Semi-Automated Border Detection for Right Ventricular Volume Estimation from MRI Images

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Magnetic resonance imaging (MRI) represents the gold standard for ventricular volumes and mass analysis. However, volumetric measurements are based on multiple contours tracing that makes the analysis cumbersome and subjective. While several semi-automated approaches exist to obtain left ventricular contours, very few have been tested and applied for right ventricular (RV) volume estimation. The RV cavity morphology appears characterized by concavities and convexities, as well as the appearance of structures (chordae and papillary muscles) that could affect the contour detection performance. Our aim was to develop and validate a technique for semi-automated RV endocardial border detection from MRI images. Methods. Dynamic, ECG-gated, steady-state free precession short-axis images were obtained (GE Healthcare, 1.5T) in 812 slices in 21 consecutive patients. An expert cardiologist provided the gold standard for RV dimensions, by manually tracing the endocardial contours. Custom software requiring the initialization of one single point in the RV cavity for each slice, and based on image noise distribution followed by level-set, was applied to obtain RV end-diastolic (EDV) and end-systolic volumes (ESV), as well as stroke volume (SV) and ejection fraction (EF). Comparison with gold standard was performed by linear regression and Bland-Altman analyses. Results: The analysis was feasible in 19/21 (90%) patients and resulted in high correlations (r, EDV: 0.96; ESV: 0.95; SV: 0.93 EF: 0.86), and small biases and narrow limits of agreement (bias ? 2SD, EDV: 8.8?21.2 ml; ESV: 4.6?15.4 ml; EF: -0.1?7 %; SV: 4.3?17.8 ml) with the gold standard values. However, in about 50% of patients multiple trial-and-test initializations were needed to obtain visually acceptable contours. Conclusion. The proposed semi-automated endocardial border detection applied to RV from MRI images provided reliable measurements of RV dimensions, hence dependent on the position of the initialized pixel due to inhomogeneity of the RV cavity videointensity.