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Cardiac magnetic resonance imaging of myocardial infarction and left ventricular remodeling in rats using a clinical 3.0 T scanner

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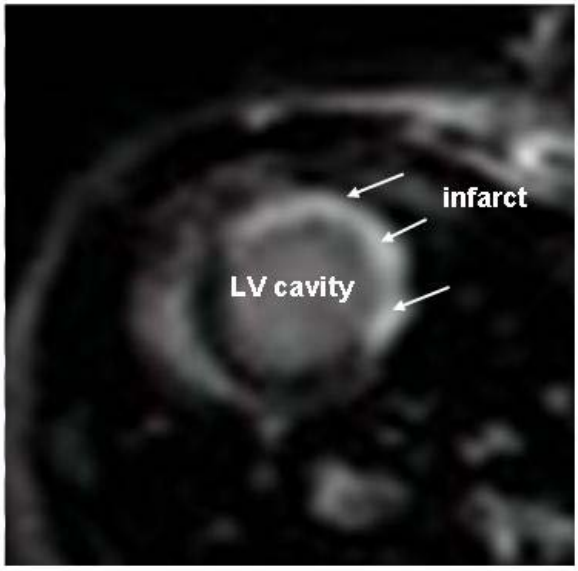
Background: Small rodents (mice and rats) are the most widely used species for animal studies of cardiovascular disease. Cardiac magnetic resonance (CMR) imaging can provide noninvasive, high resolution images of heart anatomy, viability, perfusion, and function. However, the implementation of clinical CMR imaging protocols for small rodents has been limited due to the small heart size and rapid heart rates. Therefore, most CMR studies in small rodents have been performed on non-clinical, high-field MR magnets. Because such high-field systems are not readily available at most institutions, the technical aspects that are needed to perform CMR on clinical 3.0 T MR scanners are presented here.

Methods and Results: CMR protocols for (a) cine imaging of left ventricular function and (b) imaging contrast-enhancement of the infarct zone were developed and optimized for the rat infarct model (n=20) with and without thermosensitive injectable biomaterial therapy. Scanning was performed on the 3T MR system (GE healthcare) using a dedicated rat radiofrequency coil. During MRI, rats were anesthetized using isoflurane, kept warm using hot water, and ECG monitored. For contrast-enhanced imaging of infarct scar, an ECG-gated inversion-recovery gradient-echo sequence was used. Cine images and contrast-enhanced images were analyzed using a dedicated workstation (ADW4.3 GE advanced workstation). Cardiac volumes, ejection fraction, wall thickness, and wall thickening were readily calculated from the cine images, and infarct or scar size can be computed from the contrast-enhanced images (Figure).

Conclusions: CMR performed on a clinical 3.0 T scanner is a valuable imaging modality for studying cardiovascular diseases noninvasively, in small rodents. CMR provides accurate assessment of LV function and remodeling and infarct size in a rat model of myocardial infarction. This method can be successfully used for evaluation of novel preclinical therapies.



CMR imaging of a rat heart 4 days after extensive anterior MI.
Late enhancement of infarct 45 min after IP gadolinium injection.