Effect of chronic right ventricular volume overload on ventricular interaction in patients after Tetralogy of Fallot repair

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Background: Right ventricular (RV) volume overload results in RV dilatation in patients with pulmonary regurgitation after tetralogy of Fallot (ToF) repair. Due to ventricular interaction, RV dilatation influences left ventricular (LV) function but the LV myocardial mechanics have not been well studied in relationship with RV functional parameters.

Aim: To study the effect of chronic RV volume loading on LV myocardial mechanics in patients after ToF repair.

Methods: We studied 75 subjects: 50 patients after ToF repair, and 25 age-matched controls. All ToF patients and controls underwent an echocardiography at the time of a clinically indicated cardiac magnetic resonance imaging (cMRI). Myocardial deformation, including LV torsion was analyzed using speckle-tracking echocardiography.

Results: There was no difference between the two groups in LV EF measured by cMRI. LV end-systolic ε values were significantly reduced in ToF patients compared with controls: longitudinal (-18.4±8.6 vs -22.1±2.9%, p=0.007), radial (44.3±16.1 vs 65.2±15.6%, p<0.001 and circumferential (-19.1±2.7 vs 21.6±2.2%, p<0.001). LV rotational mechanics are also significantly different with reduced basal and apical rotation and decreased LV torsion (8.7±4.6° vs 14.7±5.7°, p<0.001). Especially basal rotation was very abnormal with 38% of ToF patients having counterclockwise basal rotation. Apical rotation was reduced but not reversed. Both RV end diastolic volume index (EDVi) and RV ε were good predictors of counterclockwise basal rotation, with area under the ROC curve of 0.77 (95% CI: 0.67-0.88) and 0.76 (95% CI: 0.65-0.87) respectively, p<0.001, see figure. Cutoff values of 160ml/m² for RV EDVi and -24.5% for RV ε had the best sensitivity and specificity for predicting counterclockwise basal rotation, OR= 7.3 (95% CI: 1.9-30.6, p=0.001) and 9.4 (95% CI: 2.4-40, p<0.001), respectively.

Conclusion: All parameters of LV deformation appear to be affected in children and adolescents after ToF repair despite preserved LV EF. Especially LV basal rotation is very abnormal and often reversed, related either to RV dilatation or decreased deformation.