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Myocardial deformation characteristics of the systemic right ventricle after atrial switch operation for transposition of the great arteries

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Introduction: The atrial switch operation (Senning) has been the main surgical repair technique for d-transposition of the great arteries for many years. The Senning procedure results in a subsystemic morphologic right ventricle (RV) and a subpulmonary morphologic left ventricle (LV). This can be regarded as a model for the effects of long-term pressure overload on the RV, and of ultimately decreased afterload on the LV. We sought to determine the impact of these chronically altered loading conditions on the myocardial deformation of the RV and LV.

Methods: 26 patients after Senning (age 28.4± 7.5y) and 18 normal controls (age 22.2± 11.4y; p=0.034) underwent cardiac magnetic resonance (CMR) imaging. 2D SSFP cine images were acquired in an horizontal long axis and in a short axis covering both ventricles and post-processed with a feature tracking software (TomTec 2D CPA). Global circumferential strain was measured on a short axis mid-ventricular slice. Global longitudinal strain was measured in a long axis, separately for each ventricle.

Results: When comparing RV in either position, subsystemic circumferential strain was higher than subpulmonary circumferential strain (-16.1± 2.9% vs. -13.1± 4.3%; p<0.01), and subsystemic longitudinal strain was lower than subpulmonary longitudinal strain (-12.8± 3.3% vs. -18.3± 3.8%; p<0.001). In contrast, LV global strain in subsystemic vs. subpulmonary position was similar: LV circumferential strain (-23± 13.1% vs. -20.2± 3.9%; n.s.); LV longitudinal strain (-17.5± 4.6% vs. -16.1± 5.3%; n.s.).
The subsystemic RV showed lower circumferential (-16.1± 2.9% vs. -23± 13.1%; p<0.05) and lower longitudinal strains (-12.8± 3.3% vs. -17.5± 4.6%; p<0.001) than the subsystemic LV. The subpulmonary LV exerted greater circumferential strains (-20.2± 3.9% vs. -13.1± 4.3%; p<0.001) but similar longitudinal strains compared to the subpulmonary RV (-16.1± 5.3% vs. -18.3± 3.8%; n.s.).

Conclusions: In discordant ventriculo-arterial connection, the subsystemic RV adapts to the increased afterload with an increase in circumferential strain and an impaired longitudinal deformation. This may represent the effect of a positive interventricular interaction due to the shared circumferential fibers, since the LV shows higher circumferential strain than the RV even in subpulmonary position.