[CCAS-2] Effects of Surgical Palliation and Perioperative Brain Injury on Corpus Callosum Microstructural Changes in the First Year of Life of Infants with Congenital Heart Disease

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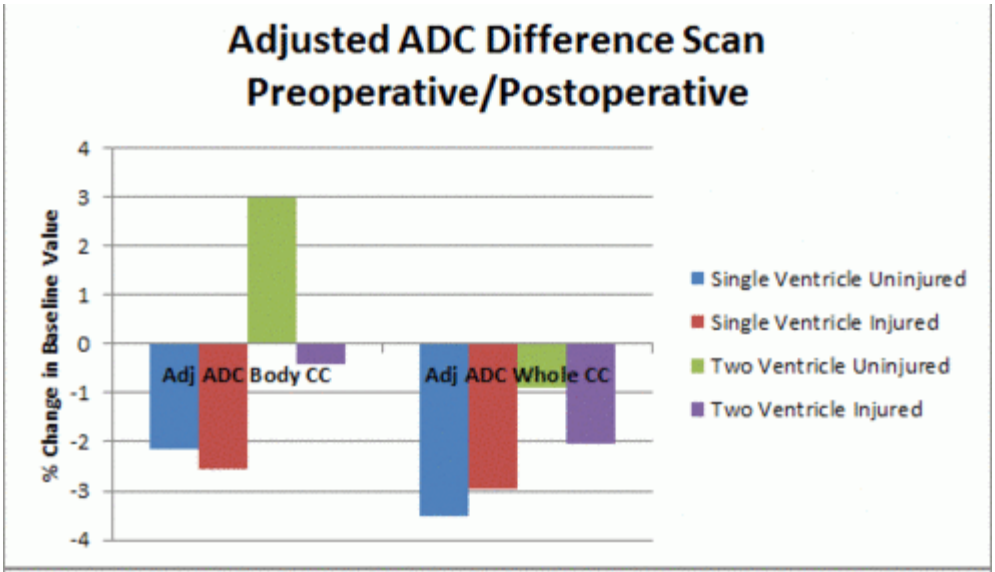
Background:
MRI diffusion tensor imaging (DTI) utilizes two separate measures, fractional anisotropy (FA) and apparent diffusion coefficient (ADC), to track the movement of water through specific anatomical regions to quantify microstructural development1. FA normally increases over time with brain development, and ADC decreases, due to increasing synaptogenesis and myelination. Among patients with congenital heart disease, surgical repair/palliation and perioperative brain injury produce changes in structures with a high white matter content such as the corpus callosum2,3. All previous studies have been limited to immediate perioperative period and have not included imaging data after recovery from surgery. We hypothesize that microstructural brain development within the first year of life will be differentially affected by the presence of perioperative injury and surgical palliation/repair.

Methods:
This prospective cohort study examined 75 patients with various types of congenital heart disease who underwent corrective or palliative surgery within the first 30 days of life. These infants had MRIs performed preoperatively, 7 days postoperatively, and follow up MRIs performed within the first 3-6 months. We examined the relationships between perioperative brain injury and surgical palliation or repair (1V vs. 2V) on FA and ADC changes, allowing for the presence of effect modification.

Results:
Changes in FA and ADC values were significantly different when comparing groups of patients defined by presence of perioperative injury and surgical palliation, and patterns in changes of ADC values in the corpus callosum provided the best stratification between groups (Figure 1). There was also significant effect modification present when examining the effect of perioperative injury and the presence of 1V surgical palliation in changes in FA values for both short term changes and long term changes (Table 1). This translated to perioperative brain injury having a profound effect on microstructural development in two ventricle patients while only having a mild effect in single ventricle patients.

Conclusions:
Microstructural changes in the corpus callosum before and after congenital heart surgery, as measured by ADC values, may be a useful predictors of subsequent microstructural brain development. Additionally, differential behavior in FA and ADC in these patients may provide insights into mechanisms of abnormal brain development that lead to poor development that may cause poor neurodevelopmental outcomes.

References:
1.Mori S et al. Neuron 51:527-39.
2.Dimitropolous A et al. Neurology 81:241-8.
3.Sethi V et al. Pediatric Research 73:661-7.



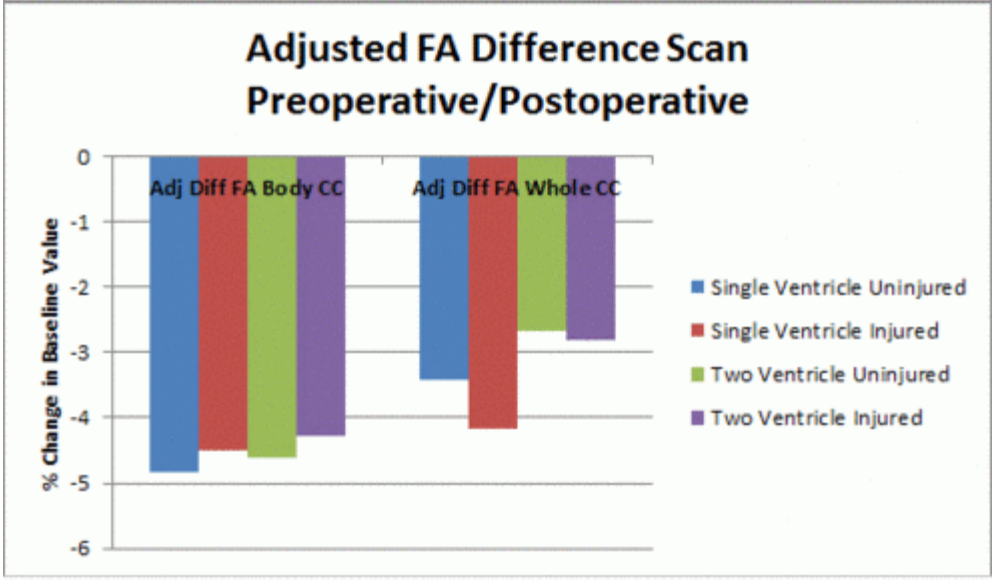


Figure 1. Adjusted DTI Measures for Body and Whole Corpus Callosum

Table 1. Linear Regression with Change of Fractional Anisotropy as Dependent Variable		
Baseline to Postoperative Change Body CC		
Variable	Coefficient (x 10^{-5})	P-Value
Gender (Female)	2.20	0.063
Preoperative Brain Injury	3.29	0.051
Biventricular Repair (vs. Single Ventricle Palliation)	1.28	0.353
Injury-Biventricular Repair Interaction Term	-5.51	0.015
Chromosomal Abnormality	1.45	0.29
Constant	-5.62	<0.001
Baseline to Follow Up Change Whole CC		
Variable	Coefficient (x 10^{-5})	P-Value
Gender (Female)	-0.55	0.754
Any Perioperative Brain Injury	3.56	0.108
Biventricular Repair (vs. Single Ventricle Palliation)	4.25	0.161
Injury-Biventricular Repair Interaction Term	-8.20	0.024
Chromosomal Abnormality	2.26	0.363
Constant	-20.35	<0.001