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Noninvasive Cerebral Oxygenation May Predict Outcome in Patients Undergoing Aortic Arch Surgery

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Introduction

Patients undergoing surgical repair of the aortic arch have a high incidence of cerebral ischemia related complications. This study population was selected to demonstrate outcome thresholds associated with cerebral oxygenation, if any, in a prospective, observational design. The study was conducted by the Dept. of Anesthesiology and Cardiothoracic Surgery, at Mt. Sinai Medical Center in New York, NY, USA.

Methods

Intraoperative Cerebral Tissue Oxygen Saturation (SctO₂) values of 30 patients undergoing aortic arch surgery were recorded along with other patient data. These data were analyzed and compared with postoperative complications for individuals and matched groups. Severe adverse outcome, extubation time, intensive care unit length of stay, and hospital length of stay data were collected and compared with threshold SctO₂ values and the time spent beneath predetermined SctO₂ thresholds [expressed as area under the threshold (AUT), and time under threshold (TUT)]. The CASMED (Branford, CT, USA) FORE-SIGHT Absolute Tissue Oximeter supplied the SctO₂, AUT and TUT data, which are unique to this near infrared spectroscopy monitor.

Results

A statistically significant association ($p < 0.05$) between the accumulated duration of decreased SctO₂ values and Severe Adverse Outcomes (SAO), which included: death, stroke with persistent neurological deficits, new heart problems, respiratory failure, severe infection, delirium, new kidney failure, gastrointestinal complications and severe fluid retention. Using logistical regression, the authors found that the risk of SAO increased with decreasing threshold SctO₂ value and AUT. As such, for every 5% decrease in the absolute SctO₂ threshold, the incremental exposure time to achieve a given odds ratio (for SAO) decreased by half for SctO₂ thresholds between 55% and 65%. SAO doubled with each decade increase in patient age, and the time to reach SAO was shortened as the SctO₂ thresholds were reduced from 65% to 60% and then 55%. For threshold values of 65% and 60%, both the AUT and TUT were correlated with postoperative mechanical ventilation and length of ICU stay. Notably, patients who spent >30 minutes under the 60% threshold had an average extended stay of 3 ICU days and 4 additional hospital days, leading to an additional cost of \$8,300 in US dollars.

Author's Discussion and Conclusions

An association between decreased perioperative cerebral oxygenation values and poor outcomes was found. An odds ratio for severe adverse outcome was linked to decreasing threshold SctO₂ values and the area under the threshold, as well as the time under threshold. Additionally, decreased cerebral oxygenation values were associated with an increased length of ICU and hospital stay. Moreover, the poorly oxygenated brain proved to be a sentinel organ for other organ failure. For this study population, the authors believe that an SctO₂ of 60% to 65% could represent the critical brain tissue oxygenation threshold value. The authors also stated that, "A potential advantage of absolute brain tissue oxygenation is that threshold values may be more strongly associated with adverse outcomes than trends."

Citation

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