Pulsed Wave Tissue Doppler Imaging in Fetuses with Aortic Stenosis and Evolving Hypoplastic Left Heart Syndrome before and after Fetal Aortic Valvuloplasty

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Background: Fetal aortic valvuloplasty is technically feasible and can improve filling and reduce afterload of the left ventricle in critical aortic stenosis. In the present study we used tissue Doppler imaging (TDI) to evaluate changes in ventricular function before and after prenatal aortic valvuloplasty.

Methods and Results: Between October 2008 and December 2012, cardiac function was assessed by TDI in 23 fetuses with critical aortic stenosis that underwent fetal valvuloplasty. Mean ± SD gestational age at intervention was 27.5 ± 3.1. Of the 23 fetuses, 14 underwent successful postnatal biventricular repair. All fetuses were examined with B-mode, M-mode, conventional Doppler and tissue Doppler imaging before and after intervention.

Before intervention the z-scores of all TDI-derived parameters (except E’/A’) and MAPSE were severely abnormal. Post-intervention TDI-E’, and TDI-S’ but not TDI-A’ were significantly higher than pre-intervention. While the E/A ratio remained unchanged, the ratios E’/A’ and E/E’ changed significantly. Values of MAPSE improved significantly as did LV MPI, but still remained abnormal. Additionally right ventricular A’, S’ and MPI improved significantly. Post-Intervention z-scores were correlated with postnatal outcome (i.e. biventricular vs. single-ventricle): a higher left ventricular E’ velocity (r= .605, 95%BCa CI [.333, .784] p=.003), a higher left ventricular E’/A’ ratio (r= .492, 95%BCa CI [.094, .889], p=.020), a lower M-MPI (r= -.534, 95%BCa CI [-.799, -.174], p=.011) and a lower T-MPI (r= -.438, 95%BCa CI [-.715, -.061], p=.042) were significantly correlated with postnatal biventricular outcome. Left ventricular E/E’ demonstrated a clear trend (r= -.379, 95%BCa CI [-.604, -.048], p=.082).

Conclusion: In critical aortic stenosis with evolving HLHS intrauterine aortic valvuloplasty led to improvement of TDI derived parameters of the LV but also of the RV. Significant improvement of these parameters was seen only in fetuses with later biventricular outcome. Some parameters continued to improve until birth indicating remodeling of the LV. This data supports the concept, that TDI in addition to currently used techniques is able to contribute to a proper patient selection and to the assessment of technical success and is of prognostic value. Therefore it should be part of the initial evaluation as well as of the follow-up examinations.