Automated Image Registration of LGE-MR Imaging and Tc-99m SPECT Myocardial Perfusion for Validation of Scar Quantification

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BACKGROUND AND OBJECTIVES
Both LGE-MR and SPECT MPI have been clinically used to assess myocardial infarction. We developed a procedure for the automated co-registration of the 3D SPECT LV perfusion distribution onto the 3D LGE-MR distribution to more accurately validate our new MPI-based scar quantification using registered LGE-MR as the reference standard.

METHODS
Twenty patients who had both LGE-MR and resting Tc-99m SPECT MPI at 6 months post-MI have already been acquired for this preliminary validation.

Extraction of Anatomical Features from LGE-MR
Binary masks were manually created from the LGE-MR: one identifying the biventricular contour and one delineating the LV endo & epicardium. Shape analysis tools allowed the rotation of the MR images to match the conventional orientation used for MPI. A 3D triangulated surface of the LV epicardium was extracted. The scar was identified on MR slices and quantified radially slice by slice as a % of local myocardium thickness.

LGE-MR / MPI-SPECT Registration
A rigid surface registration using the Iterative Closest Point algorithm was performed to register the two LV epicardial surfaces. The calculated transformation matrix was then successively used to align the two volumetric images.

Quantitative SPECT and Scar Quantification Tool
Quantitative scar analysis of the 3D LV SPECT images was performed with the ECTb using perfusion, viability and thickening criteria.

RESULTS
The registration procedure was applied to the whole cohort allowing for a co-localization of the infarcted tissue as identified by the ECTb and the MR areas with highest scar percentage. Image resolution still limits scar quantification at the apex and the base.

CONCLUSIONS
The MR/SPECT registration in combination with our newly developed scar quantitative tools allowed the co-registration of LGE-MR and SPECT and the direct comparison of scar extent for future validation using our 20 patient cohort.

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