[2006 P74]

Title: Delta and beta EEG power increase following cardiopulmonary bypass in neonates

Author(s): JB Sobol, SS Lo, MP Carson, R Corda, PG Grieve, RI Stark, LS Sun

Affiliation(s): Columbia University, New York, NY

Introduction: Abnormal neurodevelopmental outcome has been documented following arterial switch surgery performed during the neonatal period for correction of dextro-transposition of the great arteries (D-TGA) (1). Recently, 20% of these patients were shown to have evidence of early postoperative electroencephalographic (EEG) seizures, which were associated with significantly worse outcome at one year of age (2). Intraoperative EEG monitoring could potentially identify subtle EEG differences in those patients at risk for both perioperative seizure activity and poor neurodevelopmental outcome. Previous studies have included subjects of various ages and with different types of cardiac lesions (3,4). The goal of our study was to use a high-resolution EEG recording system in a homogeneous neonatal population to assess quantitative changes in EEG power intraoperatively before and after cardiopulmonary bypass (CPB).

Methods: With IRB approval and parental consent, neonates undergoing arterial switch for D-TGA were recruited. Anesthetics were standardized to intravenous fentanyl for induction and an infusion of fentanyl/midazolam for maintenance, which was supplemented with sevoflurane or isoflurane in some patients. All patients underwent hypothermia to rectal temperature $\leq 24^{o}$ C. CPB was nonpulsatile, and alpha-stat acid-base management was utilized. EEG was recorded with a 128-electrode Geodesic Sensor Net. EEG power for each 30-second epoch was summarized over the standard frequency bands. The delta (1-4 Hz) and beta (20-30 Hz) bands were used to provide a spatial depiction of EEG activity. Statistical analysis of pre- and post-bypass power values was performed using the Wilcoxon rank-sum test and significance defined as $P < 0.05$.

Results: Five full-term neonates at age 6.2 ± 4.6 days and weight 3.4 ± 0.3 kg were studied. Patients underwent CPB for 137 ± 31 minutes. Quantitative EEG analysis of global power showed that in both the delta and beta frequency bands, there was a significant increase in EEG power from immediately before CPB to 30 minutes after discontinuing CPB (delta: P=0.01, beta: P=0.03). Regional analysis of EEG power also showed a significant increase in power in the frontal polar (FP) and occipital (O) areas of both the delta and beta frequency bands (delta FP: P=0.004; delta O: P<0.001; beta FP: P=0.02; beta O: P<0.001).

Discussion: Our results indicate that there is an increase in delta power in neonates after CPB. This complements a recent report in children showing a postoperative rise in delta power within 48 hours of cardiac surgery (3). The use of a high-resolution EEG recording system yielded a detailed examination of EEG power within different regions of the brain in a homogeneous population of neonates undergoing standardized anesthetic and surgical management for a single cardiac lesion. Therefore, our study design removed possible confounding factors from the analysis. We have shown a significant increase in EEG power across frequency bands and spatial regions within a short period of time after discontinuation of CPB in neonates with D-TGA. Future studies will compare these early EEG changes with later EEG findings and will determine whether they are related to postoperative neurological outcomes in this high-risk population.

References:

1. Bellinger DC, et al, "Neurodevelopmental status at eight years in children with dextro-transposition of the great arteries: The Boston Circulatory Arrest Trial," *J Thor Cardiovasc Surg* 2003; 126(5): 1385-96.
2. Rappaport LA, et al, "Relation of seizaures after cardiac surgery in early infancy to neurodevelopmental outcome," *Circulation* 1998; 97:773-9.
3. Schmitt B, et al, "Electroencephalographic changes after pediatric cardiac surgery with cardiopulmonary bypass: is slow wave activity unfavorable?" *Pediatric Research* 2005; 58(4): 771-8.
4. Hauser E, et al, "Quantitative EEG before and after open heart surgery in children. A significant decrease in the beta and $alpha_2$ bands postoperatively," *Electroencephalogr Clin Neurophysiol* 1993; 87: 284-90.