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Poster presentation

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A segmented T2-prepared SSFP sequence for T2-weighted imaging and T2-mapping of the myocardium

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Introduction

Recent studies demonstrate that hyperintense regions in T2-weighted images in acute myocardial infarction (AMI) reflect the presence of edema [1] and area at risk. Single-shot T2-prepared SSFP methods have been presented for T2-weighted imaging in AMI [2]. Here a segmented SSFP approach suitable for multi-slice, multi-echo imaging of the myocardium is presented.

Methods

Even with accelerated imaging methods the acquisition window for single-shot SSFP techniques can be long (>200-250 ms). A segmented SSFP method is proposed, allowing for shorter acquisition windows and a corresponding capability to acquire multiple slice locations per heart beat as illustrated in Fig 1. If the number of segments is limited, the entire acquisition can be repeated with different preparation durations (TE's) in a single breath-hold, enabling T2-mapping. Such a segmented approach presents a number of challenges:

To maximize T2 contrast while minimizing eddy current effects [3], an even-odd, centric phase encode ordering scheme was implemented.

To preserve the prepared T2 contrast across multiple slices an RF chopping scheme [4] consisting of two averages with an inversion pulse following the T2-preparation on even averages was implemented. This enables subtraction of contaminant signal that recovers with time constant T1.

To preserve in-slice signal integrity, in-slice signal is catalyzed prior to, and spoiled following, data acquisition to minimize cross-slice contamination.

Finally, fat saturation was integrated into the preparation interval [5] to reduce contributions of recovering fat signal.

T2 values are estimated using a 2-parameter exponential fit or a 3-parameter fit including baseline offset.

Results

Example images at different T2-preparation durations are illustrated in Figure 2. Example T2 maps across 3-slices acquired in a healthy volunteer in a 20 second breath hold are illustrated in Figure 3. The impact of the contrast maintenance scheme on T2 mapping data obtained in a gel phantom is illustrated in Figure 4. Use of a 3-parameter fit stabilizes T2 values across multiple slices but demonstrates sensitivity to noise, TE selection and the reduced degrees-of-freedom in the fit. RF chopping with a simple 2-parameter fit best estimated the true T2.

Discussion/cnclusion

A segmented, T2-prepared, multi-slice, multi-echo imaging sequence is presented that can be applied to edema identification in AMI patients.

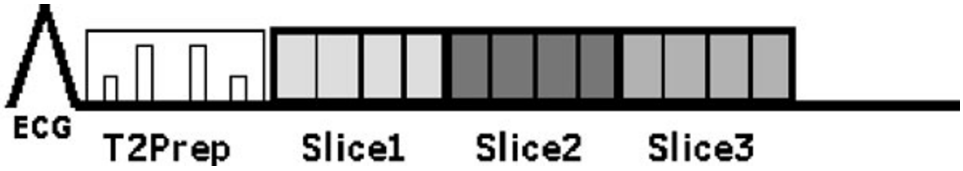

Figure 1
Sequence schematic. Following a T2 preparation, a multi-slice segmented acquisition is acquired.

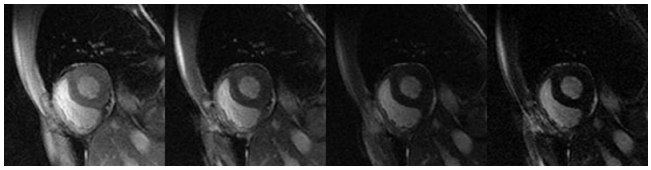

Figure 2
Images obtained as part of a multi-slice, multi-echo acquisition in a single breath hold. Images at a single slice at different T E times from left to right TE = 20, 40, 80, 120 ms

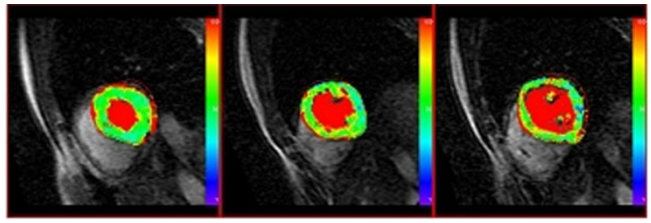

Figure 3
T2 maps from a healthy volunteer generated from a 4-echo, 3 slice acquisition acquired in a 16 heart-beat breath hold.

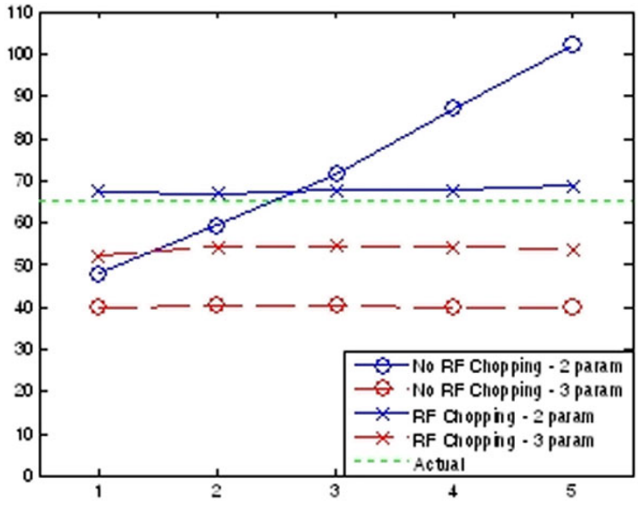

Figure 4
Quantitative T2 mapping results from a T2 phantom with actual T2 = 62 ms. Without RF chopping (o's0, recovering signal contaimates consecutive slice acquisition resulting in elevated T2 estimates. Estimating this recovery term via a T2-fit with baseline offset yields uniform, but erroneous values across slices. With RF chopping (x's) the T2-contrast is better preserved across slices and a simple 2-parameter fit yields the correct T2 values. A 3-parameter fit gives resonable estimates but suffers error from the reduced degrees-of-freedom in the fit, sub-optimal TE times to estimate the baseline and sensitivity to nois.

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