Abstract: P4648

Retrograde flow in aortic isthmus in fetuses with congenital heart defects and computer flow dynamic modeling

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On behalf: Beijing Key Laboratory of Maternal-Fetus Medicine

Topic(s):
Congenital Heart Disease: Echocardiography

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Background and objectives: Retrograde flow (RF) in the aortic isthmus is frequently observed in fetuses in various hemodynamic states including congenital heart defects (CHD). This study sought to: 1) establish the association between this observation and variables of CHD by fetal echocardiography (FE); and 2) to computer flow dynamic (CFD) model to probe the causes and mechanisms underlying this observation.

Methods: A total of 256 (gestational age (GA) 26.3±9.8 weeks) fetuses with CHD and 168 (GA: 25.8±10.3 weeks) with normal FE were examined from January, 2011 to May, 2016. The study group was divided into: 1) no RF, 2) end systolic RF, end diastolic RF, systolic RF, and diastolic RF sub-groups (Figure upper). GA, cerebroplacental ratio (CPR) of pulsatility index (PI) in middle cerebral and umbilical arteries, cardiothoracic area ratio (CTR), left and right atrial dimensions (LA/RA), left and right ventricular dimensions (LV/RV), aortic and pulmonary artery dimensions (AO/PA), and aortic isthmus and ductal arch dimensions (AI/DA), velocity ratio of aorta and pulmonary artery (AO/PAv), aortic isthmus and ductal arch in systolic (AI/DAvs) and diastolic (AI/DAvd). Using principal component analysis (PCA), the component score coefficient matrix and optional variance percent (OVP) was calculated by PCA and the RF pattern was simulated by CFD (Figure lower).

Results: RF modeling by CFD was feasible (Figure B). Component analysis by PCA showed that four types of variables were associated with RF: 1) Structural variables contribute 23.7% OVP, including LV/RV, LA/RA, AO/PA, and IS/DA; 2) Resistance variables 16.8% OVP, i.e. CPR; 3) Growth variables 12.2% OVP, i.e, GA and CTR; and 4) Velocity variables 10.9% OVP, i.e. AO/PAv, AI/DAvd.

Conclusions: Retrograde flow in the aortic isthmus is associated with structural, resistance, growth, and velocity variables in fetal circulation in various CHD and normal 3rd trimester pregnancies. Simulation and modeling by CFD is feasible and may be useful to understand the causes and mechanisms of retrograde flow and its utility in diagnosis and prognosis in CHD.
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Retrograde flow by fetal echo and CFD