Use of Brain Near Infrared Spectroscopy (NIRS) in Children with Intracranial Hypertension.

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Synopsis:
Hypothesis: Increased intracranial pressure (ICP) above 20 mmHg will be reflected by a decrease in brain regional saturation (rSO2), as measured by Near Infrared Spectroscopy (NIRS), of 10 or more points.

Specific Aims:
1. To determine utility of regional brain oxygenation (rSO2) to predict increased intracranial pressure (ICP).
2. To determine association of change in rSO2 with change in ICP.
3. To determine the association of change in clinical variables with changes in rSO2.

Background: Near infrared spectroscopy (NIRS) is a non-invasive technique that measures changes in the absorption of near-infrared light by naturally occurring chromophores like hemoglobin to estimate the change in the oxygen content of tissues. The light absorption pattern of hemoglobin changes as a function of its oxygenation state. NIRS quantitatively measures these changes providing information about regional intravascular oxygenation (rSO2). NIRS probes are able to measure the oxygen saturation of hemoglobin in a volume of tissue about 2.5 to 3.0 cm deep to the skin. When the probes are placed in the frontal area of the head it gives a value (rSO2) representing the oxygenation on the frontal cortex of the brain.

Patients with intracranial hypertension, especially after traumatic brain injury, can develop decreased cerebral blood flow and secondary brain injury due to ischemia. In previous studies in adults with increased intracranial pressure, NIRS has shown correlation with changes in cerebral perfusion pressure, hemodynamic changes in middle cerebral artery flow velocity (by transcranial Doppler), and cortical perfusion (by laser Doppler flowmetry).

Experience with NIRS in pediatrics has been mostly in patients with congenital heart disease undergoing surgery under cardiopulmonary bypass. In these patients a correlation between low cerebral oxygen saturations (low rSO2 assessed by NIRS) and adverse neurological outcome has been found. Previous studies in neonates with hydrocephalus have also shown that NIRS may be a useful tool to detect impending cerebral ischemia in patients with increased intracranial pressure. NIRS also has been found to detect changes in cerebral hemodynamics in children after severe traumatic brain injury.

Validation of NIRS as a method to predict changes in cerebral blood flow in children with intracranial hypertension can greatly improve their care since it is a non-invasive, low risk and easy to use technology.