

### Early Predictors of Neurological Outcomes after Pediatric Heart Surgery

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Introduction: Brain injury after pediatric heart surgery requiring cardiopulmonary bypass (CPB) and deep hypothermic circulatory arrest (DHCA) is common. Early identification of neurological damage is difficult and a clinically-available system to detect such injuries would be a significant advance. Near-infrared spectroscopy (NIRS) has been used to measure brain regional oxygenation saturations (RSO<sub>2</sub>) and various serological markers of brain injury (neuromarkers) have been proposed. However, a complete analysis of the ability of these systems to detect injuries that affect neurological outcome after heart surgery has not been performed.

Hypothesis: RSO<sub>2</sub> and neuromarkers are associated with adverse neurological outcome.

Methods: Prospective study of children (n = 48) undergoing heart surgery with CPB and/or DHCA. Brain RSO<sub>2</sub> was measured at baseline, continuously during surgery and the first 16h postoperatively. Neuromarkers (neuron-specific enolase (NSE), S100 $\beta$  and brain-derived neurotrophic factor (BDNF)) were measured at baseline, immediately after surgery and at 16 h postoperatively. Neurological outcomes were defined as new abnormality on (i) examination, (ii) imaging or (iii) EEG within the first 3 months after surgery. Data presented as mean  $\pm$  SEM unless otherwise specified.

Results: Median age was 8 m [5 d - 17 y], 15 were neonates and 19 had abnormal neurological outcome (39.6%; 6 seizures, 7 abnormal 3 m exam). Percentage(%) of time with RSO<sub>2</sub> < 40% during surgery or postoperatively (12.3  $\pm$  2.4 v. 5.4  $\pm$  1.9, p = 0.03; 25.5  $\pm$  8.9 v. 6.9  $\pm$  3.5, p = 0.02, respectively) and BDNF (in pg/ml) immediately after surgery (4460  $\pm$  1192 v. 2539  $\pm$  485, p = 0.001) were significantly increased in children with abnormal neurological outcomes. In multivariate analysis, percentage of time with RSO<sub>2</sub> < 40% during surgery and postoperatively and BDNF were independently associated with outcome.

Conclusion: Bedside neurological monitoring of RSO<sub>2</sub> and novel neuromarkers may be helpful in assessing neurological injuries after pediatric heart surgery. A comprehensive study to determine the role of these modalities in neurological monitoring is needed.