Prediction of abnormal brain development based on midgestational ultrasound parameters in fetuses with congenital heart disease

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Objective
To evaluate midgestational ultrasound parameters for the prediction of cortical development and brain metabolism at term assessed by magnetic resonance (MRI) in fetuses with congenital heart disease (CHD).

Methods
58 fetuses with major CHD were included. Second trimester ultrasound evaluation included cephalic biometry, conventional Doppler and frontal fractional moving blood volume (FMBV). MRI was performed at 37 weeks and brain volumetry, cortical fissure’s depth and metabolic ratios were obtained. In order to select which of these variables were more representative of the detected brain abnormalities, a dimensionality reduction was performed using a principal components analysis. Suboptimal neurodevelopment was defined by a composite score (brain volume <10th centile or parietooccipital or cingulate fissure’s depth <10th centile or abnormal frontal spectroscopy (inositol/choline >90 th centile or N-acetilaspartate/choline <10 th centile or Choline/Creatine <10 th centile). Logistic regression analyses was used to evaluate the value of midgestational ultrasound parameters to predict this composite score.

Results
Fetuses with CHD presented on average significant neurodevelopmental differences at term assessed by fetal MRI regarding volumetry, sulcation and metabolism. Logistic regression results showed that middle cerebral artery (MCA) pulsatility index (p=0.015), cerebroplacental ratio (CPR) (p=0.022) and head circumference (HC) (p=0.018) at midgestation were predictive of abnormal neurodevelopment, as defined by the composite score. Other variables analyzed (biparietal diameter, FMBV and type of CDH) did not present a significant predictive value.

Conclusion
MCA Doppler, CPR and HC at midgestation predict abnormal brain development assessed by MRI at term in fetuses with CHD. Larger studies are needed to confirm the value of these parameters as midtrimester predictors of severe neurodevelopmental impairment in fetuses with CHD.