Title: Analyzing myocardial R2* mapping post myocardial infarction using stabilized probability plots

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Structured Abstract:

Introduction: Hemorrhage within the myocardium often occurs following myocardial infarction (MI). The specificity of magnetic resonance imaging (MRI) for detecting hemorrhage has been validated in experimental studies. Visualization of hemorrhage is possible because of the degradation of erythrocytes which leads to iron deposition that can be detected by T2*-weighted magnetic resonance (MR) images, and quantitatively assessed by image based measurements of R2* (1/T2*). To clarify the distinction between normal and abnormal tissue post MI, we aimed to analyze the distribution of R2*-based measures using the stabilized probability plot method.

Methods: Analysis was performed on canine images (n=4) acquired at baseline (day 0) and several time points (3 to 43 days) following experimentally induced MI. The images consisted of 10 to 13 short-axis slices (slice thickness=6mm) covering the whole left ventricle (LV) obtained with a multi-gradient echo (eight echo times (TE) covering 3-23 ms). For baseline experiments only, single slice images (two-chamber) were available. The images were processed to generate R2* maps. The endocardial and epicardial borders were manually drawn on the shortest echo time image of each slice, and then applied to the R2* maps. The stabilized probability plot method was applied to determine a threshold of R2* below which the myocardial voxel-by-voxel values followed a normal distribution. Pixels with R2* values above this value were considered abnormal tissue. We determined the volume of tissue, relative to the LV volume, with R2* values above the threshold. This measure will be referred to as the percentage of LV volume with high R2* (%LVHR2*). We also determined the mean values of R2* for these abnormal and normal R2* regions.

Results: For baseline images R2* values followed an approximately normal distribution over the full range of values. The mean R2* values of normal regions in the post MI images remained approximately constant as a function of time post MI and were close to the mean baseline R2* values. The mean R2* values of abnormal regions appeared to peak at approximately day 3 post MI. Temporal evolution of the extent of injury (%LVHR2*) was also greatest at day 3 post MI.

Discussion: For all time points post MI, our finding that mean R2* values of normal tissue regions remained close to the mean R2* of baseline tissue is consistent with what one might expect of healthy tissue, remote from the infarct, and hence provides preliminary evidence to suggest that the probability plot method is a reasonable approach. One limitation of this method is that deviations from normality could also be created by macroscopic magnetic field variations.