Poster presentation

Myocardial edema contrast in acute myocardial infarction: a comparative study of the sensitivity of different CMR Methods

Xiangzhi Zhou*[1], Veronica Rundell[1], Ying Liu[1], Richard Tang[1], Rachel Klein[1], Shivraman Giri[2], Saurabh Shah[3], Sven Zuehlsdorff[3], Orlando Simonetti[2], Debiao Li[1] and Rohan Dharmakumar[1]

Address: [1]Northwestern University, Chicago, IL, USA, [2]Ohio State University, Columbus, OH, USA and [3]Siemens Medical Solutions USA, Inc., Chicago, IL, USA

* Corresponding author

Introduction

A number of CMR imaging approaches have been proposed for detecting myocardial edema accompanying acute myocardial infarctions (AMI). Besides the most commonly employed T2-weighted STIR (T2-STIR), T2-prepared SSFP (T2-prep SSFP) and cine SSFP (bSSFP) methods have also been proposed. To quantitatively assess myocardial edema, the utility of T1 and T2 maps has been described. However, the relative sensitivities of the various approaches in relation to the routinely used, T2-STIR, method is not fully known.

Purpose

To assess the sensitivity of T1 and T2 maps, as well as T2-prep SSFP and bSSFP methods against T2-STIR, for detecting myocardial edema in the setting of AMI.

Methods

Dogs (n = 3) subjected to an ischemia-reperfusion injury (LAD occlusion for 3 hours followed by reperfusion) were studied 2-hours post reperfusion (day 0), and on days 2, 5, and 7. Multiple breath-held and ECG-triggered T2-STIR, T2-prep SSFP, and bSSFP images and the corresponding T2- and T1-maps were acquired using a Siemens 1.5 T system. All acquisitions, except bSSFP, were acquired in mid-diastole; bSSFP images were acquired in the cine mode. Scan parameters for the various edema-weighted acquisitions are summarized in Figure 1. All scans were termi-nated with a late-enhancement acquisition to confirm the presence of LAD infarction. A semi-quantitative approach was used to identify hyperintense (edema) territories and the mean signal intensity in the edematous (E) and healthy (remote) territories (H) were computed. Myocardial edema contrast (MEC) on each slice was computed as, MEC = (E-H)/H. Normalized MEC was computed by dividing MEC obtained from the different methods by MEC of T2-STIR images. This was performed on a slice-by-slice basis and averaged across all studies. Statistical analysis (one-way ANOVA, significance $P < 0.01$) was used to compare the normalized contrast between the different methods.

Results

On all CMR methods studied, myocardial edema was detected as regions of hyperintensity (Figure 2). Relative to T2-maps, T1-maps had lower MEC. However, both T1 and T2 maps had lower MEC relative to T2-STIR. Normalized MEC between T2-STIR, T2-Prep, and bSSFP did not show any statistically significant differences. T2-STIR normalized MEC among the different methods are shown in Figure 3.

Conclusion

T1 and T2 maps appear to have lower sensitivity for identifying myocardial edema compared to T2-STIR, while no difference was found among T2-STIR, T2-Prep, and bSSFP

Scan parameters	
T1 map[1]	IR with 11 TI from approximately 80ms to 4000ms; SSFP readout (TR/TE=2.4/1.2ms, Flip angle=35°, BW=1000Hz/pixel, resolution=1.3X1.3X8.0mm³)
T2 map[2]	T2 Prep. Time=0,24 and 55ms; SSFP readout (TR/TE=2.2/1.1ms, Flip angle=70°, BW=1490Hz/pixel, resolution=1.9X1.9X8.0mm³)
STIR[3]	TI=170ms, TSE readout (echo train length=15, TE=64ms, BW=235Hz/pixel, resolution=0.9X0.9X8.0mm³)
T2-Prep[4]	T2 Prep. Time=55ms; SSFP readout (TR/TE=2.2/1.1ms, Flip angle=70°, BW=1490Hz/pixel, resolution=1.9X1.9X8.0mm³)
bSSFP[5]	TR/TE=3.5/1.7ms, Flip angle=70°, BW=930Hz/pixel, resolution=1.25X1.25X8.0mm³,

[1]Messroghli *et al* MRM 2004; [2]Giri *et al* SCMR 2009; [3]Hassan *et al* Circ 2004;
[4]Kellman *et al* MRM 2007; Kumar *et al* ISMRM 2008.

Figure 1
Imaging parameters used with the various approaches of CMR assessment of myocardial edema.
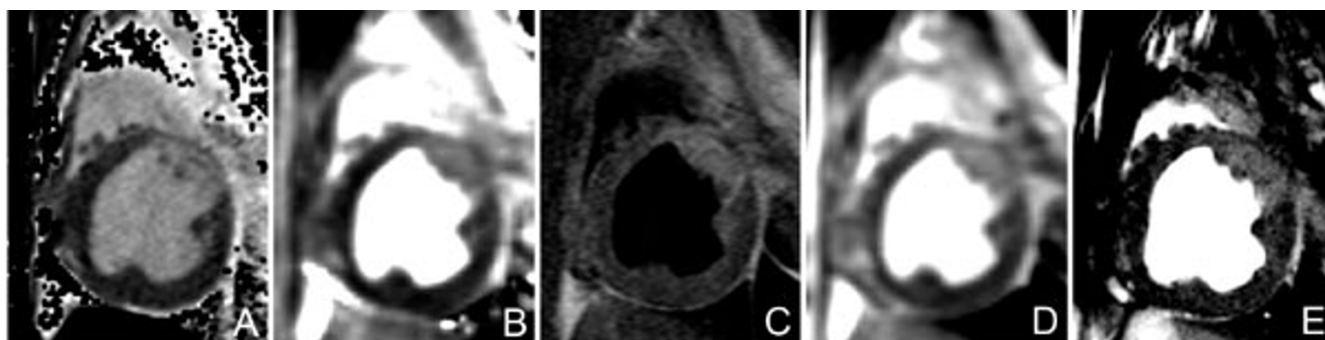
Figure 2
Representative short-axis T1 (A) and T2 (B) maps and T2-STIR (C), T2-prep SSF (D), and bSSP (E) images obtained from a canine with ischemia-reperfusion injury (day 0, 2 hours poest reperfusion). Note that both relaxation maps and edema-weighted images delineate the edematous territory as regions of hyperintensity.

methods. In addition to the sensitivity consideration, the most robust CMR method for identifying myocardial edema will also require a comparative assessment of the specificity of the different methods.
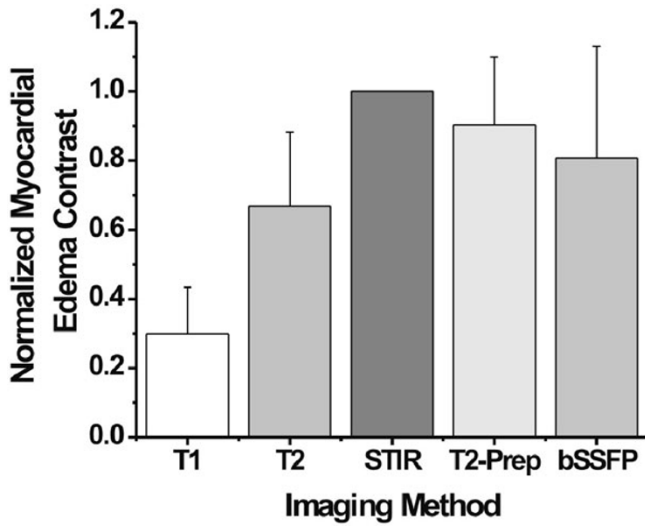
Figure 3
T2- STIR normalized myocardial edema contrast over all imaging studies in canines with AMI.