Lack of Effect of Early Anesthetic Exposure on Neurocognitive Testing and Brain Proton NMS Spectroscopy


Introduction

- Anesthetic neurotoxicity remains a concern among anesthesiologists, surgeons and parents.
- Recent work in animal models show that exposure of newborn rats and other animals to volatile anesthetics is neurotoxic and can result in impaired neurocognitive function.
- The toxicity appears to derive from interactions with the same neurotransmitters that anesthetics act on; namely, a methyl-d-aspartate (NMDA) and/or the gama-aminobutyric acid (GABA) receptors.
- Anesthetic effects on the developing brain include impaired synaptogenesis, altered dendrite geometry, neuronal apoptosis and retarded axonal neurotransmitter migration.
- Human studies have yet to resolve the clinical implications of anesthetic effects on the developing brain.
- Using available data from two developmental neuroimaging studies at The MIND Research Network, our study attempts to demonstrate a correlation between early anesthetic exposure and altered cognitive function and brain structure.

Methods

- Human term (37) and very low birth weight (VLBW) (≤1500g) infants underwent neuroimaging evaluations and IQ testing.
- Enrollment criteria included the following confounding variables: neonatal injuries, intraventricular hemorrhage, periventricular leukomalacia, necrotizing encephalopathy or other major medical comorbidity that would have significant influence on brain development.
- Neuroimaging in the left frontal periventricular white matter have been found to be affected by various pathologies of the brain. In this area we measured N-acetylaspartate (NAA), total choline-containing compounds (Cho), and combined creatine and phosphocreatine (Cr).

Results

- The only statistically significant finding was a correlation between VLBW and low IQ scores. This study failed to demonstrate an impact on IQ and neurocognitive testing among children exposed early in life to volatile anesthetic agents. This lack of effect was true for both term and VLBW infants.

Results cont.

- There was no statistically significant relationship found between anesthetic exposure and neurometabolite concentrations as determined by magnetic resonance spectroscopy for either VLBW or term infants.

Discussion

- The goal of this project was to assess if there was an association between early anesthetic exposure, brain structure and neurocognitive function, and whether that association was present in populations who were more likely to need surgical intervention (such as those born VLBW).
- Exposure to anesthesia did not demonstrate an effect on IQ, either alone or in combination with VLBW status.
- While our study failed to achieve statistical significance, the larger study from which our data was gathered is still active, and should allow us to reexamine our findings as the number of studied children increases.
- Using the difference between the means of IQ scores between those who had surgery versus those who did not (3.6), a future study would achieve statistical significance at about 500 patients.
- One major limitation of a retrospective study such as this one is that we cannot account for a variety of confounders that could contribute to fluctuations in future IQ, such as home environment, poverty or other socioeconomic or cultural factors.
- We believe that this study’s novel methodology of incorporating detailed clinical data, sensitive neuroimaging and sophisticated neurobehavioral testing can serve as a model for future studies on anesthetic neurotoxicity in human populations.

References