VIBE with Reversed Asymmetric Echo for Liver Imaging

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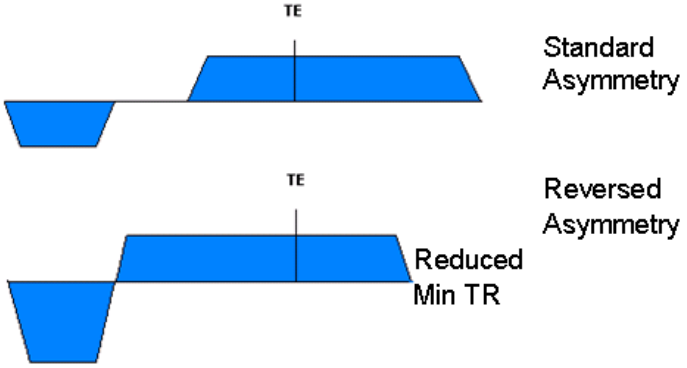
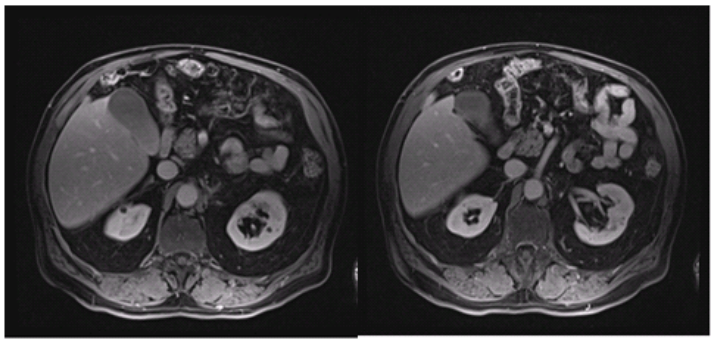
Introduction

Volumetric Interpolated Breath-hold Examination (VIBE) [1] is routinely used for dynamic contrast enhanced MR imaging of the body. Uniform fat suppression is desirable in that it increases the conspicuity of enhancement and thus improves lesion visibility. It has been shown that fat suppression in the body is optimized at opposed phase TE [2,3]. However, conventional acquisition at opposed phase TE requires a long TR and thus longer scan and breath-hold times. In this article, we develop a method of reversing the asymmetry in the readout direction such that opposed phase TE can be acquired in a shorter TR, while maintaining good fat suppression. This method significantly reduces scan times, improving the likelihood of successful breath-holding in the clinical environment.

Method

VIBE was acquired on a 1.5T MAGNETOM Espree (Siemens Healthcare USA, Malvern, PA) with Total Imaging Matrix six element body matrix coil and six to nine elements of the spine matrix coil. Acquisition parameters included 320 base resolution, TE = 2.4 ms, TR = 4.3 ms, FOV = 300-380 mm, phase FOV = 80-90%, partition thickness = 3-4 mm, slices per slab = 56-72, slice resolution = 64-67%, flip angle = 10^{o}, slice partial Fourier = 6/8, bandwidth = 360-390 Hz/pixel, and iPAT parallel imaging (GRAPPA) with acceleration factor = 2. Quick-Fatsat was used for fat suppression. Reversed asymmetric acquisition is described in Figure 1. Ten patients were scanned for the study.





1 2A 2B

Figure 1. Reversed asymmetric echo acquisition at opposed phase TE allows shorter TR than conventional opposed phase imaging.
Figure 2. VIBE images of the liver in the same patient acquired at conventional opposed phase TE and TR of 5 ms (A), and with reversed asymmetric echo and shortened TR of 4.5 ms (B) demonstrate maintained image quality and fat suppression.

Results and Discussion

The pulse sequence diagram of Figure 1 graphically demonstrates the shortening in TR gained by reversing echo asymmetry. For typical VIBE scans at 320 base resolution, scan time is reduced by 2-3 seconds compared with conventional imaging. Reversed asymmetric acquisition (Figure 2B) allows maintained image quality in comparison to the conventional method (Figure 2A), but with improved scan time (17 seconds for reversed echo asymmetry vs 19 seconds for standard asymmetry). This is a significant improvement in the clinical environment, where unsuccessful breath-holding results in motion artifacts that degrade image quality. Alternatively, these time savings can be converted into higher spatial resolution at equivalent scan times. In conclusion, reversed asymmetric echo acquisition at opposed phase TE maintains image quality and fat saturation while reducing scan times.

References

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