[NM-194] The Use of Renal Site Near Infrared Spectroscopy (NIRS) to Detect Hypovolemia in Craniosynostosis Repair

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Near infrared spectroscopy (NIRS) is a continuous non-invasive monitoring device that utilizes the differential absorption of two wavelengths of infrared light by oxygen carrying chromophores providing a value of regional oxygen saturation (rSO2).1 NIRS has been used extensively for assessment of perfusion and oxygen delivery in pediatric cardiac surgery to guide blood gas management on cardiopulmonary bypass and has been associated with a reduction in post-operative morbidity. NIRS has been correlated with mixed venous saturation and jugular venous saturation in children.2,3 Compared to SpO2 oximetry, NIRS does not require pulsatile blood flow and can be used in times of low flow and non-pulsatile states, such as cardiac bypass.

Assessing blood loss in craniofacial surgical procedures may be problematic because often the losses are under surgical drapes, and the patient can rapidly become hemodynamically unstable with little or no warning. Moreover, the hemodynamic parameters normally used to assess stability of volume status clinically lag behind the patient's physical status with rapid blood loss, making this challenging to manage. Stricker et. al., found that in children less than 24 months, increases in heart rate were an unreliable predictor of hypovolemia because of an immature baroreceptor response in this age group.4 Thus, recognizing additional monitoring methods, like NIRS, to distinguish the "transfusion trigger" for hypovolemia before hemodynamic instability is compelling.

The patient was a 7-year 8 month-old, 22 kg, female who presented for a mid-face bipartition with LeFort III advancement and Briar cranial flap with the use of intraoperative navigation. The NIRS monitor was placed on the patient's flank to assess renal blood flow as a representation of organ specific oxygenation. Along with several other monitors in this case, the NIRS allowed the anesthesiologist to be keenly aware of intravascular blood volume loss and detect the compromise in the patient's end organ perfusion before changes in arterial blood pressure and saturation. We observed gradual decreasing rSO2 over a 15 minute period before any changes in patient vital signs. As a result, the patient received blood products immediately when she needed them.

Although the most common location for NIRS application is cranial, we found the renal rSO2 site monitoring to be quite effective in detection of tissue hypoperfusion. Even though multi-site NIRS monitoring is advocated, if the cranial site is not feasible, somatic (renal) NIRS by itself can still provide pivotal information on the patient's hemodynamic status.

1Tobias JD. Expert Review of Medical Devices 3.2 (2006):235+Health Reference Center Academic. Web 28 Dec. 2010.
2Bhutta AT, et.al. Pediatr Cardiol (2007)28:34-41.
3Watzman MH, et.al.Anesthesiology (2000); 93:947-53.
4Stricker PA, et.al.Anesth Analg, (2012)115:139-46.