

brain morphometry

with Yuan-Chiao Lu

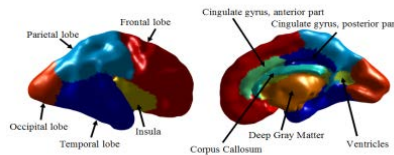
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In vivo quantification of fetal brain morphometry in healthy & congenital heart disease (CHD) fetuses

What is the study about?

In this study, we compared in vivo human fetal brain development using 3D surface curvatures of cortical folding, local gyrification index, sulcal depth, area, and volume in healthy and Congenital Heart Disease (CHD) fetuses. We also quantified brain size and shape features using in vivo MR images and 3D computational models in both healthy fetuses and the fetuses with CHD. The aim of the current study was to investigate the association of brain shape features, measured from 3D brain models constructed from T2-weighted high-resolution MR images, with CHD in singleton pregnancies.

The measured features were compared between control and CHD fetuses using longitudinal data analysis project to the entire team. Our study showed that the local gyrification index, sulcal depth, area and volume of frontal, parietal, temporal, and occipital lobes were significantly decreased in CHD fetuses. There were no significant differences in curvature-based measures. CHD fetuses with single ventricle showed decreased volumes and surface areas of the four brain lobes when compared to two-ventricle CHD.



What are the implications?

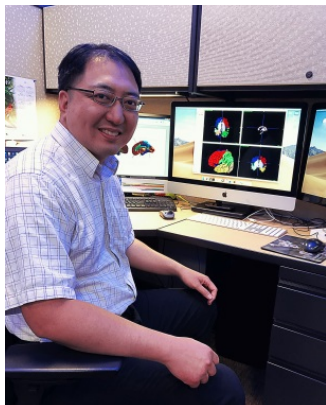
The findings suggest that fetuses with CHD demonstrate altered cerebral cortical folding over the latter half of gestation. Local gyrification index, sulcal depth, area and volume were all reduced in CHD fetuses vs. controls. Fetuses with single ventricle CHD show selective regional vulnerability of the brain regions.

Why is it important?

The study of early biomarkers of cerebral cortical development in the living fetus could provide critical insights on the timing and progression of impaired cerebral development in the high-risk fetus.

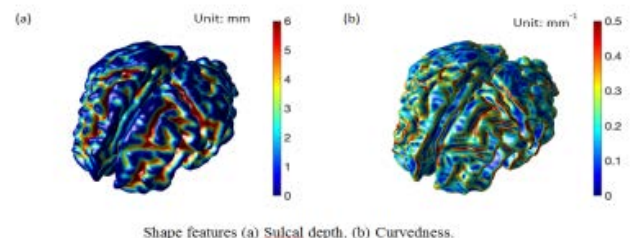
Relevancy to our work

The goal of the Center for the Developing Brain is to develop advanced MRI techniques to examine the structure, connectivity, and metabolism of the fetal and infant brain. The established approach improved biofidelic measures of human brain using 3D computational models, and these measures enabled us to accurately distinguish healthy and high-risk populations.



Yuan-Chiao Lu, PhD
Research Associate

My research interests are centered on computational modeling of human body and programming, biomedical image analysis of human brain, and biostatistics. My current projects include the investigation of brain cortical folding in fetuses with complex congenital heart disease (CHD) and in preterm newborns, and the quantification of human placental morphology in healthy and CHD fetuses. My research also involves the segmentation and shape analysis of the human placenta and fetal and neonatal brain from motion corrupted MRI.



Shape features (a) Sulcal depth. (b) Curvedness.



Welcome New Team Member!



Erin Clements
Research Nurse Coordinator

Research Publications

Ottolini K, Andescavage N, Keller S, Limperopoulos C. Optimizing postnatal brain development through nutrition: how far are we from optimal? A systemic review. *Pediatric Research.* 2019 Jul 26. doi: 10.1038/s41390-019-0508-3. [Epub ahead of print]

You W, Andescavage N, Kapse K, Donofrio MT, Jacobs M, Limperopoulos C. Altered hemodynamic responses of the placenta and fetal brain to maternal hyperoxia in the fetus with congenital heart disease. *Radiology* (In Press)



Catherine Limperopoulos for winning the Bush-Lawson Prize for Prenatal Innovation for “Advancing Perinatal Mental Health and Wellbeing: The DC Mother-Infant Behavioral Wellness Program.”

Wesley Zun on his new NIH RO1 Award “Assessment of placental perfusion and oxygenation using novel MRI approaches.”

Yao Wu on her NARSAD Young Investigator Grant “Prenatal cognitive behavioral therapy for pregnant women carrying fetuses diagnosed with critical heart disease.”



Research Presentations

Jones M. Implementation of Weekly Multidisciplinary Neurodevelopmental Rounds. Cardiac Neurodevelopmental Outcome Collaborative Oct 2019 (Poster)

Kuhn V. Determinants of Neurological Outcome of Neonates with Hypoplastic Left Heart Syndrome or D-Transposition of the Great Arteries following Congenital Heart Surgery. EACTS 2019 Oct 2019. (Platform)

Lu YC. Abnormal Brain Cortical Morphology in Congenital Heart Disease Fetuses Evaluated with Longitudinal MR Brain Images. Biomedical Engineering Society (BMES) Annual Meeting Oct 2019. (Platform)

Featured Press

Featured in the article: “Researchers receive \$2.5M grant to optimize brain development in babies with Congenital Heart Disease (CHD)” in CNHS: Innovation District. July 3, 2019

Upcoming Events

October 11-13, 2019 - Cardiac Neurodevelopmental Outcome Collaborative (CNOC)

October 19th, 2019 - Race For Every Child

October 19-23, 2019 – Society for Neuroscience 2019

November 21-22, 2019 – International Symposium on The Fetal Brain (ISFB)

Announcement



Congratulations to **Dhinesh Krishnamurthy & Dhivya** on their Wedding!



“Winter is an etching, spring a watercolor, summer an oil painting and autumn a mosaic of them all.” – Stanley Horowitz