AbstractID: 14163 Title: Diffuse Optical Measurements of Blood Oxygenation and Flow for Monitoring CMRO2 in Neonates with Congenital Heart Defects

Purpose:
Improve quantification of Cerebral Metabolic Rate of Oxygen (CMRO2) by developing a diffuse optical instrument for use in continuous bedside monitoring of neonatal patients with congenital heart defects.

Method and Materials:
A compact (17″x17″x14″) Time-Domain Diffuse Optical Spectroscopy (TD-DOS) system has been developed and combined with a Diffuse Correlation Spectroscopy (DCS) system. The TD-DOS system is composed of 3 lasers (685, 785, and 830 nm), 2 PMTs, 2 time correlated single photon counting (TCSPC) cards, and control electronics; the DCS system consists of 2 long-coherence length 785nm lasers, 8 photon-counting APDs, and a customized correlator. TD-DOS allows absolute measurement of optical scattering and absorption, which permits calculation of absolute values for local hemoglobin concentration and tissue oxygen saturation (StO2); DCS measures relative changes in microvascular blood flow.

We approximate CMRO2 changes using a compartmentalized model of the cerebral vasculature and Fick's law. However, this calculation relies upon knowledge of baseline physiological properties, namely, blood oxygen saturation and volume, both obtainable from TD-DOS. Simultaneously, relative changes in cerebral blood flow will be measured by DCS. Together, these diffuse optical modalities will allow us to calculate CMRO2 based on the individual physiological parameters of each subject.

Results:
Previous works on neonates with congenital heart defects have utilized instrumentation incapable of measuring absolute optical properties. Calculations of CMRO2 were therefore based upon sparse literature reports of baseline quantities obtained from healthy subjects, who are not representative of our patient population. We will demonstrate an improved quantification of CMRO2 by eliminating the questionable assumptions of blood oxygenation and volume in neonatal brains in favor of direct measurements.

Conclusion:
By combining TD-DOS measurements of absolute tissue optical properties with DCS measurements of relative microvascular blood flow, these TD-DOS data will permit an improved calculation of CMRO2 by providing individualized baseline values.