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Title
Shape Analysis of Corpus Callosum in Healthy and Congenital Heart Disease Fetuses

Background
Congenital heart disease (CHD), the most common cause of major congenital abnormalities, has been shown to affect brain development in utero. These developmental defects include decreased volumes of major brain structures such as corpus callosum in adolescents with CHD. However, the shape changes of corpus callosum between healthy and CHD fetuses are still largely unknown.

Objective
The objective of this study was to compare the shape differences of the corpus callosum between healthy and CHD fetuses.

Methods
A total of 146 pregnant women were recruited for this study (97 controls and 49 CHD; 87 males and 59 females), in which 208 MRI scans were performed. The average gestational age of all scans was 32.7±3.8 weeks (range: 24.4-39.0). Nine anatomical landmarks of corpus callosum were identified on the midsagittal slice of T2-weighted 3D reconstructed images using RView software. These landmarks included: 1) most anterior point of the corpus callosum; 2) junction of the corpus callosum and fornix; 3 and 4) interior tip and inferior notch of the splenium; 5) most posterior point of the corpus callosum; 6) uppermost point of the splenium; 7) uppermost point of the corpus callosum; 8) posterior notch of the genu; and 9) most-posterior point of the genu. Interlandmark distances were then calculated between the identified landmarks. Generalized estimating equations allowing for multiple measurements per subject were utilized to analyze the quantified measures between healthy and CHD fetuses, adjusting for gestational age and gender.

Results
Significant differences of interlandmark distances were found between control and CHD fetuses for landmarks 3-6, 3-7, 4-5, 4-7, 5-7, and 6-7 (p-values<0.05). These interlandmark distances were found to be greater in controls vs. CHD fetuses, and were located at the middle to posterior regions of the corpus callosum. The most significant change of interlandmark distances between control and CHD fetuses was landmarks 6-7 (controls: 20.13±5.58; CHD: 17.78±5.36; p-value=0.003). These results indicated that the posterior part of the corpus callosum was shortened in the anterior-posterior direction and the splenium was thinner in the superior-inferior direction in CHD fetuses.

Conclusion
The shape differences between CHD and control groups were localized to the posterior half of the corpus callosum, including the splenium. This study demonstrated distinguishable deficits in the morphology of the corpus callosum in fetuses with CHD. Ongoing studies are underway to determine the long-term impact of impaired corpus callosum on neurodevelopmental outcomes in CHD infants.