High Field MR Imaging of Myocardial Viability: An intraindividual Comparison of MRI at 3.0T vs. 1.5T

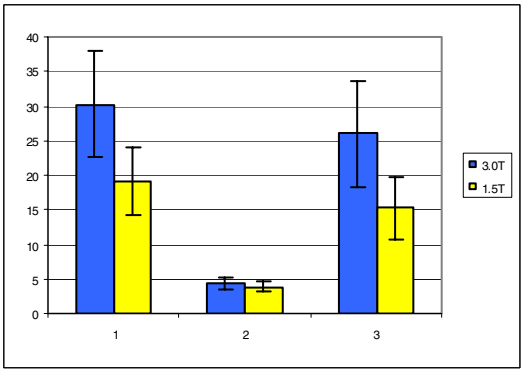
B. Klumpp[1], U. Kramer[1], T. Hoevelborn[2], A. May[2], M. Fenchel[1], K. P. Lodemann[3], N. I. Stauder[1], C. D. Claussen[1], S. Miller[1]

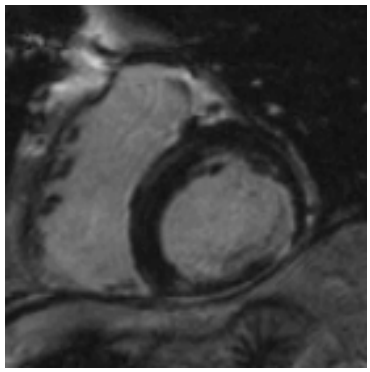
[1]Diagnostic Radiology, Eberhard-Karls-University of Tuebingen, Tuebingen, Baden-Wuerttemberg, Germany, [2]Cardiology, Eberhard-Karls-University of Tuebingen, Tuebingen, Baden-Wuerttemberg, Germany, [3]Bracco Altana, Konstanz, Baden-Wuerttemberg, Germany

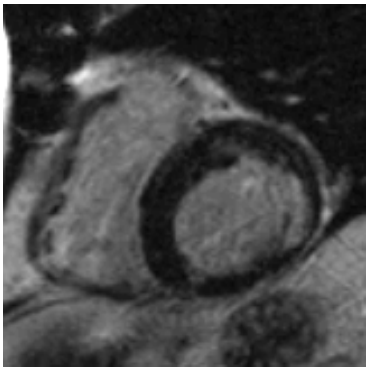
Background: Delayed enhancement magnetic resonance imaging (DE MRI) enables a reliable determination of myocardial viability (1) and therefore is increasingly used for the determination of myocardial viability before revascularization (2). Due to higher spatial resolution DE MRI has a higher sensitivity for non transmural myocardial infarctions in comparison to the traditional gold standard FDG-PET (3). DE MRI at 3.0T should be advantageous in comparison to 1.5T as higher field strength provides higher SNR and CNR (4). As longitudinal relaxation time is prolonged by higher field strengths, 3.0T is advantageous for tissue contrast in T1 weighted sequences. However higher field strength also causes additional problems including reduced field homogeneity and artefacts due to magnetic resonance effects. Moreover established sequence techniques at 1.5T cannot be implemented on 3.0T systems without prior modifications for physical and technical reasons. Aim of our study is to investigate feasibility and diagnostic potential of high field MR imaging of myocardial viability at 3.0T in comparison to 1.5T in an intraindividual approach.

Method and Materials: In our ongoing study 20 patients with proven chronic myocardial infarction were examined at 3.0T and at 1.5T within 3- 30 days (Magnetom Trio and Avanto, Siemens, Erlangen, Germany). Myocardial function is assessed by SSFP sequences. 15 minutes after injection of 0.1 mmol gadobenate dimeglumine / kg body weight (Multihance, Bracco-Altana, Konstanz, Germany) segmented inversion recovery prepared turbo FLASH sequences are acquired (3.0T/1.5T: TR=9.9/11 ms, TE=4.9/4.4 ms, flip=30°/30°, baseline matrix 256/256, slice thickness 6/6 mm, bandwidth 140/140 Hz/px). Data acquisition is synchronized with ECG in the enddiastolic phase to minimize motion artefacts. After a variable trigger delay dependent on the heart rate, a nonselective 180° pulse is applied. A variable inversion time (TI) determined by TI scout to null the signal intensity of viable myocardium after contrast administration is used to allow longitudinal relaxation. Subsequently a group of k-space lines is acquired (25 segments). Image quality is rated by two independent observers on a four point scale (score 0-3). Standardized measurements of signal intensity for calculation of SNR and CNR are performed in infracted and remote viable myocardium.

Results: Results of our first 11 patients reveal a significantly higher ranking of image quality at 3.0T (score 3.0T/1.5T=2.5±0.7/2.0±0.8, $p<0.05$, Fig 1a, 1b) with high image quality in all patients at both systems. Image quality at 3.0T was not corrupted by additional artefacts. SNR and CNR were also significantly higher at 3.0T (SNR 3.0T/1.5T=30.2±7.7/19.2±4.8, CNR 3.0T/1.5T=26±7.6/15.2±4.5, Tab. 1).







$SNR_{inf.}$	$SNR_{myo.}$	CNR

Fig. 1a

Fig. 1b

Tab. 1

Tab. 1 includes SNR in infarcted and remote viable myocardium and CNR at 3.0T and at 1.5T

Fig. 1 comprises two short axis views of a patient with myocardial infarction of the lateral wall with partially transmural extent at 3.0T (Fig. 1a) and 1.5T (Fig 1b). Exact delineation of the infarcted area is achieved at both systems with better tissue contrast between myocardial infarction and viable myocardium at 3.0T.

Conclusion: DE MRI using gadobenate dimeglumine at 3.0T is feasible and robust. 3.0T provides superior image quality and image contrast for DE MRI compared to 1.5T. Higher SNR may be used for higher spatial resolution enabling a more exact determination of the transmural extent of myocardial infarction when preparing for myocardial revascularization. Higher SNR may also be used for reduction of acquisition time by application of higher acceleration factors beneficial for patients with limited breath hold capability.

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