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Feasibility of volumetric methods in the assessment of right ventricular (RV) function in fetuses

Duliban J. (1), Pietrzak M.(1,3), Grzyb A. (1,2), Dangel J. (1,3)

(1) Reference Center for Fetal Cardiology, Warsaw Hospice for Children Foundation; (2) Cardiology Department, The Children's Memorial Health Institute; (3) 2nd Department of Obstetric and Gynecology, Medical University of Warsaw

Introduction:

Estimation of right ventricle(RV) function with standard 2D echocardiography is challenging due to its complex geometry and irregular muscle fibers arrangement. In fetuses, different loading conditions and "systemic" role of the RV should be taken into account. The aim of our study was to assess the usefulness of new technique, 4D imaging of RV which is commonly used in adult and children echocardiography but it's role in fetal echo is unknown. According to our knowledge this is the first study using this method prenatally.

Methods:

Epiq7 and volumetric 5-1 probe was used to store the fetal heart images in 3Dzoom mode. Volumes were analyzed using 4D RV Function TOMTEC Arena program. 59 examinations between 18 and 39 weeks of pregnancy were performed: 41 normal, 5 hypoplastic left heart syndrome(HLHS), 13 aortic stenosis (SA): 2 before and after fetal balloon aortic valvuloplasty(fBAV), 5 without BAV and 4 after BAV. Volumetric parameters: RVend-diastolic volume(EDV), end-systolic volume(ESV), stroke volume(SV) and ejection fraction(EF) were analyzed, as well as RV longitudinal freewall (RVLS freewall) and septal strain (RVLS septum). Tei index measured by pulsed Doppler was used for comparison with 4D measurement, as a reference method in evaluation of RV function in our department.

Results:

Analysis was easier in pregnancies above 30 weeks. RV EDV increases during gestation in all studied groups and it was from 0,4ml in 18weeks up to 8ml in 36 weeks. Significant negative correlation between RV Tei index and EF was revealed among HLHS and SA fetuses ($\rho = -0.6364$, p -value $<0,01$), but not in normal fetuses ($\rho = -0.0050$, p -value $=0,98$) in which coefficient of variation was the lowest. EF in fetuses with HLHS was lower than in normal fetuses, significance can not be calculated due to small HLHS group. RVLS freewall correlates significantly with EF in all studied cases. It was significant improvement of RV image and function in two fetuses after fBAV.

Conclusions

Volumetric methods are feasible in assessing fetal RV. EF is a promising parameter in detecting impaired RV function. Role of right ventricle longitudinal freewall strain as an alternative measure of RV function require further investigation.