

Development and Validation of Automated Endocardial and Epicardial Contour Detection for MRI Volumetric and Wall Motion Analysis

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Magnetic resonance imaging (MRI) represents the gold standard for left ventricular (LV) volumes and mass analysis, as well as for the diagnosis of regional LV dysfunction. However, volumetric measurements based on multiple contour tracings are cumbersome, and visual interpretation of cine images suffers from inter-observer variability. Our aim was to develop a technique for combined automated endo and epicardial border detection from MRI throughout the cardiac cycle, and to validate it. **Methods.** Dynamic, ECG-gated, steady-state free precession short-axis images were obtained (GE Healthcare, 1.5T) in 812 slices in 15 patients with previous myocardial infarction. An expert cardiologist provided the gold standard for: 1) LV dimensions and mass, by manually tracing endo and epicardial contours; 2) regional wall motion (WM) interpretation, by grading (normal, abnormal) three slices selected at apical, mid and basal level. Custom software based on image noise distribution (for LV endocardial detection) and level-set (for epicardial detection) was applied, from which end-diastolic (ED) and end-systolic (ES) volumes and mass were computed, as well as regional fractional area change (RFAC), from which automated classification of regional WM abnormality was defined for $RFAC < 50\%$. Comparison with gold standard was performed by: 1) linear regression and Bland-Altman analyses for LV volumes and mass; 2) levels of agreement between the cardiologist WM grades and the automated classification. **Results:** Optimal correlations ($r^2 > .97$) and no bias were found for ED and ES volumes, while LV mass resulted in a good correlation (ED: $r^2 = .81$; ES: $r^2 = .74$) with a minimal overestimation (ED: 15.2g; ES: 8.7g) and narrow 95% limits of agreement (ED: ± 30 g; ES: ± 33 g). The automated interpretation resulted in high sensitivity, specificity, and accuracy (78%, 85%, 82%, respectively) of WM abnormalities. **Conclusion.** Combined automated endo and epicardial border detection from MRI provides reliable measurements of LV dimensions and regional WM classification.