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MRI Delayed Enhancement Identifies Cardiac Fibrosis after Myocardial Infarction at the Cellular Level in *ex vivo* Rat Heart

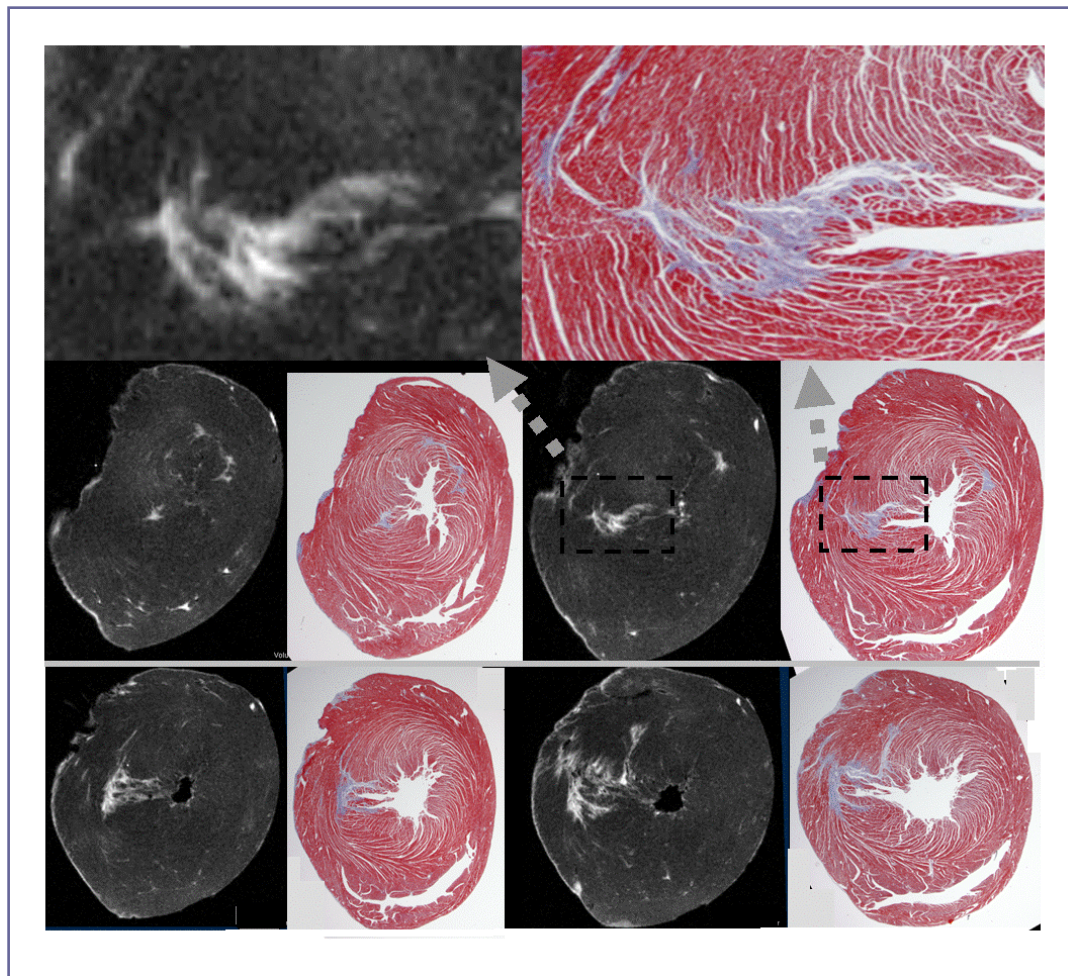
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Abstract:

Background: Delayed enhancement MRI imaging detects chronic myocardial infarction (MI) but some have questioned the accuracy of “non-specific extracellular contrast agents.” Using a resolution 1000 fold higher than previous validation studies we investigated whether MRI could detect fibrosis from chronic MI at an image resolution approaching the size of a cardiomyocyte.

Methods and Results: Eight week old Sprague Dawley rats underwent coronary ligation to create myocardial infarction; 2 months later rats were given gadolinium-DTPA (0.3 mmol/kg) intravenous and were euthanized 10 minutes later. Myocardial delayed enhancement MRI images were acquired *ex vivo* at 7 Tesla with a 3D gradient echo sequence using voxel dimensions of 50 micron³ to identify areas of fibrosis. Histologic sections of rat myocardium 50 microns apart were stained with Masson’s trichrome and digitally photographed. Using computerized planimetry, MRI correlated well with regions of fibrosis as determined by histological specimens stained with Masson’s trichrome ($y = 0.99x - 0.007$; $R^2=0.99$; $p<0.0001$). From a perspective of image resolution, MR images routinely detected clefts of viable cardiomyocytes 2-4 cells thick that separated bands of fibrous tissue.

Conclusions: Using MR microscopy at 7T, *ex vivo* delayed enhancement images were obtained with a spatial resolution roughly equivalent to three cardiomyocytes. Gadolinium-DTPA accurately identified cardiac fibrosis following myocardial infarction. These data provide important validation of the delayed enhancement technique for detection of post myocardial infarction fibrosis at an unprecedented level of



detail.

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