Myocardial Delayed Enhancement at 3T with the use of an Adiabatic IR Prep Pulse: A Comparison Study

R. Noeske[1], B. Spors[2], M. Gutberlet[2], T. K. Foo[3]

[1]GE Healthcare Technologies, Berlin, Germany, [2]Dep of Radiology and Nuclear Medicine, Charite Campus Virchow-Klinikum, Berlin, Germany, [3]Applied Science Laboratory, GE Healthcare Technologies, Baltimore, MA, United States

Synopsis

In this study an IR Prep FGRE sequence for Myocardium Delayed Enhancement was optimized at 3 Tesla by using an adiabatic inversion preparation pulse to overcome unavoidable patient dependent inhomogeneity of B1-field (i.e. flip angle) of transmit coil at 3 Tesla. 5 volunteers and 15 patients were examined at 3T with the standard and with an adiabatic inversion preparation pulse. Signal suppression of healthy myocardium in the whole heart and infarct size of patients were compared to 1.5T results.

Introduction

Myocardium Delayed Enhancement (MDE) is a established method for determination of myocardial viability. Measuring the effect of accumulated contrast agent a T1-weighted sequence is used. One common sequence is an Inversion Recovery Prepared Gated Fast Gradient Echo (IR Prep FGRE) sequence [1]. To achieve best contrast between hyper-intense areas of accumulated contrast agent (e.g. necrotic tissue) and healthy myocardium, TI time is optimized to suppress (null) signal from healthy myocardium. At high field strength RF field (B1-field) of both transmit and receive coils is dependent on sample, i.e. patient [2]. This may influence the ability to null signal from healthy myocardium in the whole heart, because TI time depends on T1 relaxation time of tissue and flip angle of preparation pulse (ideally a 180° inversion pulse).

Methods

5 healthy volunteer and 15 patient examinations were performed on a 3.0 Tesla Signa (GE Healthcare, Milwaukee, WI, USA) utilizing a 4-element Torso-Phased-Array receive coil. All patients were also examined on a 1.5 Tesla TwinSpeed Excite (GE Healthcare, Milwaukee, WI, USA). Imaging parameters for the 2D Delayed Enhancement sequence were: TE = 3.2 ms (MinFull), TR = (6.5 – 7.2) ms, flip angle 20°, receiver bandwidth ±31.25 kHz, FOV (32 – 40) cm, slice thickness 8 mm, data matrix 256 × 192, Phase FOV 1.0, views per segment 24, NEX 2. As preparation pulse the standard 5 ms Shinnar-Le Roux (SLR) and for a better insensitivity to B1-inhomogeneities a 8.6 ms adiabatic inversion pulse were used at 3T. TI time was optimized to null signal from healthy myocardium. Short (SA) and long axis (LA) slices were acquired.

Results

In 2 out of the 5 volunteers and 7 out of 15 patients the standard SLR pulse resulted in an inhomogeneous suppression of signal from healthy myocardium of left ventricle (LV) at 3T (see Figure). The use of an adiabatic inversion pulse resulted in a homogenous signal suppression in the whole LV. In patients the hyper-intense areas were in good agreement with results at 1.5T.

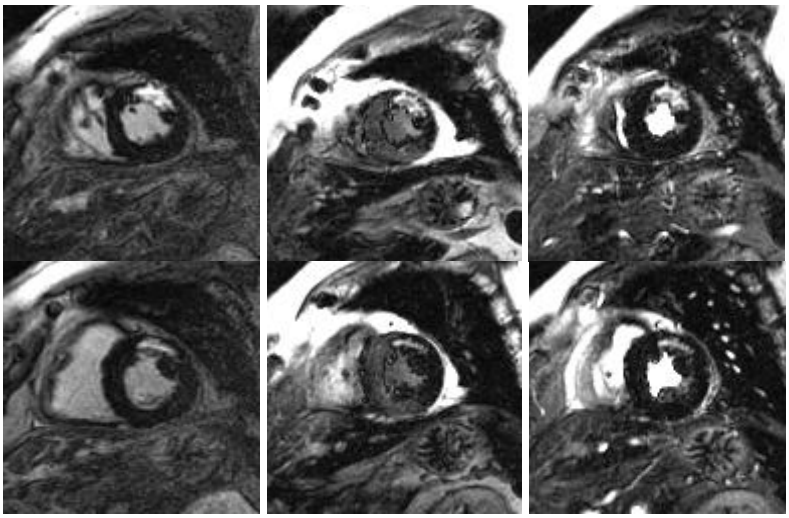

Figure: MDE images of a patient. Two SA slices acquired at 1.5T (left), 3T with standard SLR inversion pulse (middle) and adiabatic pulse (right). With standard IR pulse at 3T signal of healthy myocardium is suppressed in the lateral part but still there in the septum.

Discussion and Conclusion

The effect of inhomogeneous suppression of signal from healthy myocardium is caused by the higher B1-field inhomogeneity of transmit coil compared to 1.5T and was seen in approximately 50% of the volunteers and patients. The optimization of the IR Prep FGRE sequence for Myocardial Delayed Enhancement by using an adiabatic inversion preparation pulse overcomes this problem. Therefore the higher SNR of 3T compared to 1.5T can be well exploited for the determination of myocardial viability within a cardiac exam.

References

1. Kim, R.J., et al., *Circulation*, 100, 1999
2. Wen, H., et al., *J Magn Reson*, 65, 1997