Detection of Recent Myocardial Infarction using Precontrast T1 Weighted Edema Sensitive Imaging

J. W. Goldfarb[1,2], S. Arnold[1], J. Han[1], and J. McLaughlin[1]

[1]Saint Francis Hospital, Roslyn, New York, United States, [2]SUNY Stony Brook, Stony Brook, New York, United States

Introduction: T_2 weighted imaging has been used to detect acute myocardial infarction (MI) and reported to accurately define the myocardial area at risk[1]. Image quality with this technique often suffers from long breathhold times, image artifacts and poor contrast between myocardium and the left ventricular bloodpool. Edema has both long T_1 and T_2 relaxation times. We investigated the use of a T_1 weighted (T_1W) technique for the detection of myocardial edema resulting from recent MI. The precontrast T_1 relaxation times of the injured and adjacent myocardium were measured and compared.

Materials and Methods: Eight subjects participated in this study (7 men, MI age, 0.05 years ±0.03; range, 0.03-0.13). Imaging was performed using a 1.5T clinical scanner. Subjects underwent precontrast T_1W-CMR imaging using a TrueFISP IR CINE technique[2]. Sequence parameters were: (TR=2.5 ms, TE=1.25 ms, FA=50 degrees, BW=965 Hz/pixel, voxel size=2.5x1.8x8.0mm3, 15 k-space lines per cardiac cycle and 19 segments per cardiac cycle yielding 19 images with inversion times increasing by 40 ms). A single slice was positioned based on CINE CMR wall motion imaging to include regions with both dysfunctional and functional myocardium. After injection of 0.2 mmol/kg of the Gd contrast agent, the same TrueFISP IR CINE sequence was used to assess delayed hyperenhancement.

Four precontrast images with equally spaced inversion times showing the infarct were selected and the mean signal intensities of the infarct region and adjacent myocardium were measured. When possible, the images depicted the infarct region as both hypointense and hyperintense. T_1 relaxation times were calculated using a four point least squares fit to the analytic signal intensity formula. Means, standard deviations and ranges of MI and adjacent myocardial T_1 relaxation times were calculated. A paired two-tailed Student t-test was used to compare the infarct and adjacent myocardial T_1 relaxation times.

Results: In patients with MIs within the last two months, areas of myocardial edema in areas of MI shown by DHE imaging were well depicted using precontrast T_1W-CMR. An example is given in Figure 1 where at early inversion times an infarcted region is hyperintense when compared with the adjacent myocardium. Due to the T_1 weighting of the MR pulse sequence, both the signal intensities of the MI and viable myocardium are changing as a function of the inversion time. One can see that image contrast is dependent on the inversion time for both the precontrast and postcontrast acquisitions, demonstrating the T_1 relaxation time difference before and after contrast agent administration. The precontrast T_1 relaxation times were significantly (p=0.0005) different between the infarcted region and the adjacent myocardium (Figure 2).

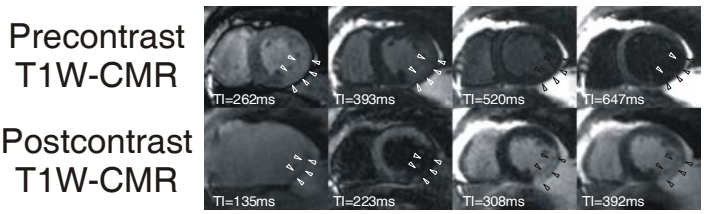

Figure 1: T1W-CMR images from a 48 year old subject with a recent MI (10 days old). Precontrast images show a mid-cavity inferolateral region (T1= 1265 ms) which is hyperintense at TIs less than 435 ms. In the same region, postcontrast images show a region hypointense for TIs less than 223 ms.

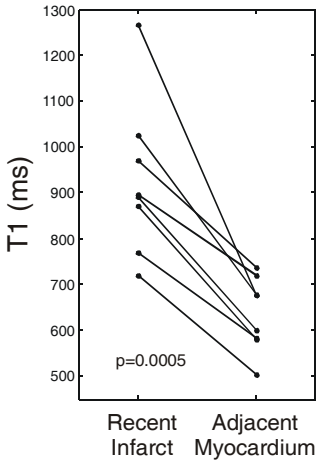

Figure 2: Graph shows the precontrast T1 relaxation time difference between infarcted and adjacent myocardium for recent myocardial infarcts.

Conclusions: In this study, we have shown the ability of precontrast T_1W-CMR to detect MI. Dating of infarcts may be done using precontrast T_1W-CMR imaging or T_1 relaxation time measurements. Our data demonstrate a significant difference between recent infarct and adjacent myocardial T_1 relaxation times. Addition of T_1W-CMR to clinical imaging protocols may provide improved risk stratification and help direct further therapy.

References: [1]Aletras AH et al, Circulation. 2006;113:1865-70. [2] Gupta A et al, Radiology 2004; 233: 921-6.