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The CURE: Quantification of left ventricular dyssynchrony in Ebstein's Anomaly by cardiovascular magnetic resonance feature tracking and 4 dimensional volume analysis.

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Introduction: Cardiovascular magnetic resonance (CMR) imaging of Ebstein's Anomaly (EA) suggests the presence of LV dyssynchrony of the basal septum. Feasibility of LV dyssynchrony assessment has recently been shown using CMR feature tracking (CMR-FT) derived circumferential and radial uniformity ratio (CURE and RURE) and 4D volume analysis derived Systolic Dyssynchrony Index (SDI).

We sought to quantify intra-ventricular LV dyssynchrony in EA patients using CMR-FT and 4D volume analysis.

Methods: 31 EA patients and 31 matched controls were included. CMR-FT was performed on short axis SSFP cine stacks, whilst 4D-volume analysis utilized long and short axis orientations employing dedicated software (Diogenes and 4D-LV-Analysis, TomTec, Unterschleißheim, Germany). CURE, RURE and 4D-SDI as measures of dyssynchrony were calculated. QRS duration, BNP and Total R/L-Volume Index (R/L Index) were registered. CMR dyssynchrony parameters were evaluated for correlations with heart failure parameters by Spearman's analysis.

Results: EA patients (mean age 26.3 years, controls 23.7 years) had significantly longer QRS duration (QRS 119 ms \pm 32 (EA) vs. 97 ms \pm 14 (controls, $p < 0.01$)). CMR derived measures of dyssynchrony were altered as follows: 4D-SDI 7.60 % \pm 4.58 (EA) vs. 2.54 % \pm 0.62 (controls, $p < 0.001$), RURE 0.72 \pm 0.09 (EA) vs. 0.79 \pm 0.06 (controls, $p < 0.001$), CURE 0.77 \pm 0.05 (EA) vs. 0.86 \pm 0.03 (controls, $p < 0.001$), ratio RURE:CURE 0.75 \pm 0.05 (EA) vs. 0.83 \pm 0.04 (controls, $p < 0.001$).

Spearman's analysis revealed significant correlations of CURE with BNP (Spearman's Rho (SR) - 0.508, $p = 0.005$) and R/L Index (SR -0.473, $p = 0.008$), 4D-SDI with R/L Index (SR 0.518, $p = 0.006$) and a trend towards a correlation with BNP (SR 0.363, $p = 0.068$). 4D-SDI and CURE correlated significantly with QRS duration (SR for SDI 0.588, $p = 0.001$; for CURE -0.425, $p = 0.017$).

Conclusions: EA patients exhibit pronounced intra-ventricular dyssynchrony of the LV as compared to a control group. Amongst the different dyssynchrony indexes CURE shows the strongest association with QRS duration and heart failure (BNP) and disease severity parameters (R/L Index). These novel markers can easily be quantified from routine CMR studies and may have a role in the assessment of deterioration of cardiac function, carrying potential value for management of EA.