.

Conclusion: Surgical treatment of recurrent glioblastoma multiforme in elderly patients is possible and can result in good functional outcome with mean KPI of 75. Gross total resection followed by adjuvant radiochemotherapy can increase the progression-free and overall free of elderly patients. Elderly patients may profit from an extended surgical and adjuvant treatment with an acceptable functional outcome. Particularly with regard to an increased risk of postoperative deficits, surgical treatment needs to be carefully and individually evaluated in patients beyond the age of 78 years.

Multiphoton imaging of deparaffinized brain tissue sections

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Objective: Label-free multiphoton (MP) microscopy is a powerful tool to study tissue morphochemistry. Most often the experiments are performed on tissue cryosections or on fresh tissues, however the extensive availability of formalin-fixed paraffin-preserved (FFPP) tissues may provide a valuable number of samples for retrospective studies. The purpose of this study was to assess the effects of deparaffinization of FFPP sections and their feasibility for MP imaging.

Methods: 4 µm thick sections of mouse brain and 8 human brain tumors tissues (3 primary tumors and 5 metastases) preserved in FFPP blocks were prepared on glass or CaF₂ slides for MP microscopy and Raman micro-spectroscopy, respectively. MP microscopy, simultaneously acquiring Coherent anti-Stokes Raman scattering (CARS), two-photon excited fluorescence (TPEF) and second harmonic generation (SHG) signals, was applied and confirmed by Raman micro-spectroscopy. The FFPP sections were deparaffinized and rehydrated according to standard protocol, using Xylene as dewaxing agent.

Results: The MP images of different tissue samples were acquired providing the following observations: (i) The tissue morphochemical contrast available from CARS signal is based on different protein content, as lipids are washed away during deparaffinization. Depletion of lipids was confirmed by Raman spectroscopy (loss of spectral bands at 1130, 1300, 1440, 1668 cm⁻¹). (ii) TPEF and SHG signals provide additional chemical contrast for autofluorescent structures and collagen, respectively. (iii) The paraffin is never completely removed and gives strong CARS signal. Paraffin deposits can mainly be observed as separate droplets, clusters in and around blood vessels and accumulations in some cells. The insufficient removal of paraffin was confirmed by Raman spectroscopy (paraffin spectral bands in strong CARS active structures at 1062, 1133, 1295, 1439 cm⁻¹). (iv) Tumor borders can be distinguished from normal tissue due to morphological differences provided by MP signals.

Conclusion: Despite the loss of lipids and several paraffin artefacts the FFPP deparaffinized samples provide sufficient morphochemical information about brain tissue structures when investigated by MP microscopy. As long as the paraffin artefacts are corrected, MP microscopy opens a door for label-free imaging of historical FFPP brain tumors for extensive retrospective studies.

Cumulative surgical morbidity in patients with multiple cerebellar and medullary hemangioblastomas.

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Objective: Patients affected with von Hippel-Lindau disease frequently develop multiple hemangioblastomas of the central nervous system, predominantly of the cerebellum, brain stem and spinal cord. Timing of surgical intervention is difficult and depends largely on the anticipated surgical morbidity. However, data regarding surgical outcome after multiple cerebellar and medullary surgeries are scarce.

Methods: To investigate cumulative surgical morbidity in patients operated on multiple hemangioblastomas of the central nervous system and to deduce recommendations for treatment, we analyzed all patients with surgical treatment of at least two cerebellar and/or medullary hemangioblastomas at the University of Freiburg between 1996 and 2013. Pre- and postoperative functional grades were determined by Modified Ranking Scale (cerebellar surgeries) or by Modified McCormick Score (medullary surgeries).

Results: A total of 36 patients underwent surgeries for at least two cerebellar hemangioblastomas (12 patients), for at least two medullary hemangioblastomas (19 patients) or for at least two hemangioblastomas in both locations (5 patients). All together 48 cerebellar and 80 medullary procedures were performed. Regarding cerebellar hemangioblastomas, postoperative functional grades determined by Modified Ranking Scale improved after 9 and remained stable after 39 out of 48 performed surgeries without one case of deterioration. Regarding medullary hemangioblastomas, postoperative functional grades determined by Modified McCormick Score improved after 3, remained stable after 54 and deteriorated after 23 out of 80 performed surgeries. The severity of deterioration did not increase with the number of performed medullary surgeries.

Conclusion: Resection even of multiple cerebellar hemangioblastomas is not associated with cumulative morbidity. Although there is a certain surgical morbidity caused by medullary surgeries, yet its extent does not increase with the number of performed surgeries. Microsurgical removal of asymptomatic tumors with radiographic progression should also be considered in patients with multiple tumors and previous surgeries.

A new model for the determination of glioblastoma cell Invasion reveals that carnosine inhibits Infiltration of tumor cells into patient derived fibroblast culture

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Objective: Carnosine (β -alanine-L-histidine) reduces the growth of glioblastoma cells in culture. Here, we investigated the specificity of the anti-neoplastic effect on proliferation and migration comparing glioblastoma cells and patient derived fibroblasts. In addition, we developed a culture model to analyze the migration of tumor cells into normal tissue.

Methods: Patient derived fibroblasts (FB) (13 cultures) and primary glioblastoma (GBM) cells (8 cultures) were cultivated in medium with different concentrations of carnosine. After 48 hours viability was assessed. Co-cultures were created using 12 well plates and cloning rings, placing GBM cells inside and patient derived FBs outside the cloning ring. Then, cultures were incubated in the absence or presence of carnosine for 3 weeks after which cells were stained. Colony formation and area occupancies of FBs and GBM cells were analyzed by microscopy and quantified using ImageJ.

Results: Both, FBs and GBM cells, respond to increased concentrations of carnosine with a reduced production of ATP although the effect was less pronounced in FBs (50 mM: FB: $95.3 \pm 5.4\%$; GBM: $88.3 \pm 8.2\%$; 75 mM: FB: $85.1 \pm 5.8\%$; GBM: $71.3 \pm 6.8\%$). A comparable observation was made by measuring dehydrogenase activities (50 mM: FB: $87.9 \pm 4.4\%$; GBM: $81.2 \pm 7.1\%$; 75 mM: FB: $78.8 \pm 5.0\%$; GBM: $61.8 \pm 4.8\%$). Co-culture experiments revealed that carnosine strongly inhibited the formation of tumor cell colonies within the fibroblast layer (85.8 ± 50.5 in the absence of carnosine) compared to 46.6 ± 26.4 (10 mM), 28.8 ± 4.0 (25 mM) and 1.25 ± 0.5 (50 mM). The tumor cell covered area was reduced from $13.4 \pm 3.9\%$ (no carnosine) to $7.7 \pm 2.5\%$ (10 mM), $6.0 \pm 3\%$ (25 mM) and $3.1 \pm 3.2\%$ (50 mM).

Conclusion: Although viability of FBs was reduced by carnosine the effect on GBM cells was more pronounced. More importantly, the dipeptide significantly inhibited colony formation and migration in a fibroblast co-culture model leading to a reduced number of tumor cell colonies without affecting fibroblast growth even at a concentration of 10 mM carnosine. Therefore, we assume that the long-term exposure to carnosine may strongly inhibit the occurrence of recurrent tumors if it would be possible to apply it directly into the excision cavity of surgically treated glioblastoma patients to prevent outspread of remaining tumor cells into the surrounding tissue.

In addition, the co-culture model presented can be a valuable tool for the analysis of drugs considered for the therapy of glioblastoma.

Perioperative neuropsychological screening with Montreal Cognitive Assessment (MoCA) in patients with brain tumors - Feasibility, Acceptance and first Results.

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Objective: Neuropsychological test batteries are time consuming. However, evaluating neurological outcome of brain tumor surgery involves assessment of neuropsychological status. The aim was 1) to test feasibility and acceptance of the German version of the Montreal Cognitive Assessment (MoCA) in patients with brain tumors perioperatively with regard to practicability of the test for neuropsychological screening and 2) to compare results in MoCA perioperatively.

Methods: We assessed patients with supratentorial located brain tumors preoperatively (preOP, day -1) and postoperatively (postOP, day 3-5) applying the EORTC-QLQ-C30 + BN20, Distress Thermometer (DT), NIHSS and the MoCA test (different versions). The MoCA consists of 8 domains, adding to a total number of 30 points (cut-off score for normal results = 26/30). We evaluated feasibility to implementing the test in clinical routine by assessing, inter alia, time needed to complete the questionnaire, difficulties experienced by the patients during the testing and potential disturbing factors. Additionally, patients were asked about perceived complexity of MoCA, possible discomfort and overstraining due to the testing.

Results: The study included 56 patients, 20 were male. Mean age was 57 years (range 23-81 years). Most represented diagnoses were brain metastases (29%), glioma (41%), followed by meningioma (18%). Mean completion time preoperatively was 11.14 min and 11.10 min postoperatively (range 6-26 min). Postoperatively implementation of MoCA testing resulted to be slightly more challenging as in 21.8% of the assessments by MoCA "severe" difficulties occurred vs. 14.0% preOP. MoCA test was well accepted: pre- and postoperatively the majority of the patients (preOP 93%, postOP 89%) negated to feel uncomfortable or overstrained by the screening test, however, preoperatively more patients indicated being distracted (42%) than postoperatively (33%). The result of the MoCA test was postoperatively significantly worse (preOP mean=22 vs. postOP mean=19, $p=0.001$, Wilcoxon). However, preOP and postOP (72% vs. 79%) most of the patients scored ≤ 26 points, although patients who preoperatively declared to have recognized cognitive issues scored lower than those who denied such problems (preOP mean=20 and postOP mean=17 vs. preOP mean=23 and postOP mean=20).

Many patients had problems with regard to memory skills (preOP 2.2 words and postOP 1.5 words out of 5 could be memorized), whereas most patients maintained good temporal and spatial orientation, however decreasing postOP (preOP 88% answered correctly ≥ 5 questions out of 6 regarding temporal and spatial orientation and postOP 79%).

Conclusion: The MoCA test was well accepted by the patients and implementable in clinical routine. Further investigations with regard to reliability and predictive power of MoCA are required.

Massive activation of various angiogenic signaling pathways in sporadic and hereditary hemangioblastoma.

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Objective: Hemangioblastoma (HB) is a rare benign tumor (WHO grade I), located mainly in the brain and the spinal cord. This tumor is classified as either sporadic HB (70-75%) or von Hippel-Lindau disease (VHL)-associated HB. VHL disease is an autosomal dominant disorder caused by germline mutations of the VHL gene. Missense mutations of the VHL gene are also present in sporadic HB and in renal cell carcinoma. The tumor is composed of 2 major components including neoplastic stromal cells and abundant microvessels. Thus, hyper-vascularization is the hallmark of this tumor. Despite the identification of germline and/or epigenetic mutations of *VHL* gene as an important pathogenic mechanism of HB, little is known about the molecular signaling involved in this highly vascularized tumor. The present study was aimed to further explore angiogenic signaling in sporadic and hereditary HB.

Methods: We investigated the key players of multiple angiogenic signaling pathways including VEGF/VEGFR2 (Vascular endothelial growth factor/ - receptor 2), EphB4/EphrinB2 (Ephrin receptor B4/ ligand EphrinB2), SDF1 α /CXCR4 (Stromal derived factor-1 α / receptor CXC-motif chemokine receptor4) and Notch/Dll4 pathways in surgical specimens of 22 HB. Nineteen patients suffered from sporadic HB and three cases had a VHL-associated tumor. The expression of key angiogenic factors was detected by RT²-PCR and Western blot. Immunofluorescent staining was performed to illustrate the cellular localization of these proteins.

Results: We demonstrated a massive upregulation of mRNA level of VEGF and VEGFR2, CXCR4 and SDF1 α , EphB4 and EphrinB2 as well as the main components of Dll4-Notch signaling in HB. There was no significant difference in the expression of these genes between sporadic HB and VHL-associated HB, except for HIF1 α . The "fold of change" for HIF1 α mRNA was 5-fold higher in VHL-associated HB than in sporadic HB. An increase in the protein expression of VEGF, CXCR4 and the core-components of Dll4-Notch signaling was associated with an activation of Akt and Erk1/2 and accompanied by an elevated expression of PCNA. Immunofluorescent staining revealed the expression of VEGF and CXCR4 in endothelial cells as well as in tumor cells. Dll4 protein was predominantly found in tumor cells, whereas EphB4 immunoreactivity was exclusively detected in endothelial cells.

Conclusion: We conclude that multiple key angiogenic pathways were activated in HB, which may synergistically contribute to the abound vascularization in this tumor. Identification of these aberrant pathways provides potential targets for a possible future application of anti-angiogenic therapy for this tumor, particularly when a total surgical resection becomes difficult due to the localization or multiplicity of the tumor. To further enlighten the molecular differences between sporadic and hereditary HB, a higher number of hereditary cases is necessary.

Cerebellar liponeurocytoma - molecular signature of a rare entity and the importance of accurate diagnosis

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Objective: Cerebellar liponeurocytoma is a rare tumor of the cerebellum histologically characterized by advanced neuronal/neurocytic differentiation with focal lipidization. It typically develops in adults, and shows low proliferative potential. Recurrences have been reported in almost 50 % of cases, in most cases without histological features of malignant progression. But in contrast some tumor recurrences also show increased proliferative and mitotic activity. The WHO classification therefore assigns the cerebellar liponeurocytoma to WHO grade II. To date, less than 40 cases have been reported. Pathological diagnosis of cerebellar liponeurocytoma remains challenging with many tumors misdiagnosed for histologic mimics with high-grade character. The presented case highlights the main clinical, radiographic and pathological features.

Methods: We report the case of a 59-year-old woman and describe the perioperative course and performed a detailed analysis of the molecular signature. We embedded our results in the available literature about cerebellar liponeurocytoma and discuss this case and the results in the light of the new WHO classification.

Results: A 59-year-old German woman presented at our department with a short history of persistent headache, vertigo and gait disturbances. Magnetic resonance imaging (MRI) showed a cerebellar tumor with positive gadolinium (Gd) enhancement in T1. The tumor was completely removed via a median suboccipital craniotomy opening of the foramen magnum. The early postoperative MRI did not detect any tumor remnants. The histological examination confirmed the diagnosis of a cerebellar liponeurocytoma WHO Grade II. To this date the patient did not receive any adjuvant treatment. The further pathological work up confirmed a negative 1p19q codeletion, a proliferative index of 5 %, GFAP positivity and MGMT promotor negativity. There was no IDH 1 Mutation in Codon 132. Further Illumina Human Methylation 450 (450k) Array was performed without any trendsetting chromosomal aberrations.

Conclusion: Medulloblastoma with lipidized cells is the most important differential diagnosis. The adipose tumor cells may also show a typical clustering comparable to liponeurocytoma. But a growth fraction of 15-40 % is not compatible in newly diagnosed liponeurocytoma. Knowing the fact that proliferative indices of up to 20 % were also shown in very few primary and recurrent liponeurocytoma. In addition genetic analysis revealed liponeurocytoma as a distinct tumor entity without a relation to medulloblastoma. The presence of TP53 mutations suggests they develop through different genetic pathways compared to neurocytoma also the cDNA expression profiles showed a relationship to this entity. The importance of accurate diagnosis should not be underestimated because of possible further therapeutic interventions and determination of the patient's prognosis.

CT-morphometric-analysis of C2 to evaluate the "safety zones" for anterior transarticular screw placements

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Objective: To measure anatomical variations in critical passages of C2 for the placement of anterior transarticular screws through C1/C2 compared to odontoid and posterior screw placement.

Methods: 50 CT data volume scans of the cervical spine were anonymously analyzed with a total of 750 measurements of C2. Angulation of the entry trajectories were assessed as well as 14 bilateral defined distances that allow to define „safe entry“ zones for the screws and their passages either into the odontoid process or transarticular through C1/C2.

Results: The angulation for an odontoid screw placement is much shallower than for the transarticular passages (24.9° vs. 39.1° and 40.5°, respectively) allowing screw placement easier even in short-neck or barrel-thoraces. While the isthmus of C2 was as narrow as 4.1mm (r) and 4.2mm (l) on average, respectively, the anterior entry zone for screw placement was between 9.7mm (r) and 10mm (l) with a length distance of 7.8mm (r) and 8mm (l) towards the vertebral artery. Length of the massae laterales was approximated with 14.6mm (r) and 14.3mm (l).

Conclusion: Our data show that the trajectory employed for transarticular screw fixation of C1/C2 is much steeper than for odontoid screw placement, suggesting a more convenient application especially in short-necked and/ or high BMI patients. The „safety zones“ in our series are more generous for the anterior screw placement with respect to the course of the vertebral artery compared to the passage of posteriorly placed screws. Hence, from an anatomical point of view the anterior transarticular screw placement bears more convenient and safer routes for the implants than the odontoid screw placement of posterior fixation.

Intraoperative Arterial Spin Labeling- Technical considerations and first results

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Objective: Intraoperative magnetic resonance imaging (MRI) is a unique tool for visualizing structures for resection control during brain surgery. Arterial Spin Labeling (ASL) might be a method allows for visualizing cerebral perfusion without any external contrast injection. The goal of this study is to present and to evaluate the use of ASL in an intraoperative setting and also to compare the results to routinely performed (contrast-enhanced) structural imaging.

Methods: In this study the same scanners were used (all from Philips Healthcare, Best, Netherlands). Pseudo-continuous ASL (pCASL) was used and CBF quantified as ml blood/min/100g brain tissue. Both the imaging protocol and quantification model used were taken from. Data was obtained on currently six patients (3 male, 3 female, mean age = 59.2 years) suffering from glioblastoma multiforme who underwent pre-, intra- and postoperative imaging according to the local standard of care with ASL performed additionally. The results from ASL regarding the possibility to visualize residual tumor mass during and after surgery were directly compared to contrast enhanced structural imaging.

Results: In four out of six patients the same results could be obtained (two had total removal, two residual tumor mass). In one patient structural imaging data was first false-positively misinterpreted. Here, a partial-volume effect of an artery was interpreted as residual tumor mass, but the result was later changed without taking the information from ASL into consideration. On the ASL data no uncertainties occurred in this case. In a second patient no residual tumor was identified on the structural images, but ASL showed an area of elevated perfusion. The results from structural imaging were then amended and concluded that there is in fact residual tumor mass.

Conclusion: The currently obtained data appears promising to use ASL routinely for intraoperative perfusion imaging. As ASL data allows to be quantified in absolute values, a comparison between different scanners and equipment can be performed straight-forward. The presented data obtained on patients shows that ASL allows for delineation of tumors in concordance with contrast-enhanced structural imaging sequences. In one case, ASL was even superior to structural imaging alone, changing the final diagnosis of the patient.

Preliminary clinical results with the new Codman Certas Plus valve

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Objective: CSF shunting always carries a risk of clinical complications. Despite development of adjustable and gravitational valves, the problem with over- and underdrainage is still present. The perfect balance between a sufficient CSF drainage and the complete prevention of overdrainage could not be implemented in a shunt system so far. In this series, the new adjustable Codman Certas Plus valve with an integrated anti-siphon device was tested. Main focus was on the performance and the early clinical results.

Methods: Between July and October 2015, the Certas plus valve was inserted during first-time shunting in 14 cases. Patients were postoperatively observed up to November 2016. The cohort consisted of 6 females and 8 males. The mean age was 76.6 years. Etiology of hydrocephalus was idiopathic in 8, and malresorptive in 6 patients. The intraoperative handling of the valve, the postoperative clinical course, valve adjustments and clinical complications were analyzed.

Results: Intraoperatively, no problems or restrictions during catheter or valve implantation occurred. The mean operation time was 46.2 ± 11.9 min (range: 24 – 64 min). All intended valve settings could be confirmed in the postoperative x-ray series. In all patients, a total of 10 valve adjustments for various reasons were performed. These adjustments were without any restrictions and always evaluated as very simple. During the postoperative course, 7 patients reported an improvement of former symptoms while 3 patients felt unchanged. A clinical deterioration occurred in 4 patients due to shunt-dysfunction (1/4), shunt infection (1/4) and overdrainage-associated subdural hygroma (2/4). Revision surgery with valve exchange (1/4), shunt explantation (1/4) and evacuation of subdural hygroma (2/4) followed.

Conclusion: The good intraoperative handling and the very simple adjustability represent benefits of the new valve. The occurrence of early overdrainage with subdural hygroma requires further analysis. In both patients, a low valve setting (Performance level 3) was chosen during insertion. However, this setting corresponds to a pressure level of about 80 mmH₂O. The patients with an initial performance level of 4 or higher (n=9) improved or felt unchanged in the short-term course. To verify reproducibility and regularity of this phenomenon higher case numbers are required.

Development of fluorescent dyes for the detection of DNA sequences in cell lines of malignant gliomas

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Objective: Optical imaging that exploits invisible fluorescent light offers several advantages for image-guided surgery, including highly sensitive and specific detection of tumors in tissue and real-time imaging. We are developing fluorophores targeted specifically to human cancer and normal structures. If translated to the clinic, these targeted fluorescent contrast agents would widen the spectrum to resect malignant tumors under direct visualization while avoiding healthy brain tissue.

Methods: Fourteen substances were synthesized with chemical structure similar to 4'-diamidino-2-phenylindole (DAPI), as a fluorescent dye, used in fluorescence microscopy for labeling of DNA. Solvents were phosphate buffered saline (PBS), methanol, ethanol and dimethyl sulfoxide (DMSO). Glioblastoma cell lines were grown for three days, to achieve an 80% occupancy of the slide. For fixation of the cells we used 4% paraformaldehyde (PFA) with fixation time of 12.5 minutes. Incubation time for staining of the cells was 15 minutes. The cells were then washed three times for 5 minutes each with PBS. Subsequently, cell lines were observed under microscope with DAPI filter and photographed for fluorescence.

Results: Three substances were not dissolved in the used solvents. They appeared extracellularly as fluorescent crystals. The remaining substances diffused into the nucleus, bound to AT-rich regions and led to fluorescence on chromatin. Maximum fluorescence was reached for the corresponding substances in different concentrations. Fluorescence of chromatin was strongest with 1-benzyl-2-(4-bromophenyl)-1H-indole, 2-(4-benzylphenyl)-1H-indole, ethyl-5-chloro-3-formyl-1H-indole-2-carboxylate, 5-bromo-2-(4-bromophenyl)-1H-indole, 2-(4-bromophenyl)-5-methyl-1H-indole und 3,3'-dicianomethyl-2,2'-diethoxycarbonyl-bis-(1H-indole-5-yl)-methane.

Conclusion: Eleven of the manufactured and investigated fourteen substances show good diffusion through the cell and nuclear membrane. Six compounds showed strong fluorescence properties upon binding to DNA in the nucleus. These substances will now be further developed.

Perforated brain injuries during routine sinonasal surgery

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Objective: Routine Sinonasal surgery is widely practiced and is considered as save procedure. Skull base injuries related to this surgery occur in less than 1% and their most frequent manifestation is rhinorrhea. Brain injuries have been reported only extraordinary. Here we present a series of four patients with iatrogenic brain injuries after routine sinonasal surgery.

Methods: Four patients with penetrating skull base fractures after routine sinonasal surgery and subsequent brain injury were identified within a 10-years period. Procedures performed were endoscopic sinus surgery in three patients and microscopic sinus surgery in one patient.

Results: There were three men, and one woman. Mean age at surgery was 50 years (range 28-66 years). All operations had been performed under general anesthesia. In three instances (in which an endoscope was used), the ENT physician had noted the perforation of the skull base during the surgery, but it went unnoticed in one patient operated with microscope. In two patients the cribriform plate was perforated, and in the other two patients the perforation canal was through the ethmoidal roof. The frontal lobe injured by blunt instruments. Hemorrhagic lesions were present in all instances, and in 3 patients infarction related to the injury of branches of the anterior cerebral artery occurred. Two patients with a vascular injury developed an acute global brain edema and succumbed despite maximal surgical and non-surgical treatment. The other two patients survived with minor neurological deficits.

Conclusion: Brain injury secondary to sinonasal surgery is rare but presumably underreported. While sometimes brain injury might even not be noticed in the intra- and postoperative setting, it might also result in catastrophic outcome. Associated vascular injuries harbour a dismal prognosis.

Melanoma and Melanotic Schwannoma: A Challenging Histological and Clinical Distinction

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Objective: Melanotic schwannoma (MS) is a very rare neoplasm composed of Schwann cells with the capacity of melanogenesis. Here we report the case of a 32-year-old woman with a 2-year history of intermittent thoracic and upper abdominal pain. An intra- and paraspinal, extradural mass Th10-Th12 was found on MRI and the patient underwent surgical resection of this mass.

Methods: Intra- and paraspinal resection of the tumor was performed. The infiltrated Th11 nerve root was resected as well as the facet joints of Th10/11 and Th11/12 and the rib head of Th11. A transpedicular stabilization and posterior spondylodesis Th10-Th12 was performed. Gömöri reticulin stain and immunohistochemical examination with the melanocytic marker, PanMela and S100 was obtained, as well as a LNA-PCR to detect point mutations in the V600 region of *BRAF*.

Results: Histological examination revealed a reticulin-rich melanotic S100 positive tumor with extensive pericellular depositions. A malignant melanoma could not be formally excluded, however the tumor had the morphological appearance of a melanotic schwannoma.

Conclusion: Even to date, the histological diagnosis of MS is challenging due to a lack of specific markers that distinguish the entity from melanoma. Since the distinction between melanoma and melanotic schwannoma is clinically relevant, reticulin stain or immunostaining with laminin and collagen IV should be performed on a regular basis in these cases.

A case of isolated angiitis of the central nervous system mimicking a malignant tumor

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Objective: Isolated angiitis of the brain is a severe but rare disease. MRI, angiography and biopsy are often required for the diagnosis. There are reports about cerebral vasculitis lesions mimicking malignant brain tumors.

Methods: We describe a case of a 61-year-old patient that presented with speech arrest and focal epileptic seizures. MRI scan showed a contrast enhancing lesion in the left frontal lobe with perifocal edema. 1[F]-FET-PET detected an increased tracer uptake (with a tumor/brain ratio of 2,8) suspicious for a high grade glioma. Surgery was planned and, due to the eloquent location of the tumor, performed as an awake craniotomy. The lesion, showing clear 5-ALA induced fluorescence, was resected completely.

Results: Histopathological examination confirmed the diagnosis of a lymphocytic vasculitis with transmural infiltration and necrosis. After recovering from a reversible aphasia and SMA-triggered hemiparesis within the first postoperative week, the patient underwent further medical therapy after complete wound healing

Conclusion: The radiologic diagnosis of an isolated angiitis of the central nervous system presents a challenge. Even with the adjunct of 18-[F]-FET-PET to standard preoperative MRI the lesion was interpreted as a malignant tumour. This case report underlines that inflammatory lesions like vasculitis might mimick malignant brain tumors. Histological diagnosis is crucial to lead the patient to adequate therapy.

Complete resection as the only option? Impact of the molecular tumor pattern following subtotal resection

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Objective: The survival benefit of a complete resection of the contrast-enhancing malignant glioma tissue has clearly been demonstrated. Recently, molecular pattern, mainly MGMT promotor methylation and IDH1 mutation gained more importance within the decision-making process of the therapy. As prognostic markers, in patients with a favorable molecular constellation overall survival is improved. However, it is not known, whether a favorable molecular constellation can compensate the disadvantage of subtotal resection. Therefore, here we analyzed the progress of residual tumor tissue depending from the molecular tumor status.

Methods: In this retrospective analysis we included (1) primary glioblastoma patients (2) with postoperative residual tumor tissue (3) who were treated according to STUPP scheme (4) at our neurooncological department. Molecular data were correlated with clinical data and survival.

Results: Between 2010 and 2015, 177 primary glioblastoma patients were treated in our department. In 78 patients (median age 60 years, f= 31, m=47, eloquent tumor location n=65), residual tumor was described in the early postoperative MRI control. MGMT promotor methylation was positive in 30, negative in 36 and unknown in 12 patients. The vast majority was IDH1-negative (98.7%). Median overall survival (OS) as well as progression free survival (PFS) was significantly increased in patients with positive MGMT promotor methylation (14 months for MGMT-methylated patients vs. 10 months for MGMT neg; p =0.06; PFS: 10.8 months vs. 6.8 months; p =0.05) Next to MGMT status, residual tumor size as well as tumor location was identified as being prognostic relevant: Patients with residual tumor volume < 1,5 cm³ (median OS 13 months; median PFS: 8 months; p =0.4) and patients with a tumor location within the temporal lobe (median OS 14 months; median PFS: 11 months; p =0.5) had a favorable outcome.

Conclusion: Our data confirm the impact of MGMT promotor methylation, residual tumor size as well as tumor localization on survival. Although there might be a benefit, the adjuvant therapy cannot control the residual tumor and the total resection should remain the gold standard.

Tumor on a string: Mobility of an intradural, extramedullary paraganglioma. Report of a case.

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Objective: Certain types of spinal intradural extramedullary tumors may spontaneously change their position with regard to their respective spinal level. In a case report with literature review performed in 2010, twenty published cases of "migrated" intraspinal schwannoma were identified within the literature [1]. In addition to these schwannoma cases, they also found one case of ependymoma and one case of neurenteric cyst. Paraganglioma has not been reported in this context until now.

Methods: A 57 Years old, male patient presented with glutealgia and pseudoradicular bilateral leg pain. The outpatient MRI showed an intraspinal, homogeneously contrast-enhancing tumor, which was considered to be a schwannoma. The tumor had a size of 24x8x12mm and was located at LW 1/2. At the time of surgery, the MRI dated 28 days.

Results: After laminectomy of LW 1, the tumor could not be found intraoperatively despite detailed intradural inspection. After X-ray reconfirmation of the correct operation-level, the intervention was aborted. Another contrast-MRI was performed the following day. The Laminectomy at LW1 was visible as expected. The tumor, unchanged in size, configuration or contrast-enhancement, now resided at LW2/3. The measured drift in caudal direction totaled 43mm. A second operation at the same day concluded with a successful complete resection via LW2-laminectomy. Intraoperatively, the tumor showed some adherence to a structure considered to be a fascicle accompanied by a small arterial vessel, but was otherwise mobile. The histopathologic result presented a paraganglioma, WHO I.

Conclusion: Spine imaging, even when considered "up-to-date", does not provide guarantees for correct operation levels in intradural tumors. This is especially true for, but not limited to spinal intradural schwannoma.

[1] Soo-Beom Kim et al: Mobility of Intradural Extramedullary Schwannoma at Spine: Report of Three Cases with Literature Review. J Korean Neurosurg Soc 47: 64-67, 2010

Surgery as part of a multimodal therapy in a rapid progressive extraosseous Ewing sarcoma of the cervical spine

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Objective: Primary extraosseous Ewing sarcomas (EESs) are an extremely rare pathological entity. Less than 32 cases have been reported in the literature. Here we report an uncommon case with very rapid progression in the cervical region with extra- and intradural involvement.

Methods: Case presentation.

Results: A previously healthy 29-year-old man complained of right-sided radiculopathy (C7). Magnetic resonance imaging showed an enhancing foraminal, sandglass shaped neurinoma-like lesion. Surgery revealed an intra- and extra-dural lesion, which was histologically diagnosed as Ewing sarcoma. Despite gross total resection, there was a massive symptomatic tumor recurrence within 6 weeks. A second gross total resection was realized. The patient was treated according to the EURO E.W.I.N.G.-Protocol (VIDE) and recovered very well (progression-free interval during therapy). Several decompressive re-surgeries were realized with adjuvant radio-chemotherapy. At the last follow-up (17 months after initial surgery) the patient was in remission with a good quality of live.

Conclusion: This case is to illustrate that despite extensive therapeutic efforts, the progression-free survival in case of primary EES may be very short. To maintain neurological function and good quality of live as long as possible, a multimodal strategy with surgery and chemo-, radiotherapy seems to be adequate.

Bilateral duplication of superior cerebellar artery with double helix "DNA-like" morphology

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Objective: although SCA is the most constant vessel feeding the cerebellum, several anatomical variations are described. Origin from P1, duplications, triplications are well known alternative patterns. We report a case of bilateral duplication of the superior cerebellar artery associated with double helix morphology of the proximal S1 segment.

Methods: A 45-years-old male patient underwent digital subtraction angiography to investigate the suspect of an incidental basilar tip aneurysm.

Results: A complete right vertebral dominance, usual ipsilateral pica and aica morphology as well as a left sided convexity characterized the proximal two third of the basilar artery. The left vertebral artery served terminated directly with the ipsilateral pica. Between the distal two third of the artery was noted an almost 90° change of direction of the vessel in dorsal direction. In this portion the angiogram confirmed the presence of a broad neck aneurysm with rostral projection. Distally on the posterolateral portion of the trunk originated bilaterally duplicated SCAs. Those showed "DNA-like" double helix morphology bilaterally. The basilar artery terminated with two usual P1.

Conclusion: Unusual DNA-like morphology of the SCA to our knowledge has never been described in the literature. This can't be explained with secondary modifications of the vessel's morphology due to hypertonia-related elongation and coiling. Variations in the formation of the dorsal carotid division represent the results of the pattern described.

Chemokine secretion and glykom profile of murine neuron-glia co-cultures influences neuronal vitality and neurite branching after exposure to supraparamagnetic iron oxid nanoparticles

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Objective: Superparamagnetic iron oxide nanoparticles (SPIOs) have been used as contrast agents in magnetic resonance imaging (MRI) and are of special interest for diagnostic and therapy of central nervous system (CNS) diseases. Currently, particular focus lies on the use of SPIOs to specifically influence neuronal regeneration after injury due to their unique composition, including size, surface coating and charge. The resulting increased interaction with and accumulation by brain cells make them ideal tools to act at the molecular level. Therefore, we investigated the cytokine/chemokine secretion profile responsible for SPIO-induced neurite outgrowth and started to analyze the changes in the glykomprofile of the extracellular matrix after SPIO treatment.

Methods: Microglia and astrocytes from C57Bl6/J pups (P0-P2) and hippocampal neurons from mice embryos (E18) were cultured separately and in a co-culture. Very Small Iron Oxide Particles (VSOP-R1/-R2), differing in size or the clinically proven polymer coated Resovist® (Bayer Schering Pharma AG) or Feraheme® (AMAG Pharmaceuticals, Inc.), were added at 0,5mM for 24 hours. Screening for increased cytokine/chemokine levels was performed using a Proteome Profiler Mouse Array (Cat. ARY006, R&D Systems) and quantification with a micro-plate reader. For the glykom analyses we used High-performance liquid chromatography and mass spectroscopy.

Results: Previous results showed that SPIOs induce degeneration of primary neurons, but stimulate neurite outgrowth in neuron-glia co-cultures in a particle- and concentration-dependent manner. SPIOs modify and activate growth promoting intracellular signaling pathways in primary neurons in different cell cultures and we identified different chemokins that responded to SPIO treatment. We obtained different glykom profiles depending on cells involved in our culture.

Conclusion: VSOPs, Resovist® and Feraheme® have so far not been thoroughly reviewed in terms of interactions with CNS tissue and potential adverse effects. Our experiments show, that there are considerable interferences between primary murine CNS cells and applied SPIOs as well as differences for the evaluated SPIOs. We just start to shed light on the influence of SPIO's on intracellular signaling cascades. The analysis of particle interactions and subsequent effects substantially contribute to the assessment of chances of SPIOs for the regeneration of spinal cord injury and limits in applications of SPIOs for diagnostics (e.g. MRI) in humans.

Impact of treatment on survival in patients with secondary glioblastoma

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Objective: Data concerning treatment outcomes of secondary glioblastoma evolving from previously treated WHO II or III grade tumors are very scarce. The aim of this study was to evaluate the impact of surgical resection and adjuvant treatment on survival in patients with secondary glioblastoma.

Methods: We retrospectively analyzed 39 patients with secondary glioblastoma that were treated between 2004 and 2015. The effect of extent of resection, pathological parameters and adjuvant treatment on progression-free and overall survival was evaluated.

Results: Primary tumor grade was WHO II in 16 (41.0%) and WHO III in 23 (59.0%) patients. Median age was 43 years (range 23-67). Median Karnofsky performance score (KPS) before surgery was 80 (range 60-100) and 70 (range 50-100) after surgery. Gross total resection (GTR) of contrast enhancing disease was achieved in 19 (48.7%) patients. Adjuvant treatment was radio-chemotherapy in 23 (59%), radiotherapy in three (7.7%), chemotherapy in five (12.8%) and none in eight (20.5%) patients. Median survival was eleven months (range 1 - 35) in the entire group. Time since initial diagnosis and previous treatment did not correlate with survival after glioblastoma. Failed GTR, poor KPS after surgery and no adjuvant treatment were prognostic factors for shorter survival in univariate analysis ($p < 0.0001$, $p = 0.028$ and $p = 0.001$ respectively).

Conclusion: In selected patients, complete resection and adjuvant treatment may prolong survival in spite of multiple previous therapies.

Codman-Hakim programmable valve dysfunction after using VPV Programmer

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Objective: The authors report a rare case of detachment of the pressure control cam in Codman-Hakim programmable valve (CHPV) after using the valve position verification (VPV) Programmer.

Methods: A 6-year old girl came to our hospital for a preplanned abdominal catheter revision due to growth. The ventriculo-peritoneal shunt system with CHPV system was implanted because of a posthaemorrhagic hydrocephalus after prematurity. There were no clinical symptoms of shunt dysfunction in the examination and no reports of headache or nausea in the past. Routine radiography after performing a 1.5-T MRI scan on the same day showed the CHPV with normal appearance. Because a different pressure-level was documented we readjusted the CHPV using the Codman VPV Programmer. The radiography after adjustment showed a dislocation of the pressure control cam.

Results: After the explantation and replacement a careful examination of the CHPV did not reveal any sign of destruction of the plastic housing of the valve while a complete detachment of the pressure control cam from the base-plate in the valve system was observed. The detachment caused the cam to move away from the flat spring that normally presses down the valve ball resulting in an obviously dysfunctional valve. In the interview of the patient and the mother none of them could remember a previous trauma causing a mechanical impact on the valve. There are few case reports about loosened pressure cams after some form of mechanical shock and a single report after a 3-T MRI scan. In these cases a breakage of the plastic housing was observed. According to the authors knowledge this is the first reported case of a detachment of the pressure control cam in CHPV after using the VPV Programmer. A traumatic damage in the past could not be ruled out completely but seemed unlikely in respect of the anamnesis and the described findings. The radiography was performed after the MRI scan and showed a regular configuration of the valve but a changed pressure level implying a normal function.

Conclusion: Dislocation of a pressure control cam in CHPV is a rare condition. The authors report this case of CHPV dysfunction after using VPV Programmer to encourage a dialogue if there are any similar cases known. In that case some considerations about prophylactic resetting CHPV to the former pressure level after MRI without previous radiography should be made.

Impact of inflammation and Staphylococcus infection on survival of glioblastoma patients

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Objective: It is still a prevalent assumption that a postoperative infection may confer a survival advantage in patients with glioblastoma multiforme. The neurosurgical literature contains some anecdotal reports of patients with malignant gliomas who experienced prolonged overall survival after a bacterial infection. This association has been analyzed before in two single-center studies in glioblastoma patients with postoperative infections, but with controversial results. We examined the impact of postoperative inflammation with or without bacterial infection on outcome in patients with glioblastoma.

Methods: A single-center analysis of patients with newly diagnosed primary glioblastoma treated from January 2004 to December 2015 has been performed. A total of 334 patients were examined. Twenty four patients (7.2%) had postoperative complications in terms of inflammation; out of these fifteen (62.5%) had a bacterial infection, ten (41.7%) with Staphylococci. Survival differences in comparison to a control group were evaluated using Kaplan-Meier curves. Other prognostic factors were analyzed in a Cox proportional hazards regression model.

Results: The selected sample was represented by 79 patients (50 men, 29 women; mean age 63 years, range 30-83). The median survival was 9 months (95% confidence interval, 6.8 -11.2 months). The inflammation group and Staphylococcus group had significant advantages in the median survival: 11 months (95% CI, 6.2 -15.8, log-rank test $p=0.028$) and 14 months (95% CI, 6.3 -27.9, log-rank test $p=0.006$). In contrast, the infection group, which includes all bacterial infections occurred, showed no significant survival advantage. The added Cox regression model showed that patients who did not develop postoperative infection and not underwent tumor progress were significantly at risk of death.

Conclusion: In this study, postoperative infection did confer a survival advantage in patients with glioblastoma multiforme. The median survival was not as impressive as shown by De Bonis and colleagues before. Because of the survival advantage in the inflammation group it can be assumed that there is an association with stimulated immune response.

Intraoperative Computed Tomography as an automatic Registration Device for Navigation

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Objective: Fiducial-based registration for navigation has an overall clinical application accuracy of 3-4 mm. The aim of this study is to increase navigation accuracy by being less user-dependent applying an automatic registration approach by intraoperative computed tomography (CT).

Methods: In a series of 26 patients (m/f: 12/14, age range: 53.65 ± 16.96 years) operated on intracranial lesions we applied a 32 slice CT scanner (AIRO, Brainlab, Munich) for pre- and intraoperative imaging, automatic navigation registration and microscope based navigation. Reflective markers on the CT scanner in combination with a detachable CT-compatible head reference star allowed automatic navigation registration. A rigid registration algorithm was further applied to register the CT data with preoperative navigation planning, based on 3T MRI. Navigation accuracy was measured by three independent skin fiducials not used for the registration process and additionally four acquired bony landmarks around the craniotomy opening. Initial registration accuracy and re-registration accuracy was determined. For pre- and intraoperative imaging after tumor resection the reference star is exchanged for an unsterile reference star, the sterile one is re-attached after scanning, so additionally registration accuracy of the reference star itself was measured.

Results: Navigation accuracy prior to skin incision documented by skin fiducials proved to be less than 2 mm in all cases. The registration accuracy of the re-mounted reference star varied for initial registration from 0.6 to 2.1mm (mean \pm sd: 1.48 ± 0.61 mm) and for re-registration from 0.5 to 2.0mm (mean \pm sd: 1.27 ± 0.62 mm). Bony landmark accuracy after intraoperative imaging ranged from 0.1 to 1.4mm (mean \pm sd: 0.58 ± 0.37 mm) for initial registration and 0.2 to 1.9mm (mean \pm sd: 0.94 ± 0.47 m) for re-registration.

Conclusion: Intraoperative CT-based automatic registration increases navigation accuracy compared to the standard fiducial based user-dependent approach.

Proinflammatory cytokines as a predictor for the postoperative outcome in minimally invasive lumbar spine procedures

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Objective: Even in spine centres with a high level of procedural and surgical skills, the percentage of an unsuccessful outcome with remaining back pain after lumbar disc operations lies at 25.4%, 12.7% reported severe back pain. (Yorimitsu, 2001). Also, there is reported to be no significant difference in outcome between macro discectomy and micro discectomy (Katayama, 2006). It seems reasonable to apply paraclinical parameters that are independent of the surgeon and to analyse their impact.

Goal of this project is to identify moderating variables for the processing of the outcome of this kind of surgery. The local release of pro- and anti-inflammatory cytokines, which can affect systemic body reactions and thus adversely affect the clinical course, might have an important role. In addition to others, TNF α and Interleukin 6 were described as key pro-inflammatory cytokines for the post-operative course.

Methods: From March 2012 to July 2014 32 patients (20 m, 12 f) with an average age of 61 years (SD 17.01) were treated via microscopically supported interlaminar fenestration and discectomy in the department of Neurosurgery, University Hospital Carl Gustav Carus Dresden. Included were patients with a herniated disc in the segments L3-L5. The control group was formed via matched pairs by healthy individuals. One day before the operation, a survey of ACTH, Cortisol, TNF α , and Interleukin 6 was taken during the stress response of the Trier Social Stress Test. This is a method under which a significant measurable humoral stress response of the relevant hormones and cytokines can be achieved. At the same time, a survey of relevant questionnaires (numerical analogue scale, McGill Pain Questionnaire) was conducted by means of which the postoperative symptom experience was made operational and comparable to the evaluation of the same information thirty days afterwards.

Results: The TNF α - and Interleukin 6-Baselines before the stress test were elevated by 26.2% and 91.2% compared to the control group. Furthermore, the whole stress response in patients, showed in an area under the curve, was significantly higher by 18.7% and 89.6%. In fact, patients with higher area under the curve were more likely to report less benefit and more postoperative pain ($p < 0.05$). All of these results appear to be independent by affecting variables such as the patient's medication and the preoperative duration of pain.

Conclusion: Recapitulatory, including a survey of cytokine reaction and baselines proofed to be a significant tool in forecasting subjective pain reduction in chronic back pain patients undergoing lumbar disc surgery. This might prove to be just as helpful in clinical settings by increasing the success rate for both the surgeon and the patient. A long term outcome analysis is being prepared.

Unforgettable neurosurgical operation of musicians in history

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Objective: There is no review study for craniotomies of famous musicians in history. Goal of this paper is to show the interesting neurosurgical operations of famous musicians which help, to understand the feelings of neurosurgeons in that time, who had limited diagnostic and technical tools..

Methods: The key words were “neurosurgery and music” or “neurology and music” and the names of composers. We used digital catalogues like “pubmed”, contacted scientists from subjects such as medicine or musicology, as well as the libraries. We analysed the dates to the kind of disease, neurosurgical intervention, outcome and the effect on musical activity of the patient.

Results: We found the clinical case reports of four musicians from early 20th century eras with different neurosurgical diseases: Maurice Ravel, George Gershwin, the female pianist Clara Haskil, and the jazz musician Pat Martino. These four musicians undergo neurosurgical procedure. The reason of Ravel’s fatal neurological disease is unknown. Gershwin suffered from a glioblastoma multiforme. Haskil was diagnosed with a suprasellar tumor. She became a successful pianist and Mozart specialist after tumor removal. She died on head trauma and intracranial hemorrhage after a fall in 1960. P. Martino suffered an intracerebral hemorrhage resulting from a cerebral arteriovenous malformation in left temporal lobe. He underwent surgery with complete removal of left temporal lobe after epilepsy associated with manic depression occurred, but no abnormalities in his musical capabilities. After surgery, he had a complete memory loss, also completely lost his musical capabilities including theory, technique, and skills, showing the expected effect of an extensive injury to the left temporal lobe. His musical capabilities completely recovered.

Conclusion: Two of these musicians led to the end of a musical career and their lives. In Haskil, the surgical procedure in 1942 was performed by awake craniotomy during she mentally played Mozart’s piano concerto E-flat Major KV 271. Brain surgery of Haskil may show the effect of Mozart’s music on the human brain in neurological rehabilitation. Martino’s musical abilities recovered over time, and he regained his previous virtuoso status. The surgery of Martino’s case demonstrates the possibility of cerebral plasticity and reorganization of professional musicians. Those unforgettable craniotomies of famous musicians show that neurosurgery is hard work. Its rewards and failures are great..

Altered somatosensory cortex neuronal activity in a rat model of Parkinson's disease and levodopa-induced dyskinesias

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Objective: Several findings support the concept that sensorimotor integration is disturbed in Parkinson's disease (PD) and in levodopa-induced dyskinesias. In PD altered neuronal connectivity activity occurs between subcortical basal ganglia (BG) and cortical circuits, where impaired somatosensory signals may influence desired motor programs.

Methods: In this study, we explored the neuronal firing activity of excitatory pyramidal cells and inhibitory interneurons in the forelimb region of the primary somatosensory cortex (S1FL-Ctx), along with its interaction with oscillatory activity of the primary motor cortex (MCtx) in 6-hydroxydopamine lesioned hemiparkinsonian (HP) and levodopa-primed dyskinetic (HP-LID) rats as compared to controls. Further, gene expression patterns of distinct markers for inhibitory GABAergic neurons were analyzed in both cortical regions.

Results: While firing frequency and burst activity of S1FL-Ctx inhibitory interneurons were reduced in HP and HP-LID rats, measures of irregularity were enhanced in pyramidal cells. Further, enhanced coherence of distinct frequency bands of the theta/alpha, high-beta, and gamma frequency, together with enhanced synchronization of pyramidal cells and interneurons with MCtx oscillatory activity were observed. While GABA level was similar, gene expression levels of interneuron and GABAergic markers in S1FL-Ctx and MCtx of HP-LID rats differed to some extent.

Conclusion: Our study shows both electrophysiological alterations and changes in gene expression in the sensorimotor cortices in a rat model of PD, which differ depending on the functional state after dopamine depletion and treatment indicating maladaptive neuroplasticity.

Attention and impulsivity in the rat 6-hydroxydopamine Parkinson model

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Objective: In Parkinson`s disease (PD), the progressive loss of dopamine (DA) neurons in the substantia nigra leads to disturbed motor function, but cognitive disturbances, including attentional deficits and impulsivity, are increasingly recognized as disabling factors. Rats with 6-hydroxydopamine (6-OHDA) induced nigrostriatal lesions of DA neurons show significant motor impairment reminiscent of PD, and recent studies also indicate cognitive impairment in this model. We here investigated the effect of bilateral 6-OHDA lesions in rats on impulsivity and attention in an auditory oddball paradigm.

Methods: Rats were trained in a 3-class auditory oddball paradigm, where they had to nose poke a hole after an infrequent correct tone, which was rewarded by a pellet, but to ignore a frequent standard tone and infrequent distractor tone. After reaching a criterion of 90% correct hits, retrograde degeneration of DA neurons in the substantia nigra were induced by bilateral striatal injection of 6-OHDA (10 µg in 1µl PBS; n=12), sham-lesioned rats (controls; n=8) received vehicle. Four weeks after surgery the rats were re-tested in the oddball paradigm.

Results: After 6-OHDA lesions, rats show deteriorated attention, as indicated by a significant decrease in the hit rate to the correct tone. Additionally, the number of impulsive nose pokes was reduced compared to controls, which would indicate less impulsive behavior.

Conclusion: We conclude that rats with bilateral 6-OHDA lesions may be used to investigate the biological basis of attentional deficits in PD, and to develop and test new therapeutic strategies for these symptoms ranging from pharmacological treatment to neurosurgical intervention.

Systematic approach for apparent diffusion coefficient assessment in vestibular schwannomas: methodology and morphological correlations

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Objective: Quantitative parameters of diffusion imaging such as apparent diffusion coefficient (ADC) can be helpful in the diagnosis and differentiation of brain tumors. However, different studies using ADC technique have used various and not structured methods for the choice of region of interest (ROI) within the lesion. To evaluate the methodology of ADC estimation in intracranial tumors using different ROI placement patterns.

Methods: Twenty consecutive patients affected by vestibular schwannoma were studied using diffusion imaging. Apparent diffusion coefficient values were obtained using different ROI placement Methods: segmentation of the whole tumor volume as ROI (vADC), random choice of 10 different ROIs (pADC) and a single ROI in the internal auditory canal portion (iADC). We calculated and statistically compared ADC values with different ROI placement patterns.

Results: There was no significant difference between mean vADC and mean pADC. There was difference between iADC and vADC resulted significant ($p < 0.01$). The statistical analysis showed a significant difference of the vADC between cystic and microcystic schwannomas ($p = 0.009$) and between cystic and solid ($p = 0.006$).

Conclusion: The standardization of ADC calculation, especially regarding the choice of different region of interests, is a crucial point in order to obtain comparable data. We could verify the applicability and reliability of both volume- and seed-based approaches with the necessity, in this second method, to use a multiple randomized seeds to overcome the variability of tumor internal structure.

Local neurosurgical treatment concepts for circumscribed glioblastoma multiforme WHO IV recurrences: microsurgical resection and interstitial brachytherapy

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Objective: Standardized treatment algorithms for recurrent glioblastoma multiforme (rGBM) are still lacking. The neurosurgical armamentarium for circumscribed rGBMs comprises resection and stereotactic brachytherapy (SBT) as possible local treatment concepts. In here, we report our experiences of both treatment options.

Methods: We retrospectively identified patients (KPS \geq 70) with circumscribed rGBM after multimodal therapy who were either treated by resection or SBT at two centers. Resections were performed using 5-aminolevulinic acid fluorescence guidance; for SBT, exclusively temporary I-125 seeds (reference dose: 50 Gy, dose rate: $<$ 15 cGy/h) were utilized. Study endpoints were overall survival (OS) and postrecurrence survival (PRS). Survival was assessed with the Kaplan-Meier method.

Results: 81 patients (median age: 58.6 years, median KPS: 80) were identified; 39 patients allotted to the SBT and 42 patients to the resection cohort. All surgical cases and 30/39 (76.9%) SBT patients were included at first recurrence, the remaining SBT cases at later stages. SBT patients were younger (56.9 vs. 64.6 years; $p=0.02$); rGBMs treated by SBT were smaller (median volume: 2.1 vs. 31.5 cm³; $p<0.01$), more commonly deep-seated ($p=0.03$) and on the dominant hemisphere ($p<0.01$). Treatment-associated morbidity was recorded at 6.2%, with wound healing deficits being the most common complication. The perioperative hospitalization was significantly shorter in the SBT cohort (median: 6.0 vs. 12.0 days; $p<0.05$). The cohorts did not differ in terms of their respective treatment-free intervals after SBT/resection. Salvage therapy included chemotherapy in 57/81 (70.4%) patients; no difference was seen between both groups. Over the course of follow-up 5/39 (12.8%) patients received multiple SBTs and 6/42 (14.3%) patients underwent multiple resections. At the end of follow-up 71/78 (91.0%) patients had died, three patients were lost to long-term follow-up. In the SBT versus resection cohorts, OS were 30.2 months (CI95%: 19.5-39.7 months) versus 25.5 months (CI95%: 16.2-30.6; $p=0.49$) and PRS 9.8 months (CI95%: 8.0-14.3) versus 9.3 months (CI95%: 6.0-15.3; $p=0.34$), respectively. Multivariate statistical analyses revealed tumor volume to be the strongest prognostic factor for favorable PRS for the total study population ($p=0.007$) and the resection cohort ($p=0.01$); no correlation between extent of resection and tumor volume was recorded.

Conclusion: Due to the differences between the two patient cohorts comparative outcome analyses are per se difficult; however, PRS was equivalent irrespective of the applied local treatment concept. Large tumor volume was identified as the strongest predictive factor for worse PRS in the resection cohort. SBT may be considered a favorable approach for small tumors due to its lesser burden of treatment.

Intramedullary Tuberculoma. Rare differential diagnosis of paraplegia

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Objective:

In 2014 a young female patient with migrant background showed an acute paresis of the legs so that walking was not possible anymore. The MRI showed an intramedullary contrast enhancing lesion at the level of 10th/11th thoracic vertebral body. Because of clinical manifestation and to get histological results we decided to remove the lesion surgically. During surgery total removal of the lesion was possible. The preoperative suspicion of a spinal manifestation of tuberculosis could be confirmed.

Methods: The primary method was the operation for removing the lesion. For assuring the diagnosis an intraoperative microscopic analysis with a specific stain (Ziehl Neelsen) was done. Postoperative we initiated a Quantiferone test.

Results: Tuberculosis was validated by detection of Mycobacterium tuberculosis (acid-resistant) during surgery and later on by Tbc-skin test and an analysis of sputum. Under calculated antibiotic therapy clinical symptoms got better, the paraplegia regressed slowly. At the last outpatient treatment there was residual pain in the left leg accompanied by a mild hypoesthesia. The paraparesis was improved profoundly. She was able to walk with crutches because of a spinal ataxia and is expecting a baby. The antibiotic treatment was stopped after 12 months.

Conclusion: This case shows the high relevance of tuberculosis as differential diagnosis becoming more and more important, especially under the aspect of the many refugees arriving in European countries at this time. If people who have an intraspinal or intracerebral lesion show other symptoms like cough, fever and malaise and if they maybe have a migrant background it is important to consider such a rare differential diagnosis like Tbc.

Observer-independent automated analysis of label-free multiphoton images of human brain tumors

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Objective: Intraoperative fast and reliable recognition of tumor borders and diagnosis is a challenge in neurosurgery. Label-free multiphoton imaging of brain tumors retrieves morphochemical information with subcellular resolution that allows detailed tissue analysis and was suggested for intraoperative application. Therefore, we tested different settings to identify parameters that balance minimal acquisition time and sufficient image quality for automated texture analysis to discriminate relevant tissue types.

Methods: Samples of human brain tissue was obtained during routine surgery and cryosections were prepared. We analyzed glioblastoma, gray matter, white matter and necrotic tissue (n=10). Based on the comparison with reference HE stainings, five representative areas were selected on each sample and subjected to multiphoton imaging: CARS (coherent anti-Stokes Raman scattering) TPEF (endogenous two photon excited fluorescence) and SHG (second harmonic generation) were simultaneously acquired. For each position, pixel size was set to 0.2, 0.5 and 1 μm and averaging was changed between 1, 4 and 16 resulting in acquisition times from 200 ms to 16 s. In total, 1800 images were obtained. Gray values of each modality were normalized (min to max) and texture analysis was performed using Matlab functions.

Results: Images of white matter were dominated by axons (CARS), gray matter displayed cell bodies with fluorescent inclusions (TPEF) while glioblastoma had a homogenous appearance. Necrotic areas exhibited large lipid droplets (CARS). First order parameter (mean, standard deviation, kurtosis, skewness, entropy) and second order parameters (contrast, correlation, energy, homogeneity, for 8 and 22 μm distances) were calculated separately for each channel. The comparison of texture parameters of images obtained with different acquisition settings showed that an averaging of 4 μm and a pixel dimension of 1 μm is sufficient for reliable discrimination. For instance, glioblastoma and white matter showed significant differences for CARS: standard deviation, skewness and entropy, for TPEF: standard deviation, kurtosis, skewness and entropy and for SHG: mean and skewness (t-test, $P < 0.05$). The second order texture parameters of CARS and TPEF likewise provided to be reliable discriminators of tissue types.

Conclusion: CARS-TPEF-SHG images of intermediate signal-to-noise ratio and a lateral resolution of 1 μm are sufficient to extract tissue characteristics using automated texture analysis. Therefore, observer-independent, reliable tissue classification of glioblastoma, white and gray matter as well as necrotic areas can be obtained. Based on this objective analysis, intraoperative multiphoton images could be classified in real-time to provide this information immediately to the surgeon. The current approach is extended to additional pathologies and tissue types.

Anterior spinal artery syndrome after cervical vertebroplasty via ventral approach in a 57-year old woman with metastasized breast cancer. Review of the literature and case report.

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Objective: Vertebroplasty and kyphoplasty are minimally invasive techniques for treatment of painful vertebral compression fractures caused by osteoporosis or osteolytic metastasis. These procedures are associated with a low risk profile. But serious complications, like cement leakage with spinal cord compression or vessel embolization, can occur.

We describe a case, developing a quadriplegia caused by arterial cement embolism with ischemia of the cervical cord after vertebroplasty.

Methods: A 57-year-old woman with pulmonary and bony metastasized breast cancer suffered from therapy resistant thoracic and neck pain. The CT and MRI scans of the whole spine showed osteolytic metastases of the fifth cervical and the fourth thoracic vertebral body. No compression of the spinal canal was seen. Cervical vertebroplasty via a ventral approach and percutaneous thoracic kyphoplasty was performed.

Results: Immediately after recovery from the anesthesia, the patient experienced a pronounced quadriplegia with loss of pain and temperature sensation below C4; however, deep pressure sensation and two-point discrimination were preserved. The directly initiated CT scan of the spine showed no cement leakage into the spinal canal; but in the thin-layer CT reconstructions of the cervical spine, a paravertebral venous vessel directly discharged into an arterial vessel feeding the anterior spinal artery could be detected. After performing a MRI scan 3 days later, an extensive cervical ischemia of the ventral horn and commissura was shown as the cause of the neurological symptoms.

Conclusion: Despite the simplicity and safety of vertebroplasty and kyphoplasty, this rare case of arterial embolism showed the possibility of grave complications with tremendous consequences for the patients further life.

Modulation of neuronal network disinhibition in treatment of spreading depression-related brain disorders

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Objective: Spreading depression (SD), a slow propagating depolarisation wave, is followed by alterations in cellular and synaptic hyperexcitability of the brain and is involved in the pathophysiology of several brain disorders, such as subarachnoid hemorrhage and traumatic brain injury. Disinhibition of GABA function is involved in the late hyperexcitability state of SD. The aim of the present study was to evaluate the role of modulation of GABA function on SD-induced neuronal network disinhibition.

Methods: The effect of KCl-induced negative DC deflections was studied on paired-pulse depression (PPD) as well as intracellularly recorded inhibitory post synaptic potentials (IPSPs). Furthermore, the role of gabapentin was investigated on SD-induced neuronal network disinhibition.

Results: SD inhibited the degree of PPD and decreased the amplitude and duration of IPSPs. Administration low concentrations of bicuculline before SD induction increased the inhibitory effect of SD on IPSPs. Gabapentin prevented the inhibitory effect of SD on IPSPs.

Conclusion: Modulation of SD-induced neuronal network disinhibition in the late hyperexcitability state of SD may play a role in therapeutic management of SD-related brain disorders.

Intracranial plasmacytomas mimicking meningiomas - two remarkable cases

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Objective: Meningeoma is the most common dural neoplasm. However, a variety of tumor entities may present clinically as meningeoma. Even though a significant number of patients with solitary plasmacytoma, will eventually develop multiple myeloma, intracranial plasmacytoma is exceptional and has been very rarely described as primary manifestation of multiple myeloma.

Methods: Case 1: A 61-year-old man presented with a protrusion occipitally on the left side of his head. Cranial MRI showed a lesion suggestive of intraosseous meningioma. Based on typical findings, a neuropathological diagnosis of plasmacytoma was established. This diagnosis prompted complete skeletal radiographs, which revealed an osteolytic lesion of the eighth rib. Bone marrow cytology also revealed neoplastic plasma cells.

Case 2: In this 52 year old patient with a progressive occipital mass a MRI supposed a highly vascularized meningioma with compression of the sagittal and transversus sinus. An interventional embolization was conducted preoperatively. Neuropathological examination demonstrated a plasmacytoma.

Results: Intracranial plasmacytomas are rare and infrequently diagnosed by imaging due to their resemblance of meningiomas. On MRI, plasmacytomas are often indistinguishable from meningioma, with intermediate signal on T₂-weighted sequences and isointense signal to gray matter on proton density and T₂-weighted sequences. With contrast, they frequently demonstrate homogenous enhancement, similar to our two cases. The tumors showed the typical histological and immunohistochemical staining profile of plasmacytoma. Since additionally CD20-expressing lymphocytic tumor cells were also encountered in case 1, a diagnosis of "lymphocytic plasmacytoma" was established, which is very rare and may be associated with IgA-heavy chain restriction.

Conclusion: In conclusion, solitary intramedullary plasmacytoma should be considered in the differential diagnosis of meningioma in dural based neoplasms. Vice versa in dural based plasmacytoma lymphocyte rich meningioma must also be considered as a differential diagnosis. In some cases differentiation may be difficult.

Staggered reversal of rivaroxaban in setting of decompressive craniectomy after severe TBI: a case report

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Objective: Rivaroxaban is a direct inhibitor of factor Xa and is one of the novel oral anticoagulants (NOACs). The use of NOACs has increased over the last years and is expected to continue to rise. Although, there are several advantages in using rivaroxaban, its lack of specific antidotes may present neurosurgeons with a major challenge in managing patients requiring emergency neurosurgical intervention. Here, we report on one patient treated with rivaroxaban and, due to severe traumatic brain injury (TBI) requiring urgent decompressive craniectomy (DC).

Methods: A 79-year-old woman was admitted to our neurosurgical department after a fall on the staircase. The patient had been treated with rivaroxaban (Xarelto®) 20 mg/day due to permanent atrial fibrillation. At the time of admission the patient had a Glasgow Coma Scale (GCS)-Score of 13. The examination of motor function revealed a right-sided hemiparesis. The radiological trauma work-up with computed tomography (CT) showed a left-sided acute subdural hematoma (aSDH) with midline-shift, a left-sided traumatic subarachnoid hemorrhage (tSAH) fronto-parietal, and a left-sided temporal contusion. The initial blood testing revealed a highly elevated peak-level of rivaroxaban (> 433 ng/ml) with strong therapeutic anticoagulant activity measured by anti-factor-Xa-activity level > 1.14 IU/ml. We started the reversal of rivaroxaban activity with intra-venous (i.v.) bolus application of 1 g tranexamic acid (TXA) followed by continuous i.v. application of TXA in a dosage of 20 mg/kg. Furthermore, prothrombin complex concentrates (PCC) were administered with a dosage of 50 IE/kg.

Results: The surgical treatment was performed with DC in a standardized fashion. During the surgery diffuse bleeding occurred from the left temporal brain surface, which could not be managed surgically. The intra-op blood analysis revealed persistent anticoagulant effect of rivaroxaban despite the decrease of rivaroxaban-level after reversal (198 ng/ml, anti factor-Xa-activity level: > 1.14 IU/ml). In this case, in accordance with our guidelines we decided to apply 2 mg recombinant activated factor VII (NovoSeven®) as ultimo ratio treatment. Thereafter the bleeding was controlled and DC was finished successfully. A CT-scan performed postoperatively showed a complete removal of aSDH with consecutive decrease of midline-shift. The blood analysis showed a decreased anticoagulant effect of rivaroxaban (rivaroxaban-level: 34 ng/ml, anti factor-Xa-activity level: 0.33 IU/ml).

Conclusion: The staggered reversal of direct factor-Xa-inhibitor rivaroxaban as shown in our institutional protocol, provides a sufficient approach to evaluate and manage patients treated with this anticoagulant in the setting of urgent neurosurgical interventions.

The value of the intraoperative MRI in resection of skull base chordoma

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Objective: Safe gross total resection of chordomas offers the best chances for overall survival and progression free survival. We are evaluating the value of the iMRI in achieving maximal safe resection of skull base chordomas.

Methods: Retrospective analysis of patients with skull base chordoma, who were operated at INI Hannover between 2010 and 2014, under navigation guidance and iMRI control (1.5 Tesla, Espree, Siemens). The preoperative images, the operative data and findings, the intraoperative MRI images and the surgeon's expectations before performing the control were evaluated. The postoperative course and complications has been reported.

Results: Eight patients with skull base chordoma were operated under iMRI control. Two patients (25%) had recurrent tumors. Two patients (25%), operated first without iMRI, underwent redo surgery under iMRI. All the patients harbored tumor that extended into 2 or more skull base compartments. Five patients (62%) had intradural part of the tumor. The aim of surgery was gross total tumor resection in 4 patients (50%). In four patients (50%), the aim of surgery was tumor debulking and brainstem decompression. Six patients (75%) were operated via the endoscopically assisted extended transsphenoidal approach and one patient (12.5%) was operated via the anterior petrosal approach. The pterional approach was used in one patient (12.5%). Gross total resection was achieved, as planned, in 4 cases (50%). Tumor debulking and decompression of the brainstem were performed in 4 cases (50%). Repeated intraoperative control was necessary in three patients (37.5%) in whom the iMRI showed inadequate resection and/or inadequate decompression of the brainstem..

Conclusion: The iMRI is useful during resection of complex skull base chordoma which involve multiple skull base compartments. It can confirm the gross total resection of the tumor and give also an idea about the degree of debulking and brainstem decompression. According to the iMRI control, the surgeon may proceed for further resection.

Clinical Evaluation of the non motirc facial nerve dysfunction after resection of vestibular schwannoma

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Objective: motoric facial nerve dysfunction is a known possible postoperative complication of vestibular schwannoma surgery. In this study we are systematically analyzing the clinical aspects of the postoperative non-motoric facial nerve dysfunction after resection of vestibular schwannoma.

Methods: prospective analysis of patients operated for vestibular schwannoma in the international neuroscience institute. Twenty patients are endorsed in this study. The taste functions were examined using taste strips. The patients are required to identify the modality and the intensity and compare it to the healthy side. The lacrimation function was tested with Schiermer's test. Furthermore, the patients were asked to report if they have abnormal taste sensation or disturbance in lacrimation.

Results: The taste test was abnormal in one patient. Two patients reported about subjective changes in the taste (metallic taste). There was no significant correlation between the disturbance in the taste function and the degree of motoric facial nerve dysfunction. Six patients reported about disturbances in lacrimation. This symptom was significantly correlated to the motoric facial nerve dysfunction. One patient developed crocodile tear 4 months after surgery in spite of normal postoperative motoric facial nerve function.

Conclusion: The taste function of the facial nerve is rarely affected even in cases of early postoperative profound facial nerve palsy. The disturbed lacrimation is a more common symptom which is related to the degree of motoric facial nerve dysfunction. The patients should be informed about this possible complication.

Chronic Subdural Hematoma: The Impact of Head Trauma and Anticoagulative Medication, a Single Center Experience

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Objective: Chronic subdural hematoma (cSDH) is a common form of intracranial haemorrhage, especially in elderly patients. It plays an increasingly important role in context of the demographic change with increasingly aged patients with many comorbidities & associated treatment costs. Head trauma & oral anticoagulative medication (OAC) are discussed as influential factors for treatment duration, recurrent SDH & discharge modality. Aim of this study was to show the effect of both: head trauma & OAC on course of cSDH treatment.

Methods: A retrospective analysis was performed, 2 groups were formed: group1 with memorable/observed head trauma; group2 w/o head trauma. Both groups were analysed according to basic characteristics, treatment with OAC, duration of hospital treatment, modality of discharge & need for recurrent surgery. OAC was defined as history of OAC medication + altered blood samples (high INR, prolonged PFA); INR was lowered (e.g. PPSB) prior to operation. Primary endpoint was duration in hospital & discharge modality (rehab, hospital, home). Statistical performance included χ^2 -, t- & Mann-Whitney-test, level of statistical sign. was assumed at $p < 0.05$.

Results: Between 01/2010 & 12/2015 $n=207$ pat. with cSDH were enrolled. Group1 contained $n=56$; group2 $n=151$. Most pat. were male (71%) & 60 - 80 yrs old (6% <60yrs, 33% >80yrs). No difference in gender distribution nor age (mean age ~75yrs) in both groups was found. Although in group 1 most pat. (60.7%) took OAC & group 2 was dominated by pat. w/o OAC (53.6%), no significant difference was found ($p=0.08$). All tests didn't show any significant disadvantage for pat. with OAC in comparison to no OAC. Hospital stay was significantly shorter in pat. w/o head trauma (group1 12.0d, group2 14.7d, $p=0.02$). In both groups OAC had neither significant impact on hospital stay nor requirement of recurrent operation. >60% pat. in group1 were discharged home, while 50% pat. in group 2 needed direct admittance to rehab/another hospital ($p=0.16$). OAC had no impact on discharge modality in both groups.

Conclusion: In most forms of intracranial bleeding OAC has significant impact on hospital stay and/or need for rehabilitation. cSDH patients with head trauma had longer hospital admittance & were less likely to be discharged home. OAC had no significant influence on duration of hospital stay & discharge modality in both groups. In literature there are different studies with similar results. Yet there are few studies looking deeper on effects & mechanisms which lead to inferior outcome of cSDH after head trauma. According to our results, history of head trauma should be paid as much attention as commonly is paid to reviewing anticoagulation. The results stretch the importance of detecting head trauma as a predictive item & underline the need for falling prevention in all elderly patients. Furthermore they suggest more research on mechanisms of cSDH in head trauma.

Human cortical tissue obtained from epilepsy surgery as a model system to study plasticity of human neuronal networks and mechanisms of epileptogenesis

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Objective: The human brain is constantly challenged to balance the ongoing electrical activity, which is the basis of many essential processes including the integration of information. A dysregulation of this balance can shift neuronal networks into an overexcited state, ultimately leading to epileptic seizures. The cause of epileptic brain activity is very diverse and the mechanisms participating in the generation and development of an epileptic disorder are very complex. Many studies have used animal models to investigate the cellular and network changes within the CNS occurring during this critical time. However, it is only poorly investigated how far these results can be directly translated to the human brain. Toward these questions we established an organotypic slice culture system based on human access tissue from resective epilepsy surgery, amenable to immunocytochemical and electrophysiological studies.

Methods: Approval of the ethics committee of the University of Tübingen as well as written informed consent from patients was obtained, allowing spare tissue to be included in our study. In several instances removal of cortical tissue outside the epileptic focus is required in order to get access to the pathology. Even though neurons within access tissue have been part of an epileptic brain for many years, data by other groups demonstrate that intrinsic properties of neurons may remain unaffected. Therefore, cortical access tissue was carefully microdissected and resected with only minimal use of bipolar forceps to ensure tissue integrity, transferred into ice-cold aCSF equilibrated with carbogene, and immediately transported to the laboratory. After removal of the pia tissue chunks were trimmed perpendicular to the cortical surface, thick acute slices were prepared using a vibrating microtome, and tissue was cultured under subsequently optimized conditions.

Results: State-of-the-art whole cell patch clamp recordings of human cortical neurons in combination with immunocytochemistry, morphological reconstruction after biocytin filling, and extracellular field recordings were performed. Results demonstrate that optimized culture conditions preserve viability including maintenance of network activity of cortical cultures up to several weeks.

Conclusion: This model system will serve as a platform to study a) the plasticity of human neurons and b) the influence of epilepsy-causing mutations - following virus-mediated overexpression - on the excitability of human neurons in direct comparison to murine organotypic cultures.

New craniocaudal expendable implant for the minimally invasive reconstruction of vertebral body compression fractures

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Objective: We present surgical technique and patient data of 76 patients with one year follow up treated for osteoporotic and traumatic compression fractures of the thoracic and lumbar spine. Patient data were collected prospectively. The aim of this study is to evaluate safety of the technique and the clinical outcome for the patients.

Methods: We treated 76 patients for 84 spinal fractures with an age ranging from 26-87 years (41 female, 35 male). Fractures were osteoporotic in 14 patients and traumatic in 62 patients. Magerl classification was type A.1.1 (3), A.1.2 (19) A.1.3 (6), A.2.1 (32), A.2.3 (12), A.3.1 (15), A.3.2 (16) und A.3.3 (10). Fracture localization was 48 (63%) T11L1, 12 (15%) T4T10 and 24 (32%) L2-L5. All implants were applied percutaneous transpedicular. For augmentation PMMA or a combination of PMMA / hydroxylapatit was used. All patients received preop a clinical examination, spine x-ray, CT and MRI and postop clinical examination and x-ray after mobilization. For pain evaluation we utilized the VA-scale. For each patient we measured the height of the vertebral body as well as the kyphosis angle of the fractured vertebral body. All included patients had a 1 year follow up.

Results: Within the 1 year follow up period the reduction of pain according to VA-scale was 77%. Increase of vertebral body height was 15% after the procedure and 11% after 1 year. The kyphosis angle was -6° prior to surgery and -4° 1 year later. Cement leak was seen in 31 cases (41%), in all of them without neurologic deficit. There was no reoperation in the same segment and no implant dislocation within 1 year.

Conclusion: The presented method with an craniocaudal expandable implant is efficient, safe and is providing excellent results at 1 year follow up. We achieved long lasting reduction of pain and pain medication in our patients. The presented technique and the results are at least comparable to kyphoplasty.

Towards systematic screening of gene signatures mediating resistance to radio- and chemotherapy in GBM

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Objective: Glioblastoma multiforme (GBM) is characterized by high rates of relapse (~90 %) after surgery despite patients receiving radio- and chemotherapy. The main reason for relapse is the survival of glioblastoma stem cells (GSCs) which is characterized by increased expression of specific resistance genes. Our aim is to identify and target those genes in personalized medicine.

Methods: GSCs were isolated from GBM patients via neurosphere formation assay and characterized by IF-staining for established markers (GFAP, Nestin) and their ability to differentiate. Their sensitivity towards radio- and/or chemotherapy was compared with patient-derived GBM cell lines (n=4), using WST-1 after 5 days or 3D Cell Viability Assay after 7 days, respectively. To determine gene expression correlated with resistance mRNA expression of various genes were analyzed by qPCR, GeneChip microarrays, and RNAseq analysis.

Results: For combined treatment of patient-derived GBM cell lines, semi-lethal doses of 5 Gy and 100 μ M temozolomide (TMZ) were used. TMZ and radiation showed an additive effect and reduced cell viability by 78 ± 1 %. In contrast to the primary GBM cell lines, GSCs showed significantly reduced sensitivity towards radio- and chemotherapy. Sensitivities were determined by spheroid size and Cell Titer Glo[®] Assays. After 5 days following radiation with 10 Gy, viability of primary GBM cells was reduced by 96 ± 0.02 %, whilst viability and spheroid size of GSCs was reduced by only 37 ± 14 % after treatment applying the same radiation dose. Resistant GSCs were treated with 350 μ M TMZ and 30 Gy irradiation. Compared to control cells, the combination therapy reduced cell viability and spheroid size by 69 ± 8 % according to both methods, while single treatment affected cell viability significantly less. Despite a relatively harsh treatment, GSC spheroid sizes still increased slightly (≈ 1.5 -fold) over 7 days of cultivation. Differential expression of genes induced by the latter treatment involve genes for ABC transporters as well as *HAS2*, *CD44*, and *ITGA6*. In addition, results of differential analysis using microarray and NGS techniques will be presented.

Conclusion: To minimize occurrence of GBM relapse it is essential to eliminate GSCs, which are particularly resistant to standard therapy. A workflow for the systematic determination of relevant genes in GBM patient material has been developed and provides a platform for further clinical use in order to optimize the existing therapy options.

Surgical treatment for metastatic disease of the cervicothoracic junction (C6-D2) - A single center experience

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Objective: The skeleton is the third most common site of metastatic disease. Spinal metastases are apparent in approximately 70% of these cases. As a transition zone between thoracic and cervical spine, the cervicothoracic junction (CTJ) is of special relevance regarding surgical strategy in case of symptomatic tumorous disease.

Methods: We have performed a retrospective analysis including 54 patients who have undergone surgical treatment for metastatic disease of the CTJ in our institution over a period of seven and a half years (August, 1.st, 2008 until December 31.st, 2015). We have performed survival analysis using the Kaplan-Meier method and tried to identify independent risk factors via nonparametric statistics and the Cox's proportional hazards model.

Results: The mean age of our cohort at the time of surgery has been 64.2 ± 10.4 years, with a clear male predominance (41=76%). Bronchial carcinoma has been the most prevalent entity (n=17), followed by prostate (n=10) and mammary carcinoma (n=7). The overall mean survival after surgery has been 1.32 ± 0.28 years, with the lowest survival for patients with bronchial carcinoma. Patients who have undergone surgical stabilization (36=66,7%) showed a higher survival time. A low Tokuhashi score and neurological deficit at the time of surgery turned out to predict reduced survival in the first analysis.

Conclusion: The selection of surgical strategy is crucial, depending on live expectancy and spinal instability. The revised Tokuhashi score is a good tool to guide through the surgical decision making for metastases of the CTJ, which is needed in presence of new neurological deficit.

First Intraoperative Experiences with a Hyperspectral Imaging Setup for Cortical Brain Tumor Identification

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Objective: Besides accurate preoperative surgical planning based on MRI images, intraoperative information about tumor localization and brain tissue functionality is essential for the successful resection of brain tumors. Intraoperative Optical Imaging (IOI) is a technique that identifies areas of increased metabolism caused by stimulation of specific brain functions. IOI uses a special hardware setup that analyses selected wavelengths or broad band spectra (RGB) of the reflected light from the exposed cortex. Results after performing a stimulation protocol and complex image processing algorithms are two-dimensional navigated activity maps. IOI is already applicable in clinical routine use during neurosurgical interventions. Seeking for more information within the complete continuous light spectrum between 500 ... 1000 nm, a new Hyperspectral Imaging (HSI) setup was tested

Methods: An intraoperative usable hardware setup, based on a standard surgical microscope, a halogen light source and a hyperspectral imaging unit was built. The hyperspectral imaging system was attached to the surgical microscope using a standard beam splitter. Custom built illumination was coupled into the optical path of the surgical microscope via a fibre-optic. The image of a common RGB camera, likewise attached to the surgical microscope via beam splitter, was used to adjust focus and zoom. White and dark references were acquired before measurements on patients, that underwent resection of cortical tumors, were performed. A hyperspectral datacube, that includes the spectral information in its third dimension, was acquired and spectral characteristics of different tissue types of the cortical surface were compared.

Results: The evaluation of the hardware setup reveals that hyperspectral imaging can be integrated in a clinical setup without any remarkable changes. The additional hardware setup was easy to manage for the neurosurgeon. It was able to acquire robust hyperspectral data of the cortical surface during the neurosurgical procedure. Differences within the spectral characteristics of different tissue types were visible after postoperative evaluation of the acquired imaging data.

Conclusion: First results indicate the feasibility of the method: tissue differentiation with hyperspectral imaging is possible. Intraoperative hyperspectral imaging is able to extend optical imaging. Further work will focus on light source characteristics and on data classification algorithms.

Combined surgery and fractionated stereotactic radiation therapy for the treatment of meningiomas involving the cavernous sinus

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Objective: Despite the advances in skull base surgery, radical microsurgical resection of cavernous sinus meningiomas (CSM) is associated with high cranial nerve and vascular morbidity. A conservative therapeutic approach appears to be more suitable for this subgroup of meningiomas. We present a series of 24 patients with meningiomas involving the cavernous sinus (CS), who received a combined treatment of surgery and fractionated stereotactic radiation therapy (FSRT).

Methods: From 2006 to 2012 24 patients underwent surgery for a meningioma involving the CS and received an adjuvant FSRT. Surgical approach and extent of resection was planned preoperatively according to the tumor origin and the tumor extension. Meningiomas were divided into 2 groups. Group 1 consisted of primary cavernous sinus meningiomas with or without extension outside the CS and group 2 of meningiomas with secondary CS invasion. Tumor volume and neurological deficits were evaluated during regular follow-up visits.

Results: Our series includes 19 women and 5 men. Biopsy only was performed in 8 tumors, whereas near total or subtotal resection of the extracavernous portion of the tumor with or without decompression of cranial nerves in 16 cases. There was no perioperative mortality. Histological examination revealed a WHO grade I meningioma in 21 patients and an atypical meningioma in 1 patient. In 2 cases histological confirmation was not possible and the diagnosis was determined by typical imaging criteria and intraoperative findings. All patients received a FSRT 1 to 40 months following surgery (mean 4,5 months). Median total dose was 50,4 Gy with 1,8 Gy per fraction. Two international patients were lost to follow up. Two-year follow up was available in 20 patients. The last follow-up was available at a mean of 62,5 months (6-120 months). Deterioration of IIIrd cranial nerve function was evident in 5 patients after surgery. In 5 patients improvement of pre-existing neurological deficits was observed. No late toxicity grade II or higher was seen. Tumor control was achieved in 21/22 patients. One patient had tumor progression of the extracavernous residual tumor 96 months after combined treatment. In 6/22 patients partial remission of tumor remnant was observed.

Conclusion: Meningiomas involving the cavernous sinus are a challenging subtype of meningiomas. A combined treatment of accurately planned surgery and radiotherapy can provide a sufficient tumor growth control avoiding the high mortality of radical surgical resection.

Factors related to a prolonged hospital stay in spinal neurosurgery

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Objective: The concept of fast-track surgery (FTS) aims to shorten convalescence and reduce perioperative morbidity by improvement of clinical and organizational factors. One of the key parameters of FTS is the length of hospital stay (LOS), which is potentially influenced by multiple parameters. Little is known, however, about FTS in spinal neurosurgery. Thus, the purpose of this study was to identify factors related to a prolonged LOS for neurosurgical spine operations.

Methods: This prospective analysis of a retrospective database included consecutive patients ≥ 18 years of age undergoing a neurosurgical spine operation between 7.10.2016 and 25.11.2016. Patients receiving a neuromodulation procedure or a spinal infiltration were excluded. Demographic, intra- and perioperative data were extracted from electronic records including the Charlson Comorbidity Index (CCI) and specific pain-related (VAS, ODI, NDI) and quality of life (SF-8; higher value indicates lower quality of life) scores. Patient satisfaction (max: 100 pts.) was assessed with a 12-item-questionnaire ≥ 10 days after surgery. Univariate analysis was carried out to identify factors related to a prolonged (i.e., $>$ median) LOS.

Results: 54 patients (f: n=21) with a median age 66 years were included. A total of 62 procedures were performed in the following spine regions: 28% cervical, 20% thoracic, and 52% lumbar. 39% of the operations were instrumented and 61% non-instrumented (microsurgical) procedures. The median LOS was 16 days (range: 3-46 days), 15 patients had a prolonged hospital stay. The median patient satisfaction was 84/100; the main reason for patient dissatisfaction was the postoperative physical therapy. Organizational factors related to a prolonged LOS were higher preoperative LOS ($p < 0.001$), mainly due to logistical problems, and shorter interval between informed consent and surgery ($p = 0.002$). Medical factors with a relationship to a prolonged LOS were higher CCI ($p = 0.003$), longer duration of symptoms ($p = 0.005$), lower preoperative haemoglobin ($p = 0.006$), higher preoperative CRP ($p = 0.004$) values, as well as higher ODI ($p = 0.002$) and SF-8 ($p = 0.03$) values at discharge. Lower patient satisfaction was clearly interrelated ($p = 0.001$) with a longer LOS.

Conclusion: The LOS for a neurosurgical spine operation is influenced by various organizational and medical factors. Targeted intervention might help to reduce LOS and healthcare costs, and to improve patient satisfaction and convalescence.

The metalloprotease ADAM8 mediates brain metastasis formation by regulating transendothelial migration

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Objective: Brain metastases outnumber primary neoplasms ten-fold, and are associated with a poor prognosis. Patients with metastatic, triple negative breast cancers are at high risk (25-46%) of developing brain metastases at some point in the course of their disease. Recently we demonstrated that high ADAM8 expression in breast tumors lead to increased numbers of circulating tumor cells and a higher frequency of brain metastasis in mouse tumor models. Thus, we evaluated the mechanistic role of ADAM8, a metalloprotease-disintegrin, in facilitating trans-endothelial migration and in the formation of brain metastases.

Methods: Brain metastases were analysed using immunohistochemistry for ADAM8. To model brain metastasis of breast cancer cells, stable shRNA ADAM8 knock-down clones of the breast cancer cell line MDA-MB-231 (shA8) and control (shCtrl) cells were generated and subjected to functional assays assessing migration, invasion, and transmigration through a Blood Brain Barrier model consisting of endothelial cells and astrocytes. In addition, MMP expression was analysed in MDA-MB-231 shCtrl and shA8 cells by qPCR. Furthermore, comparative phospho-kinase arrays were utilized. Cell model data were correlated to brain metastases from primary breast tumors.

Results: A significant increase in ADAM8 expression was identified in 34% of primary site tumors, and was found to be 2-fold higher in brain metastases of different origins, including breast cancer. In transendothelial migration assays, MDA-MB-231 ADAM8 knock-down cells showed a reduced endothelial adhesion as well as a reduced transmigratory capacity both in serum-induced transmigration and in transmigration triggered by the chemokine SDF-1, a mediator of metastasis. This was further supported by the blood-brain barrier *in vitro* model as well as in matrigel invasion assays. ADAM8 knockdown caused reduced ERK1/2 and CREB phosphorylation and affected expression levels of MMP9 specifically. We demonstrated that in the course of transendothelial migration, the P-selectin glycoprotein ligand, a membrane protein important in leukocyte extravasation, is shed by ADAM8.

Conclusion: Our results suggest that ADAM8 is an important mediator for brain metastasis of breast cancer by affecting transendothelial migration and may offer an attractive target for therapeutic interventions.

Intra-operative molecular spectroscopy of brain metastases

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Objective: The *translation of analytical methods* into clinical applications is a current process driven by the requirements of molecular and individualized medicine. Currently, molecular spectroscopy, in particular infrared and Raman spectroscopy, complements the standard method for tissue diagnostics, in particular for the intra-operative use. In this contribution we demonstrate that infrared spectroscopy as a special method of molecular spectroscopy can be used to classify brain metastases based on the biochemical composition of the tissue

Methods: A portable infrared spectrometer was for used for a quick diagnostic performed during the operative resection of brain tumors. In this study, infrared absorption spectra of freshly resected tissue were collected using the attenuated total reflection configuration. No sample preparation was performed. The "water-free" spectral range from 1000 - 1400 cm^{-1} was used to classify the tissue. Currently, samples from more than 75 patients with different metastases were analyzed, classified and compared with histological assignment.

Results: A general marker band for primary tumor tissue and metastases arises from RNA. Tumor cells have a high proliferation rate and exhibit significantly stronger RNA signals. The symmetric and antisymmetric stretching vibrations of phosphate groups from nucleic acids are located between 1040 and 1270 cm^{-1} . In spectra of metastases, the band at 1080 cm^{-1} becomes stronger, which can be attributed to increased levels of RNA in the cells. This variance is expected to be higher in fresh samples, as RNA is degraded by enzymes within hours of cell death. Normal tissue exhibits a higher content of glycolipids which show a series of strong signals in spectral region between 1020 and 1250 cm^{-1} . Moreover the absorption bands of lipids as well as of proteins exhibit slight but significant variances between different types of metastases.

Conclusion: The spectroscopic analysis of freshly resected tissue allows the identification and classification of metastases within few second and without any preparation steps. The spectral classification was always in agreement with the histological assignment.

In this study, we show that infrared spectroscopy can be used as a tool for a quick analysis of tissue in intra-operational settings.

Stereotactic biopsy in old and very old patients

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Objective: Stereotactic biopsy is an everyday procedure among various neurosurgical departments. The procedure is performed to obtain tumor tissue of unknown origin. Going in hand with low complication rates and high diagnostic yield, stereotactic biopsies can be performed in adults and children, too, for lesions particularly in eloquent localizations.

In this study we focused on old (80-84 years) and very old patients (85 years and above) in order to evaluate whether stereotactic biopsy should be performed and leads to further therapy. We also assessed complication rates of the procedure.

Methods: We performed a retrospective analysis of our database and included all patients over 80 years who underwent stereotactic biopsy at our department from October 2005 until May 2016.

47 Patients were included in this study. These patients were divided into two subgroups: group one from 80- 84 and group two 85 years and above. All patients underwent stereotactic biopsy to establish histopathological diagnosis. We excluded patients who underwent cyst puncture or puncture of hemorrhage because the procedure was not performed for diagnostic purposes.

We assessed gender, neuroradiological diagnosis, Karnofsky performance score, number of tissue samples taken, histopathological diagnosis, localization, postoperative hemorrhage, modality of anesthesia, anticoagulation, and further therapy

Results: We included 34 patients in group one (age 80-84), they showed a median KPS of 80, and a median of 14 tissue samples was taken.

In group two (age 85-88) 13 patients were included. A median number of 15 tissue samples were taken, median KPS was 70.

67.7% of the patients of group 1 wanted postoperative therapy (Radiation: 44.1%, Chemotherapy 11.8%, Radiochemotherapy 11.8%). In group 2, 53.3% of the patients wanted further therapy (Radiation: 15.4%, Radiochemotherapy: 23%, Chemotherapy 7.7%, Resection: 7.7%).

Conclusion: Stereotactic biopsy of intracerebral lesions leads to final histopathological diagnoses in 100% of the cases. The procedure is of low risk and, thus, should not be withheld aged patients since the majority of the elderly actively wishes further treatment.

A self inflicted penetrating brain injury by an electric drill – a rare case of suicide attempt in a patient with acute schizophrenic disorder

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Objective: Self-inflicted non-missile penetrating brain injuries are rare and unusual among civilian population. In this case report we describe a self-inflicted penetrating brain injury of a 41 year old male patient in case of suicide attempt in an acute schizophrenic episode by an electric drill. Neuroimaging studies are described and a review of the operative and clinical management concerning this rare pathology is done.

Methods: The 41 year old male patient with schizophrenic disorder was admitted via the emergency department in our clinic. He reported about an accident while working with an electric drill. Physical examination of the awake and adequate patient (GCS15) revealed right lower extremity paresis, no loss of sensibility and a penetrating rounded scalp wound to the left parasagittal region. The CT-scan showed a drill hole (5mm diameter) in the left parasagittal region with small bone fragments, a slight subarachnoid hemorrhage and an intraparenchymal hematoma (1.5x1.8x2.5cm) with no mass effect in the central region. A psychiatric evaluation ruled out a suicide attempt in an acute schizophrenic episode. The patient was transferred to the ICU for observation of his neurological status. Follow up CT-scan with CT-angiogram after 2 hrs showed no signs of vascular lesion but a progress of the intraparenchymal hematoma (5x2x3cm) with a mass effect. The reexamination of the patient showed a right hemiplegia. The patient was taken immediately to the operating room for intraparenchymal hematoma evacuation via craniotomy. Antibiotic prophylaxis was administered. Intraoperatively there were no sinusoidal vein affections or arterial lesions. Postoperatively the patient was observed for 3 days on ICU. Postoperative CT-scan showed a regular result after intraparenchymal hematoma evacuation and no signs of secondary bleeding. The patient's neurostatus improved with slight motoric function of the right upper extremity but persistent plegia for the right lower extremity. To exclude a false aneurysm a cerebral angiography was performed before discharge to the psychiatric department. No signs of artery abnormalities were registered in the vascular imaging.

Results: Nine days after the operation patient could transfer for specific anti-schizophrenic treatment to the psychiatric department. Patient's right hand mobility improved further, but right lower extremity plegia continued. Wound healing showed no signs of infections.

Conclusion: A self-inflicted penetrating brain injury by an electric drill is a rare entity. It is essential to exclude a penetrating brain trauma whenever a scalp wound is noticed in order to provide proper medical treatment. Cerebral vein affections and arterial lesions should be excluded by a CT-angiogram and cerebral angiography if necessary. Neurological deficits are related to the degree and location of the primary injury.

Syringomyelia associated with Cervical Spondylotic Myelopathy causing Canal Stenosis. A rare Association

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Objective: Although cervical spondylosis is extremely common, only few cases with associated syrinx have been reported. Depending on review of two large data bases, we report this case series. In addition; we evaluated the posterior decompression as the management option in treatment of this rare condition.

Methods: Data of all cases with cervical spondylosis and canal stenosis that sought medical advice or needed decompressive laminectomy/laminoplasty between the years 2006-2015 were checked in manually. Perioperative data, together with follow up were reviewed.

Results: Out of five cases found in the reviewed data; four cases undergone posterior decompression (laminectomy in two cases and laminoplasty in the other). One case refused surgery. Along mean follow up period of 6.25 months; three cases improved markedly, while in one case no improvement occurred.

Conclusion: Cervical spondylotic myelopathy can rarely cause syringomyelia. Posterior decompression would be the preferable management option with clinical improvement of most of the cases.

Pituitary melanoma with pulmonary metastasis: case report and review of the literature

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Objective: Although malignant melanoma frequently metastasizes into the brain, pituitary melanoma is rare. We report an uncommon case of pituitary and lung metastatic melanoma and deliver a brief review of the literature on primary and metastatic pituitary melanoma.

Methods: An 81-year old female presented to our emergency room with a 1-week history of progressive horizontal diplopia. She denied further symptoms and any history of cancer. Except of left abducens palsy, neurological examination was normal. Magnetic resonance imaging demonstrated a multinodular pituitary mass with heterogenous contrast enhancement. Considering an endocrine-inactive pituitary adenoma, transsphenoidal resection was performed. Postoperatively, the initial symptoms recovered fully. Histological examination revealed a pituitary malignant melanoma.

We performed a literature search on PubMed using the keywords "pituitary", "metastatic", "primary" and "melanoma".

Results: As no history of melanoma was known, staging workup was performed revealing multiple pulmonary lesions. However, there was no evidence of cutaneous, uveal or gastrointestinal melanoma as a primary tumor. Refusing adjuvant brain radiation and further oncological treatment, the patient died 5 months after surgery.

Six reports of metastatic and seven reports of primary pituitary melanoma were analyzed. Next to diplopia due to cranial nerves III, IV and VI palsy, diabetes insipidus, headache and visual disturbance were common symptoms at first presentation. In metastatic pituitary melanoma, symptoms tend to progress more rapidly than in primary pituitary melanoma. Due to its melanin content, pituitary melanoma showed a high intensity on T1-weighted images. In contrast, pituitary adenoma is generally T1-hypointense. Transsphenoidal resection often resulted in immediate relief of symptoms. Normally, adjuvant irradiation of the sellar region was performed.

Conclusion: Since pituitary melanoma is rare, it may be misinterpreted as endocrine-inactive adenoma. Occasionally, pituitary melanoma could be identified preoperatively by characteristic appearance of melanin in MRI tomography. Transsphenoidal resection relieves symptoms and prognosis is dependent on overall tumor stage and local tumor control.

Cyclooxygenase (COX) Inhibition by acetyl salicylic acid (ASA) enhances antitumor effects of nitric oxide in glioblastoma in vitro

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Objective: Glioblastoma multiforme (GBM) is characterized by a high treatment resistance, an infiltrative growth pattern and a short overall survival. Experimental strategies against malignant gliomas include cyclooxygenase (COX) inhibition and nitric oxide-based (NO) therapies. Therapeutic doses of NO can be delivered to tumor cells by NO donors such as JS-K (O₂-(2,4-dinitrophenyl)1-[(4-ethoxycarbonyl)piperazin-1-yl]diazene-1,2-diolate) which releases NO upon enzymatic activation by glutathione-S-transferase (GST). The aim of this study is to analyze the impact of NO on COX expression and metabolism and to determine potential synergistic antitumor effects of COX inhibition by acetyl salicylic acid (ASA) and JS-K in glioma cells.

Methods: U87, LN229 and primary glioblastoma cells (IC) were treated with JS-K (1-15 µM) for 6h. Cell viability was analyzed by MTT assay after therapy with JS-K and/or ASA (10 mM). COX-2 expression was determined by qRT-PCR and regulation of COX-2 activity by ELISA. To differentiate between apoptosis or necrosis as distinct forms of cell death, Western Blot for caspase-3 and FACS analysis for AnnexinV and propidium iodide were performed. Intracellular ATP and calcium levels were measured by ELISA to assess cellular energy metabolism. Phosphorylation and activation of Akt was determined by Western Blot. Statistical analysis was performed by Student's t-test.

Results: JS-K significantly increased COX-2 expression and COX activity (LN229, 200±11 %, p=0.0001) time- and dose-dependently. Cell viability was significantly reduced by JS-K to 64±10 % (LN229, p=0.003), 57±4 % (U87, p<0.0001) and 37±8 % (IC, p=0.0002) after 6 h. Combination therapy with ASA reduced cell viability further to 26±3 % (LN229, p<=0.0001), 25±3 % (U87, p<0.0001) and 21±3 % (IC, p<0.0001). Both treatments led to a dose-dependent increase in necrotic cell death (LN229, 80±20 %, p= 0.004). The lack of caspase-3 activation and the persistent small apoptotic population in FACS analysis exclude apoptosis as the major cell death mechanism. Both mono- and combination therapy induced activation of Akt signaling which is associated with antiapoptotic pathways. JS-K decreased intracellular ATP which is indicative of a necrotic process. While ASA did not alter intracellular calcium concentration alone (LN229, 118±12 %, p=0.05), it significantly enhanced the rise in intracellular calcium induced by JS-K (289±10 %, p<=0.0001).

Conclusion: COX inhibition by ASA enhances the cytotoxic effect of NO released from JS-K at doses which are not cytotoxic and do not cause changes in energy metabolism. Glioma cells predominantly die by necrotic cell death as shown by reduced energy metabolism and activation of anti-apoptotic mechanisms. Combining COX inhibition by ASA and NO-based antitumor strategies provides the opportunity to increase treatment efficacy with a well-established remedy.

Impact of burrhole placement on the revision rate of patients with chronic subdural hematoma

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Objective: Chronic subdural hematomas (cSDH) are a frequent disease especially in elderly patients and often require surgical treatment. While different approaches exist, a common and widely used technique to evacuate the hematoma is the drilling of burrholes and placement of subdural drains. This study aims to analyze whether the location of burrhole placement plays a role in the rate of revision surgery in these patients.

Methods: A single center retrospective analysis of cSDH-patients treated with hematoma drainage by burrhole craniotomy trepanation between 2007-2014 was performed. At first, exact location of the burrholes (frontal vs. parietal) as well as surgical complications were assessed. For further analysis, only patients with revision surgery were selected. Demographic as well as imaging and clinical data were collected from these patients' hospital records. The modified Rankin scale (mRS) was documented at admission and discharge. Statistical analysis for possible correlations of the burrhole placement with the patients' clinical parameters was performed.

Results: Screening of 844 patients revealed frontal burrhole placement in 611 (72%) and parietal placement in 233 (28%) cases, respectively. Revision surgery was performed in 71 patients (8%). In this subgroup (16 female / 55 male; age 77 ± 22 years), burrhole placement was more frequent in the frontal than in the parietal region (76% vs. 23%). Further analysis of the patients with revision surgery revealed ataxia as the most common symptom (22%) and a mean mRS on admission of 3.7 ± 0.8 . Furthermore, 56% of these patients were on anticoagulant therapy. Hematomas were predominantly located on the left side (35%) with a mean diameter of 1.83 ± 0.75 cm. Duration of surgery was 37 ± 17 min and a single subdural drain was placed in 56% of cases. The reason for revision surgery was recurrent hematoma or secondary bleeding in most of these cases (79%), with a median time to surgery of 5 days (IQR 2-11). During revision surgery, a craniotomy was performed in 55% of cases. After a mean hospital stay of 9 ± 6 days, patients were mostly discharged to another hospital or rehab facility (70%) with a mean mRS of 3.4 ± 1.1 and improvement of symptoms in 81% of cases. Statistical analysis revealed no significant impact of frontal vs. parietal burrhole placement on the various clinical parameters.

Conclusion: Placement of burrholes in the frontal region compared to the parietal region shows a trend towards a higher rate of revision surgery without reaching statistical significance. Furthermore, patients with frontal burrholes required multiple revision surgeries more frequently (40% vs. 20%) whereas patients with parietal burrholes could be discharged home more often (42% vs. 25%) and had better improvement of symptoms (86% vs. 79%).

Intraoperative radiotherapy after the resection of brain metastases (INTRAMET) - protocol of a phase 2 feasibility study

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Objective: Brain metastases occur in up to 40% of all patients diagnosed with systemic cancer. Without adjuvant radiotherapy after resection of space occupying lesions local recurrence rates are high. That is why guidelines recommend a cavity boosting with x-rays. External beam radiotherapy can lower the risk of local recurrence but means longer hospitalization, prolongs the time to systemic salvage therapies and bears risks of radionecrosis and leucoencephalopathy with neurological and cognitive decline. A solution for this problem could be onetime intraoperative radiotherapy (IORT) with soft x-rays to sterilize the resection cavity, which may provide both: freedom from local recurrence fast track salvage therapy initiation.

Methods: We here introduce for the first time the study protocol of a single institution, open-label, prospective, phase 2 feasibility study for intraoperative radiotherapy immediately following resection of brain metastases. 50 adult patients with not before locally treated, resectable not dural brain metastases should be treated in surgery after tumor resection with IORT with 20-30Gy prescribed to the margin of the resection cavity. The highest dose tolerable to surrounding risk structures (N. opticus, brainstem) should be used.

Results: Primary endpoint will be local progression-free survival (PFS) of the treated metastasis. Secondary endpoints will be overall survival which will be differentiated between death related to global cancer progress and death from brain metastases. Further we will analyze the time to salvage cancer therapy, cognitive performance and the quality of life. Another secondary endpoint will be global and regional PFS to account for possible abscopal effects on the total cancer status and cancer status in the brain. Additional it should be proved that there are no dose limitation toxicities like wound healing disorders, cerebral hemorrhage or ischemia or radionecrosis with the need of surgical intervention.

Conclusion: With our new method we hope to show similar local control rates to postoperative external beam radiotherapy in line with guideline recommendations with less patient hospitalization and faster start of rescue therapies which could lead to a favorable overall outcome and less cognitive side effects.

The prognostic value of Fas and FasL in WHO grade II glioma progression.

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Objective: The cell-surface of tumor cells is a target for antibody-driven immunotherapy and cell-surface molecules that can be used as biomarker. The well known cell surface receptor Fas (Apo-1, CD95) plays an important role in the mechanisms of induced cell death. Targeting Fas with an antibody or its ligand FasL (CD95L, CD178) drives the cell into apoptosis. The aim of this study was to evaluate the value of Fas/FasL in WHO grade II glioma progression. As low-grade gliomas do evolve and proceed towards glioblastomas, the question was whether there is a possible use for Fas/FasL as biomarkers regarding the malignant progression and progression free survival (PFS).

Methods: All samples were classified based on the 2007 WHO classification of CNS tumors. Quantitative real-time PCR was performed with Cycler Rotor Gene Q and the Rotor-Gene SYBR Green PCR Kit (Qiagen). SDHA was used as a housekeeping gene. Data analysis was performed with Graphpad Prism 7. Statistical tests used: Log-rank test for Kaplan Meier analysis. The significance level (α) was set on 0.05. Expression levels are displayed in mean values and standard error of the mean (SEM).

Tumor samples were frozen, cut, mounted on slides and fixed with paraformaldehyde and acetone. The ImmPACT DAB substrate Kit (SK-4105) was used for staining with Diaminobenzidine (DAB). Vitro-Clud was used as embedding medium for covering the coverslips.

Results: 44 patients with primary grade II gliomas (22 astrocytomas, 16 oligoastrocytomas and 6 oligodendrogliomas) were included. The patients were divided in two groups according to whether the Fas or the FasL value was higher or lower as the mean value of all patients. The two groups were compared regarding their PFS, which was set as the time in months between first resection and tumor-recurrence operation. Patients with a high FasL expression level had a significantly longer time to progression (median PFS: FasL-high 42.93 vs. FasL-low 29.93; Log-rank $p < 0.05$). The level of Fas did not show significant difference in the median PFS (Fas-high 44.07 vs. Fas-low 35.89).

Conclusion: Fas-L may be of value as a low-grade biomarker regarding progression free survival. In order to set clear cut-off values further studies are warranted.

ENPP3 overexpression in astrocytomas

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Objective: The ENPP (ectonucleotide pyrophosphatase/phosphodiesterase) ectoenzymes 1, 2 and 3 are type II transmembrane proteins with ATPase and ATP pyrophosphatase activities. ENPP3 (CD203c) is an activation marker for mast cells and basophils. In addition, it is regularly expressed in both uterus and prostate. First publications indicate a role of ENPP3 in glial tumors. The expression has been shown in both rat glial precursor cells and in human glioma cell lines. The exposure to N-ethyl-N-nitrosurea (EtNU) causes an overexpression of ENPP3 in neuroectodermal tumors originated from glial precursor cells in rats. A recent study demonstrated high ENPP3 expression in clear renal cell carcinoma and tumor growth inhibition was noticed via antibody-drug conjugates.

The goal of this study was to evaluate whether ENPP3 is expressed on low- and high-grade gliomas. In order to assess the further value of targeting ENPP3 only patient tissue and no cell-line was used for this study.

Methods: Quantitative real-time PCR was performed with Cycler Rotor Gene Q and the Rotor-Gene SYBR Green using two primers with different target locations. SDHA was used as a housekeeping gene. Data analysis was performed with Graphpad Prism 7. Statistical tests used: Kruskal-Wallis for ANOVA and Mann-Whitney U for two-tailed t-tests. Expression levels are displayed in mean values and standard error of the mean (SEM). In addition, immunostaining was performed with a primary antibody from Biolegend (ABIN2661579) and with Diaminobenzidine.

Results: Fresh frozen samples of 50 patients (10 control brain tissue, 10 grade II astrocytomas, 10 anaplastic astrocytomas, 10 secondary- and 10 primary-glioblastomas (GBM)). Both primers detected a significantly higher level of ENPP3 in astrocytomas compared to control brain tissue (Primer A: 0.51 ± 0.09 vs. 0.15 ± 0.04 , $p=0.0045$; Primer B: 1.13 ± 0.32 vs. 0.37 ± 0.14 , $p=0.0216$), whereas primary GBM did not show elevation in comparison to control brain tissue (Primer A: 0.144 ± 0.016 vs. 0.15 ± 0.04 ; Primer B: 0.476 ± 0.104 vs. 0.37 ± 0.14). The expression levels of primary and secondary GBMs did not differ significantly. Immunostaining mainly showed positive staining in astrocytomas, while GBM exhibited little positive staining only.

Conclusion: To the best of our knowledge, this is the first study to prove ENPP3 expression on glioma patient-samples. Low-grade gliomas have significantly higher ENPP3 expression than control brain tissue. Unlike most cell surface molecules, ENPP3 shows stronger expression in low-grade glioma compared to glioblastoma. This finding could play a role for immunotargeting ENPP3 in gliomas.

Regional spinal cord atrophy is associated with poor outcome after surgery on intramedullary spinal cord ependymoma: a new aspect of delayed neurological deterioration

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Objective: A considerable number of patients suffer delayed neurological deficits even after a successful removal of intramedullary spinal cord ependymoma. The underlying pathology remains unknown. Radiological findings could be an explanation for poor outcome after surgery on intramedullary spinal cord ependymoma.

Methods: We conducted a retrospective study of all cases treated from 1980 to 2016 in our department. Included were all patients with intramedullary spinal cord ependymoma treated with microsurgical excision. The cross-sectional area (CSA) of the spinal cord at the level of the former performed surgery was compared in MRI scans with postoperatively, adjacent not affected levels and with control group.

Results: 54 patients with an intramedullary spinal cord lesion were treated in this period. Ependymoma was the predominant tumor (28) followed by intramedullary gliomas and vascular lesions. Mean age was 48.2 ± 10.5 years with a female predominance (f=16, m=12). An unfavorable outcome was observed in 53% of the patients after an initially uneventful postoperative course. The cross-sectional area of the spinal cord was significantly reduced in these patients. Sagittal and axial spinal MRI showed spinal cord narrowing due to atrophic changes in the area of the performed surgery in 53 % of patients with resected ependymoma after a mean follow-up time of 9 years. Functional outcome in ependymoma was significantly associated with spinal cord atrophy ($p < 0.05$).

Conclusion:

Spinal cord atrophy seems to be a predicting factor in long term outcome after surgical removal of intramedullary spinal cord ependymoma.

Analysis of impaired cerebral perfusion in a murine model of subarachnoid hemorrhage by laser speckle contrast imaging

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Objective: Neurological deterioration due to delayed cerebral infarctions (DCI) is a major cause of poor outcome after subarachnoid hemorrhage (SAH). A major focus of experimental SAH studies is therefore on analysis of cerebral perfusion. However, *in vivo* perfusion measurements are complicated in small animal models. Here we used laser speckle imaging – a method that allows two-dimensional visualization of tissue perfusion at the level of microcirculation *in vivo* – in mice with SAH to map cortical perfusion through the intact calvaria.

Methods: SAH was induced in C57BL/6 mice by endovascular filament perforation. Sham animals were treated identically but without endovascular perforation. Before and after induction of SAH and after 24 and 72 hours cortical perfusion was analyzed through the intact calvaria by laser speckle imaging using a laser perfusion imager. Flux values representing cortical perfusion were determined from a region of interest of a size of 6.9 mm² placed on the left parietal region.

Results: 14 animals were included; 5 were assigned to the sham group and 9 to the SAH group. 2 SAH animals died (days 1 and 3 after SAH). Flux values determined before induction of SAH were similar between SAH and sham animals. Induction of SAH induced a significant decrease in cortical perfusion in SAH animals to 34.1±3.6% compared to the values before SAH induction ($p<0.001$). In the further course perfusion recovered partly to 69.3±17.8% after 24 hours, but remained significantly lower compared to preoperative values ($p<0.05$), and stayed at 73.4±9.4% after 72 hours (n.s.). In contrast, in the sham group, pre- and postoperative flux values and those after 24 and 72 hours were not significantly different (postop.: 101.4±10.2%, 24 hours: 110.6±11.4%, 72 hours: 97.2±11.6%).

Conclusion: In mice changes in cortical perfusion induced by SAH can be depicted and quantified by laser speckle imaging, which could therefore be a promising tool for analyzing regional cerebral perfusion in experimental small animal studies on the mechanisms of DCI after SAH.

Neurosurgical interventions for spinal disorders during pregnancy

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Objective: Low back pain is a common complaint during pregnancy. There are certain disorders, however, with including disc herniation, intraspinal tumors and spontaneous spinal epidural haematoma which require special attention. Here, we present our experience in the surgical management of spinal pathologies during pregnancy.

Methods: Data of pregnant women who underwent surgery for spinal pathologies within the period from 2005-2015 were collected and analysed.

Results: Ten pregnant women presented in the spinal emergencies and underwent spine surgery within the study period. Maternal mean age was 31.5 years. Six women presented with lumbar disc herniation, two patients suffered from thoracic or lumbar arachnoid cyst and two other patients suffered from thoracic spinal cord cavernoma and large thoracic neurinoma. Mean gestational age at the time of emergency presentation was 25.6 weeks. Cesarean section was the mode of delivery in all patients which resulted in nine live-born fetuses. Development of the infants was unremarkable.

Conclusion: Surgical procedure, either alone or in combination with complementary procedures, ensures good maternal neurological recovery and fetus survival. It is a challenge in team work and interdisciplinary management between all parties concerned in the patient' care.

Fixation of subdural strip electrodes during brain tumour surgery - comparison between different fixation options: Technical note

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Objective: Intraoperative neurophysiological mapping and monitoring (IOM) is now a standard procedure during brain tumour surgery. Strip electrodes are used to identify and monitor primary motor cortex (M1) function. However, strip electrodes frequently become displaced during surgery, which can impact the safety of the procedure. This technical note compares temporary electrode strip fixation options in the context of improvement of intraoperative monitoring.

Methods: A sheep brain model was used to analyse temporary fixation options of subdural strip electrodes on the brain surface. Strip electrodes were placed on sheep brain cortices and connected to a spring balance. The mechanical resistance of nine different fixation techniques (1: TachoSil[®], 2: TissuFleece E[®], 3: Tisseel[®], 4: TissuFleece E[®] + Tisseel[®], 5: TissuFleece[®], sequential + Tisseel[®], 6: Hemopatch[®], 7: Hemopatch[®] + citrate blood, 8: Oxidised cellulose, 9: DuraGen[®]) were tested and compared with a strip electrode without additional cortical fixation. Using a surgical microscope, brains were investigated for surface damage after fixation removal. The different fixation options were evaluated according to the following three criteria: (A) adhesion strength, (B) brain surface damage and (C) cost.

Results: Significant differences were observed between the different fixation techniques. Fixation results ranged from no additional benefit to high resistance compared with no additional fixation (mechanical resistance: 3 → >60 g). However, some fixation techniques resulted in microscopic damage to the cerebral surface. The best adhesion properties were observed using TachoSil[®] and Hemopatch[®]. However, removal of Hemopatch[®] resulted in microscopically visible surface damage in the sheep brain models. Individual product cost ranged from a few cents to a hundred euros.

Conclusion: The use of temporary fixation options for subdural strip electrodes prevents loss of time during neurosurgery and reduces patient risk. The adhesion properties and cost of different fixation techniques varied. Furthermore, in some cases, microscopically visible cerebral surface damage was observed. The simple and safe handling and low cost of some fixation methods may help in ensuring an efficient operative course; however, the possibility of tissue damage must be taken into consideration.

External ventricular drain placement: Two techniques-one result?

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Objective: Placement of ventricular drains (VD) is one of the most common procedures in neurosurgery. Priority should be given to avoidance of complications like infections, malposition and procedure associated haemorrhages. Furthermore, the technique should be cost-efficient, feasible and quickly available. We compared two techniques of VD placement in respect of those factors.

Methods: In this observational-descriptive study patients with acute hydrocephalus and the necessity of a VD insertion are compared concerning complications rate by their placement technique: twist drillbore (tdb) hole versus trepan bore (tb)hole trepanation. The further comparisons include the location of surgery: operating theatre versus ICU versus emergency room. Statistical criterias include malpositioning (definition: VD outside the ipsilateral ventricle), infection rate and bleeding complications. Significance was put up to $p \leq 0.05$.

Results: 147 (42%) patients receive the VD via twist drill bore (Tdb) hole and 201 (57,4%) patients via trepan bore (tb) hole trepanation. There were no differences between infection rate $N_{tdb} = 14$ (9,5%) versus $N_{tb} = 8$ (4%), ($p=0,154$) and the frequency procedure associated bleedings $N_{tdb} = 8$ (5,4%) versus $N_{tb} = 12$ (6%), ($p=0,167$) in both groups. Patients, getting their VD via trepan bore hole, had a significant lower risk for malposition $N_{tdb} = 36$ (24,5%) versus $N_{tb} = 42$ (20,9%) ($p=0,05$). However, there was no significant difference at all for intraparenchymal malposition ($p=0,06$). Furthermore there was no significant difference between the location of surgery and the infections rate ($p=0,339$).

Conclusion: Placement of VD via twist drill bore hole is an adequate procedure to trepan bore hole related to infection- and bleeding rate. Frequency of malposition in twist drill bore hole is higher. However, the incidence of relevant malpositions (intraparenchymal malposition) does not differ significantly from both techniques. Advantages of tdb are the independence of the location of the surgery and therefor the quick practicability.

Cerebrospinal fluid fistulae in macroprolactinomas

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Objective: Cerebrospinal fluid (CSF) rhinorrhea is a rare complication after dopamine agonist treatment of macroprolactinomas. Up to 90% of these fistulae need surgical repair. However, there are controversial opinions about the necessity of radical or maximal tumor resection on this occasion. Here we present our long-term follow-up experience in three patients.

Methods: Three patients presented with cabergoline-induced CSF rhinorrhea. None of the patients had undergone prior transnasal or transcranial surgery for tumor resection. One patient with tumor expansion to the ethmoidal cells had undergone transnasal tumor biopsy two weeks prior to the onset of CSF rhinorrhea.

Results: Two out of three patients underwent transsphenoidal/transnasal surgical repair of CSF rhinorrhea by fat graft and fibrin adhesive. In one patient, CSF rhinorrhea resolved spontaneously after two weeks without recurrence (follow-up period 84 months). One out of the two patients with surgical CSF leak repair had no recurrence of CSF rhinorrhea during the follow-up period of 80 months. Due to dopamine agonist resistance, the third patient underwent tumor debulking surgery 21 months after CSF leakage repair. CSF rhinorrhea did not recur during the follow-up period.

Conclusion: In the rare case, dopamine agonist treatment of macroprolactinomas may result in CSF fistulae due to tumor shrinkage. Exceptionally, these CSF fistulae may even close spontaneously without recurrence. If persistent, closure of CSF fistulae represents an easy and efficient treatment and dopamine agonist treatment may be continued.

Zileuton stimulates expression of Sema 3A-mRNA in hypothalamus of ovariectomized rats

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Objective: Semaphorins are membrane-bound or secreted glycoproteins which have important functions in regulation of axonal guidance but also in immunoregulation, vascularization, in regulation of bone-matrix and oncogenesis. Single axon has the ability to extend multiple branches and form terminal arbors allowing neurons to integrate information from divergent region of the nervous system. Sema 3A is repellent axon guidance protein that functions in assembly of neuronal circuits. Recently it has been shown that this protein has a critical role in layer-specific axonal branching, which contributes to target innervation. Estrogen is known to play an important role in maintaining axonal growth and synapse formation. Zileuton, an anti-inflammatory drug (an inhibitor of Arachidonate 5-lipoxygenase), has been described to have positive effects in cerebral ischemia by inhibiting neuronal apoptosis and to restore memory impairments in a mouse model of Alzheimer's disease. We studied the effect of zileuton on the expression of Sema 3A in brain of estrogen deficient rats.

Methods: Eight weeks after ovariectomy (Ovx) 5-month-old Sprague–Dawley rats were assigned into four groups: (1) untreated Ovx; (2-4) groups: Ovx treated with zileuton (1, 10 or 100 mg/kg body weight, respectively). Group five serves as a control group (Non-Ovx and untreated). Eleven rats per group were analyzed. After 5 weeks, the expression of protein and mRNA of Sema 3A in hippocampus and hypothalamus were defined with western-blot and real-time PCR. We have chosen these two brain region because hypothalamic neurons are targets of sex hormones and in the hippocampus sex hormones regulate neurogenesis in adults.

Results: The expression of Sema 3A-mRNA was reduced after Ovx in hypothalamus, whereas, treatment with zileuton (10 mg/kg) significantly increased it ($p=0.0001$) compared to other groups. The difference in total cellular protein levels (Sema 3A), between the groups were not significant. In hippocampus the changes were not detected.

Conclusion: Zileuton improved the expression of Sema 3A-mRNA which, was reduced after Ovx. This suggested a positive effect of zileuton on hypothalamic Sema 3A. A discrepancy between expression of protein and mRNA should be further analyzed. Since the axon branching occurs far from the cell body assessment of protein localization could be helpful in order to understand this.

Predictors of outcome after decompressive hemicraniectomy for malignant cerebral infarction

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Objective: Decompressive hemicraniectomy (DHC) significantly reduces the mortality of malignant cerebral infarction (MCI), but still a high rate of disability is observed among the survivors. Although DHC has been increasingly used in the last years, the right point of time to perform DHC is still not defined. In this study, we aimed to identify parameters associated with outcome after DHC, that would facilitate the treatment decision-making in patients with MCI.

Methods: A retrospective analysis of patients with MCI, who underwent DHC from 2011 to 2015 was performed. The initial and preoperative clinical status were documented using the Glasgow Coma Scale (GCS). Volumetric measurements of the infarction area were performed preoperatively and at discharge based on the CT scans. The time from symptom onset to DHC was noted. The midline-shift and the presence of anisocoria were documented. The clinical outcome was determined according to the modified Rankin scale (mRS) at discharge.

Results: A total of 90 patients (49 male, 41 female) were analyzed. The mean age was 58 years (25-86). The mean initial GCS was 9.5 and direct preoperatively 5.5. In 93% (84/90) a midline-shift (mean 6.9; 1-35mm) and in 14% (13/90) anisocoria was observed direct preoperatively. The DHC was performed in 64% (58/90) within 24 hours, in 15% (13/90) within 48 hours and in 21% (16/90) within 72 hours after symptom onset. The mean initial infarction volume was 188ml and 305ml at discharge. Good outcome (mRS 0-3) had 14% (12/90). A smaller infarction volume was associated with a better outcome (linear regression, $p=0.0004$). A better preoperative clinical status was correlated with a smaller infarction volume (linear regression, $p<0.0001$) and with a better outcome (linear regression, $p=0.0003$). A trend of smaller infarction volume in case of earlier DHC was found (linear regression, $p=0.05$). Midline-shift and anisocoria were no predictors of outcome.

Conclusion: The preoperative clinical status is a predictor of infarction volume and of clinical outcome after DHC for MCI. A prospective study is needed to evaluate the right point of time for performing DHC in order to reduce disability among the survivors with MCI.

The use of programmable shunts in patients treated with tumor treating fields: Multicentric case series

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Objective: Tumor Treating Fields (TTFields) are an established, non-invasive, anti-mitotic therapy for the treatment of patients with newly diagnosed or recurrent glioblastoma multiforme (GBM). TTFields are low intensity, intermediate frequency, alternating electric fields, which are delivered directly to the tumor in the brain via a System called Optune®. The Phase 3 EF-14 study demonstrated significantly prolonged overall survival in newly diagnosed GBM patients treated with TTFields + Temozolomide (TMZ) compared to TMZ alone. In addition, TTFields therapy was well tolerated without additional side effects, except of skin irritations. However, the use of a programmable shunt together with Optune still remains a contraindication.

Methods: We treated six patients (male=4, female=2) of median age 47.3 years (range 26-59 years) with newly diagnosed or recurrent GBM who had received programmable shunts due to different indications such as hydrocephalus, CSF fistula or compression of cerebral ventricles. Shunt types differ among the most commonly used types. All patients were treated with Optune together with their programmable shunt; the shunt valve was controlled at predefined time points after the initiation of Optune therapy. Additional MRI or CCT images were performed in selected cases to ensure that the shunt valve was still functioning and not negatively influenced by TTFields. Patients were treated at 4 different centers in Germany and Austria, respectively.

Results: All different programmable shunt types were functional after the simultaneous use of TTFields without any negative influence on the shunt valve setting or valve's mechanics. Additional images in selected cases clearly showed that the shunt valve by itself worked well in the combination of both therapies.

Conclusion: This is the first multicentric case series that demonstrates the safety and feasibility of using Optune in patients with different types of programmable shunt valves. Additional studies are needed to show comparable efficacy of TTFields in patients population, as previously shown in patients without programmable shunts.

Rapid cortical reorganization following traumatic spinal shock: a well-documented case

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Objective: Damage to the spinal cord is known to be associated with a posterior shift of the cortical upper limb representation, i.e. to the sensorimotor cortex. Due to missing pre-traumatic data, knowledge is acquired by comparing findings between patients and healthy subjects. Here, we present an exceptional case of traumatic spinal shock resulting in acute 5-hours tetraparesis followed by a left-sided hemiparesis lasting for 4 weeks. By chance, this patient had a pre-trauma (PT) navigated transcranial magnetic stimulation (nTMS) motor mapping 2 years before. Hence, nTMS mapping was repeated during the acute (after 1 day), sub-acute (after 10 days) and chronic (after 1.5 years) phase in order to trace the cortical reorganization following this incident.

Methods: Clinical work-up included magnetic resonance imaging (MRI) of the spine and brain as well as electroencephalography (EEG) and navigated transcranial magnetic stimulation (nTMS). Motor mapping was performed with 110% of the abductor pollicis brevis muscle (APB) resting motor threshold (rMT). Amplitudes and latencies of the motor-evoked potential (MEPs) were recorded and analyzed. In addition, motor performance was evaluated by the Medical Research Council (MRC) scale and by a reaction time (RT) task.

Results: MRI and EEG revealed no aberrant findings. nTMS mapping, however, showed a posterior shift of the APB representation from the anatomical hand knob to the sensorimotor cortex in the acute in comparison to the PT phase. Concomitantly, there was an increase of rMT (approx. 10%) and APB MEP latencies (2-3 ms). Within 10 days, there was an incomplete reversal of the posterior shift in parallel with the improvement of the clinical motor performance. MRC increased from 3/5 to 4/5 while RTs improved from 0.78 ± 0.21 s to 0.61 ± 0.11 s (Student's t-Test, $p < 0.001$). However, long-term follow-up revealed a complete restitution of nTMS cortical mapping and behavioral measures.

Conclusion: The present case report well documents a rapid cortical reorganization within a few days after a transient spinal shock. Our data adds further evidence to the literature suggesting a posterior shift of cortical representation following spinal cord injury. For the first time, cortical reorganization was shown idiosyncratically in a single patient arising from the fortuitous fact of having a pre-shock nTMS map.

Upregulated expression of the Aryl hydrocarbon receptor pathway in brain metastases from malignant melanoma

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Objective: The Aryl hydrocarbon receptor (AHR) is a ligand activated transcription factor initially linked to exogenic carcinogenic agents such as 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD, dioxin). In 2011, the tryptophan (TRP) catabolite kynurenine (KYN) was identified as the first endogenous ligand activating the AHR pathway. AHR has been shown to be involved in several biochemical pathways and cellular processes such as cell cycle, cell migration, tumorigenesis, cell migration and immune function. AHR is expressed in cells of the central nervous system and dysregulation of AHR, its nuclear translocator (ARNT), its Repressor AHRR and the KYN building Enzyme TRP-2,3-dioxygenase 2 (TDO) has been linked to poor survival in patients with Glioblastoma.

In this study, we aimed to evaluate a potential role of the AHR pathway in brain metastases.

Methods: Using quantitative RT-PCR, gene expression was analyzed in 19 brain-metastases of melanoma patients, 10 control tissues from peritumoral brain areas, histopathologically classified as tumorfree and 10 glioblastoma (GBM) samples. Differences in the expression of AHR, ARNT, AHRR, TDO as well as the AHR/AHRR ratio between tumor tissue and control were analyzed using the Mann-Whitney-U test. Results are depicted in mean values with standard deviation (SD) and in Arbitrary Units (AU). A Value of $p < .05$ was considered significant.

Results: Both, AHR and ARNT were massively overexpressed in metastatic tissues ($p < .01$) (6- and 4.5-fold) compared to normal brain (AHR: 3.64 ± 2.32 vs. $.58 \pm .50$; $p < 0.01$ and ARNT: 3.81 ± 2.25 vs. $.83 \pm .48$, $p < .01$). AHRR and TDO were not significantly upregulated ($.73 \pm .88$ vs. $.41 \pm .35$; $p = .31$ and $.37 \pm .61$ vs. $.14 \pm .09$; $p = .46$). However, when comparing the ratio of the transcription factor AHR and its Repressor AHRR (AHRR/AHR) in metastatic and control tissue, the imbalance between the severely upregulated AHR in tumortissue and AHRR was distinctly significant. ($.55 \pm 1.09$ vs. $.18 \pm 1.60$ $p < .01$) Comparing AHR expression between malignant melanoma metastasis and GBM exhibited the following values: 3.64 ± 2.32 vs. 1.27 ± 1.89 ; $p = .055$. Moreover, ARNT was significantly elevated in metastasis compared to GBM: 3.81 ± 2.25 vs. 1.7 ± 1.15 , $p < .01$.

Conclusion: Our data reveal a significant upregulation of key components of the AHR pathway in melanoma brain metastases in comparison to peritumoral brain and partly even GBM. This could indicate a major pathophysiological role of this pathway not only in GBMs like shown before, but also in the progression of brain metastasis. While the AHR-pathway can play a dual role in tumorigenesis, i.e. it can be both tumor-suppressive or tumor-promoting, based on these findings its role in brain metastases of melanomas should be further elucidated.

Ventral C1 fracture combined with congenital posterior cleft: what to do?

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Objective: We present a treatment approach for a rare condition of patients with a ventral C1 fracture and a congenital cleft in the posterior arch (half-ring Jefferson fracture) with an intact transverse atlantal ligament. Our technique aims to achieve stability of the atlanto-occipital and atlanto-axial joints while preserving mobility of the upper cervical spine.

Methods: Two male patients, 43-year-old and 29-year-old, were admitted to our hospital due to a fracture of the ventral arch of the atlas with no damage of the transverse atlantal ligament. Both individuals also presented a congenital cleft of the posterior arch. Initial conservative management with a Halo-Thoracic-Vest was performed in one case and failed. As a result, surgical treatment was carried out in both cases using bilateral C1 mass screws and a transverse connector.

Results: The patients showed no neurological deficits on follow-up examination four weeks after surgery with a full range of head and neck motion. The CT-scan showed no dislocation of the implanted material with a good dorsal alignment and a stable ventral fracture distance. Furthermore, follow up CT-scan showed osseous stability in both cases with beginning bony ossification of the bone graft.

Conclusion: Isolated instable fractures of the ventral arch of the atlas with a congenital cleft of the posterior arch with no damage of the transverse atlantal ligament can be stabilized using bilateral C1 mass screws and a transverse connector preserving upper cervical spine mobility.

giant Lipomas as an extremely rare cause for brachial Plexus compression

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Objective: Brachial plexus lipomas are extremely rare benign tumors with only 8 cases reported in the literature that may cause slow progression of neurological deficits. Aim of this report is to present our surgical treatment regime and long-term neurological outcome in two cases of giant brachial plexus lipomas.

Methods: Retrospective analysis of patients treated in our center in the last 3 years revealed giant brachial plexus lipomas causing thoracic outlet syndrome in two cases. Both patients underwent preoperative magnetic resonance imaging (MRI), ultrasound examinations and electrophysiological testing. Tumors were removed microsurgically via anterior, posterior, supraclavicular and infraclavicular approaches. Both patients were accessed postoperatively for early and late MRI and clinical follow-up.

Results: Case One: A 61-year-old male patient presented with a 10 year history of right sided thoracic outlet syndrome causing hypoesthesia of digitus IV and V, a paresis of the triceps brachii muscle, the biceps brachii muscle and the dorsal and palmar interossei muscles. Ultrasound and MRI of the neck depicted a large lipomatous mass compressing the right brachial plexus. Electrophysiological testing showed impairment of the axillary nerve. Total tumor resection via a two-portal supraclavicular/infraclavicular approach and neurolysis finally led to long-term relief of the symptoms.

Case Two: A 62-year-old male patient presented with a left-sided brachial plexus lipoma. The tumor showed progressive and visible growth on the left shoulder over a period of more than 7 years, finally causing atrophy and a paresis of the triceps brachii muscle, the biceps brachii muscle, the deltoid muscle and the supraspinatus muscle. Electrophysiological testing revealed an impairment of the left brachial plexus and MRI showed a giant lipomatous tumor ranging from the area of the triceps brachii muscle towards the supraspinatus muscle, the clavicle and the brachial plexus on the left side. Total tumor resection via a dorsal suprascapular, infraclavicular approach and neurolysis finally led to long-term relief of the symptoms.

Conclusion: Giant brachial plexus lipomas are an extremely rare cause for brachial plexus compression. Total microsurgical removal with intraoperative electrophysiological monitoring is the treatment of choice with excellent long-term MRI and clinical outcome.

Psycho-oncological counseling in neuro-oncology - analysis of topics and needs of brain tumor patients

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Objective: In the field of neuro-oncology an increasing focus is being directed towards the psychosocial needs of patients diagnosed with brain tumors. However, it remains challenging to establish psycho-oncological therapies and interventions that meet the specific needs of these patients. Therefore, the aim of this study was to identify major concerns and burdens of brain tumor patients on the basis of our clinical experience.

Methods: This retrospective chart analysis included 53 patients attending supportive psycho-oncological counseling at the Department of Neurosurgery, University of Münster between 2010 and 2014. All patients were counseled by the same therapist, a neurosurgeon with specialization in psycho-oncology. Notes were analyzed based on qualitative content analysis. With regard to physical and psychological symptoms, coping strategies and further concerns mentioned by the patients, thematic categories were established. Notes were then assigned to the categories to analyze their frequency distribution and identify the patients' main concerns.

Results: The cohort had a mean age of 48 years. 30 (56.6%) were female. 23 (43.4%) were diagnosed with high grade glioma, 16 (30.2%) with low grade glioma, 10 (8.9%) with a benign brain tumor and 4 (7.5%) had cerebral metastasis. The median number of consultations per patient was 4 (range 1 – 47). During their first consultation, 36 (67.9%) patients listed their physical symptoms and limitations. 40 (75.5%) suffered psychological symptoms, often accompanied by a depressive disorder.

The majority of patients expressed issues related to questions concerning meaning of and priorities in life (71.7%), medical topics and questions (62.3%) and death and mortality (56.6%). Furthermore, the following concerns were primarily mentioned: the shock of being diagnosed with a brain tumor, work and occupation, loss of roles and tasks in daily life, family conflicts, reduced mobility, excessive demand and reduced capacity. Concerning coping modes, more patients showed appropriate strategies (including an active attitude toward the disease; 39.6%) than inappropriate strategies, comprising resignation (20.8%) and rumination (18.9%). Concerning psychological symptoms and topics of conversations, there were no significant differences among patients regardless of the dignity of tumor ($p = n.s.$).

Conclusion: These results provide an insight into major concerns and issues that patients diagnosed with a brain tumor are frequently dealing with. Therefore, they can serve as an important basis for the development of psychosocial intervention concepts. No significant differences between the diagnosis groups were found. This suggests that, regardless of prognosis and tumor natural history, the burdens of patients diagnosed with a brain tumor are similar and all patients, despite of their diagnosis, might benefit from psychosocial support.

Intrinsic hyperexcitability of the distant spinal cord in patients with cervical cord lesions

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Objective: Damage of the proximal spinal cord is associated with negative (e.g. paresis) and/or positive (e.g. hyperreflexia) motor symptoms of the upper and lower limbs. While negative symptoms are attributed to the disturbance of corticospinal output, positive symptoms are supposed to evolve from an increase of spinal excitability. This study evaluated the spinal output gain after transcortical and transspinal stimulation in patients with intra- (IM) and extramedullary (EM) lesions of the cervical spine.

Methods: Spinal output gain was evaluated by motor-evoked potentials (MEPs) after transcranial magnetic stimulation (TMS) and transspinal electrical stimulation (TES) in seventy paired-matched patients with IM and EM lesions of the upper cervical spinal cord. A multivariate analysis of covariance (MANCOVA) was applied on MEP amplitudes and latencies establishing the impact of lesion type, paresis and hyperreflexia while controlling for gender, age and body height.

Results: There was a significant higher rate of positive motor symptoms (i.e. hyperreflexia) in patients with IM lesions. The MANCOVA revealed a significant reduction of MEP conduction times to the lower limbs after TMS in patients with lower limb paresis. In contrast, there was a significant increase of MEP amplitudes after TES associated with lower limb hyperreflexia.

Conclusion: The present study suggests an intrinsic hyperexcitability of the lower spinal cord in response to efferent input in patients with lower limb hyperreflexia.

Segmental Lordosis Restoration with Anterior Lumbar Interbody Fusion (ALIF) following Rigid and Semi-rigid Posterior Pedicle Screw Fixation

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Objective: Some pathologies such as spondylodiscitis, fractures or degenerative disease of the lumbar spine mandate internal fixation and anterior lumbar interbody fusion (ALIF). We compared the pre-/postoperative radiological findings after rigid and semi-rigid internal fixation with Titanium-alloy or Polyetheretherketone (PEEK) rods.

Methods: 49 consecutive patients (20 m, 29 f; mean age 67.27 ± 9.81 years (range 35-83)) who underwent ALIF at our department between February and December 2014 were included. We radiologically evaluated 84 segments L3/4 (n=13), L4/5 (n=37), L5/S1 (n=34). All patients underwent a baseline physical and neurological examination on admission.

The diagnostic routine included MRI and CT scans and if possible, an upright x-ray of the lumbar spine before and after surgery. The local lordosis angle of the endplates and lumbar lordosis was measured. All patients received a primary posterior pedicle screw fixation, followed by insertion of a titanium cage over an anterior retroperitoneal approach (ALIF).

A radiological assessment of the spinal geometry was performed and the differences between both groups were statistically analyzed.

Results: Average OR-time for the ALIF was $105.82 \text{ min} \pm 37.01$ (35-188 min).

The mean segmental lordosis angle prior to posterior fixation was 8.64 ± 5.96 degrees (-6.7 to 17) in the group with rigid (Titanium) posterior fixation (n=26) as opposed to 9.04 ± 4.15 degrees (0.8 - 17.2) in the semi-rigid (PEEK) group (n=23).

After rigid posterior fixation, the segmental lordosis increased by a mean of 4.01 ± 1.98 degrees (1.5-10.7) significantly more than after semi-rigid posterior instrumentation (mean of 0.95 ± 0.57 degrees (-0.1 to 2.8)) ($p < 0.05$).

After ALIF, the segmental lordosis increased by a mean of 1.47 ± 1.04 degrees (-1.60-5.70) for the patients with Ti-alloy rods significantly less than in the patients with PEEK rods (mean 4.66 ± 0.85 degrees (-0.10-2.80)) ($p < 0.05$).

However, there was no significant difference between the final segmental lordosis in both groups (14.12 ± 5.17 rigid vs. 14.65 ± 3.90 semi-rigid).

The initial lumbar lordosis was similar in both groups 47.18 ± 15.19 vs. 48.61 ± 11.07 ($p = 0.71$), as was the final lumbar lordosis 52.77 ± 13.77 vs. 50.16 ± 11.05 ($p = 0.48$).

Conclusion: Posterior fixation and ALIF seem to yield similar results in terms of final segmental and lumbar lordosis. The semi-rigid PEEK rod system seems to allow less lordosis correction during posterior fixation compared to the rigid titanium-alloy rod system but this can be compensated by a higher lordosis correction through the ALIF procedure.

The use of ultrasound Doppler enhances the precision in image-guided approaches to the cerebello-pontine angle

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Objective: The edges of the transverse and the sigmoid sinus mark the border for the most common approach to the posterior cranial fossa and the cerebello-pontine angle, the retrosigmoid approach. Injury to these anatomic structures bears a potentially lethal risk. The asterion, i.e. the junction of the lambdoid, temporooccipital, and occipitomastoid bone sutures is not a safe outer landmark for the transition of the transverse to the sigmoid sinus inside the skull. The image guidance based on pre-operative magnetic resonance (MR) and computed tomography (CT) scans is superior to other methods in locating these landmarks before the craniotomy. The dural coverings of the sinuses may obscure these venous structures. The margins of error of current image guidance systems in daily routine demand for real-time guiding methods to enhance precision. We have investigated the applicability of a micro-Doppler ultrasound probe for this purpose.

Methods: In a series of 25 patients undergoing a surgery for lesions in the cerebello-pontine angle we have dispatched both image guidance and a micro-Doppler ultrasound probe (16Mhz, Multi-Dop pro®, Compumedics, Germany) to the task of locating the transverse and sigmoid sinus. The mean maximum error of the image guidance system (Kolibri®, Brainlab, Germany) was calculated from the measured distance between the location of the sinuses as indicated given by the navigation system and the real location as indicated by the Doppler probe. The depth of the ultrasound probe was set at 2mm. The shape and the cross-section area of the sinus were determined by ultrasound measurements. Visual detectability of the sinuses under the operating microscope was also noted. Finally, the time required to prepare and apply image guidance and ultrasound Doppler was measured for this specific procedure.

Results: Accidental incision of the transverse or sigmoid sinuses did not occur in any case when the two localizing methods have been used in combination.

Image guidance was off-target by a mean of 2.64 mm (range 0-6mm, SD 1.55 mm, D in Fig. 1). The exact location of the transverse sinus was invisible in 7 cases, while the sigmoid sinus was visually undetectable in one case.

The shape of the cross section of the sinuses resembled a flat triangle in 23 of the cases. The ultrasound Doppler indicated blood flow outside the visible borders of the sinuses in 5 cases.

Conclusion: A combination of MR- or CT-based image-guidance and micro-Doppler allows for precise location of the transverse and sigmoid sinus in retrosigmoid approaches. The method prevents injury to these important venous structures by restricting the craniotomy strictly to the very edges of the sinuses and by indicating blood flow outside the borders of the sinuses as detected by preoperative imaging methods before the dural incision is performed.

NKG2D ligands in glioma stem-like cells: Expression *in situ* and *in vitro*

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Objective: Glioblastoma multiforme (GBM) is a highly malignant brain tumor. Tumor stem cells have a major influence on tumor malignancy and progression, and immunological escape mechanisms, involving the Natural Killer Group 2, member D (NKG2D) receptor-ligand system, are key elements in tumor progression. Cell-bound NKG2D-ligands (NKG2DL) such as MHC class I related molecule A and B (MICA and MICB), and the UL-16 binding protein family (ULBP1-6) are recognized by the NKG2D-receptor and trigger cytotoxic effector activity in NK- and T-cells. By releasing soluble NKG2DL, tumor cells inhibit the killing potential of effector cells. Numerous studies documented the importance of the NKG2D-system in *in vitro* GBM-model systems, but the role for glioma stem cells has not been described yet.

Methods: We analyzed the expression profile and localization of NKG2DL (MICA, MICB, ULBP1 and 2) and embryonic and neural stem cell markers (Klf-4, Oct-4, Sox-2, Nanog, Musashi-1) in solid human GBM and stem-like cells isolated from glioma cell lines using quantitative RT-PCR and two color immuno-staining. We also evaluated the effect of temozolomide (TMZ) on NKG2DL and stem cell marker expression in stem-like cells derived from glioma cell lines by qRT-PCR.

Results: Whereas Musashi-1 and Oct-4 were rarely costained with NKG2DL, Sox-2 and Nanog showed partial costaining. For Klf-4, we observed a complete costaining with MICA, MICB, ULBP1 and ULBP2. NKG2DL were found in a distinct tumor cell subpopulation and were broadly costained with each other. qRT-PCR of stem-like cells derived from glioma cell lines T98G and U251MG in comparison to differentiated cells revealed that T98G stem-like cells were predominantly positive for MICB and ULBP1, whereas MICA, ULBP2, Sox-2, Nanog and Musashi-1 were more pronounced in U251MG stem-like cells. Upon differentiation, T98G displayed significantly less MICA, MICB and ULBP2, whereas in U251MG expression of NKG2DL was mostly unaltered, and expression of most stem cell markers decreased significantly, as expected. This was consistent with findings on protein level, which were obtained by immunostaining. Stimulation with TMZ led to a significant upregulation of NKG2DL in stem-like cells derived from T98G and U251MG.

Conclusion: The role of the NKG2D system concerning glioma stem cells is complex: in solid glioblastomas NKG2DL are found in a subset of tumor cells that coexpress some but not all investigated embryonic and neural stem cell markers. Stem-like cells derived from glioma cell lines show a heterogeneous expression pattern of NKG2DL and stem cell marker expression. TMZ leads to an upregulation of NKG2DL, with some variation between cell lines. As stem-like cells from GBM cell lines *in vitro* show a higher expression of NKG2DL than more differentiated tumor cells, the NKG2D system might play an important role in regulation of tumor stem cell survival.

Navigation guided endoscopic decompression of lumbar spinal stenosis via translaminar approach. Introduction of the Spondyloskop

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Objective: To preserve integrity of facet joints, we have changed the routine of microscopic decompression. Starting at the basis of the spinous process, the bone is removed with a high speed drill and the interlaminar route can be replaced by the translaminar access. After elimination of the central stenosis, both topassing nerve roots are able to be decompressed and the hidden zones can be reached for the upper nerve roots. This strategy could be transferred into endoscopy. Until now, endoscopy permits only the interlaminar and the transforaminal access and the technical requirements are still missing for the translaminar approach. As more bone must be removed for the translaminar approach, our task was to create a downwardly conically opening, fully-turned tube, in which a high speed drill and an endoscope can be placed simultaneously.

Methods: Firstly we report translaminar access via a navigated guided tube together with a high speed drill, afterwards to perform decompression with a conventional endoscope in 27 patients with central lumbar stenosis and radicular pain due to additional recess stenosis caused by facet joint hypertrophy. Performing the translaminar approach with the navigation guided high speed drill endoscopic decompression could be completed in an appropriate surgical time. Patient and surgical data, numeric rating scale (NRS) for back and leg pain, core outcome measures index (COMI) and Oswestry disability index (ODI) were recorded preoperatively and three months after surgery.

Results: Average age was 69.3years. No conversion to open surgery was necessary. 17 patients suffered from two levels spinal stenosis. In these patients both levels were successfully decompressed via one single endoscopic port. The mean operative time including the time necessary to perform the 3D-scan was about 132min while the mean surgical time (without scan) per level was 63min. There was no measurable intra- or postoperative blood loss due to continuous saline lavage and missing need for drainage. The mean hospital stay was 6.2days. No nerve root injury, infection or cerebrospinal fluid fistula occurred. Comparison between preoperative and 3-months follow-up showed improvement of clinical scores: ODI improved from 48.3 to 17.5; NRS-back improved from 7.3 to 1.5; NRS-leg improved from 8.2 to 2.5; COMI decreased from 9.6 to 2.9.

Conclusion: This successful proof of principle for navigation guided endoscopic assisted decompression of lumbar stenosis via translaminar access made us to advance this technique developing the Spondyloskop® for simultaneous high speed drilling under full endoscopic control. Spinal stenosis can be effectively treated via the translaminar approach. Without difficulty it is possible to reach up to two levels using the same endoscopic skin incision. Additionally the use of navigation contributes a steeper surgeon's learning curve.

Comparison between open-door laminoplasty and bilateral spinal canal decompression via unilateral approach in patients with cervical spondylotic myelopathy

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Objective: The majority of patients suffering from cervical spondylotic myelopathy (CSM) are treated by anterior cervical decompression and fusion (ACDF) or corpectomy. Laminectomy and laminoplasty are less frequently employed techniques. We propose an alternative bilateral dorsal compression technique via an unilateral approach. The present study was conceived to elucidate differences in the neurological outcome between the bilateral decompression and the laminoplasty approach.

Methods: Patients with symptomatic CSM with or without radiculopathy were included. In all patients, preoperative magnetic resonance (MR) imaging and pre- and postoperative computerized tomography (CT) were obtained. MRI was analyzed for cervical myelopathy. In the bilateral decompression group, either a laminotomy or hemilaminectomy was performed, depending on the number of involved segments. Bilateral decompression was achieved via undercutting technique. In the laminoplasty group, "an open-door"-technique with suture-muscle-fixation of the lamina without plates or implants was performed. Neurological status pre- and post-operatively was obtained regarding paresis and sensory deficits.

Results: A total of 145 patients was included, 85 in the laminoplasty and 60 in the bilateral decompression group. The mean age was 68 years (30-89). The median follow-up was six weeks. The neurological status significantly improved in each group in separate univariate analysis, in the laminoplasty group with $p=0.045$ and in the bilateral decompression group with $p=0.001$. Comparison of postoperative neurological status focused on sensory and motor deficits showed significant differences between both groups. Patients with unilateral radicular pain benefited from bilateral decompression rather than laminoplasty.

Conclusion: Unilateral laminotomy or laminectomy, followed by bilateral decompression via undercutting is a promising treatment in patients with cervical spondylotic myelopathy. We assume, that inter alia less muscle trauma and neck pain compared to laminoplasty leads to faster patient recovery.

Minimally invasive endoscopic rhizotomy: a treatment for lumbar facet and Iliosacral joint syndrome – technique and clinical experience

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Introduction: The facet joint has been implicated as a source of chronic low back pain, especially in degenerative arthritis. The radiofrequency rhizotomy or cryotherapy of the dorsal nerve branches can provide pain relief. The result of the intervention is highly depended on surgeons experience and the positioning of the intervention needles. Anatomic structures were represented only indirectly by X-ray or ultrasound images. In contrast, endoscopy allows a controlled anatomical rhizotomy under direct visualization of the facet joints. Goal of this study is to describe the endoscopic technique, present our clinical experiences and analyse our results.

Methods: We performed endoscopic rhizotomy of the lumbar and sacroiliacal facet joints under general anesthesia in patients who have previously reported at least a pain relief of 50% on the numerical analogue scale (NAS) after infiltration test. We analyzed the surgical technique, the complications during and after intervention, and described advantages and disadvantages compared to other forms of rhizotomies described in the literature. Furthermore, the primary clinical outcome was specified in the relative difference, both at discharge and at the follow-up after 18 months.

Results: A total of 251 patients (158 women, 93 men; mean age 60.37 years; 26-87 years) were included. 1004 facets and 102 sacroiliacal joints were endoscopically thermo frequency coagulated. At discharge, 215 of 251 (85%) and at follow-up study 180 of 251 (72%) patients reported improvement in pain of > 50% on the NAS. Complications were minimal and average surgical time per segment was 10 minutes.

Conclusion: Endoscopic rhizotomy of lumbar and sacroiliacal facet joints provided satisfactory results concerning pain control in patients with chronic lumbar back pain. Our preliminary results were very promising concerning the long-term outcome of relief in chronic lumbar back pain. However, further detailed long-term results need to be obtained in the future.

Indirect decompression by ELIF - potential and limitations

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Objective: Extreme lateral interbody fusion (ELIF) is a powerful tool for interbody fusion and coronal deformity correction. However, evidence regarding the success of ELIF in indirect decompression is lacking. The purpose of this study was to systematically review current literature on the potential and limitations of ELIF in indirect decompression and to identify factors influencing clinical and radiographic outcome.

Methods: A systematic literature search in the PubMed, Cochrane and ScienceDirect databases was performed. Radiographic and clinical outcome measures as well as information on study design, sample size, population, procedure, number and location of involved levels, follow-up time and complications was extracted and evaluated.

Results: 20 publications were selected for review including a total of 1080 patients. The majority of publications (90%) were retrospective case series. Most frequent indications for ELIF included degenerative disc disease, spinal stenosis, spondylolisthesis and degenerative scoliosis. Mean foraminal area and central canal area increased by 31.6mm² and 28.5mm², respectively. ELIF successfully improved foraminal stenosis, contradictory results were found for indirect decompression of central canal stenosis. Amount of indirect decompression seems to be independent from factors like cage position, side of approach or presence of facet degeneration.

Conclusion: Current data suggest ELIF to be an efficient technique in decompression of foraminal stenosis. Evidence on decompression of central canal is low and results are inconsistent. Based on literature predictive factors could not be identified, however, some evidence exists for cage diameter to be influential. Other factors were found to be non-influencing or data were insufficient.

Cervical device study (CDS): Is adjacent Level disease a device specific pattern or the natural course? Introduction of biokinematic triangle

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Objective: To elucidate the optimal cervical cage or prosthesis for patients suffering from cervical degeneration, a prospective randomized study in patients after single level cervical discectomy was enrolled. It consists of one arm, in which Elastic Spine Pad™ (ESP) and Squale™ are compared concerning the Neck Disability Index (NDI) in patients suffering from cervical stenosis (PNS) and a second arm, in which ESP is compared with Rotaio™ in patients with cervical prolapse (PNR). ESP is a cervical prosthesis made of titanium endplates with an elastomer in between and could be interpreted as an elastic cage. Squale™ is a ring-shaped PEEK cage and Rotaio™ is a titanium prosthesis. To standardize the implanted device height and to reduce neck pain, the height was software assisted determined.

Methods: The software vertaplan™ detects the worst segment of the considered spine region analyzing the movement recordings in inclination, neutral position and reclination from the plain X-rays. It repeats ROM (range of motion) analysis by using the best segment simulated in the worst to define optimal height of the device and considers current degeneration.

After the segmental movement was cinematographically characterized by fluoroscopy examination of healthy volunteers, for CDS the biokinematic triangle was inserted into the software, to be able to characterize movement of each segment, regarding the variation of the surface area of this triangle during movement, as we noticed that ROM of the adjacent levels is affected by the implanted device. ROM analysis, based on angular observations, requires complete execution of the movement to be able to make a meaningful comparison between single levels and different examinations whereas the triangle's consideration characterizes movement behavior in a way which makes movement's observation independent of its complete execution.

Results: In the patients enrolled in this study, significant changes ($p < 0.05$) in movement characteristics of the adjacent levels could be shown depending on the implanted device. Segments communicate with each another, as it was observed, that the change caused by the implant propagated over several adjacent levels, until the changing finally disappeared.

Conclusion: Depending on the indication leading to surgery (stenosis in PNS or prolapse in PNR) a high-speed drill is used (PNS) or not (PNR) by a single surgeon. This individual bias requires that the implanted devices in PNS are 0.5mm higher than suggested by the software. The biokinematic triangle significantly describes the segmental changes of motion characteristics. After completion this study, it may be shown whether the implant-specific changes in the movement characteristics of the adjacent levels lead to different courses of degeneration. Adjacent level disease would therefore be an implant-specific pattern and not the natural course.

Is an effective functional replacement of a lumbar Segment possible? Biokinemetrie as a surgical projection

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Objective: Spine's extent of movement is larger than the linear sum of the individual movements of the facet joints. Such small movements of the facet joints, which guide the whole segmental movement, are progressively added together via lever arms. Describing the segmental motion pattern we could show that each segment has the same motion characteristic but is provided at another point of this characteristic depending on the progress of the movement. In stabilizing operations whether rigid, dynamic or prosthetic, a fracture-like release of the segment is done. In case of fracture, unnatural movement patterns are possible, so bone is attached. Therefore, in order to create an effective functional lumbar replacement, the movement of the segment must be measured, then it must be simulated by adjusting it to the adjacent levels to finally restrict it to avoid fast ossification.

Methods: After the segmental movement was cinematographically characterized by fluoroscopy examination of healthy volunteers, the movement characteristics of every lumbar segment were simulated. The software targeted the worst segment of the considered spine region analyzing the movement recordings in inclination, neutral position and reclination from the plain X-rays. The software repeated the range of motion analysis by using the best segment simulated in the worst to define optimal height for segmental replacement regarding current degeneration.

The segment was first improved regarding its optimized segmental height and then the extrapolated characteristics were transferred to this segment to define placement and bearing surface reflecting the movement pattern of an interspinous device that supports the facet joints.

Results: Construction of an artificial bearing area which is able to support the progressive movement of the facet joints. A device "lock-move" which results from this consideration is able to be implanted into the interspinous space using cortical bone trajectories. Such device was implanted in a 38-year-old male patient with a follow up time of four years, who had been operated 10 times on a prolapse in L5/S1, thereby damaging the facet joints. He refused stabilization. He was supplied with monoblock prosthesis and a poly-axial head based facet joint support, which allowed a restricted translation.

Conclusion: Measuring and consecutive simulation of movement patterns to provide mathematical - algorithmic theorems for the development of a surface reflecting the movement pattern of a lumbar segment to construct an interspinous device that supports the facet is possible. Pedicle screw based dynamic support (topping-offs), which does not allow the segmental height to increase and to decrease progressively during the movement can't work according the results of this examination.

Petroclival meningiomas: Which is the ideal surgical approach?

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Background: Petroclival meningiomas are posterior fossa tumors located medial to the fifth cranial nerve and pose different surgical challenges.

Objective: This study aimed to review a surgical series of petroclival meningiomas and the factors considered in the choice of approach.

Methods: Retrospective review of 22 petroclival meningioma patients.

Results: Retrosigmoid approach was used in tumors <3 cm and in those at or below the internal auditory meatus. Posterior petrosectomy was performed for tumors extending into the middle fossa. Gross-total resection was performed in 11 patients (50%). The mean follow-up time was 32 months (6–75 months). There were four cases of tumor progression or recurrence, which were treated with radiosurgery.

Conclusion: Resection of petroclival meningiomas remains challenging. In most cases, the retrosigmoid approach was sufficient, without affecting the degree of tumor resection. Petrosal approaches were reserved for patients with tumor extension into the middle fossa.

Endoscopic assisted surgery of posterior skull base. Analysis of the advantages.

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Objective: To perform a risk assessment of endoscope-assisted microsurgery via transcranial approaches for posterior fossa lesions.

Methods: We evaluated 85 patients who underwent endoscope-assisted surgery for various pathologies of the posterior fossa via transcranial approaches in our department from February 2010 to March 2015. Retrospectively we analyzed the patients charts, surgical reports, pre- and postoperative neuroradiological data, intraoperative video recordings, ICU charts and follow-up data. We focused in particular on morbidity and mortality due to the endoscopic procedure.

All surgeries were performed combining microscope (Pentero OPMI, Karl Zeiss, Oberkochen) and the rigid endoscope (0°, 30°, 45° optics, Karl Storz, Tuttlingen). The angled optics were always introduced under direct microscopic control.

Results: The mean age of patients was 47.24 ± 13.99 years; 37 were male and 48 were female. The pathologies treated were: Vestibular schwannomas (40), Epidermoid cysts (17), Posterior circulation aneurysms (6), one Chordoma (1), one Chondrosarcoma (1), Meningiomas (3), Trigeminal neuralgias (6), one Trigeminal ganglion inflammation (1), one Trigeminal neurinoma (1), Fourth ventricle ependymomas (3), one Brainstem cavernoma (1), one Vagus neurinoma (1), one Brain stem glioma (1), one CSF Fistula (1), Foramen magnum lesions (2), one Hemifacial spasm (1).

The lesions were managed by following approaches: lateral suboccipital (72 cases), median suboccipital (8 cases), pterional (3 cases), far lateral (1 case), subtemporal (1 case).

New neurological deficits immediately after surgery appeared in 22 cases and included 1 case of dysphagia, 1 case of abducens paralysis, 1 case of trochlear paralysis, 19 cases of facial palsy. All deficits were temporary and recovered in the follow-up besides the trochlear lesion and one case of facial palsy which needed a sural graft. Further, occurred 2 cases of postoperative infection, 4 cases of CSF fistula, 1 case of vascular insult (PICA insult). The mortality rate was 0%.

Regarding the use of the endoscope, no thermal CN injury occurred. In one case the trochlear nerve was injured mechanically due to the endoscope.

Conclusion: The endoscope helps to explore hidden areas of posterior fossa minimizing drilling and retraction of neurovascular and brain structures. Using the endoscope in addition to the microscope enables a safer surgery in posterior fossa even for lesions which aren't visible in a straight line by microscopic view. The risks due to insertion of the endoscope under microscopic guidance are minimal. We expect that new advancement in the endoscopic instrument will enable more improvement in the endoscopic-assisted surgery.

Impact of anticoagulants in elderly patients with sella pathologies

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Objective: Old patients are at high thromboembolic risk, but also at high hemorrhagic risk. As the proportion of elderly patients increases, we are facing age-related complications such as drug-induced hemorrhage. This study demonstrates the incidence of bleeding complications and evaluates the role of anticoagulants as a prognostic factor in a cohort with old patients with sella pathologies.

Methods: We identified all patients > 70 years with sella pathologies from 2007-2015. Sella pathologies were categorized according to entity and frequency. We then investigated the incidence of bleeding complications and the association with the use of anticoagulants.

Results: 256 patients presented to our department with sella pathologies from 2007-2015. 40/256 patients (15%) were 70 years and over. 32/40 patients underwent transsphenoidal surgery, 1/40 patient transcranial surgery, 7/40 received non-surgical treatment. The most frequent sella pathology in our series of patients > 70 was non-functioning pituitary adenoma (26), followed by craniopharyngioma (2), chordoma (2), pituitary apoplexy (2), lymphoma (2), hemorrhagic Rathke's cleft cyst (1), xanthogranuloma (1), hemorrhagic prolactinoma, nasopharyngeal carcinoma (1), mucocele (1) and meningioma (1). The average age of our patients was 76 years. The oldest patient was 85-year-old. Prior to surgery the most frequent symptoms were chiasmal syndrome and hypopituitarism. 50% of the patients (16/32) received anticoagulant therapy prior to admission (Aspirin 8, Vitamin K antagonist 5, Xarelto 3). All hemorrhagic complications were related to drug-induced bleeding disorder (4/32). Neurological deficits were induced by bleeding complications and always required immediate treatment.

Conclusion: In our cohort with elderly patients there is a high prevalence of anticoagulation therapy. Routine preoperative coagulation tests may miss coagulation abnormalities caused by anticoagulants. Expanded coagulation tests such as platelet function test should be established to reduce the risk of hemorrhage prior to surgery.

Expectations and outcome of patients undergoing stabilization surgery of the cervical spine - a prospective monocentric observational study

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Objective: Various diseases can lead to spinal stabilization surgery. A main element of preoperative discussion with the patient is clarification of therapeutic goals. For this, defining the patient's clinical condition and identifying his expectations with regard to his symptoms (such as pain, or disability) is crucial. Expectations can be quantified using standardized tools (e.g., VAS, mJOA score, NDI). It is unclear to what extent expectations measured by means of these tools correlate with postoperative symptom burden and satisfaction and how this depends on the primary diagnosis.

The goal of this study is to measure the preoperative clinical status, expectations and outcome of patients undergoing cervical stabilization surgery.

Methods: This was a prospective monocentric observational study including patients undergoing cervical spine stabilization surgery. Preoperatively, we measured the clinical status using VAS, mJOA and NDI. In addition, patients specified, by means of these tools, the condition they expected at least to be satisfied with the outcome. Six and twelve months after surgery, scores were measured again, and patients specified whether they were satisfied with the outcome.

Results: 105 patients (57 male, 48 female) were included. Preoperative neck pain was 4.9 ± 3.4 (mean \pm s.d.) and arm pain was 3.9 ± 3.6 on the VAS. The values expected for postoperative satisfaction were 1.1 ± 1.4 and 0.8 ± 1.1 . Preoperative NDI was $39.0 \pm 22.4\%$; patients expected $8.5 \pm 11.7\%$. Preoperative mJOA was 13.7 ± 3.0 ; patients expected 15.9 ± 1.8 .

At six (80% follow up rate) and twelve (75% follow up rate) months after surgery, there was substantial improvement of perceived pain and disability. Neck pain at six months was 2.3 ± 2.9 (twelve months: 2.6 ± 3.2), arm pain was 1.2 ± 2.3 (1.1 ± 2.4), NDI was 19.0 ± 22.8 (19.1 ± 22.8), and mJOA was 14.8 ± 3.0 (14.4 ± 3.3). Overall, the high expectations were not met in many cases, especially with regards to NDI (60% did not meet their expectation), mJOA (57%) and neck pain (44%). Yet, satisfaction with the outcome was high (73% at six months and 80% at twelve months).

Patients with radiculopathy had higher expectations, better outcome and were more likely to be satisfied than patients with myelopathy (satisfaction rate at six months: 75 vs. 47%; at twelve months: 87 vs 61%).

Conclusion: Patient expectations are high ahead of cervical spine stabilization surgery. NDI and mJOA achievement, more than pain achievement, underestimate success; pain reduction is more important than disability improvement for most patients. However, there are indication-specific differences.

These results provide the basis for a better appreciation of preoperative patient expectations, improved patient information, optimized surgery indication, and higher patient satisfaction.

Serious implications due to radiation necrosis- mimicking a recurrent brain metastasis

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Objective: Cerebral metastasis originating from tissues outside the brain are the most common tumours of the central nervous system. Among woman the most common primary source is breast cancer. While surgical resection of a solitary lesion is consentient policy, the indication for surgery in the management of multiple or recurrent metastases is discussed controversial to date. Owing to an estimation as far advanced disease stage the diagnosis of a recurrent cerebral metastatic spreaded breast cancer implies significant therapeutical consequences.

Method: We report a case of a 66-year-old female patient with diagnosis of a recurrent cerebral metastatic spreaded breast cancer by radiological and nuclear medical imaging and try to illuminate the cardinal differential diagnosis following surgical resection and radiation, radiation necrosis, vital for management decision making.

Results: This 66-year-old female patient presented in our hospital with the primary diagnosis of a solitary cerebral metastatic spreaded breast cancer 2 years earlier. Following microsurgical extirpation and radiation therapy the cerebral lesion disappeared. Though in the meantime regular staging diagnostics revealed hepatic metastases, a palliative treatment regime was conducted. While the peripheral lesions vanished, a routine MRI-scan then exposed slightly contrast enhancement in the region of the former metastasis, radiological well suitable for a recurrent disease. After confirming the imaging result by one of the recent imaging modalities - O-(2-[18F]-fluoroethyl)-L-tyrosine positron emission tomography (FET-PET), we decided for a "wait and see" strategy based on the good clinical state of the woman and the far advanced disease state. Expeditious an obvious clinical impact of the newly diagnosed cerebral lesion in terms of behavioral changes and affected alertness occurred. An extraordinary fast growing contrast enhancing lesion, space occupying with median line shift was exposed by a refreshed MRI-scan. The initiated steroid therapy showed an excellent clinical improvement. We performed surgery under the presumption to resect a recurrent life threatening brain metastasis. Indeed the pathological examination verified a radiation necrosis.

Conclusion: We show that in a case of recurrent brain lesion after radiation therapy treatment decision making based on radiological and nuclear medical imaging may mislead and indication for surgery should be discussed and provided generous. Otherwise vital consequences are threatened. Furthermore, we highlight the absent specificity and sensitivity of one of the more recently implemented milestones in nuclear medicine, positron emission tomography used with different tracers, for assessing metastases as well as primary tumors and for monitoring their disease extension during therapy respectively their early detection in case of recurrence.

Modulation of vasomotor response in rat cerebral arteries in response to extracellular acidosis: role of acid-sensing ion channels (ASICs)?

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Objective: The presence of acid sensing ion channels (ASICs) has recently been identified in non-neuronal tissues including the vessel wall. We have therefore addressed the question of whether these channels are expressed in rat cerebral arteries and whether they play any role in vasomotor response to acidosis.

Methods: Studies on the functional importance of ASICs were performed by measurement of isometric force in ring segments of rat middle cerebral and basilar artery (MCA, BA). Following precontraction with U46619 (0.3 μ M) acidosis was induced by cumulative application of lactic acid or HCl in HEPES buffer (pH range, 7.05 - 6.56) and in Krebs buffer (pH range, 6.96 - 6.41). We studied the effect of amiloride (30 μ M) – a known blocker of ASIC and ASIC-like channels on acid-induced relaxation as well as on resting tension and U46619-induced tone. Expression of the ASIC subtypes was studied using real time semi-quantitative PCR (rt-PCR) methodology in pial arteries with brain tissue serving as reference.

Results: In HEPES-buffered solution, acidosis induced a pH-related relaxation of MCA and BA ring segments with the maximal effect observed with 4mM lactic acid (pH=6.56). In MCA ring segments amiloride increased relaxation (expressed in % of precontraction induced by application of 0.3 μ M U46619) in moderate acidosis (but decreased relaxation in severe acidosis (pH<6.65; p<0.01 in each case)). Similar trends (though not statistically significant) were observed in BA ring segments. In Krebs buffer, acidosis-induced relaxation was largely suppressed in MCA and BA segments. Amiloride also lowered resting tension (MCA: 18.5 \pm 1.7% vs 9.7 \pm 1.7% in solvent control conditions; p<0.01 and BA: 16.4 \pm 1.7% vs 1.9 \pm 0.8% in solvent control conditions; p<0.01) and reduced the contractile response to U46619 in MCA segments (contraction in % reference obtained in 124mM K⁺ Krebs solution: 71.7 \pm 2.8% vs 80 \pm 2.7%; p<0.01) but not in BA segments. Using rt-PCR methodology we found ASIC-1 and ASIC-2 mRNA in the MCA vessel wall, although at a markedly lower level than in brain tissue. In addition, ASIC-4 mRNA was detected in brain tissue but not in the vessel wall.

Conclusion: The results suggest expression in rat cerebral arteries of ASIC1 and ASIC2 which appear to modulate acidosis-induced vasomotor reactivity. In moderate acidosis ASICs may confer a propensity to contraction but may increase relaxation in marked acidosis. In addition, ASICs appear to be involved in regulation of tone in the physiological pH range. Moreover, the differences in HEPES and Krebs buffer strongly point to an important role of intracellular pH changes in extracellular acidosis due to accumulation of a fixed acid.

Brain metastasis in the precentral region due to choriocarcinoma- mimicking an acute cavernoma haemorrhage with recurrent seizures

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Objective: Choriocarcinoma is a rare female disease of childbearing age. An early diagnosis, especially of intraplacental metastatic spreaded choriocarcinoma is often aggravated due to separation from the primary tumour with delivery. The first clinical presentation of metastatic disease often is associated with respiratory symptoms due to pulmonary metastases. Brain metastasis are rarely reported.

Method: We report a case of a 31-year old female patient with a cerebral metastatic spreaded choriocarcinoma and try to elucidate this rare, untreated usually rapidly spreading fatal disease.

Results: This case report describes a 31-year-old female patient 6 months after delivery, who presented in our hospital with a single seizure and subsequent postictal Todd's paralysis. On admission to our emergency department we observed an alert and fully oriented patient with a right-sided pure motor hemiparesis. A cranial CT scan with angiography showed an atypical nodular haemorrhage. MRI verified the "popcorn" pattern of the haemorrhage. A venous malformation adjacent to the lesion strengthened the diagnosis of a present cerebral cavernous malformation with acute bleeding. Based on clinical worsening we decided to perform surgery. Histopathological findings revealed a metastasis of an adenocarcinoma of unknown primary origin by the time. The most common primary sites for brain metastasis in women- breast, kidney and melanoma- were ruled out by dermatological, gynecological as well as urological examinations. Screening by 2- [18F]-fluoro-2-deoxy-D-glucose positron emission tomography (FDG-PET) depicted no tumour. Merely a subsisted increase in serum hCG β level gave a constructive hint for choriocarcinoma. The patient underwent subsequent chemotherapy analogous to the EMA/CO-scheme. Eight months following surgery the patient is assessed as cured.

Conclusion: In conclusion highlights this case of a 31 year old female patient with intraplacental metastatic spreaded choriocarcinoma the necessity to consider also uncommon entities for intracranial tumours in female patients of childbearing age. Otherwise profound consequences are threatend. It also points out the not rarely delicate distinction between haemorrhagic and tumoural lesions solitary based on radiologic imaging. Likewise nodular non-hypermetabolic lesions in FDG-PET aren't in principle non-malignant.

Quadriplegia after trauma of the cervical spine without radiographic signs of injury - immediate surgery or wait and see?

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Objective: Spinal concussion is defined by a transient neurological deficit without signs of instability or structural damage. A constitutionally or degeneratively narrow spinal canal is a predispositional condition, which can have a pincer like impact on the spinal cord in case of flexion-/extension trauma. Neurological deficits range from paresthesia to incomplete or complete paralysis.

Methods: A 30 year old rugby player and trainer has been hit by another player who was jumping into his neck while he was squatted. Afterwards was unable to move and had severe back pain. The movement of both arms was impaired and he had paresthesia of the lower limbs. The clinical examination in our rescue center revealed proximal accentuated high grade palsy of the upper and lower limbs and a hypesthesia from th2 level. The CT scan showed no traumatic injury but the cervical canal was constricted with a remaining sagittal width of eight mm. Under the suspicion of a cervical spinal cord injury a complimentary MRI has been performed. In the MRI there were signs of a cervical spinal cord edema. Additionally a disc herniation at C5/C6 level without nerve root or spinal cord compression has been revealed. In the course of the initial emergency diagnostics the paresthesia and paralysis has been markedly reduced and the primarily considered surgery has been postponed. The patient was admitted to the intensive care unit for further surveillance. During the day the neurological deficit continuously improved.

Results: After 48 hours there was a complete regress of the high grade paralysis. Radiographic signs of spinal cord edema have not been seen anymore. The clinical follow up after two and eight weeks showed a stable result. Because of the constitutionally narrow spinal canal the patient was recommended to avoid sports with physical contact and a follow up MRI scan.

Conclusion: Due to constitutional and/or degenerative impairments of the cervical spine an isolated spinal cord concussion can lead to a transient quadriplegia. If there are no other injuries a wait and see strategy with close monitoring and clinical surveillance is an appropriate therapyoption.

30-day complication rate following cranioplasty: incidence and predictors

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Objectives: Cranioplasty is believed to be a simple neurosurgical procedure, so much so that it has become the “beginners” cranial case. However, these “simple” procedures may have high complication rates. The factors that contribute to periprocedural complications, both patient and surgery specific, need to be thoroughly assessed. The aim of this study was to evaluate such risk factors.

Methods: We conducted a review of all patients who underwent cranioplasty following craniectomy for stroke, subarachnoid hemorrhage, epidural hematoma, subdural hematoma and trauma between 2010 and 2016.

Results: 152 patients were identified. The overall complication rate was 26%. The mortality rate was 2%. 53% were male. Median age was 48 (range 11-78). Median duration till cranioplasty was 102 days (range 14 - 378). A young resident, old resident and an attending performed the surgery in 22.5%, 51.7% and 25.8% of cases, respectively. None of the following potential risk factors was associated with increased risk of periprocedural complications: Gender ($p=0.3$), Age ($p=0.3$), cause of initial surgery ($p=0.07$), duration of surgery ($p=0.08$), surgical experience ($p=0.1$), and duration until cranioplasty ($p=0.3$)

Conclusion: The 30-days complication rate following cranioplasty is relatively high. Thereby we found no clear predictor for 30-day complication development.

Postoperative evaluation after VP-Shunt Operation using low dose CT vs conventional imaging using cCT and X-ray of skull, thorax and abdomen

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Objective: An operative implantation of VP-Shunt system is the most common used therapy for different types of hydrocephalus. Postoperative cCT and X-ray of head, thorax and abdomen are commonly used to evaluate the position of the VP-Shunt components (ventricular catheter, abdominal catheter, valve position and connection Points). Since few months low dose CT (of head, thorax and abdomen) emerged as a novel evaluation method. Our study aims to compare between the 2 modalities (Comparing the total CT dose used and the ability to assess the different VP-Shunt components but also of the postoperative mechanical complications)

Methods: Comparing between 2 groups of patients in a retrospective study including adult patients older than 18 years old after an operative implantation of a VP-Shunt system. The 1st group is composed of a total of 44 postoperative low dose CTs and the 2nd group is composed of postoperative 27 cCTs accompanied by Xray of head, thorax, and abdomen. The comparison is regarding the effective dose of CT in mSv, the quality of both modalities (evaluated on a scale from 1 to 5 while 1 is not assessable and 5 is assessable with highest accuracy) to show the position of ventricular catheter, abdominal catheter, valve position, the pressure level of the valve and the possible dislocation or disconnection of the shunt system.

Results: The mean dose of the low dose CT was calculated as effective dose of 6.666 mSv while the mean dose of the conventional cCT was calculated as effective dose of 10.984 mSv. To be taken in consideration, that the patients of the 2nd group are exposed in addition the the CT to X-ray with additional radiation exposure. The standard estimates of the X-ray doses equal 0.13 mSv, so that the mean effective dose of the 2nd group is calculated as 11.078 mSv.

Using the low dose CT we could diagnose 6 catheter dislocations out of total 6 dislocations and 1 catheter disconnection out of 1 disconnection with high image quality and high accuracy with a mean on the measuring scale of 5/5. In all cases of the 1st group was the pressure level of the valve not measurable with the mean on the evaluation scale of 1/5. In contrary the 2nd group had the advantage of recording the pressure level of the valve with a mean from 5/5.

Conclusion: Using low dose CT to evaluate the postoperative Position of the VP Shunt system could replace the traditionally used method using CT and X-ray, offering high quality, high accuracy and lower dose exposition(Effective dose of 6.666 mSv against 11.078 mSv). If pressure level of the valve is clinically important, an additional lateral X-Ray of the skull is necessary(Standard effective dose 0.01 mSv).

Unusual polytopic pleomorphic tumor of the CNS: a case report

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Objective: We present a patient with a polytopic CNS tumour raising the differential diagnosis of an unusual histiocytic tumour and an anaplastic glioma. Several biopsies of brain and spinal lesions with repeated histological and immunohistochemical analyses showed cell characteristics indicating mainly histiocytic, but also partly glial origin, and inflammatory changes.

Method: A 50-year-old-male patient presented with brachialgia, paresthesia of the legs and ataxia.

Results: MRI: space occupying lesion C6/7 which was removed and showed inflammation. Detailed CSF examination was inconclusive. Bone marrow biopsy, CT thorax and abdomen: normal.

Subsequently, lumbar spinal lesions were detected. Neuropathology: chronic neuritis.

Symptoms progressed in spite of steroids. Additional brain lesions were diagnosed by serial MRI brain and F18-FET-PET.

Biopsies of a frontal lesion and, later, of a lesion in the right caudate nucleus revealed a malignant tumour with chromatin rich small cells, elongated nuclei lacking prominent cytoplasm; expression of CD45, CD68, CD11c, and CD163 epitope, but negative for S100 protein and Langerin leading to the diagnosis of an unusual histiocytic tumour. Treatment was initiated with Vinblastin and steroids (protocol for Langerhans cell histiocytosis) with no improvement. Imaging showed tumour progression. Methotrexate and Ifosfamide were also unsuccessful and treatment then changed to high-dose chemotherapy with stem cell rescue (Freiburg protocol for primary CNS lymphoma). After 2 cycles of HD-Cytarabin/Thiotepa, all MRI lesions disappeared and the patient reached complete remission. 8 weeks later the patient deteriorated as he had developed new lesions in the posterior fossa and compression of the 4th ventricle. Histopathology of a removed cerebellar lesion revealed tumour cells with the same characteristics as before. Some areas, however, harbored tumour cells with fibrillary processes, expression of GFAP / S100 protein, suggesting astrocytic differentiation. As an immunoreactivity of glioma cells with antibodies against histiocytic epitopes has been reported, further molecular profiling was suggested (450k Array) which is expected to differentiate between tumours of histiocytic/haematopoietic and glial origin.

Conclusion: This highly unusual pleomorphic CNS tumour cannot be classified on the basis of morphology and immunophenotype with certainty. This case illustrates the necessity of molecular analyses in the neuropathological diagnostic pipeline in order to initiate appropriate treatment.

Postinflammatory polycystic circulation disturbances of the cerebrospinal fluid treated by a lumbar-peritoneal shunt

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Background: Intraspinal epidural empyema or abscess can result in postinflammatory arachnoiditis. One of the complications of spinal arachnoiditis are meningeal septal compartments with circulation disturbances of the cerebrospinal fluid. These cysts might grow in size due to a valve mechanisms with impaired back flow of the CSF from the cyst to the spinal canal. This increases the intracystic pressure and thus might cause neurological symptoms.

Aim: Case report about progressive development of postinflammatory polyseptal intraspinal meningeal cysts with progressive neurological deterioration with partial relief by lumbar and thoracic peritoneal shunts.

Case presentation: Female, 29y. Sept. 2015: after diagnosis of degenerative disc disease with L5 pain periradicular infiltration, followed by an iatrogenic abscess of the right psoas muscle with an intraspinal multilevel empyema and meningitis. Surgical evacuation of the epidural abscess at level T12 to L4. Psoas abscess was treated with CT guided drainage and antibiotic therapy. In MRI postinflammatory intradural cystic compartment T12 to L2; March 2016: complaints about radicular pain and paresthesia L5 right side with L5 paresis and bilateral numb feet; surgical sequesterectomy and nucleotomy L4/5 in addition to intradural fenestration of the postinflammatory arachnoidal cyst at T12/L1 through a right sided approach. Slight improvement of paresthesia. April 2016: progressive paresis of foot extension bilaterally. In MRI unchanged size of the cystic compartment from T12 to L2 and in addition new multiple cysts C7-T5. Surgical fenestration at these levels without significant subjective improvement. In the electrophysiological examination tibial nerve evoked potentials (SEP) showed bilateral increased latency indicating a functional damage to the spinocortical tract. Because of persistent pain in the legs, numbness in both feet and gait disturbances a navigated lumboperitoneal shunt was implanted in May 2016. This resulted in a significant relief of the pain and improvement of gait disturbances. October 2016: the pt. complained of increasing radiating pain in both arms from the shoulder to the fingers. MRI spine showed regression of the thoracolumbar drained cystic compartment, but an unchanged intramedullary myelopathic pathology from C7 to T5. In the electrophysiological study at C7/C8 level signs of a neurogenic damage. Based on the neurological deterioration another cervico- and thoraco-peritoneal Shunt was implanted.

Summary: Postinflammatory cysts of the meninges at different spinal levels may cause progressive subjective impairment, sensory disturbances and even paresis. MRI can demonstrate the cysts and electrophysiological studies the functional impairment. Spino-peritoneal shunts may decrease size of the cysts and improve functional capacity.

In vitro system to dissect the molecular basis of vanilloid/TRPV1 mediated anti-tumoral activity of human neural progenitor cells in glioblastoma multiforme

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Objective: Malignant gliomas (GBM) are the most frequent primary brain tumor in adults, with no curative therapy and an average survival rate of 15 months (Curado *et al.* 2007). It has been shown that endogenous vanilloids (fatty acid amides) secreted by neural progenitor cells induce cytotoxicity in GBM cells. This anti-tumoral effect appears to be mediated by the direct stimulation of the Transient Receptor Potential Vanilloid 1 (TRPV1,) specifically present on GBM cells. As neural progenitors represent only a small and difficult to access cell population in the adult human brain we turned to neural progenitors differentiated from human induced pluripotent stem cells as well as directly induced from fibroblasts as *in vitro* models for dissecting Vanilloid-mediated anti-tumoral activity in humans.

Methods: Human induced pluripotent stem cells (iPSCs) were differentiated into long-term expandable neural stem cells (lt-NSCs) following published protocols {Koch:2009cw} and we directly reprogrammed patient derived fibroblasts into induced NPCs (iNSCs) with a viral free insertion method. Both lt-NSC and iNSCs were expandable, expressed NPC markers (at genomic and protein level), differentiated into mature neurons and glial cells, showed a stable karyotype and had active membrane potentials.

Results: Human primary glioma initiating cells (GICs) were exposed to conditioned media from both lt-NSC and iNSCs. We observed an increased cell death in GICs. Exposure of TRPV1-deficient GICs to the same conditioned media preparations resulted in an attenuated cytotoxic response, suggesting an involvement of endogenous vanilloids secreted by lt-NSC and iNSC in the observed GBM cell death.

Conclusion: In summary, we have established a human *in vitro* model with two different source for human neural progenitors in order to molecularly dissect vanilloid-mediated GBM cytotoxicity. This system may be either exploited via transplanted, isogenic neural progenitors in GBM patients or, more ideally, used to identify metabolic pathways leading to the synthesis of individual, highly bioactive endogenous vanilloids as potential chemotherapeutic agents for the treatment of GBMs.

HF 10 Stimulation for treating complex regional pain SyndromeA case series

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Objective: The complex regional pain syndrome type I (CRPS I) is a seldom pathology of the extremities which commonly presents after trauma with an estimated international overall incidence of 26.2 per 100,000 person year. Actual conservative and surgical therapy regimes prove to be insufficient in most cases. High frequency SCS (HF10) stimulates epidurally at a rate of 10,000Hz.

Methods: We present a series of three patients in which a high frequency SCS was implanted to treat a CRPS I. All of the patients have the certain diagnosis of a CRPS I and showed no improvement with medical care. Patient1 had already been treated successfully with a tonic SCS but showed a loss of effect after 2 years. Two octrones were implanted epidurally, paramedian in a shifted fashion. The success of therapy was measured by pain relief (NRS).

Results: All patients showed a relevant pain improvement. Also changes in trophic signs were documented. Two of the three patients also were able to reduce their analgesics dosis. In one patient a caudal electrode luxation occurred which was corrected surgically. None of the patients underwent an amputation.

Conclusion: High frequency SCS shows to be effective in treating CRPS I. All patients had an improvement in their pain scales after implantation.

It is reasonable to try a HF10 in those patients in which medical care is insufficient before extreme procedures are undergone. Further studies with longer follow ups and larger series are needed to confirm this observation.

Impressions of Boston scientific Cartesia directional lead (Boston scientific) after 61 implantations

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Objective: Deep brain stimulation is mainly used for treatment of movement disorders with target points in the STN, the VIM or the GPI. Despite a high precision of electrode placement in the target area side effects can occur by stimulating adjacent fibers or nuclei. There are different types of deep brain stimulation electrodes, which until 2015 all had circular electrode poles in a row, e.g. Vercise lead (Boston scientific) with eight poles or 3389-lead (Medtronic) with four poles. Since 9/2015 the first directional lead (Cartesia, Boston scientific) is available. It contains four circular electrode poles in a row, whereof the two central ones are segmented in respectively three poles, which individually can be controlled. Thereby a more precise adjustment of the applied electric field compared to the circular poles is possible.

Methods: 28 patients underwent a bilateral implantation of Cartesia directional leads, three patients a unilateral implantation. Four of these cases were revision operations with a new placement of the electrodes. Nine of the patients were female, 23 male (ø59,9 years). In 27 cases the patients had a Parkinson's disease, three patients had a tremor, and one patient had dystonia. Also the intraoperative test stimulation was unchanged. The application of a directional electric field via the test electrodes was not possible. Depending on the effects and the side-effects of the test-stimulation and especially on the stimulation-range between these it was decided, if a directional lead was necessary or if a standard electrode with circular poles would be. The implantation of the directional lead was controlled by x-ray. In contrast to standard electrodes not only the precision along the planned trajectory was important, also the rotation of the lead had to be controlled. Different to the standard electrodes the two segmented circular poles of the directional lead should lie in the area of the target point. The deeper one begins 3,1mm from the tip of the electrode. Consequently these electrodes have to be implanted more ventral than the standard ones to use their unique effect.

Results: In three cases complications occurred, which were no consequences of the used type of electrode and did not differ from the usual complications that could occur. A not significant higher x-ray-dose was needed for the placement of the directional lead compared to Vercise- or 3389-leads (415,53 vs. 328,96 Gy cm^2 ; $p=0,09$). The mean duration of the implantation was nearly the same (08:59 vs. 08:55 h:min).

Conclusion: From a surgeons point of view the exact implantation of the directional leads is slightly more challenging, but of course feasible. The higher x-ray-dose is surely acceptable. The first impression of the improved clinical effects seems optimistic. Prospective studies to compare ring-mode-stimulation with directional-stimulation are needed and are already in process.

Neurophysiological investigation of patients treated with Spinal Cord Stimulation (SCS) for chronic pain

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Objective: Spinal Cord Stimulation is an evidence based neuromodulatory procedure for the treatment of chronic pain disorders. However, its mechanism of action has not been explored yet sufficiently. Stimulation paradigms like burst and high frequency modes and their clinical results indicate that SCS acts through different, highly complex pathophysiological pathways. Apart from pilot studies, little is known about the effect of SCS on nociceptive thresholds.

Methods: We present results from a currently ongoing study aiming to systematically assess the impact of SCS on somatosensory perception. We used quantitative sensory testing (QST), a highly standardized methods to quantitatively measure nociceptive parameters. So far, n=6 patients were enrolled in our study. All of them were treated for chronic pain and were examined twice, during her "off" phase and one hour after switching on the stimulator.

Results: According to current interim-analysis, spontaneous pain due to SCS was reduced by 60% at the Visual Analogue Scale (VAS). In all patients showing paradoxical heat sensations (PHS) during the "off phase" (n=2), PHS were abolished during the "On Phase". Four of our patients exhibited dynamic mechanical allodynia (DMA), which was abolished in three of them during the "On Phase". Due to the currently limited number of patients, we did not find any significant changes regarding Mechanical pain threshold (MPT), Pressure pain threshold (PPT), Mechanical pain sensitivity (MPS), Wind-up ratio (WUR), Mechanical detection threshold (MDT) and Vibration detection threshold (VDT).

Conclusion: QST is a reliable tool to quantitatively assess SCS effects on evoked pain. We suggest including sensory mapping and a comprehensive quantitative sensory testing battery as standard measures for SCS patients to ameliorate selection procedures and to assess long-term effects of SCS.

Complications in impulse generator exchange surgery for Deep Brain Stimulation

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Objective: Low or empty battery status of non-rechargeable deep brain stimulation impulse generators (IG) requires a surgical IG exchange several years after initial implantation. Complications in patients undergoing DBS surgery are reported in the range between 7,6 % up to 25,3 %. The aim of this study was to investigate the rate of complications after IG exchanges and to identify risk factors for complications.

Methods: We retrospectively analyzed the complications in IG exchange surgery from 2008 to 2015 in a single center university hospital setting. Medical reports from all patients, who had undergone IG exchange surgery were systematically reviewed. The shortest follow-up was 11 months.

Results: From 2008 to 2015, 438 generators were exchanged in 319 patients. Overall complication rate and revision rate was 8,9 % of cases. 13 patients (2,96%) developed an infection of the IG with a secondary removal of the IG. Five patients (1,14 %) suffered from local wound erosions surrounding the IG; for this particular complication in one patient the IG had to be removed while in the other 4 patients a local wound revision was sufficient. We found hardware malfunctions in 11 patients (2,51 %) and local hemorrhage surrounding the IG in three cases (0,68 %) requiring surgical revision. In two patients (0,46 %) the IG needed to be refixated. In two patients (0,46 %) tension of the connecting cables triggered a surgical revision because of patient's discomfort. One 80 years patient (0,23%) suffered from worsened severe heart failure and died 4 days after IG exchange in local anesthesia. In two cases (0,46 %) the IG was placed abdominally or exchanged to a smaller device due to patient discomfort from initial positioning.

Conclusion: IG exchange surgery, although often considered a "minor surgery", is associated with a complication rate of roughly 9% in our center. Infection is the most relevant complication as it causes removal of the IG. The implantation of smaller IGs might reduce complications such as wound erosions or local hemorrhages. Patients and physicians should know the rate of complication in IG exchange surgery since this information might facilitate a decision in favor of a rechargeable IG.

Rechargeable pacemaker technology in deep brain stimulation: a step forward, but not for everyone

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Objective: Since a few years rechargeable pacemaker technology is available in deep brain stimulation. This technical innovation becomes more and more important in clinical practice, particularly for patients with a need for high energy delivery. Unforeseen handling issues, however, may compromise its use in certain patients.

Methods: Over a period of ten years, 360 patients underwent deep brain stimulation for various indications. Rechargeable pacemakers are increasingly used upon replacement after battery depletion. Despite meticulous screening for suitability, we had to switch battery to non-rechargeable technology because of unforeseen technical difficulties in two patients.

Results: A 73-year-old man with a high cognitive performance with Parkinson's disease, underwent bilateral deep brain stimulation in the internal globus pallidus. Pulse generators were replaced because of battery depletion in 2-year intervals. At the time of third replacement, it was decided to use rechargeable technology because of the relatively frequent need of pacemaker replacements. Two years later the patient requested to remove the pacemaker and reimplant a non-rechargeable once more because of increasing problems with handling of the recharger and inconvenience with the daily monitoring of the battery level.

A 62-year-old woman underwent bilateral deep brain stimulation in the nucleus accumbens for alcohol addiction. She needed biennial pacemaker replacements, the pacemaker was replaced against a rechargeable device at the time of the second replacement. Two years later system malfunction was detected with fracture of the extension cable secondary to twiddler's syndrome. The patient for the main part had had increased difficulties recharging the battery.

Conclusion: Rechargeable pacemaker undoubtedly are a step forward in providing standard of care medical treatment. Many patients stand to benefit from rechargeable technology, smaller devices and fewer replacement operations. However, with new technology we also have new requirements concerning technical capabilities and compliance. Although removal of a rechargeable device before end of service of the battery and replacement with a non-rechargeable pacemaker poses an undue economic burden, it may be the only solution under certain circumstances to guarantee the benefit of chronic stimulation.

Reward processing modulates subthalamic beta band activity in patients with Parkinson's disease

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Objective: Tonic dopamine levels modulate the power of beta oscillations in the subthalamic nucleus. The physiological role of this relationship, however, remains unclear. Phasic changes in dopamine may be caused by rewards.

Methods: Here, we investigated whether beta activity might therefore be related to reward processing. We recorded local field potentials (LFPs) from the subthalamic nuclei of 19 patients with Parkinson's disease who performed a computer-based reinforcement-learning task. Afterwards, we correlated the magnitudes of patients' obtained rewards with task-related power changes in their LFP oscillations.

Results: During reward presentation, beta activity was positively correlated with reward magnitudes. During responding, moreover, alpha and low beta activities were negatively correlated with previous reward magnitudes, while the likelihood of repeating the previous response correlated positively.

Conclusion: Our results thereby suggest a role of beta activity in the processing of rewards, while alpha and low beta activity might be involved in reward-based response adaptation.

Deep brain stimulation of the internal capsule or the nucleus accumbens in patients with obsessive-compulsive disorder: where to modulate?

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Objective: Several targets have been implicated in the study of the effects of deep brain stimulation (DBS) on obsessive-compulsive disorder (OCD) symptomatology. The most common targeted areas are the nucleus accumbens (Nacc), the internal capsule (IC), the ventral capsule/ventral striatum, and the subthalamic nucleus. To these days, there is still an ongoing debate about the best target for DBS in OCD patients. Furthermore, these structures cannot be considered as completely distinct targets as the NAcc is located immediately underneath the anterior limb of the IC and extends dorsolaterally into the ventral putamen and dorsomedially into the ventral caudate nucleus. Therefore, the differences between contact position may determine the clinical postoperative outcome. The objective of this study was to determine the association and differences between location of active contacts within the Nacc and the IC and clinical outcome at long-term follow-up.

Methods: Twenty-three patients who underwent implantation of unilateral (N=3) or bilateral (N=20) electrodes for Nacc DBS were included in this study. OCD symptoms were measured with the Yale-Brown Obsessive Compulsive Scale (Y-BOCS) scale before surgery and postoperatively for a long-term follow-up at different time points. For the lead location, preoperative MRI scans were fused with postoperative CT scans in order to assess the exact location of the active contacts.

Results: The mean postoperative follow-up was 18 ± 7 months (range from 9-51 months). Mean stimulation parameters were $3.9 \pm 1V$ (range from 2.5-6.5V), $96 \pm 17\mu s$ (range from 90-150 μs), $135 \pm 7Hz$ (range from 130-145Hz). Patients with active contacts in the Nacc showed an average improvement on the Y-BOCS of 47%, whereas patients with active contacts located in the IC showed an average improve of 32%. However, if the active contacts were located within a maximum distance of 1,5 mm of the transition between Nacc and the IC, the average improvement on the Y-BOCS scores was of 58%.

Conclusion: OCD patients with active electrodes for DBS in the transitional zone between Nacc and IC showed the best clinical outcome on the Y-BOCS scores at long-term follow-up compared to active electrodes located in Nacc or IC. Further studies will be required to determine if different regions of the cortico-striato-pallido-thalamo-cortical network are activated during stimulation of this region.

Neuromodulation against resistant hypertension: Efficiency of ECG-synchronized selective vagal nerve stimulation in an acute sheep model

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Objective: We recently demonstrated that constant and intermittent selective stimulation of afferent vagal nerve fibers can trigger the baroreflex and lower the blood pressure in rats. In this study we perform selective vagal nerve stimulation in an acute sheep model. Beside investigating the selectivity of the stimulation we compare the efficiency of constant vs. ECG-synchronized stimulation. ECG-synchronized stimulation not only resembles a way more physiological stimulation form, it is also more energy efficient than constant stimulation and could pave the way for an antihypertensive vagal nerve stimulator with a long lifetime.

Methods: The left vagal nerves of 3 male sheep were surgically prepared and positioned in a multichannel cuff electrode (MCE). Real-time blood pressure monitoring was achieved by an intra-arterial microtip probe in the carotid artery. First, the contacts of the MCE that caused cardiocirculatory effects were identified, and then several runs of stimulation with different amplitudes, frequencies and pulse widths were performed both in a constant and in an ECG-synchronized manner. Blood pressure and heartrate responses in relation to the applied energy were analyzed.

Results: In comparison to stimulation in rats, the heartrate responded more severely to any kind of vagal nerve stimulation on specific contacts, while other contacts did not cause any change in blood pressure or heartrate. Using constant stimulation, the strongest drop in heart rate was -32 bpm, while the highest drop in blood pressure was 40 mmHg (MAP). The average efficacy coefficient across all stimulation parameters in stationary stimulation was 1.91 mmHg/bpm. For ECG-synchronized stimulation, strongest drop in blood pressure was 17 mmHg MAP, the strongest reduction in heartrate was -7 bpm. The efficacy coefficient in pulsatile stimulation was 6.34 mmHg/bpm.

Conclusion: Selective vagal nerve stimulation in sheep causes more cardiac side effects then in rats. While constant stimulation caused the most pronounced drop in heartrate with accompanying drop in blood pressure, less bradycardia with comparable drop in blood pressure was achieved with ECG-synchronized selective vagal nerve stimulation. Differences in efficiency of constant and synchronized selective vagal nerve stimulation become obvious that may be interesting for a chronic implantation.

Comparison of battery-life of non-rechargeable generators in Deep Brain Stimulation Kinetra versus Activa-PC

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Objective: The operative change of non-rechargeable generators after DBS-surgery is necessary after several years. Since 2008 a new generation of Medtronic generators is available and the non-rechargeable Activa-PC replaced the Kinetra. From a clinical view the hypothesis was generated that Kinetra has a longer battery-life than Activa-PC. The aim of this study was to verify these findings.

Methods: We retrospectively captured the battery-life of every single patient after implantation of DBS electrodes and generators between 2005 and 2012 in our department due to Parkinson's disease and compared the battery-life of the Kinetra- and the Activa PC groups. To calculate the current usage, the total energy delivered (TEED) was estimated for each patient using stimulation parameters one year after electrode implantation and compared the TEED in both groups.

Results: 192 patients could be included in the study, among those 105 with Kinetra generators and 86 with Activa-PC generators. The mean battery-life of the Kinetra was significant longer ($5,439 \pm 0,199$ y) than of the Activa PC ($4,438 \pm 0,165$ y) ($p = 0,023$).

The mean TEED without impedance for the Kinetra group was $219.903,1 \pm 121.531,0$ W * Ohm and for the Activa-PC group $145.132,1 \pm 72.672,9$ W * Ohm, which implied significant lower stimulation parameters in the Activa PC group ($p = 0,00038$).

Conclusion: A significant shorter battery-life of the new generator Activa-PC in comparison to the older model Kinetra was shown. Since higher battery consuming stimulation parameters as a reason could be excluded, a shorter battery-capacity is probable. Reasons for this e.g. the smaller size of the new implant, new functions or other causes could not be revealed by this study.

Burst Motor Cortex Stimulation neuropathischer trigeminaler Beschwerden

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Objective: Motor cortex stimulation offers a therapeutic option in patients suffering from chronic neuropathic pain unresponsive to conventional means. Although best results are commonly observed in patients suffering from trigeminal neuropathy, sufficient pain reduction cannot be achieved in all patients. Some patients report stimulation induced side effects. Burst stimulation might be an add on option to increase responder rate, therapeutic efficacy and reduce side effects.

Methods: A 39y female patient suffered from severe neuropathic trigeminal pain following repeated neurovascular decompression procedures. Tonic motor cortex stimulation lead to some pain reduction (reduction VAS 10 to 3) in the first place. Over the time of 6 months treatment efficacy was partially lost and stimulation induced side effects (unpleasant stimulation sensation) occurred. Reprogramming did not solve these. We therefore decided to switch to burst stimulation.

Results: Reprogramming was done in an inpatient setting. Classic burst stimulation as used in spinal cord stimulation was applied (40-Hz burst, 5 spikes at 500 Hz per burst) with the lead configuration unchanged and stimulation intensity set at 60% of the motor threshold.

Following a latency of around 20 hours the patients reported a significant decrease in pain intensity and side effects. Although stimulation induced side effects were still palpable for the patient these were not unpleasant. Pain reduction was again at 2-3/10 on the VAS. These results were stable at three month follow-up (9 months postoperative).

Conclusion: Burst stimulation seems to be an option in patients with loss of treatment effect and stimulation induced side effect in motor cortex stimulation for trigeminal pain. Regarding long term efficacy and safety and the question whether burst should be used as a first line stimulation setting further studies will be done. One has to keep in mind that burst stimulation has a high energy consumption, rechargeable device are mandatory. Further studies are warranted to proof this concept.

Impact of Susceptibility Artifact Correction on Fiber Tractography of the Corticospinal Tracts

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Objective: Diffusion Tensor Imaging (DTI) and DTI-based fiber tractography (DTI-FT) has become a routine tool in multimodality neuronavigation to outline major white matter tracts non-invasively. The spatial extent of white matter tracts is commonly underestimated, leading to larger safety margins and thereby in case of doubt leading to reduced extent of tumor resection. DTI and DTI-FT is thereby largely dependent on image quality being affected by e.g. different artifacts during data acquisition. For example susceptibility artifacts occur as non-linear distortions within the image data in phase-encoding direction leading to a shift of white matter tracts and higher uncertainty in location and spatial extent. Correction of susceptibility artifacts can be achieved applying inversed phase-encoding directions during image acquisition and calculation of according deformation maps.

Methods: To evaluate the impact of susceptibility artifact correction on the reconstruction of the corticospinal tract (CST) diffusion imaging data of 20 healthy volunteers (mean age: 25.50 ± 2.06 , male/female: 10/10) was acquired at a 3T Trio MRI System (Siemens, Erlangen, Germany) including an echo planar imaging sequence with voxel size $2 \times 2 \times 2 \text{mm}^3$, 30 diffusion encoding gradients, b-values: 0, 1000 and phase encoding directions anterior-posterior and posterior-anterior. Image data was processed using the SPM Toolbox ACID for artifact correction and the Diffusion Toolkit and TrackVis for tensor calculation and fiber tractography.

Results: Without artifact correction mean fiber bundle volumes of $2.32 \pm 1.15 \text{cm}^3$ (right CST) and $3.15 \pm 1.32 \text{cm}^3$ (left CST) were achieved in contrast to significantly larger fiber bundle volumes of $3.93 \pm 2.01 \text{cm}^3$ (right CST, $p < 0.001$) and $4.54 \pm 2.19 \text{cm}^3$ (left CST, $p = 0.003$) with application of artifact correction. Comparing localization of white matter tracts using a measure of spatial overlap (Dice Coefficient) severe differences were seen for the left CST with a spatial overlap of $54.93 \pm 21.74\%$ and $51.24 \pm 23.55\%$ for the right CST.

Conclusion: Susceptibility artifact correction leads to a reconstruction of significantly larger fiber bundles in comparison to fiber tractography without susceptibility artifact correction. Distortion due to local susceptibility artifact can be at least in part be compensated for using the artifact correction toolbox. Achieved equalization of images leads to a change in location (shift) and spatial extent in the corticospinal tract.

Diffusion Kurtosis Fiber Tractography of the Arcuate FascicleMiriam Bopp¹, Julia Arhelger¹, Barbara Carl¹, Christopher Nimsky¹¹Universitätsklinikum Marburg, Klinik für Neurochirurgie, Marburg, Deutschland

Objective: Nowadays, Diffusion Tensor Imaging (DTI) and DTI-based fiber tractography (DTI-FT), as available in commercial neuronavigation systems, is used to outline major white matter tracts. Thereby, spatial extent of white matter tracts is often underestimated, due to several aspects of image acquisition and image processing. The tensor model itself is not capable of resolving multi fiber populations, as present in at least one third of the brain, only modeling Gaussian distributed diffusion patterns. More sophisticated diffusion models overcome the limitations of the tensor model, but in most cases are not applicable in clinical practice due to extensive image acquisition times. Diffusion Kurtosis Imaging (DKI), modeling also non-Gaussian diffusion properties, uses multi-shell diffusion imaging doubling acquisition times to overcome limitations of the tensor model.

Methods: To evaluate the impact of DKI-FT under clinical time constraints we analyzed fiber tractography results of the arcuate fascicle, relevant in language production and processing, using DTI-FT and DKI-FT in 20 healthy volunteers (mean age: 25.50 ± 2.06 , male/female: 10/10) and 6 glioma patients. For every volunteer and patient MR image data was acquired at a 3T Trio MRI System (Siemens, Erlangen, Germany) including an echo planar imaging sequence with voxel size $2 \times 2 \times 2 \text{ mm}^3$, 30 diffusion encoding gradients, b-values: 0, 1000 and 2000 s/mm^2 and acquisition time of 9 minutes. Image data was processed using the Diffusion Kurtosis Estimator and TrackVis.

Results: Results differed for DTI-FT and DKI-FT. In all volunteers DKI-FT outlined more solid and compound white matter tracts in contrast to DTI-FT with tract volumes of $3.23 \pm 1.25 \text{ cm}^3$ vs. $2.58 \pm 1.28 \text{ cm}^3$ ($p=0.04$). In 4 out of 6 patients DKI-FT outlined more solid tracts with tract volumes of $3.63 \pm 1.43 \text{ cm}^3$ vs. $3.21 \pm 1.01 \text{ cm}^3$. In 2 cases the arcuate fascicle could only be visualized anatomically plausible using DKI-FT, whereas DTI-FT failed to outline the tracts at all.

Conclusion: DKI-FT shows promising results in order to visualize major white matter tracts in close vicinity to brain lesions with short imaging sequences applicable under clinical time constraints.

Deep Brain Stimulation of the subthalamic nucleus improves sensorimotor gating in patients with idiopathic Parkinson's disease

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Objective: Deep Brain Stimulation (DBS) of the subthalamic nucleus (STN) is known to improve motor symptoms and quality of life in patients suffering from idiopathic Parkinson's disease. The exact mechanisms of how STN-DBS affects neuronal network activity are not well understood. Prepulse inhibition (PPI) of acoustic startle describes an operational measure of the pre-attentive filtering process known as sensorimotor gating. Alterations in PPI indicate disturbances in network activity as found in neuropsychiatric disorders like Parkinson's disease. In the present clinical study we investigated the effects of STN-DBS on PPI in patients with idiopathic Parkinson's disease.

Methods: Eight patients with idiopathic Parkinson's disease and STN-DBS were investigated three months after implantation of electrodes. The medication was stopped 12h before testing. PPI was tested under two conditions: no stimulation (Med-OFF/ Stim-OFF) and with the stimulation setting of the best UPDRS-III-result (Med-OFF/ Stim-ON). UPDRS measurement was conducted before PPI testing.

Results: DBS of the STN (Med-OFF/ Stim-ON) compared to no stimulation (Med-OFF/ Stim-OFF) significantly increased the PPI ($t(7)=-2.4$, $p<.05$).

Conclusion: STN-DBS positively influences PPI in patients with Parkinson's disease. Therefore, PPI could represent an indicator how DBS modulates network activity. Our results render PPI measurement as a potential tool for disease- and target specific optimization of DBS settings independent of the examiner or the patient.

Functional intraoperative Navigation using preoperative TMS and direct intraoperative Stimulation of the Motor Cortex in Patients with Brain Tumors in the Vicinity of the Central Region

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Objective: Feasibility and value of non-invasive transcranial magnetic brain stimulation (TMS MagVenture MagPro R30 Denmark), for preoperative diagnosis and surgical planning in everyday clinical practice.

Methods: A prospective study was conducted, which included preoperative a neurological and electrophysiological examination, TMS and display of functional data in the navigation (Localite TMS Navigator Germany). Before surgery TMS data were presented in our neuroimaging board. During surgery the TMS data were correlated with the intraoperative monitoring (IOM). Between 24h-96h and after 3 months a neurological, electrophysiological examination and an additional TMS stimulation were performed.

Results: A total of 26 patients with tumors in or near by the motor cortex region were included in the study. 8 out of 26 patients were diagnosed with glioblastoma, 3 with meningioma, 12 with metastases and 3 with lymphoma. We did not include patients with preoperative epileptic seizures. 22 patients could complete both preoperative and the first postoperative TMS. The 4 excluded patients suffered a pulmonary embolism, a postoperative seizure, a swelling of the larynx or it led to claustrophobia in the MRI. Preoperative TMS data influenced surgeons' decision in planning operative approach and resection strategy. In first postoperative control 7 out of 22 stimulated patients showed slight worsening of motor cortex function, 10 patients had an unchanged state and 5 patients showed an improvement immediately after surgery. A correspondence between the intraoperative findings (IOM, TMS), postoperative diagnosis and postoperative electrophysiological examination could be found. The changes of the electrophysiological examination completely matched with the postoperative neurological outcome. So if patients showed a change in the SEP's, the postoperative results revealed new occurrences of deterioration. A preserved continuity of SEP's showed an improvement of the clinical outcome.

Conclusion: TMS allows a safe and reliable representation of the primary motor cortex both preoperatively and intraoperatively. In summary the combination of preoperative TMS and intraoperative SEP's contribute to an improvement of the representability of the motor cortex, thereby reduced surgical scope and finally the enhanced clinical outcome.

Comparison of techniques to measure visual evoked potentials in neurosurgical patients with diseases affecting the visual pathway

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Objective: Visual evoked potentials are routinely employed for monitoring the function of the visual pathways during surgical removal of pathologies involving the sella, parasellar and temporo-occipital areas, thus providing information about the integrity of the visual pathways on the timescale the system operates on. Historically, visual evoked potentials are measured in awake subjects using a reversing-pattern checkerboard of standard contrast, whereas during surgical interventions under general anesthesia the visual stimulus consists of light flashes delivered at a given intensity through closed eyelids. Although there exists a consensus about the usefulness and reliability of the intraoperative monitoring of the visual evoked potentials, it remains unclear how the responses of the visual neurons elicited by flashes of light at various wavelengths and intensities compare to the reversing-pattern checkerboard.

Methods: 20 healthy subjects are included in the protocol. First we measure the visual evoked potentials using the reversing pattern checkerboard in a room with dimmed light, as to bring the photoreceptor elements in a state of adaptation. Recordings are done with skin needle electrodes positioned in a standard fashion over O1 (left), O2 (right), Oz and Cz, while the visual stimulus is delivered from a calibrated monitor placed 1m in front of the subject. The frequency of the reversal of the checkerboard pattern is chosen at 1 Hz. The light intensity at the 1m distance is measured using a photometric diode, and the contrast of the stimulus adjusted as to match the light intensity delivered by the eye pads and goggles.

Next we measure the visual evoked potentials using the flashing white light LED goggles (Medtronic) as well as red light (660 nm) LED flash goggles (Inomed). The pulse length is set at 10ms with a stimulation frequency of 1-4 Hz, delivering a light intensity of 3000-7000 lux. Each eye is examined separately and the result of 100 trials averaged for each of the techniques.

Results: Measurement of N75 and P100 is reproducible and reliable with reversing-pattern checkerboard stimuli. We will report about the difference in response amplitude and latency using visual stimuli delivered with flashing goggles of different types.

Conclusion: The measurement of VEP using three different techniques (pattern reversal, LED goggles, and LED eye pads) in normal volunteers allows the decision whether goggles or eye pads are more reliable to recognize evoked potentials over the occipital lobe. The most reliable technique will be introduced in the operative setting.

Successful pain relief using Multiple Independent Current Control technology (MICC) and 3D-Illumina™ programming platform following failure of the conventional SCS systems

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Objective: Spinal cord stimulation (SCS) remains an important and clinically validated treatment option for chronic, intractable pain of the back and/or leg(s). Conventional SCS systems on the market are still working with either constant voltage or constant current technology delivering the stimulation from single current source. Others use multiple independent current control technology (MICC) steering each contact individually and apply sophisticated platforms for programming the patients. The latter is supposed to achieve better pain coverage and clinical outcome. The aim of the study was to assess how much the technology can improve the clinical outcomes in patients with unsatisfactory pain relief treated with conventional SCS system, simply by swapping the implantable pulse generator (IPG), in cases where the battery needs to be replaced.

Methods: 4 patients with chronic intractable back and leg(s) pain, who had been initially implanted with Medtronic SCS systems and overall unsatisfactory long-term pain relief, undergone at some time point IPG replacement (3 of them Precision Spectra™ SCS System and one Precision Novi™ (BSC Valencia, CA)) by using a required adaptor either M1 and or M8 (BSC Valencia, CA), without having to change the already implanted lead. Pain coverage percentage and NRS scores were recorded prior and after the replacements.

Results: The mean overall pain coverage across the 4 patients before replacement was 66.3±39%. After replacement was 95±5%. Mean overall pain before replacement was 8±1.4 VAS and after replacement dropped to 5±1.4 VAS. All the patients commented that the paresthesia feeling was more pleasant after the replacement.

Conclusion: In this small cohort we observed that, the usage of the advanced technology of the MICC combined with the Illumina 3D programming platform, allowed to improve the pain coverage and achieve better pain reduction scores. We conclude that in complex cases with unsatisfactory pain relief from conventional SCS systems the technological improvement do significantly influence the clinical outcomes.

Long-term surgical complications of Deep Brain Stimulation in Parkinson's disease patients - single center experience

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Objective: The study evaluates long-term complications of deep brain stimulation (DBS) surgery for Parkinson's disease (PD). A number of studies deal with short term DBS-surgery complications. However long-term complications (>30 days post-surgery) are described in only few reports.

Methods: Retrospective analysis of PD patients treated in our department from 2007 to June 2016. N=540 patients with DBS-implantation were included in the analysis. Primary parameters were infections, electrode dislocation, bleedings, granulomas, and stimulator dysfunction. Secondary parameters were new onset of gait disturbance, depression, REM sleep disturbance, hormonal disturbance, cardiac symptoms, cerebrovascular incidents, new tumors, alcohol abuse, nicotine abuse, autoimmune diseases, metabolic disturbance, polyneuropathy, pain syndromes and adipositas. The data was compared with the cohort of age matched patients with medical treatment.

Results: Mean follow-up was 8 years. Mean patient age was 63 years, and female: male ratio was 1:1,6. Long-term complication could be seen in 43/540 patients (8%). 2.6% had an infection, 0.8% electrode dislocation, 0.8% scar granuloma, 1.1% an intracerebral bleeding, 1.1% an extracerebral hematoma and 2.3% needed stimulator removal due to infection or mechanical complication. The rate of new onset falls in the DBS treated patients was 2.5%/year and new depression was 2.5%/year. REM sleep disturbance was 2%. There was a significant decrease of falls, depression and REM sleep disturbance of 75% in the DBS treated group compared to medically treated patients cohort.

Conclusion: In this retrospective analysis, we could show that surgical complications of DBS implantation in our center are rare. Falling incidents, new onset of depression and REM sleep disturbance were significantly lower in patients with DBS stimulation compared to age matched patients with medical treatment.

Occipital Nerve stimulation (ONS) with body compliant leads for treatment of chronic migraine

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Objective: Migraine is a highly prevalent disease and often refractory to medical therapy. ONS has been shown to provide pain relief in patients with refractory primary headache disorders. It is also less invasive than other surgical approaches; however, drawbacks have been reported, including technical issues with implantable components and lack of efficacy of the treatment. The mobility of the head-neck region causes patient discomfort at the implantation sites, when conventional straight wire SCS leads are used in ONS. We therefore investigated a new flexible, body compliant SCS lead and system for its suitability in ONS in a series of patients for efficacy, complications and overall outcome.

Methods: We hereby present a series of 10 patients suffering from chronic migraine (CM) (ICH criteria), who underwent ONS lead implantation (12 contact leads bilaterally, Algovita, Algostim). Prior to implantation, all patients received unsuccessfully conservative and surgical therapies, including antidepressants, occipital nerve blocks, opioids and botulinum toxin injections. Using a midline incision at C1-2, two 12 contact leads were placed subcutaneously and positioned under fluoroscopy bilaterally at the level of C1, respectively. Leads were tunneled and the generator was placed in an all-in-one procedure under general anesthesia.

Results: At three months follow-up, a reduction in headache days in 9 out of 10 patients (25.73 to 13.17 days) was observed, corresponding to a pain relief (9.9/7.1 on the VAS). Eight (8) patients reported a pain reduction of more than 30%, one (1) patient did not benefit so far (3 months postop). Decrease in pain led to an improvement in functional capacity of the patient during the 3 months follow-up post implantation. (6-months results will be included at the time of presentation). One failure occurred due to skin erosion of the lead tip during initial placement; a successful revision was performed. No other complications, side effects or reports on patients discomfort were noted.

Conclusion: There is an ongoing debate about optimal implant technique, indications and outcome measurement of ONS. By using a new 20% stretchable implantable lead, mechanical complications can be reduced. Due to delayed effect of the treatment we used an all-in-one approach with an outcome follow-up of 3-6 months. This series of implants was dedicated to proof technical advantages of the body compliant leads and pulse generator. Further prospective investigations are currently conducted to support this approach.

What do medical students know about DBS?

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Objective: DBS is a well-established therapy for movement disorders such as dystonia, Parkinson's disease (PD) and tremor and it is currently under investigation in neuropsychiatric disorders. Little is known about medical students' knowledge about this powerful tool when they enter university and what they learn about it during their medical formation.

Methods: A 10-item questionnaire with open and closed questions was designed. Questions addressed indications for DBS, its costs, impact on parkinsonian symptoms, complications, battery life, possible targets and percentage of PD patients who might profit from DBS. Students at Hannover Medical School were asked to complete the questionnaire in the preclinical study period and in the next to last year of the study.

Results: The first group included 204 students (duration of study: 3 months) and the "advanced" group comprises 162 students (duration of study: 48-72 months). In group one 63.4% of the students knew that DBS is routinely used in PD patients, 36.6% knew that DBS is a routinely used treatment for tremor and only 10.3% knew that DBS is used in patients with dystonia as compared to the second group whereas 83.3%, 71.5% and 34% of students knew about the routine use of DBS in PD, tremor and dystonia respectively. Outcome after DBS, its costs, the frequency of side effects, and established and future targets were nearly unknown.

Conclusion: DBS is partly known among medical students in the preclinical phase with a moderate gain of knowledge during further study. We advocate to teach students appropriately and to expand clinical knowledge during the clinical phase of medical studies.

Successful combination of ONS and SPG

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Objective: Migraine is a highly prevalent disease and often refractory to medical therapy. ONS has been shown to provide pain relief in patients with refractory primary headache disorders. It is also less invasive than other surgical approaches; however, drawbacks have been reported, including technical issues with implantable components and lack of efficacy of the treatment. The mobility of the head-neck region causes patient discomfort at the implantation sites, when conventional straight wire SCS leads are used in ONS. We therefore investigated a new flexible, body compliant SCS lead and system for its suitability in ONS in a series of patients for efficacy, complications and overall outcome.

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SiLuDrain (silver-coated lumbar Drainage) Trial: Results from a prospective randomized study

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Objective: The use of silver coated external ventricular drainages has been shown to reduce the number of CSF infections. So far, no data for silver coated lumbar drainages is available. We present first results from a prospective, randomized, monocentric trial reporting on the number of catheter associated infections, catheter handling and complications.

Methods: N=48 patients with an indication for temporary lumbar CSF drainage were enrolled. Patients were randomly allocated (1:1) to receive silver coated or otherwise comparable regular lumbar drainage catheters. Physicians assessed the handling of the systems via a questionnaire. Device related infections (>100 colony forming units on the catheter, positive CSF culture) as well as catheter associated complications were prospectively recorded.

Results: Mean duration of lumbar drainage placement was equal in both groups (4.4 days). Physicians rated the handling of the silver coated lumbar drainages to be significantly superior to the regular ones ($p=0.004$). There were significantly less ($p=0.04$) device-related complications (disconnection, dislocation or occlusion) in patients with silver coated lumbar drainages. One device-related infection occurred in the group with silver coated drainages, whereas four infections occurred in the control group with non-coated catheters ($p=0.15$). In all cases of infection, staphylococci were identified (staph. epidermidis, staph. haemolyticus, staph. hominis) as pathogens. Combined adverse events (infections and device related complications) were significantly lower in the group with silver-coated lumbar drainages ($p=0.02$)

Conclusion: A significant reduction of catheter-associated infections by using silver coated lumbar drainages could not be shown in our prospective, randomized sample of 48 patients. Although the number of infections was four vs. one in favour of the silver coated catheters, a larger sample size is needed to properly assess the hypothesis that silver coated drainages are indeed beneficial to reduce infection rates. However, the significantly lower rate of device-related (non-infectious) complications and adverse events in general already justifies the use of these catheters in patients with an indication for temporary lumbar CSF drainage.

Decrease in blood flow velocity in middle cerebral artery after Ganglion stellate block following non traumatic subarachnoid hemorrhage

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Objective: Cerebral vasospasm (CV) is a major cause for disability following aneurismal subarachnoid hemorrhage (aSAH). aSAH has a 30-day mortality rate of 45% and leaves 30% of survivors disabled. Narrowing of large cerebral vessels averagely occurs 3-14 days after aSAH and often leads to delayed cerebral ischemia (DCI). Standard treatment for aSAH patients with suspected CV is nimodipine and induced hypertension, which can be escalated to angioplasty of the large cerebral vessels. Ganglion stellate block (GSB) was shown to significantly lower cerebral blood flow velocity (CBFV) due to decrease in vascular tone. In contrast to angioplasty it is a minimally invasive, bedside applicable treatment. Our study elicits further evidence for lowering of CBFV after GSB application in aSAH patients.

Methods: Data from patients admitted to our intensive care unit (ICU) between 2013 and 2016 with aSAH and severe CV were collected from the hospital's database. After endovascular occlusion or surgical clipping, standard treatment at the time of hospitalisation consisted of nimodipine (oral 60 mg/4h or iv 2mg/h) for at least 14 days, regular neurological evaluation (every 8h) and transcranial Doppler sonography (TCD) every 24h. If clinical signs of CV were observed and / or TCD showed elevated CBFV (≥ 120 cm/s) hypertension was induced. If symptoms persisted, GSB was performed on the ipsilateral side of CBFV elevation. Patients were re-evaluated neurologically and with TCD 2-24 hours after GSB. If severe CV still persisted angiography was performed. Increase or decrease beyond 100 cm/s or 50% in MCA (median cerebral artery) blood flow velocity were not eligible.

Results: 43 patients received GSB. Data of 36 patients were analyzed (mean age 48.9 ± 12.4 years, f:m=23:13, clipping n = 10, coiling n = 25). In one patient aneurism treatment failed. Median Hunt & Hess (HH) grade in treated patients was 4 and Fisher grade (FG) was 4. GSB was administered after 7.1 days (± 3) following admission. The blood flow velocity (BFV) in the ipsilateral MCA decreased after GSB administration in 80.6% of patients, by a mean of $26.5 (\pm 39.1)$ cm/s from baseline $157.3 (\pm 27.3)$ ($P < 0.001$). The contralateral MCA showed a less marked BFV decrease of $17.4 (\pm 33.1)$ cm/s from baseline (122.6 ± 42.1) within 2 - 24h after GSB ($P < 0.001$). The decrease in CBFV following GSB showed no relation to gender, age, HH and FG. No major complications resulting from GSB were observed in this cohort. 19 patients were significantly disabled (Modified Rankin Scale score ≥ 4), five patients died in the ICU.

Conclusion: Our preliminary data demonstrate a decrease of CBFV in over 80 % of patients with a mean reduction of 16% after GSB. Our results confirm GSB as a safe technique with potential merit in the treatment of CV.

Second-look Strokectomy of Cerebral Infarction Areas in Patients with Severe Herniation

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Objective: Decompressive craniectomies (DC) are performed on patients suffering from a large volume cerebral infarction or severe traumatic brain injury (TBI) with elevated intracranial pressure (ICP). The efficacy of this procedure has been shown in several studies. Yet, in some cases this procedure alone is not sufficient and patients still suffer from high ICP and uncal herniation. Former studies showed a very bad outcome for patients suffering infarction in more than one vascular territory and some authors consider DC as unhelpful in these cases. Resection of the infarction area -strokectomy- is propagated by some experts.

Methods: We retrospectively evaluated data of patients who underwent a DC due to infarction in our department in the last years (2011-2016). Lesion type, side of pathology, age, sex, initial treatment, history of the patient including cardiovascular risk factors, National Institutes of Health-Score (NIHSS), Glasgow Coma Score (GCS), Glasgow Outcome Score (GOS), modified Rankin Score (mRS), intracranial pressure (ICP), CT scans and neurological symptoms were analyzed.

Results: We detected 10 patients who underwent second-look strokectomy (mean age was 52,05 ±16,99 years, median NIHSS 19 (15–32) and GCS 9 (3-12)) after initial DC. Refractory increased ICP above 20mmHg and herniation on CT scan were triggers for surgery. Eight of 10 (80%) patients had an infarction in more than one vascular territory. One patient died (10%), 80% survived and had a moderate neurological outcome (mRS ≤ 4 after 12 months).

Conclusion: All strokectomies were performed as a lifesaving procedure. In comparison to former studies mortality rate was lower and clinical outcome was comparable to previously published RCTs regarding MCA infarctions. Second-look surgery including strokectomy may endorse much acceptable outcome even in cases of infarction in more than one vascular territory.

Predicting of in-hospital outcome in patients with spontaneous cerebellar hemorrhage

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Objective: Cerebellar hemorrhage is a potentially lifethreatening condition and an understanding of the factors influencing outcome is essential for sound clinical decision-making. The aim of our to present the short-term course of patients suffering from a spontaneous cerebellar hemorrhage and to evaluate possible in-hospital outcome predictors.

Methods: We retrospectively evaluated data from 50 consecutive patients, who suffered a first spontaneous cerebellar hemorrhage (SCH) from 2009 to 2014, analyzing their short-term outcomes and identifying possible clinical, radiological and therapeutic risk factors for poor prognosis and death within 30 days.

Results: Among 50 patients with first SCH, the mean age was 72 ± 10 years. Median Glasgow Coma Scale (GCS) score on admission was 11 (IQR = 7 - 11). 19 patients (38%) underwent surgical hemorrhage evacuation with placement of an external ventricular drain (EVD), 12 patients (24%) received an EVD only and 19 patients (38) were treated conservatively. The 30-day mortality rate was 36%. In multivariate analysis only the admission GCS score was a significant predictor of 30-day mortality (OR = 0.598; 95% CI = 0.406 - 0.879; $p = 0.009$). For prediction of 30-day mortality, receiver operating characteristic (ROC) curve analysis confirmed that the best cut-off point was a GCS score of 10 on admission (AUC: 0.882, 95% CI = 0.717 - 1, $p < 0.001$).

Conclusion: Lower GCS score on admission was associated with increased 30-day mortality and poorer short-term outcome in patients with SCH. For patients with a GCS score < 10 on admission, it is important to balance the possibility of survival afforded by further therapy against the formidable risk of significant functional disability and poor quality of life.

Septic shock in spondylodiscitis: better survival with critical treatment strategies

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Objective: Septic shock represents a formidable complication of spondylodiscitis. Despite advances in surgical and intensive care treatment, it is still burdened by high morbidity and mortality. Here, we present our experience in the treatment of this emergency over a 10-year period.

Methods: Eight patients with spondylodiscitis complicated by septic shock were identified in our department from 2005 until 2016. Clinical, laboratory and radiological data were analyzed retrospectively.

Results: There were 7 men and 1 woman. Age ranged between 53 und 78 years (mean age: 62 years). All patients had a history of chronic disease: diabetes mellitus (3 patients), malignancies (2 patients), cardiovascular diseases (5 patients: arterial hypertension, cardiomyopathy, arrhythmia, valvopathies). Six patients presented with paraparesis. Besides spondylodiscitis, intraspinal and/or paravertebral abscesses were evident on MRI imaging studies in all patients. Surgery was performed in all cases including decompression of the abscesses and of the spinal canal. Bacteria were isolated in blood cultures in only 3 patients, and in samples obtained during surgery in 6 patients. Isolated bacteria were gram positive in 6 patients and gram negative in one patient. The mean duration of stay in the intensive unit was 21 days. The clinical course was complicated with respiratory failure (ARDS, in 5 patients) and renal failure (in all patients). Reanimation was necessary in one patient. Another patient succumbed due to septic shock and multi-organ failure. Seven Patients could be referred to rehabilitation in a stable condition.

Conclusion: The management of septic shock in spondylodiscitis needs an interdisciplinary team work. Surgery is necessary for decompression but it also allows determining the causal bacteria and the optimal antibiotic regimen in patients with negative blood culture. Aggressive treatment strategies might result in an increase of the survival.

Limitation of therapy in neuro-intensive care emphasized by FDG-PET/CT

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Objective: This is the first case report to describe the use of PET-Computed tomography in a comatose patient.

Methods: A 61-year-old patient was operated for an acute subdural hematoma. After emergency surgery, the patient remained in coma, the initial anisochoria declined. Follow-up computed tomography (CT) revealed additional intracerebral lesions and remnants of the extra cerebral hemorrhage.

Results: As the initial polytrauma-CT scan already raised the strong suspicion of a neoplastic metastatic illness, unknown so far to the patient and his family, further craniotomy or craniectomy were critically discussed. After consultations with nuclear medicine and oncology, a full-body PET / CT with 226 MBq 18F-FDG with 8 bed positions was performed (as low-dose CT without contrast medium). The investigation of the ventilated patients took 4 hours due to isolation times and technical retrofits. It confirmed a renal cell carcinoma with pulmonary and various nodal metastasis. Cerebral metastasis was not excluded because the perifocal hypermetabolism of the contusion possibly masked a tumor. Therapy was limited; there was no further operation, the patient died due to increased intracranial hypertension.

Conclusion: The average sensitivity of the PET / CT in case of a renal cell carcinoma is 86.2% (compared to 75.7% in CT), with average specificity of 85.9% (46.8% for the CT). In addition, the frequency of detection of metastases is significantly higher. These statistics justify the use of PET / CT in the decision process towards therapy limitation. Disadvantages of the method are the long absence of the patient from the ICU and the high personnel expenses. The problem of informed consent has to be discussed individually.

Multimodal Interventional Therapy of Refractory Vasospasm after SAH

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Objective: Cerebral vasospasms is one of the main causes of morbidity and mortality after aneurysmal subarachnoid haemorrhage (SAH). Detection in comatose patients is difficult and requires multimodal monitoring. The aim of the therapy is the improvement of the cerebral blood flow in order to prevent delayed cerebral ischemia, whereby there are little evidence-based therapy approaches. With recent improvements in endovascular techniques many positive case studies of interventional vasospasm therapy are reported in literature.

Methods: Transluminal balloon angioplasty for large vessels and intra-arterial nimodipine or papaverine infusion for small vessel vasospasm are complimentary approaches to interventional treatment of cerebral vasospasm. We report about our initial experience with endovascular vasospasm therapy in eight patients treated in last three years.

Results: 7 female and 1 male patients (average age 46) were treated with this method for refractory vasospasm after aneurysmal SAH between 2013 and 2016. Aneurysms closure was microsurgical in 2 and endovascular in 6 cases. The number of endovascular interventions for vasospasm was between 2 and 6. The outcome in mRs was 0 in 3 cases, 3 in 2 cases, 5 in 2 cases and 6 in 1 case.

Conclusion: The endovascular treatment with balloon angioplasty and/or selective intra-arterial vasodilator therapy should be considered as valuable therapy option in patients with symptomatic cerebral vasospasm who are not responding to conservative treatment but it is logistically sophisticated and time-consuming therapy. Prospective randomized trials with larger case numbers are desirable.

Significance of Transcranial Doppler Sonography and CT Angiography in Vasospasm Monitoring of the Middle Cerebral Artery

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Objective: Posthemorrhagic cerebral vasospasm contributes to delayed neurological deterioration, a major cause of poor outcome after subarachnoid hemorrhage (SAH). Non-invasive diagnostics for vasospasm include blood flow velocities measured by transcranial Doppler sonography (TCD), assessment of vasospasm by CT angiography (CTA), and CT perfusion measurements (CTP). In the present study we assessed the correlation of TCD blood flow velocities and CTA vasospasm to examine whether CTA could be dispensible in patients with TCD exams of sufficient quality.

Methods: SAH patients with TCD vasospasm monitoring, CTA and CTP were identified retrospectively. Vessel diameters and vessel volumes of the M1 segments of the middle cerebral arteries were determined from CTA data using Amira software by following a standardized protocol. Vessel diameters and volumes were correlated with TCD blood flow velocities. Predictive values concerning presence of a perfusion deficit with consecutive indication for interventional vasospasm treatment were calculated for CTA and TCD.

Results: In 24 SAH patients, 84 CTA exams with corresponding CTP and TCD exam were identified. There was a negative correlation between vessel diameters and blood flow velocity (-0.59 , $p < 0.001$), and between vessel volume and blood flow velocity (-0.47 , $p < 0.001$) of the M1 segment. We found high negative predictive values concerning presence of a cerebral perfusion deficit for blood flow velocities > 120 cm/s (100%) and CTA-derived vessel diameter < 2.5 mm (100%) or vessel volume < 7.5 μ l/mm (97.6%), while positive predictive values were lower (25%, 20.5% and 14.5%).

Conclusion: Our data indicate similar conclusions from CTA and TCD concerning vasospasm of the M1 segment with indication for interventional treatment. Further studies are needed to confirm these results for other vascular segments.

Measuring ICP by extraventricular drainage: common practice but not suitable for continuous ICP monitoring and prone to false negativity

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Objective: A drawback in the use of external ventricular drainage (EVD) originates in its nature that draining CSF (open system) and ICP monitoring is feasible at the same time, but considered to be not reliable regarding the ICP trace. Furthermore, with the more widespread use of autoregulation monitoring using the blood pressure and ICP signal, the question arises if ICP signal from an open EVD can be used for this purpose. Using an EVD system with an integrated parenchymal ICP probe we compared the different traces of ICP signal and their derived parameters under opened and closed CSF drainage.

Methods: 20 patients with either subarachnoid or intraventricular hemorrhage and indication for ventriculostomy plus ICP monitoring received an EVD in combination with an air-pouch based ICP-probe. ICP was monitored via the open ventricular catheter (ICP_evd) and the ICP probe (ICP_probe) simultaneously. Neuromonitoring Data (ICP, ABP, CPP, PRx) were recorded by ICM+ software for the time of ICU treatment. Routinely (at least every 4 hours) ICP was recorded with closed CSF drainage system for at least 15 minutes. ICP, ICP amplitude and the autoregulation parameters (PRx_probe, PRx_evd) were evaluated for every episode with closed CSF drainage and during the 3 hours before with open drainage system.

Results: 144 episodes with opened/closed drainage were evaluated. During opened drainage overall mean ICP_evd levels were non-significantly different from ICP_probe with 9.8 ± 3.3 versus 8.2 ± 3.2 mmHg, respectively. Limits of agreement ranged between 5.2 and -8.3 mmHg. However, 51 increases of ICP >20 mmHg with a duration of 3-30 min were missed by ICP_evd and in 101 episodes difference between ICPs was greater than 10 mmHg. After closure of EVD, ICP increased moderately for both methods. Mean PRx_evd was significantly higher (falsely indicating impaired autoregulation) and more objected to fluctuations than PRx_probe.

Conclusion: The general practice of draining CSF and monitoring ICP via an (usually opened) EVD plus frequently performed catheter closure for ICP reading is feasible for assessment of overall ICP trends. It has however clinically relevant drawbacks, namely a significant amount of undetected increases in ICP above thresholds and continuous assessment of cerebrovascular autoregulation is less reliable. In conclusion, all patients who need CSF drainage plus ICP monitoring due to the severity of their brain insult, are in need of either an EVD with integrated ICP probe or an EVD line plus a separate ICP probe.

Early impairment of pressure reactivity (PRx) after experimental subarachnoid hemorrhage correlates to outcome and recovery of cerebral blood flow

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Objective: Disturbed cerebrovascular autoregulation (CA) has been identified as risk factor for secondary ischemic brain damage after SAH in patients. Monitoring of Pressure reactivity index (PRx), allowing for continuous and dynamic CA assessment, is more and more frequently used in the clinical but not in the experimental setting so far.

Methods: SAH was induced in Sprague-Dawley rats by endovascular puncture. In addition to monitoring regional cerebral blood flow (rCBF) in both hemispheres, intracranial pressure (ICP) and mean arterial blood pressure (MAP) were used to continuously calculate cerebral perfusion pressure (CPP) and PRx as measure for CA. Monitoring was continued for 60 minutes after SAH and subsequently mortality was assessed for 7 days (n=12). In a second group long-term monitoring was performed for 180 minutes after SAH and in sham operated animals (n=5 each).

Results: PRx is significantly higher (more disturbed CA) in the first hour after SAH compared to sham operated animals (0.20 vs. -0.04). This phenomenon exceeds the initial ictus and then slowly disappears over the next hours. Besides a more severe initial hemorrhage and a less pronounced recovery of rCBF non-surviving animals exhibited a tendency to more and longer impaired CA (46 vs. 40% of 1-hour monitoring after SAH). CPP in relation to rCBF and PRx allows for the assumption that CA plateau in severely altered and shifted to the right (higher CPP) after SAH.

Conclusion: Implementation of PRx monitoring in experimental SAH is feasible and adds valuable information about a frequently disturbed CA in the initial phase after SAH and may help evaluate the pathophysiology of early brain ischemia.

Review of literature, safety and feasibility of long-term volatile sedation with isoflurane in patients with severe SAHCF and CVDB contributed equally

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Objective: Despite many positive effects, use of volatile anaesthetics in intensive care neurosurgical patients is rare. We aimed at evaluating the (long-term) use of isoflurane administered via the anaesthetic conserving device (AnaConDa®) in patients with severe aneurysmatic subarachnoid haemorrhage (SAH) on our neurosurgical intensive care unit (NICU) with regard to safety and feasibility.

Methods: We performed a systematic review of literature on Pubmed database. Additionally, 7 patients with severe SAH were sedated with isoflurane in addition to conventional continuous intravenous sedation between January and July 2016 on our NICU. We analysed the course of intracranial pressure (ICP), partial cerebral tissue oxygen pressure (ptiO₂), pulmonary function, incidence of delayed cerebral ischemia (DCI), length of weaning phase, short-term outcome at discharge, unusual clinical findings and dosage of conventional sedatives.

Results: The review of the literature revealed that the use of isoflurane in critically ill neurosurgical patients might be safe, although sample sizes are small, and studies were exclusively monocentric and not randomized. Currently, systemized data on long-term use of isoflurane of SAH patients is not available: Only one study reported long-term sedation in three SAH patients. One other study evaluated the use of isoflurane in SAH patients, but gave the drug for only one hour. In our patients, use of isoflurane was safe in the majority of cases regarding the ICP. Two patients with a baseline ICP of 20mmHg and 9mmHg developed a critical ICP crisis, which emerged quickly and led to an immediate cessation of isoflurane administration. When both patients were sedated with isoflurane again in the later course of treatment with an ICP of less than 15mmHg when starting the administration (one patient had undergone decompressive hemicraniectomy in the meantime), isoflurane was tolerated without a rise in ICP and on a long-term basis. In patients with stable ICP isoflurane was given for a minimum of 5 hours and a maximum of 12 days. PtiO₂ and pulmonary function were not altered in five of seven patients. DCI occurred in 6 of 7 patients. We did not observe long term complications. As unusual clinical findings, two patients developed abnormalities regarding pupillary diameter. Other sedatives like midazolam could be reduced in two patients.

Conclusion: Isoflurane should only be administered to SAH patients, when baseline ICP is not higher than 15mmHg and patients are not at risk of developing an ICP crisis. Continuous ICP monitoring is absolutely mandatory. As there is a lack of systemized data, larger prospective and randomized trials on the long term use of isoflurane in SAH patients are urgently needed.

Microdialysis findings in a patient with refractory generalized non-convulsive status epilepticus

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Objective: Microdialysis has primarily been used in patients and models with subarachnoid hemorrhage or traumatic brain injury. Little is known about brain metabolism during epileptic seizures.

Methods: In this case report a 52-year-old female with a primary onset of a tonic-clonic seizure and consecutive status epilepticus was transmitted to our neurosurgical ICU. The EEG of the now intubated and analgosedated patient showed a persisting status epilepticus which was non-convulsive and refractory to midazolam, levetiracetam, lacosamid and phenytoin. Due to a cerebral edema visible on MRI scans an ICP probe as well as a microdialysis catheter were implanted with a combined bolt into the right frontal lobe. Extracellular microdialysis samples were collected hourly for the following five days.

Results: Initial glutamate and pyruvate levels were markedly elevated up to 98 μM and 385 μM , respectively, while the lactate-pyruvate-ratio was within normal limits. After initiation of a continuous intravenous thiopental therapy glutamate levels dropped despite a persisting status epilepticus on EEG monitoring. A burst suppression encephalogram was achieved after a fractionated bolus application of thiopental. The microdialysis samples now revealed decreasing levels of both, glutamate and pyruvate. However, both increased again during the course of time. Concurrently, the EEG revealed a reoccurring status epilepticus pattern. After reapplying 750 mg fractionated thiopental a sustained burst suppression pattern was achieved. Subsequently, glutamate decreased from 79 μM to normal levels below 30 μM within 24 hours. Also, pyruvate further decreased, still showing a normal lactate-pyruvate-ratio. Glucose was within a normal range over the whole course of disease.

Conclusion: The elevated cerebral pyruvate levels but normal lactate-pyruvate-ratios during a refractory non-convulsive status epilepticus in the reported case might reveal an increased metabolism but preserved perfusion and mitochondrial function. Extracellular glutamate levels, indicating excitotoxicity, already decreased before achieving burst suppression. Microdialysis might be a useful additional diagnostic tool in neurointensive therapy of refractory status epilepticus.

Early and late cranioplasty in patients that underwent decompressive craniectomy for trauma: A systematic review and meta-analysis of cohort studies

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Objective: To compare occurrence of postoperative complications and mean operating time in early (< 3 months) versus late (> 3 months) cranioplasty, in trauma patients who had undergone a decompressive craniectomy (DC).

Methods: The authors present a systematic review and meta-analysis of the postoperative overall complication rate, infection rate, subdural fluid collection and operating time in cranioplasty of patients who had received a DC for trauma. The data bases PubMed, EMBASE and the Cochrane Library were systematically searched.

Results: Five cohort studies, comprising 413 patients, were included in a quantitative analysis. There was no significant difference between the early and late cranioplasty cohorts in overall postoperative complications [RR=0.68, 95%CI (0.36, 1.29), $p > 0.05$] and postoperative infection rate [RR=0.50, 95%CI (0.20, 1.24), $p > 0.05$]. Significant differences were found in postoperative subdural fluid collection [RR=0.24, 95%CI (0.07, 0.78), $p < 0.05$] and the mean operative time [mean difference = -33.02, 95%CI (-48.19, -17.84), $p < 0.05$], both in favor of early cranioplasty.

Conclusion: Regarding overall postoperative complications as well as infections there was no significant difference between early and late cranioplasty. However, in early cranioplasty a significantly shorter operation time, as well as less postoperative subdural fluid collection was observed. Therefore, an early cranioplasty should be considered in these patients.

Volumetric findings in patients with poor-grade aneurysmatic subarachnoid hemorrhage and their clinical association during a two-year follow-up period

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Objective: The aim of the study was to compare the clinical outcome of patients with a poor-grade aneurysmatic subarachnoid hemorrhage (aSAH) with measurable volumetric data on the initial cranial CT scan.

Methods: In a retrospective study clinical data of all patients treated in our neurosurgical department between 2008 and 2013 and admitted with a poor-grade aSAH (Hunt & Hess grade IV or V) was collected. All patients with a cranial computed tomography (CCT) scan not older than three days after the bleeding were included. The volumetric analysis was carried out with Analyze 12.0 (AnalyzeDirect). We calculated the blood volume of the basal cisterns as well as the subarachnoid blood, the intraventricular blood and the intraparenchymal blood volume. The clinical data was extracted from the clinical charts during the in-patient stay. A follow-up examination was performed two years after the aSAH if possible. Patients with no follow up information available were assumed with an unfavorable extended Glasgow outcome score (1-4). We compared volumetric data with the extended Glasgow outcome scale, the development of delayed cerebral ischemia (DCI), the need for a ventriculoperitoneal shunt implantation and the need for a decompressive craniectomy.

Results: A total of 80 patients were admitted to our neurosurgical intensive care unit with an aSAH Hunt and Hess grade IV or V. A favorable outcome (extended Glasgow outcome score 5-8) was achieved by 11 % of patients on discharge and by 26,3 % after two years. High ventricular cerebrospinal fluid (CSF) volumes were associated with a better outcome two years after the aSAH ($p=0,019$). Lower ventricular CSF volumes ($p=0,005$), larger intraparenchymal blood volumes ($p=0,001$) and larger intraventricular blood volumes ($p=0,028$) were associated with a decompressive craniectomy being performed during the in-patient stay. Higher volumes of subarachnoid blood correlated with the occurrence of DCI visible on the CCT scan 6 weeks after the aSAH ($p=0,012$). DCIs were associated with an unfavorable outcome on discharge ($p=0,04$). No relation between blood or ventricular volumes and the need for a VP-Shunt-implantation was found. Furthermore, there was no correlation between ventricular or blood volumes and patient age. A higher age on admission correlated with a worse outcome on discharge as well as on follow-up after two years ($p<0,001$).

Conclusion: Our findings showed that a notable rate of patients with poor grade aSAH achieved a favorable outcome after a two-year follow-up period. A larger ventricular CSF volume was identified as a marker for a favorable outcome. We could also identify risk factors for the development of DCIs as well as the need for a decompressive craniectomy.

Management of hyponatremia with the vasopressin V2-antagonist Tolvaptan in the neurosurgery

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Objective: Hyponatremia below 135 mmol/L is the most frequent electrolyte imbalance and occurs in up to 50 % of neurosurgical patients. The most common cause of hyponatremia in neurosurgical patients is the syndrome of inappropriate antidiuretic hormone secretion (SIADH). The inappropriate oversecretion of antidiuretic hormone (ADH, syn. arginine-vasopressin AVP), causes water retention and volume overload. The aim of the study was to determine the optimal treatment and dosage of the vasopressin V2-antagonist Tolvaptan.

Methods: A cohort study included a total of 315 patients (148 male, 167 female) admitted to the neurosurgical department of the University of Erlangen, Germany over a 5 year period. The control group without hyponatremia consisted of 186 patients (59 %), 39 patients (12 %) were treated with fluid restriction, 41 patients (13%) were treated with Tolvaptan at 3.75mg and 49 patients (16 %) with Tolvaptan at 7.5mg as an initial dose.

Results: The cumulative average dose for the patients were treated initially with 3.75mg Tolvaptan was 7,63mg and for those who were initially treated with Tolvaptan 7.5mg was 12.83mg. The mean time until normalization of the serum concentration was 5 days following fluid restriction, 4 days following 3.75mg Tolvaptan and 3,5 days following 7.5mg Tolvatan. No complication due to overcorrection of the serum sodium concentration occurred. However, in both Tolvaptan groups, the cumulative dose was still below the 15mg preparation commercially available, a tight patient surveillance is recommended.

Conclusion: The increased mortality and morbidity as well as the duration of hospitalization, in hyponatremia after intracranial procedures especially pituitary surgery, brain injury and subarachnoid hemorrhage prompts the necessity for optimizing the treatment. A group of drugs called vaptans can substitute fluid restriction. The selective vasopressin V2 antagonist Tolvaptan in a moderate dose offers a safe and effective treatment in neurosurgical patients suffering from hyponatremia.

Facial nevi, intracranial venous anomaly and hydrocephalus: A variant of Shapiro Shulman Syndrome?

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Objective: In 1976 Shapiro and Shulman described a syndrome consisting of bilateral facial nevi, macrocephalus and anomalous venous drainage in infants. One child developed hydrocephalus, both patients showed additionally dilated superficial head veins. To date, only a few other cases have been published in the literature. We report an exceptional case with venous anomaly and rapidly increasing hydrocephalus.

Case presentation: At the age of 9 months, the head circumference increased by 6 cm. The child developed a tense fontanelle and a sunset phenomenon, the superficial head veins were dilated and we found several facial nevi. Ultrasound demonstrated enlarged external cerebrospinal fluid (CSF) spaces and a relevant midline shift, similar to arachnoidal cysts. The magnetic resonance imaging (MRI) showed additionally a combined hydrocephalus and a developmental venous anomaly. A unilateral subduroperitoneal shunt with gravitational unit was implanted and shortly after the intervention the sunset phenomenon disappeared. In the postsurgical MRI we saw unexpectedly massively enlarged draining veins.

Conclusion: The clinical findings in our child are similar to those described in 1976 by Shapiro and Shulman. Comparing the published reports of neurocutaneous syndroms with hydrocephalus, one finds differences in the anomalies of venous drainage. In our case the existing hydrocephalus concealed a preexisting varices, which we detected only in the postsurgical MRI.

The role of TET2-promotor methylation and -protein expression in pediatric posterior fossa ependymoma.

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Objective: Ependymoma are among the most common brain tumors in children, with a predominant (60-70%) location in the posterior fossa. Recent studies established two main subtypes of posterior fossa ependymoma (PF): PF type A (PFA) occur in younger children, reveal a higher rate of recurrence or metastasis, are associated with a poor survival, and are located predominantly in the midline. Genetically, they show a low mutation rate and only rare copy number changes. PF type B (PFB) develop in older children, carry a better prognosis and demonstrate a high rate of copy number changes. For PFA tumors, a hypermethylation phenotype has been described. Ten-eleven translocation (*TET*) proteins catalyze the conversion of 5-methylcytosine (5mC) to 5-hydroxymethylcytosine (5-hmC) leading to DNA demethylation. Therefore, silencing of *TET2* protein is supposed to lead to DNA methylation and is linked to the hypermethylation phenotype. We sought to investigate the epigenetic silencing of *TET2* protein in PF and its effect on *TET2* protein level.

Methods: *TET2* promotor methylation in 11 pediatric PF was assessed by methylation-specific PCR using DNA extracted from FFPE tissue. Results were documented by agarose gel electrophoresis. In selected cases (due to the availability of frozen tissue), Western blot (WB) was performed to detect protein levels in PF. Additionally, clinical data comprising age, gender, days to progression, recurrence and location were analyzed.

Results: Promotor methylation of *TET2* was detected in 6 of 11 children. In 6 selected cases, WB could be performed which revealed a reduced protein expression in 4 tumors. Interestingly, 3 of these 4 tumors harboured a *TET2* promotor methylation. Children with *TET2* methylated tumors tended to be younger (3.7 vs 4.2 years) and had a shorter time to progression (616 vs 748 days). Four patients (67%) with *TET2* promotor methylation experienced recurrence and five patients (83%) had a midline location, respectively.

Conclusion: According to our results, *TET2* promotor methylation is detectable in 6 of 11 (55%) PF patients, which was further associated to a reduced *TET2*-protein expression. Interestingly, clinical characteristics are striking similar between *TET2*-promoter methylated cases and hypermethylation phenotype in PFA. A prospective, multicenter investigation is mandatory, to further evaluate clinical implications of *TET2* promotor methylation and PFA.

Unusual Cases of Programmable Valve Breakage in Shunt- Systems of Children with Posthemorrhagic Hydrocephalus

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Objective: We report three unusual cases of programmable valve breakage (Codman Hakim-Medos valve) in shunt-systems of children with posthemorrhagic hydrocephalus. Only four similarly studies have been published in the current literature.

Methods: Between 2010 and 2016 three children with posthemorrhagic hydrocephalus were admitted to our pediatric department. All patients had a history of slight blows to the head in a minor trauma. One patient presented with auto-aggressive behavior and initial vomiting, one with vomiting and neurologic deterioration, another one with focal seizures for 2 months. After initial examination, CT scan and X-ray were conducted.

Results: In all cases pumping the reservoir resulted in very slow refilling. The cranial computertomography (CT) in one patient showed slit ventricles confirming the suspicion of an overdrainage, the other cases a slight enhancement of the hydrocephalus. In lateral X-rays of the skull in comparison to the first X-ray control of the shunt-valve, the pressure control chamber could be seen dislocated in the inferior part of the reservoir in all cases. Surgery revealed that the shunt valve was broken. The pressure control chamber had dropped to the bottom of the reservoir. After implantation of a new shunt valve the symptoms resolved completely in all three children.

Conclusion: The well accepted Codman-Hakim programmable valve is part of a tube-system, which is designed to offer the possibility of a reliable and precise treatment of hydrocephalus. Various mechanical and non-mechanical complications of shunt-systems have been reported. The most common complications in the childhood are mechanical complications like obstruction, fracture and dislocation of the tubings. Valve breakage is a very rare condition but must be kept in mind when head trauma is reported.

Isolated Intracerebral Langerhans Cell Histiocytosis with Multifocal Lesions

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Objective: Langerhans cell histiocytosis (LCH) is a rare and extremely heterogeneous disease with a largely unknown etiology and an unpredictable clinical course. Most cases of LCH occur in children. The clinical picture in LCH can vary from single organ involvement, usually of either bone or skin, to multiple organ involvement. However, central nervous system (CNS) involvement is rare. When involving the CNS, abnormalities of the hypothalamic-pituitary region are common. Here, we report the case of a 7-year-old boy with isolated intracerebral LCH with multifocal lesions.

Methods: Clinical investigation, cranial magnetic resonance imaging, CSF examination, as well as a FDG PET of the entire body was performed. A mini-craniotomy was performed to resect the frontal lesion and histological examination of the brain tissue was done. Hematoxylin-eosin stain, Immunohistochemical studies with langerin (CD207), S100 protein and CD 68, as well as PCR were performed.

Results: MRI findings revealed not only a space-occupying intra- and suprasellar lesion, but also multiple lesions in the brain stem, supratentorial white matter and the meninges. Histopathological examination revealed features of intracerebral LCH.

Conclusion: The clinical and radiological heterogeneity of cerebral LCH suggests a diversity of differential diagnoses ranging from inflammatory diseases such as neurosarcoidosis, infections such as neurocysticercosis to neoplasms such as germinoma. Thus surgery is highly recommended to obtain tissue sample.

Identification of cellular and molecular markers in Tethered Cord Syndrome

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Objective: Various forms of spinal dysraphism and intradural surgery can lead to the fixation of intrathecal nervous structures within the spinal canal, thus leading to neurologic signs of “tethered cord syndrome” (TCS). So far traction resulting in ischemia and further hypoxia in affected neural structures are considered the main driving forces for developing clinical relevant TCS. The aim of this study was to identify further specific mediators of molecular lesion cascades that may contribute to the development of TCS.

Methods: Ethical approval was obtained. Specimens from 14 TCS-surgeries were investigated; only patients with previous myelomeningocele repair were included. Clinical characteristics were obtained retrospectively and included neurological status, bowel/bladder-dysfunction, contractures/spacities of lower extremities and back pain or leg pain. Furthermore MRI scans were retrospectively evaluated for tethering signs like i.e. syrinx and conus position. Normal adult spinal cords (sc) (n=4) served as controls. Sections were immunostained with neural, glial, neural crest, mesenchymal and epithelial markers (GFAP, Vimentin, neurofilament (NF 200kD), NeuN, synaptophysin, CNPase). Immunohistochemistry and real-time RT-PCR for inflammatory cytokines (interleukin-1beta (IL-1b), IL-1R1, tumor necrosis factor-alpha (TNF-α), TNF-R1), and hypoxia inducible factors (HIF-1a/-2a) were performed. Further apoptotic marker cleaved-PARP and Caspase-3 were immunostained. Data were analyzed qualitatively and semi-quantitatively. Double-fluorescence-labeling confirmed cellular expression patterns with markers for neuronal, astrocytic and microglial cells.

Results: The investigated specimen exhibited significant gliosis with strong GFAP- and Vimentin-immunolabeling. IL-1b and TNF-α and their receptors became detectable in cellular composites of intrathecal nervous structures on significantly elevated level (p<0,05 and p<0,001 vs. control). TNF-R showed significant induction on mRNA level in real-time RT-PCR. The investigated cytokines were co-stained with NeuN (TNFα/TNF-R1/IL-1b/IL1-R1) and GFAP (IL-1b) as well as CD68 (IL-1b/IL1-R1) as a marker for microglial cells. Hypoxia-inducible factors HIF-1a and HIF-2a were also induced in TCS specimen co-stained with neuronal and microglial markers.

Conclusion: Pro-inflammatory and hypoxia-induced cytokines might influence symptomatology and outcome of patients with TCS. As specific molecular composites of the underlying pathophysiology they potentially offer new therapeutic opportunities.

Automatic Volumetry of the Cerebrospinal Fluid in severe pediatric hydrocephalus

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Objective: Monitoring the volume of the Cerebrospinal Fluid (CSF) is desirable under therapy but very time consuming to assess. Common model based segmentation algorithms often have their limitations in gross anatomic changes as found in severe pediatric hydrocephalus. For this purpose, a more robust segmentation algorithm based on a hidden Markov random field model was implemented. We evaluated the CSF volume in an automatic fashion and estimated effects under therapy.

Methods: Retrospectively pre and postoperative true fast imaging with steady state precession (TrueFisp, 1mm isovoxel) were analyzed in 16 patients with pediatric hydrocephalus (male n=9, mean 3,6 ± 4,7 years, posthemorrhagic hydrocephalus n=3, hydrocephalus occlusus n=13). Patients were surgically treated (ventriculo-peritoneal shunt n=10, endoscopic third ventriculostomy (ETV) n=6).

After preprocessing the 3D-datasets were skull stripped to estimate the inner skull surface, following a 3 class segmentation into different tissue types (brain matter, CSF) was performed. On the segmentation matrix the CSF-Volume was calculated.

Results: The method could be implemented in an automated fashion in all 16 patients. Mean CSF Volume at the beginning of the treatment was 384 ml ± 183 ml [163ml;824ml]. After surgical implantation of a ventriculo-peritoneal shunt CSF volume decreased significantly from 388 ml ± 169 ml [163ml;824ml] to 300 ml ± 114 ml [152ml;558ml]. Following an endoscopic third ventriculostomy CSF volume decreased significantly from 372 ml ± 205 ml [201ml;815ml] to 339 ml ± 201 ml [172ml;778ml].

Conclusion: A reliable segmentation could be performed with the implemented algorithm. The method was able to track changes in therapy.

Laminoplasty in children: is it a safe and feasible procedure?

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Objective: Laminoplasty has been shown to be advantageous in adults. In pediatric patients however, there is limited experience with this method, especially concerning progressive kyphotic deformity or instability in adjacent segments. Here we investigate the safety of laminoplasty in pediatric neurosurgery focusing also on postoperative development.

Methods: Fifteen children underwent laminoplasty, mainly for removal of spinal tumors in our department over a period of 10 years.

Results: At the time of surgery, patients' mean age was 9.2 years (range: 0-17 years). Laminoplasty was performed over 1-11 segments (mean: 4.3 segments). Laminoplasty was performed for tumors (n=11), decompression of arachnoidal cysts (n=2), a perineural cyst, and for correction of spinal cord deformity (n=1, each). There were no procedure-associated complications with the exception of dislocation of a screw in one patient. Epidural bleeding occurred postoperatively in one intramedullary subtotal tumor resection. Progressive kyphosis was noted only in one patient after laminoplasty from Th 3-11. There was no difference in outcome according to the method used for fixation of the laminae (sutures vs. platelets). Spinal instability was not observed in adjacent segments. Four children died during follow-up because of progressive tumor disease. Mean follow-up was 21 months.

Conclusion: We conclude that laminoplasty in children is safe and it might convey several advantages. Dorsal instrumentation was not necessary during follow-up in any instance.

5 years, 476 children, hydrocephalus and its treatment in the complete range

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Objective: In Europe the prevalence of congenital and infantile hydrocephalus is 0.5 – 0.8 per 1000 births. After primary shunting further interventions become necessary during lifetime. Despite significant improvements failure rate can be up to 40% during the first year. The aim of this study was to analyse a typical pediatric hydrocephalus cohort regarding etiology, shunt types and revision rates and underlying causes.

Methods: We retrospectively analyzed all consecutive patients with congenital or infantile hydrocephalus operated between 1/2010 and 12/2014 in our institution. We also included children who were previously operated in another institution or inhouse before 2010 requiring a shunt revision. Hydrocephalus etiology, number and cause of revisions, shunt types/pressure levels and site of derivation were investigated.

Results: 476 children (283 males, 193 females) were included in to the analysis. Hydrocephalus etiology was posthemorrhagic in 162, dysraphic in 119, brain malformation and cystic in 79, tumor in 28, syndromal in 11, posttraumatic in 11, postinfectious in 11, pseudotumor cerebri in 8 and other causes in 33 cases. Drainage of hygroma became necessary in 14 patients. In 46% the primary shunt insertion was in another institution. In the primary inhouse group a nonadjustable valve with integrated gravitational unit was implanted in 78%. In 40 cases initially an antibiotic coated catheter were used. The preferred derivation was lumboperitoneal (84%). 50% of the patients did not require revisions in the follow up period (1/2010-12/2014), the other half had 2 to 5 revision surgeries. No mortality and no intraoperative complications occurred. In the high risk population with posthemorrhagic hydrocephalus 2 to 5 revisions became necessary in 43%.

Conclusion: Posthemorrhagic and dysraphism-associated hydrocephalus are the most common etiologies, both with higher revision rates. Shunt surgery in early childhood is a safe procedure. The high rate of patients primarily treated in another institution demonstrates a trend to refer complicated cases to a specialized pediatric neurosurgical center.

It's not always the shunt to blame: sterile peritoneal malabsorption of cerebrospinal fluid in children.

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Objective: Ventriculoperitoneal shunt (VPS) malfunction due to peritoneal malabsorption of cerebrospinal fluid (CSF) is a rarely described and incompletely understood phenomenon in the absence of infection. We sought to analyze the incidence and risk factors of this complication in a large contemporary cohort of children with VPS.

Methods: Cases were defined as reoperations due to peritoneal CSF malabsorption in the absence of proven infection or occlusion of the shunt system itself. Patients were retrospectively identified from an institutional database comprising 181 pediatric VPS implantations performed between 2010 and 2016 and relevant medical charts were reviewed.

Results: Sterile CSF malabsorption occurred in 4 patients (2 male, 2 female) at a mean age of 12.5 months (range 1 to 24 months). An increase in abdominal girth and ventricular size were the presenting signs in all patients. Excessive intraabdominal accumulation of fluid could be detected on ultrasound. Regarding the etiology of hydrocephalus, three patients had previous brain tumor resections (two medulloblastomas, one choroid plexus carcinoma) and one patient had congenital aqueductal stenosis. Analysis of possible risk factors revealed previous chemotherapy in the three oncological patients (actinomycin D in one and methotrexate in two patients, respectively) and premature birth at 30 weeks of gestation in the child with congenital hydrocephalus. Of note, one oncological patient was subsequently diagnosed with veno-occlusive disease of the portal vein after additionally developing hepatomegaly and raised liver enzymes, presumably secondary to chemotherapy with actinomycin D. All patients underwent temporary externalization of the VPS and then conversion to a ventriculoatrial shunt (VAS) with adjustable Codman Hakim valves used in three cases and a Miethke paedigAV 4/19 valve in one patient. Ventricular size improved in all patients and ascites regressed.

Conclusion: VPS failure due to peritoneal malabsorption of CSF is a rare event and should be taken into account in shunted children presenting with concomitant CSF underdrainage and significant ascites. Risk factors suggested by our data include previous chemotherapy as well as prematurity. Conversion to a VAS appears to be an effective treatment. To further analyze this rare complication a multicentric registry would be desirable.

A diagnostic conundrum: Temporal arachnoid cyst and limbic encephalitis.

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Objective: Arachnoid cysts of the middle cranial fossa have been associated with seizure activity as well as behavioural and psychiatric symptoms. However, in case of an atypical presentation the diagnostic challenge of identifying the arachnoid cyst as the causative pathology or as a mere bystander can arise.

Methods: We present a case study of two concomitant intracranial pathologies and highlight the diagnostic challenges and therapeutic considerations.

Results: A 15 years old boy presented with a one week history of dizziness, diffuse dysesthesia of the body and loss of the sense of reality. Cranial MRI revealed a large right temporal arachnoid cyst with midline shift and significant compression of the right cerebral hemisphere, formally classified as Galassi type III. Electroencephalography (EEG) did not demonstrate epileptiform activity. A microsurgical fenestration of the arachnoid cyst into the basal cisterns was performed without complications. After an initial improvement following surgery, the patient presented with up to 16 daily episodes of acute anxiety, disorientation, short term memory loss as well as gustatory and olfactory sensations. EEG now showed scattered sharp waves, although it was not considered diagnostic for epileptic activity. Treatment with levetiracetam was commenced. Cranial MRI now revealed a decrease in arachnoid cyst size and an improvement in right hemispheric compression. However, fluid attenuated inversion recovery (FLAIR) sequences now demonstrated significant thickening and increased signal intensity of the right hippocampus. In retrospect, subtle limbic signal alteration could be detected also on preoperative MRI, although findings were masked by severe right hemispheric compression due to the untreated arachnoid cyst. A working diagnosis of limbic encephalitis was made and confirmed by a pathological glutamate decarboxylase (GAD) auto-antibody serum titre of 1:40,000. Given the protracted diagnosis of limbic encephalitis and the spontaneous improvement subsequently observed in our patient, immunotherapy was withheld.

Conclusion: This is a case of an atypical clinical presentation initially attributed to a Galassi type III arachnoid cyst of the right middle cranial fossa. As symptoms persisted despite successful fenestration, further diagnostic workup revealed a concomitant diagnosis of limbic encephalitis. In retrospect, the patient's symptoms appear to be related to autoimmune disease rather than to the large arachnoid cyst. This diagnostic conundrum highlights the complexity of differentiating causal and incidental findings in patients presenting with atypical clinical features.

Osteopetrosis, Chiari type I malformation and Hydrocephalus-a rare combination

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Objective: Osteopetrosis ("marble bone disease") is a heterogeneous group of rare, inherited disorders of the skeleton due to deficient osteoclastic resorption of the primary spongiosa. The major neurological effects result from the restriction of growth of foramina through which the cranial nerves, spinal cord and major blood vessels traverse the skull. Therefore patients develop cranial nerve palsies. The specific cranial and intracranial manifestations reflect the varying calvarial and skull base thickening. Neurosurgical management of increased intracranial pressure or cranial nerve compression is often required. We present a case of Chiari-I-malformation due to osteopetrosis associated with hydrocephalus and the respective surgical management.

Methods: 10-year-old boy from Sudan with genetically not determined osteopetrosis and Chiari-I-malformation admitted for craniocervical decompression. He suffered from headaches 3-4 times a week especially after sleeping, balance problems and recurrent pathological bone fractures. The examination revealed macrocephaly, midfacial hypoplasia, poor visual acuity due to optical neuropathy, papilledema, VII palsy on the right side, hearing loss, gait disturbance. No sensory or motor deficits, deep tendon reflexes normal. MRI head and spine: Chiari-I-malformation with a 13 mm descent of cerebellar tonsils and syringohydromyely C2-Th8, brain atrophy, disturbed CSF circulation, thickened skull bone.

Large enough posterior fossa decompression with C1 laminectomy and duraplasty under SSEP and MEP monitoring was performed uneventfully. The bone was grossly abnormal. Intraoperative ultrasonography showed a pulsation and motion of the tonsillar tips. After surgery the patient still had severe headache and nausea, MRI showed signs of perturbed CSF circulation, a persisting hydrocephalus and CSF collection over the craniectomy. 3rd ventriculostomy was planned but could not be performed because of severe coagulopathy. Hematologic work up showed an altered aggregation of the platelets and factor XIII-deficiency, not visible in normal blood work. Consequently the patient got a VP-shunt with padi-9/24-valve, preoperatively he received 4µg desmopressin and 500 IE factor XIII. Additionally 4x250 mg tranexamsäure was given until the end of wound healing.

Results: The boy could be discharged in good clinical condition, without headache or nausea, gait improved during hospital stay.

Conclusion: Osteopetrosis is a rare disease, which can cause a symptomatic Chiari-I malformation and hydrocephalus that require neurosurgical treatment.

Erste Erfahrungen mit dem proGAV 2.0 Ventil in 51 pädiatrischen Patienten

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Objective: Hydrocephalus is one of the most common diseases in paediatric neurosurgery. Shunt system design has evolved with the attempt to minimize failure rates and to improve handling. The proGAV 2.0 (Miethke) is the latest, technically improved adjustable valve to prevent overdrainage in shunt dependent hydrocephaly. The differential pressure unit is adjustable. It is to combine with a gravitational unit. There is a tool set to determine, vary and control the opening pressure of the proGAV 2.0- valve, similar to the predecessor, but the latest version also has some different features, like different tool set for adjustment and control. The mechanism to adjust the valve is also different. According to Miethke the valve has improved magnet strength, is MRI compatible up to 3 tesla and now has a new tactile feedback mechanism and "Soft-Touch" instrumentation. The range of the adjustable unit is from 0 to 20 cmH₂O. We report our experience with the advanced version of this adjustable valve in 51 consecutive patients.

Methods: From 12/2014-11/2016 we implanted the proGAV 2.0 system in 51 consecutive paediatric patients with hydrocephaly because of tumours, aqueductal stenosis, myelomeningocele (MMC), Dandy-Walker malformation, trauma, intraventricular haemorrhage and hydrocephalus of unknown origin. The 24 female and 27 male patients were between 0 and 23 years old.

Results: There has been no surgical revision because of valve malfunction. There were no spontaneous adjustments detected like in the predecessor and no incidental adjustments during MRI. According to Miethke the opening pressure can be set by pressing lightly with the finger on the adjustable unit but especially in older children or children with thicker skin more than a light pressure is needed to adjust the valve which is connected to more or less discomfort for the patient and make younger children or infants more difficult to handle. A good alternative is to use the proGAV checkmate to adjust the valve in these patients.

Conclusion: The improved proGAV-2.0-valve represents a safe adjustable valve with occasional discomfort during readjustment in patients with thickened skin.

Semi-sitting position in children younger than 3 years of age for resection of posterior fossa midline tumors

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Objective: The semi-sitting position is one of the preferred positions for resection of posterior fossa midline tumors. Nevertheless, it harbors some risks, with the most dreaded being air embolism. In small children another additional risk is rigid head fixation in the Mayfield clamp. Here we report about our experience with the semi-sitting position in children younger than 3 years of age.

Methods: Seven children younger than 3 years of age were operated in the semi-sitting position (mean age: 20 months; range between 3 and 36 months). Persistent foramen ovale was excluded preoperatively. Intraoperative incidents were recorded and patients course followed postoperatively with a special focus on possible complications.

Results: The histopathological diagnoses included ependymoma (n=2), pilocytic astrocytoma (n=2), glioblastoma (n=1), medulloblastoma (n=1) and ganglioglioma (n=1). External ventricular drains were inserted in 5 of 6 children who presented with hydrocephalus preoperatively. No major intraoperative complications occurred. Air embolism was detected in 3 patients during surgery. In two of them, the air embolism was recorded in TEE without cardiovascular or respiratory signs or symptoms. In one patient arterial hypotension with reduction of pCO₂ occurred and it was treated successfully with chatacholamin infusion and suction of air embolism via a central venous catheter without postoperative complications due to the embolism. Postoperatively all children showed pneumocephalus and one of them developed a subdural hygroma and was treated by a permanent subduroperitoneal shunt. In two children small asymptomatic impression skull fractures at the side of a Mayfield pin were evident in the postoperative scans. Revision surgery was necessary in one child with a suboccipital CSF fistula. One child needed permanent CSF diversion because of persisting hydrocephalus (ventriculoperitoneal shunt).

Conclusion: The semi-sitting position for tumor resection of the posterior fossa in children under 3 years of age entails certain risks, however, it can be successfully performed taking special caution to detect and treat potential complications in an interdisciplinary teamwork with specialized neuroanaesthesiologists.

Aneurysmal subarachnoid haemorrhage masking associated glioblastoma: case report and review of literature

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Objective: Reports on malignant glioma associated with intracranial aneurysms are rare. Here, we describe the case of a 15-year old girl that presented with all the typical features of subarachnoid hemorrhage (SAH). The confirmed aneurysm was later found to be secondary to a malignant glioma.

Methods: The patient presented with all typical signs of SAH, which was confirmed by CT-scan. Bilateral ventricular drains were placed but refractory elevated intracranial pressure necessitated decompressive craniectomy before diagnostic angiography and coiling of the fusiform aneurysm could be performed. Subsequent rehabilitation was accompanied by neurologic deterioration. On follow-up imaging unmasked a contrast enhancing mass, suspicious of a high-grade glioma, which was deemed earlier as hemorrhage secondary to aneurysm rupture. Craniotomy and partial tumor resection was performed before adjuvant treatment was initiated.

Results: The course of the diagnosis and treatment is presented and discussed. Literature search revealed a very limited number of reported cases and lack of a treatment algorithm.

Conclusion: SAH in children is uncommon. Therefore, it is paramount for the treating physician to be aware of other causes.

Antyllos and the surgery of aneurysms in the imperial Roman time

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Antyllos together with Heliodor, Leonides and Archigenes belong to the most recognized Roman surgeons living between 1st and 3rd century AD. Antyllos main surgical work „cheirurgoumena“ got lost but passages of it can be found in the encyclopedic medical work of the Byzantine physician Oreibasios (325-403AD).

In the ancient time only palpable periferal aneurysms were known. Antyllos treated differently two types: spontaneous and traumatic aneurysms. The first fusiform in appearance and if not too great in size were cured ligating the artery at the proximal and distal end of the pathology. To prevent fatal intraoperative bleeding he gave a meticulous surgical description of the procedure. He paid great attention to the preparation of the aneurysm removing all sheets around the aneurysm and parts of the adjacent normal artery till it was “naked” (gymnazomene). Then with great caution he pushed a probe under the aneurysm and a needle with a twice boiled linen thread or string. The thread was cut close to the needle resulting in two threads each placed proximally and distally of the pathology. After ligation, the aneurysm could be safely punctured and the blood inside evacuated without danger of causing bleeding. Opposed to other surgeons Antyllos did not recommend to remove the aneurysm between the two ligatures because, he argued, sometimes by intravascular pulsation of blood and air at the stoma the ligation can loosen and slip.

For traumatic aneurysms, saccular in appearance, he proposed after sizing as much as possible of the skin with the aneurysma to set stitches underneath and ligate the artery on both sides transcutaneously before evacuating the aneurysma by skin incision.

This trapping technique was nearly identically taken over by the Byzantine physicians such Aetios in the 6th , Paulus in the 8th century and the Arabic physicians Rhazes in the 9th and Albucasis in Andalusia in the 10th century.

Although Antyllos never treated intracranial aneurysms, this is the first description of a surgical treatment of an aneurysm which credibly could have been successful if done by a skillful surgeon and the collateral blood supply was sufficient. The way how Antyllos describes the preparation of the aneurysm confirms his extraordinary anatomical knowledge and surgical skills.

Neurological deterioration after extra-/ intracranial bypass for Moyamoya disease: a tightrope act between hyper- and hypoperfusion shown in a special case

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Objective: The occurrence of hyperperfusion syndrome after superficial temporal artery-middle cerebral artery (STA-MCA) anastomosis for Moyamoya disease (MMD) is well known and described in the literature. A critical coexistence of hyper- and hypoperfusion syndrome after revascularisation surgery is very rare.

Methods: A 57-year-old woman was afflicted with recurrent TIAs (transient ischemic attacks) for 4 years. She developed a stroke in April 2011 with hemiparesis on the left, motor aphasia with left-handedness and facial palsy. A bilateral stenosis of the middle cerebral artery (MCA) with suspicion of moyamoya syndrome was found and so a revascularisation surgery on the symptomatic side was indicated. During the were no complications, but in the course, the woman developed again neurological deficits in blood pressure fluctuations, so that a strict blood pressure control (130mmHg) was required to avoid hyper- or hypoperfusion.

Results: In a systolic blood pressure of above or below 130 mmHg the patient developed a hemiparesis and motor aphasia. Only by setting very close blood pressure limits, there was an almost complete regression of neurological deficits.

Conclusion: To prevent neurological deficits after STA-MCA (superficial temporal artery-middle cerebral artery) anastomosis the knowledge of hyperperfusion and hypoperfusion syndrom with all facets is required, since a very accurate blood pressure control deficits can be solved or even avoided.

Reliable? The value of early postoperative magnetic resonance imaging after CCM surgery

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Objective: Cerebral cavernous malformations (CCM) can cause intracerebral hemorrhage. The lesions themselves are frequently associated with perifocal hemosiderin deposits due to repetitive microhemorrhages. Main indications for a surgical treatment are recurrent symptomatic hemorrhages or cavernoma-related epilepsy (CRE). After surgical resection, follow-up MR-imaging is usually performed to confirm a) the complete resection of the CCM and, especially in cases of CRE, b) the complete resection of the hemosiderin deposits. This prospective study evaluates the value of early postoperative MRI regarding the detection of CCM or hemosiderin remnants compared to a "standard" 3-6 months postoperative MRI control.

Methods: In 61 surgically treated CCM cases (including 3 spinal cases), early postoperative MRI (within 72 hours) and follow-up MR images (after 3-6 months) were acquired. All imaging was performed on whole-body 1.5 Tesla MRI systems. MR sequences included T1, T2, and hemosensitive (T2*/SWI) sequences. MR images were evaluated by two experienced raters in consensus reading. Early postoperative and follow-up MRI images were assessed focusing on presence of CCM remnant, and hemosiderin remnant. Calculations of sensitivity, specificity, positive predictive value, and negative predictive value were performed for the early postoperative MRI, compared to the late postoperative MRI as reference results.

Results: Overall image quality was good for both early postoperative MRI and follow-up MRI. Sensitivity of early postoperative MRI for CCM remnant detection was 66.67% (95% CI 9.43% - 99.16%), specificity was 76.74% (95% CI 61.37% - 88.24%), positive predictive value was 16.67% (95% CI 2.09% - 48.41%) and negative predictive value was 97.06% (95% CI 84.67% - 99.93%). Due to the high number of patients that could not be evaluated due to imaging artifacts caused by surgical artifacts (air, blood, hemostyptics), sensitivity and specificity analysis was not performed for early postoperative MRI using T2*/SWI to assess hemosiderin remnants. Sensitivity of early postoperative MRI for hemosiderin remnant detection using T2 weighted sequences was 90.0% (95% CI 68.30% - 98.77%), specificity was 46.67% (95% CI 21.27% - 73.41%), positive predictive value was 69.23% (95% CI 48.21% - 85.67%) and negative predictive value was 77.78% (95% CI 39.99% - 97.19%).

Conclusion: Our data suggests that early postoperative MRI after CCM surgery is often hampered by imaging artefacts and therefore ineligible for a resection control.

Endovascular intervention of an iatrogenic induced spinal pseudoaneurysm - rare complication after lumbar puncture

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Objective: Spinal pseudoaneurysm are a rare but possible complications after spinal surgical interventions. Some case reports describe these types of iatrogenic injuries, most of them involving lumbar interbody fusion techniques or vertebral biopsies. In this case study we present a German female patient with a subarachnoid hemorrhage and following hydrocephalus malresorptivus. An external ventricular drain was initially placed and later replaced by a lumbar drain, which caused a pseudoaneurysm by injuring a segmental artery. There are no statistics showing the frequency of this kind of complication and its management.

Methods: A selected Pubmed research was performed using the key words: "iatrogenic spinal aneurysm", "iatrogenic spinal hematoma", "spinal aneurysm" and "lumbar puncture complication". The data were evaluated with regard to the frequency of complications and what kind of surgical intervention was performed.

Results: We report the case of a 72-year-old German woman presented at our department with acute headache and meningism, without any neurological deficit. Computed tomography (CT) imaging showed a subarachnoid hemorrhage. Because of a known atrial fibrillation she was under oral anticoagulation with Rivaroxaban. Due to a beginning hydrocephalus malresorptivus a ventricular drain was placed without any complications. Digital subtraction angiography (DSA) confirmed a left vertebral incidental fusiform aneurysm, with no therapy relevance. A lumbar drain replaced the ventricle drain after two weeks. The placement was difficult because of advanced lumbar osteochondrosis; at the end it drained spinal fluid without any problems. After two days the patient showed signs of acute anemia. Hemolysis parameters were determined, with normal levels of lactic dehydrogenase, reticulocytes, bilirubin and haptoglobin. Abdominal-CT showed a right retroperitoneal localized hematoma spreading down through the psoas muscle caused by a pseudoaneurysm of the second right lumbar artery. 48 hours later the abdominal-CT revealed the bleeding still being active and an increase of the retroperitoneal hematoma volume. Digital spinal angiography was performed in general anesthesia. A complete embolization was achieved via coiling without any complications.

Conclusion: To our knowledge this is the first published case of lumbar puncture induced pseudoaneurysm. Common and well-known complications after lumbar punctures are: post puncture headache, bleeding, infection, radicular pain or numbness and more uncommon: cerebral herniation. There are a few published cases reporting about vascular injuries after spinal surgery, which were successfully endovascularly embolized. It is important to acknowledge possibility of this complication.

The AB bloody type is associated with an increased risk of non-aneurysmal subarachnoid hemorrhage

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Objective: In patients with non-aneurysmal subarachnoid hemorrhage the aetiology is unknown and the bleeding source usually remains unidentified. It is known that the ABO blood type plays an important role in hemostasis and thrombosis. To date the aspect of ABO blood type in incidence, clinical course and outcome after non-aneurysmal subarachnoid hemorrhage has not been investigated.

Methods: In our retrospective study 81 patients with non-traumatic and non-aneurysmal subarachnoid hemorrhage treated between 2010 to 2014 at our institution were included. WFNS admission status, cerebral vasospasm, delayed infarction, ventriculoperitoneal shunt necessity and fisher grade were analyzed for their association with ABO blood type. Risk factors, clinical progress and outcome were evaluated. 470 patients with aneurysmal subarachnoid hemorrhage served as control group

Results: There is a significant difference in blood type distribution between aneurysmal and non-aneurysmal subarachnoid hemorrhage. The blood type AB is more frequent in non-aneurysmal subarachnoid hemorrhage patients ($p= 0.02$, OR: 2.45; 95% CI: 1.16 - 5.16). However, in our cohort blood type distribution difference did not significantly influence sequelae after non-aneurysmal subarachnoid hemorrhage.

Conclusion: The AB blood type is associated with an increased risk of non-aneurysmal subarachnoid haemorrhage. However, a role in patient's outcome remains to be further evaluated

Cranial Dural Arteriovenous Fistula Type Cognard V: A Rare Cause of Cervical Myelopathy

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Objective: Cranial dural arteriovenous fistulas (DAVFs) are rare disorders. They share only 10-15% of cerebral arteriovenous malformations (AVMs). One of the entities rarely diagnosed is cranial DAVF type V according to the Cognard classification. We report on two cases of cranial DAVF Cognard type V presenting with spinal cord disorders due to cervical myelopathy.

Methods: Reviewing the medical charts and imaging studies of two patients with cranial DAVF Cognard type V.

Results: The first patient, a 44-year-old woman presented acutely with subarachnoid haemorrhage Hunt and Hess IV, Fisher group III. Before that she complained gait disturbances and prickling at the lower extremities since several weeks. Magnet resonance imaging (T2-weighted) showed an edema of the cervical cord and enlarged perimedullary vessels. Cranial angiography revealed a DAVF, Cognard type V, of the posterior fossa feeding from left occipital artery with drainage to the transverse sinus and perimedullary spinal veins. The fistula was successfully embolized. However, the patient developed subsequently cerebral vasospasms and died 16 days later from consecutive multiple cerebral infarctions.

The second patient, a 50 years old woman presented with incontinence and progressive tetraparesis. Magnet resonance imaging (T2-weighted) showed a cervical myelopathy and enlarged perimedullary vessels. Angiography revealed a cranial DAVF (Cognard type V) from left occipital artery and drainage to the superior petrosal and to enlarged anterior and posterior perimedullary veins. She was treated first with embolization and subsequently underwent surgical revision after angiographic evidence of recurrence via multiple small dural arteries. 7 months later the fistula recanalised again und was successfully reembolized. The neurological symptoms improved partially. Postprocedural magnet resonance imaging (T2-weighted) showed a regredient edema of the cervical spinal cord.

Conclusion: Cranial DAVF Cognard type V may present with cervical myelopathy and consecutive spinal cord symptoms in variable clinical pictures. Outcome depends on the extent of primary and secondary damage caused by bleeding or venous congestion and the timing of treatment.

Cavernoma of the foramen of Monroi

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The authors report on a patient who presented with an intracerebral hemorrhage in the left temporal lobe and an intraventricular mass located at the level of the left foramen of Monroi.

This 57-year-old man was initially admitted to stroke unit with acute exacerbation of the pre-existent dysarthria und hemiparesis of the right side after a stroke in 2008.

Initial CT scans demonstrated a 15-mm hyperdense lesion within the left lateral ventricle that was mostly occupying the left foramen of Monroi and the intracerebral hematoma (ICH) in the left temporal lobe without manifest compression of the brainstem and without midline shift. A cerebral CT-angiographie revealed no pathological vascularisation.

On day 7 after admission the patient deteriorated to somnolent state und became hemiplegic. Emergency CT demonstrated an increase of the ICH size in the left temporal lobe with midline shift and uncal herniation. No changes in the intraventricular mass occurred. The ICH was then removed via osteoplastic kraniotomie using microsurgery. Histopathological findings identified no vascular malformations.

After the rehabilitation und re-admission 5 month later a definitive MR-navigated microsurgical removal of the ventricular mass via transventricular approach was ultimately performed.

Histopathological findings confirmed the diagnosis of cavernous angioma.

The postoperative course was uneventful. The patient was discharged on the 6th day after surgery with no further neurological impairment.

This is a case of a save treatment of a rare intraventricular pathological entity. Surgery is advocated in cases of repeated bleeding and to eliminate the mass effect of the cavernoma.

The duration and rate of cerebrospinal fluid drainage during the acute phase after aneurysmal subarachnoid hemorrhage correlate with shunt dependency

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The duration and rate of cerebrospinal fluid drainage during the acute phase after aneurysmal subarachnoid hemorrhage correlate with shunt dependency

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Objective: Temporary cerebrospinal fluid (CSF) drainage is often required to treat acute hydrocephalus in the early phase after aneurysmal subarachnoid hemorrhage (aSAH). According to the literature, 15-20% of the patients later require a permanent CSF diversion. In experimental studies a higher production rate of CSF as a part of the pathophysiology of hydrocephalus after aSAH was postulated. Higher CSF production might contribute to higher CSF drainage volumes in the acute phase after aSAH. The aim of this study was to evaluate the CSF drainage rate and duration in the acute phase after aSAH as a predictor of shunt dependency

Methods: A patient population with aSAH admitted to our department from January 2012 to September 2016 was retrospectively analyzed for the development of shunt dependency. Additionally, we analyzed the CSF drainage rate per day and the CSF drainage duration in the acute phase after the diagnosis of aSAH (day 0-14). The correlation of the CSF drainage rate and duration with shunt dependency was assessed.

Results: A total of 203 patients were enrolled in the study. The mean age of the patients was 55 years (range 23-90), 67% (136/203) were female and 33% (67/203) male. In 89% (181/203) of the patients CSF was drained (in 25% via an external ventricular drainage, 28% had a lumbar drainage and 36% had both). In 24% (48/203) of the patients the insertion of ventriculoperitoneal shunt was required. The patients with shunt dependency had a significantly higher CSF drainage rate compared to the patients without shunt dependency (mean 182ml/day vs 136ml/day, linear regression $p=0.003$). The cut-off was 120ml/day (ROC analysis, AUC 0.67 95% CI 0.59-0.76, $p=0.0002$). The duration of CSF drainage was longer in the patients with shunt dependency compared to the patients without shunt dependency (mean 20 days vs 11 days, linear regression $p<0.0001$). The cut-off was 7 days (ROC analysis, AUC 0.80 95% CI 0.74-0.87, $p<0.0001$).

Conclusion: A higher CSF drainage rate and a longer CSF drainage in the acute phase after aSAH are predictors of later shunt dependency. Our results support the hypothesis of experimental studies that a higher CSF production might be a contributor to hydrocephalus and shunt dependency after aSAH.

Decision making in surgery for non-saccular PICA aneurysms

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Objective: Posterior inferior cerebellar artery (PICA) aneurysms represent a challenging pathology. PICA sacrifice is often necessary, due to high proportion of non-saccular aneurysms that can be found in this location. Several surgical treatments are available to face this complex vascular lesions, with or without revascularization, but the infrequency of these aneurysms and increasing number of endovascular techniques have limited the development of a standardized algorithm for treatment. The aim of this study was to present our series of non-saccular PICA aneurysms in the attempt to define an algorithm for their surgical management.

Methods: We retrospectively reviewed the our operation database, identifying patients harbouring non-saccular PICA aneurysms who were surgically treated at the Department of Neurosurgery, Charité University Hospital, Berlin from 2007 – 2016.

Results: During a 9-year period, 17 patients harbouring 18 non-saccular PICA aneurysms were surgically treated at our institution. Fourteen (77.7%) aneurysms were located within the proximal PICA (including those located at Vertebral Artery (VA)-PICA junction), and four (22,2%) were located distally. We performed PICA revascularization in eight (57.1%) cases of proximal aneurysms (n= 4: PICA-PICA bypass; n= 4: Occipital Artery (OA) to PICA bypass). We based our decision whether to perform bypass on intraoperative test occlusion with Indocyanine Green (ICG) videoangiography and neurophysiological monitoring. In no cases bypass was necessary for distal aneurysms. We did not experience major post-operative complications. One patient died a few weeks after surgical procedure, due to very poor clinical grading on admission (H-H V).

Conclusion: For non-saccular PICA aneurysms, microsurgery has the advantage of direct inspection of anatomy, live assessment of collateral vascularization and the possibility to perform revascularization in case of PICA occlusion. PICA-PICA and OA-PICA bypass are, in our opinion, the best choices for revascularization, providing good results in terms of bypass function, and a lower complication rate compared to other techniques. Intraoperative occlusion test with ICG videoangiography and neurophysiological monitoring plays a critical role in decision making whether to proceed with revascularization, providing live assessment of collateral circulation within the PICA territory.

Patient with two SAH from two different aneurysms, one of them a real de novo aneurysm - case report

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Introduction: We report of a meanwhile 48 years old woman who suffered from a SAH twice during the last 10 years. The first bleeding occurred in 2005 from an AComA aneurysm, the second one in 2015 from a de novo pericallosal aneurysm. Additional risk factors were a hypertension and a nicotine abuse.

Case Report: In 2005 the 1968 born patient suddenly suffered from severe headache and vomiting during skating, subsequently diagnosed as a SAH H & H II / Fischer II. Angiography revealed a 4 mm AComA aneurysm, which was clipped on the same day. 3 weeks later she could be discharged without neurological deficit. No other vascular malformations could be detected nor during her hospitalization, neither at control angiography one year later. At this time, the AComA aneurysm was totally occluded. 10 years later in 2015, the patient suffered from the same symptoms during her own wedding and collapsed. CAT scan revealed a interhemispheric SAH mainly in the corpus callosum area without basal SAH. CTA and DSA demonstrated a left side 3 mm pericallosal aneurysm with a direct contact to the hematoma, furthermore a 10 mm recurrent AComA aneurysm. The AComA aneurysm was occluded by coils, afterwards, the patient was transferred to the OR for open clipping of the pericallosal aneurysm. During surgery, it could be confirmed, that this aneurysm was the origin of the bleeding. 3 weeks later the patient was discharged for rehab in stable neurological conditions (modified Rankin score 2, Barthel index 85 / 100P.) with a slight left hemiparesis, which totally resolved 6 months later. The ultimate control angiography on august 22, 2016 showed a complete occlusion of both aneurysms. We did not find any evidence for a mycotic aneurysm disease.

Discussion: The present case is highly exceptional in several aspects. First, our patient is one of the few cases developing a de novo aneurysm, which subsequently ruptured. Second, a clipped aneurysm can relapse, even if the one year angiographic control does not show any pathology. Third, both ruptured aneurysms were smaller than 5 mm, especially the second bleeding did not originate from the bigger recurrent AComA aneurysm. As in coiled patients we recommend a yearly follow up for at least 10 years after clipping.

Perfusion CT fails to predict vasospasms after subarachnoid hemorrhage but responds to intraarterial vasospasmolysis

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Objective: There is still controversial discussion of the value of perfusion computed tomography (CTP) in predicting vasospasms in patients with aneurysmal SAH (aSAH). The present study was conducted to evaluate changes of CTP values in patients with intraarterial spasmolytic therapy (angiographically) before and after the intervention.

Methods: Retrospective analysis of, CTP and angiographies of N=141 patients treated from 2013-2015. In N=59 patients intra-arterial spasmolysis had been performed and in these cases CTP data were compared before and after lysis.

Results: After i.a. spasmolysis in patients with vasospasms the MTT showed significant improvement indicating to a significant correlation of blood flow in angiography and CT-perfusion. Surprisingly, there was no correlation between the known thresholds of mean transit time (MTT) in CTP and vasospasm.

Conclusion: Even when CTP did not identify vasospasms by changes of the MTT in order to establish a definitive pathological cut off value the MTT after angiographically lysis of spastic vessels was significantly lower compared to the values before lysis. CTP can not identify vasospasm but correlates to a response of spasmolytic therapy.

Major depression caused by the unruptured right temporo-mesial arteriovenous malformation

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Objective, Methods: Temporal lobe arteriovenous-malformations (AVMs) account for 12-16 % of intracranial AVMs and most commonly present with seizures and headache. An isolated major depression as a main symptom of temporal AVM was not reported until now.

We present the case of a temporo-mesially located unruptured AVM with an isolated major depression and the results of its successful multidisciplinary treatment.

A 19-year-old man was referred to our clinic for evaluation of a severe depression refractory to conservative treatment ongoing for the past 3 years. The patient had to quit school due to the depression and was unable to feel any emotions at all. There was no history of seizures or headaches. Neurological examination was normal.

A magnetic resonance imaging (MRI) scan showed a right temporo-mesial AVM with a nidus of 3,2 cm × 2,5 cm x 1,7 cm with shifting of hippocampus without any signs of previous bleeding. The AVM was classified into grade IV of the Spetzler-Martin grading system.

Due to the highly probable steal syndrome from the limbic system, the decision was made to treat the AVM surgically via open surgical removal and by preoperative transarterial transfemoral embolisation.

Results: Immediately after the 75% embolisation of the AVM the patient already experienced improvement in his depressive symptoms. There were no neurological deficits. One week later microsurgical total resection of the AVM was performed. There were no postoperative complications.

Patient mental status was evaluated in preoperative and postoperative period using Hamilton Depression Rating Scale (HDRS), Frankfurt Complaint Questionnaire (FCQ), Beck-Depressions-Inventar (BDI) and SLC-90-R. At postoperative evaluation functioning was improving with resolvment of the depressive symptoms.

Conclusion:

1. Temporo-mesial brain AVM can cause a depression and total surgical removal of such AVM may potentially lead to full recovery.
2. Treatment of unruptured brain AVMs is highly debated since the ARUBA study had to be stopped. Nevertheless, such a major depression as reported with such a heavy impact on patients life should be considered as an appropriate treatment indication.
3. A multidisciplinary approach for the management of the patients with brain AVMs should be used.

Early Mobilization in Patients with SAH - a Retrospective Single-Center Study

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Objective: Early mobilization (EM) has been proven beneficial in a number of neurological diseases including stroke and trauma. Only scarce data are available on patients with aneurysmal subarachnoid hemorrhage (SAH), where EM is usually avoided due to the feared association with vasospasm and perfusion disbalance. The objective of the current study was to assess the safety of early mobilization in terms of possible effects on complications and general outcome in patients with SAH.

Methods: We compared in a retrospective manner 190 patients admitted to our clinic between 2011 and 2015. They were separated in two groups according to different mobilization regimes at our ICU. Patients between 2011 and 2012 formed the control group (n = 95) as they were hardly mobilized in the chair. Starting from 2013 our clinic initiated a more liberal mobilization concept in order to prevent complications associated with bed riddenness. Hence, patients admitted to our clinic between 2013 and 2015 formed the EM group (n=95). Mobilization was assessed for days 1-14 after SAH onset and was quantified as hours/d in the mobilization chair or beach chair position (BCP). Data on SAH-associated- as well as general complications were analyzed, together with data on patients outcome.

Results: Within the two groups, patients were similar in terms of distribution of age, sex, SAH grade, aneurysm location and treatment modalities. In the control group, 25 % of patients were mobilized early within the 1st week, compared to 45 % in the EM group. However, the rate of vasospasm-associated DCI (18 % vs 15%), and the number of patients with favourable outcome did not differ between the groups (MRS 0-2 on discharge: 34 % vs 43 %). Furthermore, the rate of nosocomial pneumonia and LAE did not differ significantly.

Conclusion: In the current retrospective study, early mobilization shows no detrimental effects on outcome and therefore seems safe to perform in patients with SAH. Possible beneficial effects of mobilization described for other types of acute brain damage, might be masked by the lack of established mobilization guidelines in this controversial group of patients. We therefore suggest that further evaluation should be performed in a prospective study according to a standardized protocol.

Aneurysmal subarachnoid hemorrhage lead to elevated systemic levels of proinflammatory cytokine IL-23

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Objective: IL-23 is a pro-inflammatory cytokine secreted by activated macrophages and dendritic cells. Serum IL-23 is increased in numerous inflammatory diseases including neurodegenerative diseases. The role of serum IL-23 has still not been investigated in aneurysmal subarachnoid hemorrhage (aSAH). The present work investigates the serum IL-23 and its association with post hemorrhagic complications in patients with aSAH.

Methods: 69 patients with aSAH (Hunt and Hess grade I-V) were prospectively recruited in this study. We enrolled 23 control patients with lumbar spinal stenosis. Peripheral venous blood was withdrawn from controls and aSAH patients at day 1 and day 7, allowed to clot and centrifuged to obtain serum. A standard enzyme linked immunoassay kit was employed to determine the serum levels of IL-23 by applying 50 µL of serum samples on the microwell plate. Post hemorrhagic complication and patient's data were recorded prospectively.

Results: Serum IL-23 levels were significantly elevated in aSAH patients at day 1 ($p = 0.03$) and day 7 ($p = 0.036$) as compared to control patients. Further analysis after dichotomy of patients who suffered from post hemorrhagic complications including cerebral vasospasm, chronic hydrocephalus, seizures, cerebral ischemia, delayed neurological deficits did not differ in serum IL-23 levels as compared to patients without post hemorrhagic complications. Serum IL-23 levels did not correlate with clinical outcome.

Conclusion: Serum IL-23 was elevated in patients with aSAH showing upregulation of inflammatory immune response after aSAH. Serum IL-23 levels did not correlate with post hemorrhagic complications and clinical outcome.

Influence of morphological vascular parameters and the anatomical variations of the Sylvian Fissure on the bleeding pattern of ruptured middle cerebral artery aneurysms

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Objective: The aim of the study was to analyse the influence of the morphological variations of the Sylvian Fissure (SF) and vascular parameters on occurrence of different bleeding patterns in patients with ruptured middle cerebral artery (MCA) aneurysms.

Methods: We analysed the data of patients with ruptured MCA aneurysm of the past ten years. The patients were divided into two groups. Group 1 with subarachnoid hemorrhage (SAH) and group 2 with accompanied intra-cerebral hemorrhage (ICH). The SF was classified in five types according to the previously described classification. The vascular parameters, which were analysed in the study, were size, localization, presence of a daughter aneurysm, angulation and shape of the aneurysm. SPSS 23.0 for Windows was used for statistical analysis.

Results: N=193 patients were included to this study with a mean age of 51.6 years. N=76 (39.4%) patients had a SAH and n=117 (61.6%) presented with accompanied ICH. Univariate analysis showed only a significant association of the SF types to the different bleeding patterns. Types 1-3 were associated more frequently with the presence of SAH and types 4&5 more frequently with SAH with accompanied ICH. The other determined parameters were not significant. Logistic regression analysis showed that the type of the SF was the most powerful predictor for occurrence of the different bleeding patterns.

Conclusion: The role of the anatomical configuration of the SF on the bleeding pattern of ruptured MCA aneurysms is an issue, which is not examined yet in the literature. The results of our study confirmed our hypothesis that a narrow and twisted SF configuration forwards the presence of ICH with statistical significance. In contrast, different vascular parameters alone had no significant influence on the occurrence of the bleeding pattern.

Development of a printed 3-D model of a complex aneurysm to simulate clipping and choose clips before surgery

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Objective: In this case we saw a 59 year old female patient with a complex aneurysm of the middle cerebral artery bifurcation in our outpatient clinic. We decided to build a 3-dimensional model for surgical planning. The goal was to evaluate which clips should be used in which order to carefully plan our surgical strategy.

Methods: The patient underwent routine diagnostic procedures which were, digital subtraction rotational angiography and an MRI scan. We used the DICOM files from the MRI scan and open source software to build a 3-dimensional model of the main vessels including the vessels surrounding the aneurysm. The model was then printed within 24hours using a 3D printer.

Results: We were able to choose all 3 clips which we finally used pre-op. It proved that it was very helpful to choose the clips before surgery, because one of the difficulties in this aneurysm was that 2 clips were located very close together. As a result we used a special bent clip, which we had to order to solve this problem. Due to our pre-op planning the surgery for this complex aneurysm went without any complications. Intraoperativ angiography with Indocyanine green and intraoperative microvascular Doppler sonography showed complete occlusion of the aneurysm with no stenosis of the vessels. The patient was discharged 7 days after surgery without any clinical symptoms. Control imaging after 3 months showed complete occlusion without reoccurrence.

Conclusion: The model fitted the patients anatomy exactly. We could choose the clips and the clipping strategy before surgery. The planning was very helpful for the surgical team in the operation room and helped to make this operation very save and successful. In further studies we want to improve on this tool, and make it available for more clinics as a fast, easy and affordable tool.

Relation between delayed cerebral ischemia and aneurysm localization in patients with aneurysmatic subarachnoid hemorrhage

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Objective: To determine the area most at risk of delayed cerebral ischemia (DCI) in relation to the localization of the ruptured aneurysm in patients with aneurysmatic subarachnoid hemorrhage (aSAH).

Methods: We retrospectively analyzed the occurrence and localization of delayed cerebral ischemia (defined as a visible infarction on cranial computed tomography scans 6 weeks after an aSAH) and their relation to the site of the ruptured aneurysm in all patients who were treated at our neurosurgical intensive care unit between 2007 and 2014 due to an aSAH.

Results: 28,7 % of ruptured aneurysms were localized at the middle cerebral artery (MCA), 24,6 % at the anterior cerebral artery (ACA), 22,1 % at the anterior communicating artery (AcomA), 19,5 % at the internal carotid artery/posterior communicating artery (ICA/PcomA), and 5,1 % originated from posterior circulation arteries, respectively. DCI occurred in 18,1 % of all admitted patients. 4,8 % of patients died within 6 weeks after the bleeding and were excluded from further analyses. There was no significant difference in the occurrence of DCI based on the localization of the aneurysm.

Of all patients with an aneurysm of the ICA/Pcom who developed a DCI, 85,7% presented with a DCI of the ipsilateral MCA supply area. In 85% of patients with an ACA aneurysm, who developed a DCI, an ischemia of the contralateral ACA supply area occurred whereas 71,4% showed a DCI of the ipsilateral ACA supply area. All patients with DCIs after the rupture of an AcomA aneurysm showed a DCI of the right ACA supply area. Also, all patients with an aneurysm of the MCA or an aneurysm of the posterior circulation, who developed a DCI, presented with a DCI of the ipsilateral MCA supply area.

Conclusion: Few studies exist which could determine the area most at risk of delayed cerebral ischemia after an aSAH. Our analyses confirmed the hypothesis that the area supplied by the artery carrying the ruptured aneurysm is the one most at risk of a DCI in many cases. However, in ACA aneurysms the contralateral ACA supply area was endangered even more often. In aneurysms of the posterior circulation DCIs occurred most likely in the ipsilateral MCA supply area. These findings may help with choosing the probe position during multimodal neuromonitoring and prevention of DCI.

Risk factors of shunt-dependency in patients presenting with brain arteriovenous malformations – a single center series

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Objective: In patients suffering from ruptured or unruptured brain arteriovenous malformations (AVM), data on possible shunt-dependent hydrocephalus with subsequent ventriculo-peritoneal shunt (VPS) placement is scarce. We therefore analyzed our institutional data to identify risk factors determining a shunt-dependency in patients with AVM.

Methods: From 2009 to 2016, 99 patients with ruptured or unruptured AVM were admitted to the authors' institution. Patient characteristics, radiological features, clinical symptoms, treatment modality, location and size of AVM, functional outcome, and presence of VPS were assessed and analyzed.

Results: Overall, 41% of AVM patients presented with AVM-related hemorrhage. VPS implantation due to shunt-dependent hydrocephalus was necessary in 6 out of 99 patients (6%). Shunt-dependency was associated with AVM-related hemorrhage ($p=0.004$) and AVM location in the posterior fossa ($p=0.0003$).

Conclusion: The present data suggests that shunt-dependent hydrocephalus is rare in patients with AVM. However, location of AVM and the presence of AVM-related hemorrhage are significantly associated with development of shunt-dependency in patients with AVM throughout the treatment course.

The impact of segmented leads for DBS

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Objective: Deep Brain Stimulation is an established treatment modality in various movement disorders. Targets are usually located within the basal ganglia. Due to the proximity of the target points to critical functional structures as the internal capsule, therapeutic yield might be limited by side effects. Furthermore energy consumption is potentially higher in conventional monopolar stimulation. Recently, segmented DBS leads have been made available. This technique comes with the promise of increased efficacy and side effect reduction. We therefore compared our preliminary data with segmented leads with the data from the Libra study conducted 4 years ago.

Methods: The purpose of the Libra study was to evaluate the effects of a new Deep Brain Stimulation System for reducing symptoms of advanced, Parkinson's disease. Also the Activities of Daily Living, UPDRS scores, Quality of life of subject, device parameters including active contact in relation to efficacy, frequency, type and severity of therapy related AE's events were evaluated. 3 months data from patients with segmented leads (Infinity) 6 patients will be compared to the Libra data (6 patients).

Results: DBS Targeting was guided by three micro electrode recording tracts and a directional lead system (Infinity DBS, SJM) was implanted in an all-in-one GA setting in 6 patients. The segmented contacts were intensively tested at 90µs and 130 Hz in the postoperative course. Distinct effect/side-effect patterns for each contact were observed. Comparison of Parkinson's symptoms as demonstrated by the UPDRS motor scores in the medication "off" state at Baseline compared to the medication "off" with stimulation "on" 3 months after device implantation. No differences in efficacy were seen between Libra and Infinity data among those 6 patients. However compared to the Libra data, no stimulation dependent side effects occurred in the Infinity group. Amplitude and frequency did not differ, however lower pulse width was used in 2 patients.

Conclusion: Segmented leads allowing current steering offer new perspectives for DBS and will likely result in increased treatment efficacy while reducing side effect at the same time. While this is true for DBS in general, there are cases with no good benefit/side-effect ratio could be achieved with conventional DBS. Since the threshold for side effects is higher in segmented leads, they are more adaptable to the individual patients' needs and potentially resulting in a longer battery life.

Der therapeutische Effekt des BurstDR(TM) Microdosing in der Behandlung chronischer Schmerzen

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Objective: BurstDR™ spinal cord stimulation (SCS) has been shown to be safe and effective in the treatment of chronic refractory pain conditions. In this randomized, double-blinded, crossover study we compared the therapeutic efficacy of standard BurstDR™ stimulation to two energy efficient BurstDR™ Microdosing paradigms.

Methods: Patients with chronic pain due to failed back surgery syndrome or neuropathic pain that were using only BurstDR™ for at least 3 months were enrolled in the study. Subjects evaluated each of the following stimulation paradigms for 2 weeks in a randomized order:

- Standard BurstDR™ stimulation - 5 pulses per burst, 500Hz intraburst frequency, 40Hz interburst frequency, 1000µs pulse width
- BurstDR™ Microdosing stimulation paradigm A- BurstDR™ STIM ON for 5s followed by BurstDR™ STIM OFF for 5s
- BurstDR™ Microdosing stimulation paradigm B - BurstDR™ STIM ON for 5s followed by BurstDR™ STIM OFF for 10s

Subjects completed a one week Visual Analog Scale (VAS) pain diary the last week of evaluation of each stimulation paradigm. VAS, quality of life (EQ-5D) and patient satisfaction questionnaires were completed during each follow up visit. During the final visit, subjects were asked to express their preference between the three stimulation paradigms.

Results: To date 7 subjects have completed the study. Average \pm SD VAS scores were 62.1 ± 17.6 , 64.7 ± 23.3 and 57.8 ± 19.6 for standard BurstDR™, BurstDR™ Microdosing stimulation paradigms A and B, respectively and not significantly different between each other; equivalent values were obtained from the pain diaries. Average EQ-5D index were 0.51 ± 0.19 , 0.46 ± 0.17 and 0.6 ± 0.18 for standard BurstDR™, BurstDR™ Microdosing stimulation paradigms A and B, respectively, and not significantly different between each other. On average subject satisfaction was 3.6 ± 1.3 , 2.7 ± 0.75 and 2.14 ± 0.38 (1 = Very satisfied, 5 = Very unsatisfied) for standard BurstDR™, BurstDR™ Microdosing stimulation paradigms A and B, respectively. At the end of the study, three subjects preferred BurstDR™ Microdosing stimulation paradigm B, and 4 did not have a preference between the three stimulation paradigms.

Conclusion: These preliminary results from the study have only limited validity due to the small sample size, but strongly suggest that use of BurstDR™ Microdosing stimulation paradigms (i.e. stimulating with alternating ON and OFF periods) can provide clinically equivalent results to standard BurstDR™ stimulation parameters while substantially reducing battery consumption.

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69. Jahrestagung der Deutschen Gesellschaft für Neurochirurgie (DGNC)

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WICHTIGE TERMINE | IMPORTANT DATES

Abstractanmeldung online	20. Okt. – 30. Nov. 2017
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Abstract submission open	Okt 20 – Nov 30, 2017
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Vorprogramm online	Dezember 2017
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Preliminary program online	December 2017
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Deadline vergünstigte Anmeldung	20. Dezember 2017
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Industrierausstellung	
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Early bird registration deadline for exhibitors	December 20, 2017
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Anmeldung für Teilnehmer und Hotelbuchung online	ab 10. Januar 2018
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Online registration and from January 10, 2018 hotel reservation open	
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Benachrichtigung der Autoren über Annahme/Ablehnung	31. Januar 2018
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Notification of authors about acceptance	January 31, 2018
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Benachrichtigung der Autoren	15. März 2018
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Notification of authors	March 15, 2018
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Deadline Anmeldung zur ermäßigten Teilnahmegebühr	bis 30. März 2018
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Early bird registration deadline	until March 30, 2018
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Programm online	März 2018
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Final program online	March 2018
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