Intraoperative monitoring of brain tissue oxygenation in aneurysm surgery: 15mmHg $p_{tiO2}$ as a dichotomising threshold for prediction of procedure-related ischemic events

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Objective: To evaluate the feasibility of intraoperative monitoring of $p_{tiO2}$ for intraoperative detection and prediction of surgery-related focal cerebral ischemia during aneurysm surgery.

Methods: $p_{tiO2}$ was monitored within the vascular territory of aneurysm bearing arteries of the anterior cerebral circulation in 40 patients (subarachnoid hemorrhage: 37; complex elective surgery: 3; 42 aneurysms) during aneurysm surgery and correlated to cardiovascular and ventilatory parameters as well as Hunt-Hess and Fisher grading at surgery. Position of the $p_{tiO2}$ probe and the incidence of new ischemic events were evaluated by CT (surrogate criteria for immediate postoperative outcome) on the first postoperative day. Clinical outcome was evaluated 30 days postoperatively using GOS.

Results: Data from 40 recordings (38 patients) were analyzed, two patients were excluded from analysis (probe dysfunction and mislocation). Baseline $p_{tiO2}$ was 23.9mmHg (range 2.0-67.2). After clipping a significant relative decrease in $p_{tiO2}$ (20% from individual baseline) occurred in 12 patients with ischemic lesions on postoperative CT (versus 5/28 with steady $p_{tiO2}$; positive predictive value (PPV) 0.42, sensitivity (sens) 0.5). Analysis of absolute values of postclipping $p_{tiO2}$ nadir using receiver operating characteristic analysis (ROC) identified 15mmHg as a dichotomising threshold for prediction of surgery-related ischemia (PPV 0.56, sens. 0.9; p<0.001 between groups) and prediction of unfavorable outcome (GOS=3, PPV 0.63, sens. 0.63; p<0.069). Utility analysis revealed a clinically relevant diagnostic benefit of intraoperative monitoring using 15mmHg $p_{tiO2}$ as predictive threshold for surgery related ischemia.

Conclusion: Intraoperative monitoring of $p_{tiO2}$ with 15mmHg as predictive threshold identifies patients at risk for surgery-related morbidity, i.e. focal cerebral ischemia, during aneurysm surgery.