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Poster presentation

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Black blood TPM imaging at 3 T: comparison of two SAR reducing black blood methods

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Introduction

For tissue phase mapping (TPM) the suppression of the blood pool is necessary to reduce flow related artifacts. Black blood contrast in CINE imaging can be obtained using spatial presaturation. At high field MR systems, however, spatial presaturation considerably increases the specific absorption rate (SAR). Due to SAR limitations the number of measured heart phases is limited, since idle times have to be introduced into the sequence.

Purpose

The aim of this study is to evaluate two different approaches for SAR reduced black-blood CINE imaging.

Methods

13 volunteers were enrolled in this study. Image acquisition was performed on a 3 T whole body MR scanner with 32 element receive coil. One mid-slice short-axis view was acquired. For respiratory motion compensation navigator-gating was performed. Black blood imaging was performed using two saturation slabs adjacent to the imaged slice. Tissue phase mapped images were acquired using a segmented gradient-echo phase contrast sequence. The acquisition parameter were: TE/TR = 5 ms/7 ms, flip angle = 30°, FOV = 340 × 340 mm^2, in-plane resolution: 2 × 2 mm^2, slice thickness = 8 mm, VENC = 30 cm/s, B1-amplitude = 8 μT. One sequence without further SAR reduction, one sequence with SAR reduction by reducing the flip-angle to 53° and one sequence with alternating presaturation pulses was applied (Schema in Figure 1). The 53° were chosen since this flip angle allows the same heart-phase number as the alternated application of saturation pulses approach. For the reduced SAR sequences the number of maximum heart phases is 21 for 60 bpm compared to 13 bpm for the sequence without SAR reduction. For comparison of the methods, the blood-myocardial contrast and the correlation coefficient between the obtained radial velocity curves were calculated.

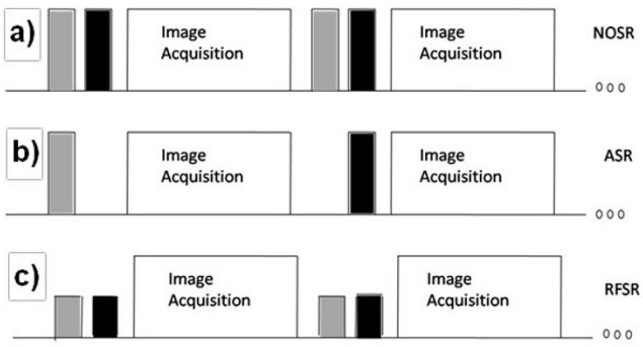

Figure 1
Schema of different sequences. a) Both presaturation pulses were applied; b) presaturation pulses were applied in alternated fashion; c) presaturation pulse flip angle was reduced to 53°.

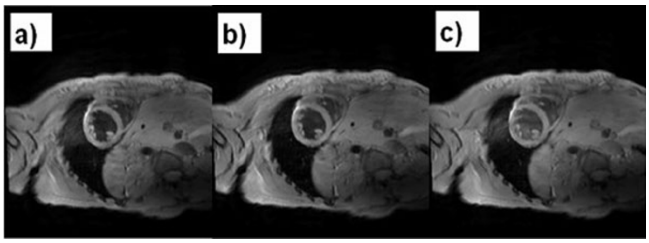

Figure 2
Black blood images acquired by a sequence with a) application of both presaturation pulses; b) application of alternating presaturation pulses; c) presaturation pulses with reduced flip angle.

Results

Figure 2 shows the black blood images obtained by the three different techniques. The contrast between myocardium and blood pool is 0.45 ± 0.04 for the sequence without SAR reduction, 0.42 ± 0.04 for the sequence with the alternating saturation pulses and 0.36 ± 0.04 for the sequence with reduced flip angle of presaturation pulses. The correlation coefficients between the sequence with alternating presaturation pulses or reduced presaturation flip angle and the sequence without SAR reduction was 0.96 ± 0.03 and 0.96 ± 0.02.

Conclusion

For black-blood suppression at high field strength combined with TPM the alternated application of presaturation pulses is preferred because a better contrast between myocardium and blood could be obtained. With both techniques a better temporal resolution could be obtained without motion information loss.