Evaluation of a Semi-Automatic Algorithm for Tracking Tricuspid Valve Annulus on Magnetic Resonance Images

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Despite cardiac magnetic resonance (CMR) is the reference imaging technique for the evaluation of ventricular function, its use for the assessment of valve morphology is still minimal. We recently proposed a method for the quantitative evaluation of tricuspid (TA) annulus morphology, based on manual selection of reference points on multiple long-axis images followed by 3D reconstruction. Our aim was to test the accuracy of semi-automated tracking of TA points, in order to reduce their cumbersome manual identification frame-by-frame. CMR imaging (1.5 T) of 18 long-axis planes, evenly rotated of 10 along the long-axis ideally passing through the center of TA , was performed in 10 healthy volunteers using SSFP sequences (20 frames per cardiac cycle, spatial resolution 0.74 mm). TA points, initialized in each plane at end-systole and end-diastole by an experienced cardiologist, were automatically tracked throughout the cardiac cycle using a recursive algorithm: 1) a region of interest (ROI) centered in each initialized point was considered; 2) a region of search (ROS) was defined in adjacent frame; 3) TA points location was estimated as the maximum of the normalized cross-correlation between ROI and ROS. Tracking was performed forward and backward, and the final position of TA points was estimated by weighted averaging the resulting points. Tracking was performed using widths for ROI and ROS of 10 and 20 pixels, respectively. An expert reader visually inspected each frame and judged as appropriate or not the TA points position. Analysis was feasible in all datasets, and took about 3 minutes for each subject. Tracked TA points positioning were visually judged as accurate in 3122 out of 3600 images (87%). The proposed algorithm, based on minimal manual interaction, showed good tracking accuracy, demonstrating its applicability to obtain the dynamic 3D morphology of TA, with potential benefits in patient evaluation and surgical planning.