# Assessment of Myocardial Infarction in Mice by Contrast-Enhanced MR Imaging using an Inversion Recovery Pulse Sequence at 9.4T

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## Introduction

Delayed contrast-enhanced (CE) magnetic resonance (MR) imaging is becoming an increasingly accepted modality for the diagnosis of myocardial infarction. Segmented inversion-recovery (IR) pulse sequences are commonly used for contrast-enhanced MR imaging in humans and larger animals. Over the past decade, the mouse animal model has become an essential part of basic medical research such as those applied to cardiac studies. Nevertheless the assessment of infarct size in small animals at high field strength is currently performed using cine-flash with a high dose of Gd-DOTA because of the rapid heart rate (1). The aim of this study was to show the feasibility of assessing myocardial infarction in mice using an inversion recovery pulse sequence, and to define the optimal inversion time (TI) for myocardial infarction MR imaging at 9.4T.

## Methods

Myocardial infarction was induced by permanent ligation of the left coronary artery in male C57Bl/6 mice. MR imaging was performed at 9.4T (horizontal-bore MR scanner, Varian, Palo Alto, CA, USA) using a quadrature transmit receive coil with an internal diameter of 25 mm (Magnetic Resonance Laboratories, Oxford, UK). For contrast-enhanced imaging, a 0.6 mmol/kg bolus of gadolinium-DOTA (Dotarem, Guerbet, France) was injected through the tail vein. An ECG-gated magnetization-prepared FLASH sequence was used with the following parameters: TR=18 ms; TE=2.2 ms; FOV=25x25mm; matrix 128x128; flip angle 30º; slice thickness 1 mm. A total of 16-20 images were obtained whereby TI of the first image was 20 ms, and then TI applied at 20 ms intervals. Imaging was performed starting immediately after contrast injection and continued for 40 minutes. The optimal TI was defined visually as the value at which the signal intensity (SI) of the normal myocardium was nulled. The contrast-to-noise ratio for the infarcted myocardium compared with the normal myocardium was defined as $(SI_{inf}-SI_{norm})/Sd_{noise}$. Infarct areas corresponding to the hyper-enhanced areas were defined manually on the post-injection images and compared to post-mortem infarct size measurements using TTC staining.

## Results

The signal intensity was nulled in the normal myocardium with a TI of 300ms at 30 minutes post-Gd-DOTA injection. The maximum contrast-to-noise ratio between the infarcted and the normal myocardium was observed with a TI of 340ms.

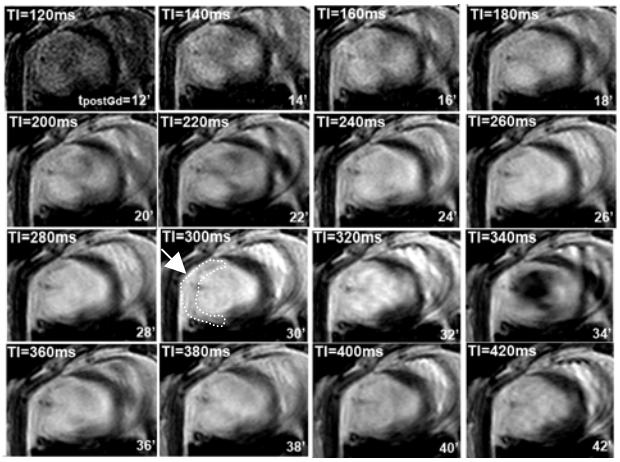


***Figure 1****: Short- axis MR images corresponding to each inversion time (TI) following Gd-DOTA injection (the dotted line shows the hyper-enhanced area corresponding to the infarcted myocardium at 30 minutes post-Gd-DOTA injection).*

## Discussion

Despite the rapid heart rate in mice (~500 bpm), this study demonstrates that an accurate assessment of myocardial infarction in small animals, using gadolinium delayed enhancement, can be performed. Such methodology is essential due to the use of rodent cardiac models for basic medical research. However, the high magnetic field required for cardiac MR imaging in small animals results in longer longitudinal relaxation time. Hence, longer inversion times for inversion recovery MRI are required compared with studies in humans and larger animals at lower field strength (2).

1. Yang Z, *et al*. Circulation 2004;109(9):1161-1167.
2. Barkhausen J, *et al*. J Am Coll Cardiol 2002;39(8):1392-1398.