Accuracy in Warping ECT LV Surfaces to CT Angiography Coronary Vessels.

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Objectives: With the introduction of multislice computed tomography (CT) systems, coronary angiographic images (CTA) can be acquired and correlated with myocardial perfusion emission tomographic (ECT) images. While hybrid ECT-CT systems minimize the requirements for spatial registration, warping registration is still required to account for differences in cardiac cycle between the CTA and ECT images. We investigated the accuracy of an algorithm to warp the 3D ECT LV surfaces to the CTA images in an effort to preserve the high resolution information from the CTA images.

Methods: Eleven randomly selected gated myocardial perfusion SPECT studies (EF range 32% to 75%) were processed with 4D-MSPECT software to provide the LV endo and epicardial surfaces at end-diastole (ED), end-systole (ES) and a frame midway between ED and ES (MID). A mathematical coronary tree was constructed onto each of the ED surfaces that included the LAD, LCx, D1, D2, OM1, OM2, and the PDA vessels. The MID and ES surfaces were then warped to the ED coronary tree using a new algorithm and the mean absolute error was computed from the difference between the true ED surface and the warped estimate to the ED surface. The algorithm identified control points from the coronary tree mapped to the nearest point on the LV surface which were used to warp the surface to the arterial tree using a first-order transform. The warped LV surface points were then resampled into a uniform grid using thin-plate-spline interpolation. The process was repeated with the registered surface where additional control points were included to stabilize the unrestricted LV surface during the final warping using a third-order transformation.

Results: With all arteries included, the mean absolute error was (1.3 ±0.4)mm for warping the MID frame and (2.3 ±0.5)mm for the warped ES frame. With D1, D2, OM1, and OM2 removed, the mean error increased to (1.7 ±0.4)mm for the MID frame and (3.0 ±0.6)mm for the warped ES frame. Qualitative assessment showed good to excellent agreement between the warped and ED surfaces where the largest errors were in the apex due to the small number of control points from the CTA tree.

Conclusions: The warping algorithm demonstrated excellent accuracy in fusing ECT surfaces with full and partial CTA coronary trees which will be clinically applicable for both gated and ungated ECT studies. With this method, correlation of coronary stenosis with perfusion abnormality can be achieved without degradation to the high resolution coronary data.

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