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Connectivity and Complexity During General Anesthesia in the Developing Brain

Abstract

The network-level effects of general anesthetics in the developing brain are largely unknown. Recent electroencephalogram (EEG) studies in adult patients have identified a reduction of EEG complexity during general anesthesia as well as dynamic changes in functional connectivity patterns despite pharmacokinetically stable anesthesia. In the proposed studies, I will test the central hypothesis that the complexity of cortical dynamics increases in the maturing brain and that dynamic shifts in functional connectivity are observable in anesthetized children. To test this hypothesis, I will conduct a prospective observational trial of 60 healthy children (8-16y/o) undergoing surgery, with continuous whole-scalp EEG recording in the perioperative period. This age range was chosen because it is a period of dramatic cortical maturation. Specific Aim 1 will test the hypothesis that EEG complexity, as measured by the Lempel-Ziv algorithm, will increase with developmental age and decrease during general anesthesia. Specific Aim 2 will test the hypothesis that the developing brain undergoes dynamic transitions in connectivity states during the maintenance phase of surgical anesthesia. We will use functional connectivity measures, principle component analysis and k-means clustering to identify the presence and structured transitions of these brain states. The long-term objective is to contribute new neuroscientific knowledge to understanding anesthetic mechanisms and monitoring in the developing brain. The support of FAER will also facilitate a structured mechanism by which to progress toward my long-term goal of independent scientific discovery.