Utility of multiple-echo data image combination sequence for SPIO-enhanced T2*-weighted MR imaging of liver MRI at 3.0 T system

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Introduction

At 3.0 T MR system, superparamagnetic iron oxide (SPIO)-enhanced liver magnetic resonance imaging (MRI) may have the theoretical advantage of high SNR and high liver to lesion contrast, because of stronger susceptibility effect compared with that at 1.5 T. On T2*-weighted gradient recalled echo (GRE) sequences essential for SPIO-enhanced liver MRI, positive effects of 3T on lesion-to-liver CNR were offset by the substantially reduced image quality, secondary to motion and susceptibility artifacts. MEDIC (multiple-echo data image combination) sequence can provides a potential solution by using a series of GRE images at different echo times.

Purpose

We assessed the utility of T2*-weighted MEDIC sequence for SPIO-enhanced liver MRI at 3T system.

Materials and Methods

Fifty patients with 76 hepatic lesions (48 solid lesions, 26 non-solid lesions) underwent SPIO-enhanced MRI at 3T system using T2*-weighted fast imaging with steady precession (FISP) (TR/TE, 126/9; flip angle, 30°) and MEDIC (TR/TE, 186/9; flip angel, 30°) sequences. Three radiologists independently reviewed images in random order. Sensitivity and accuracy for the detection of focal hepatic lesions were compared by analyzing the area under the receiver operating characteristic curve. Image artifacts (flow artifact, susceptibility artifact, dielectric artifact, motion artifact), lesion conspicuity and overall image quality were evaluated according to a 4 point scale: 1, poor; 2. fair; 3, good; 4, excellent. Signal–to-noise ratio (SNR) and contrast-to-noise ratio (CNR) of the lesion were compared.

Results

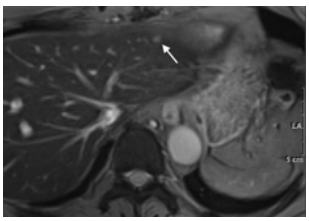
Image artifacts were more frequent on FISP ($p<0.05$). Mean scale of image artifacts were 2.76, 3.13, 3.42 and 2.89 for flow artifact, susceptibility artifact, dielectric artifact and motion artifact on FISP, 3.47, 3.43, 3.47 and 3.39 on MEDIC. There was no significant difference of lesion conspicuity between FISP (3.15) and MEDIC (3.30). Overall image quality was significantly ($p<0.05$) better on MEDIC (3.37)than on FISP (2.89). The mean SNR and CNR of the lesion were significantly ($p<0.05$) higher on MEDIC (79±23 and 128±59, respectively) than on FISP (38±11 and 102±44). Lesion detection accuracy and sensitivity were not significantly different between FSIP and MEDIC. Mean accuracies and sensitivities were 0.864 and 0.785 for FISP and 0.847 and 0.785 for MEDIC.

Conclusion

At 3T system, MEDIC sequence can be a useful alternative sequence to replace FISP sequence for SPIO-enhanced MRI by improving overall image quality and decreasing flow artifact and undesired susceptibility artifacts.

Figure 1.

A 53-year-old man with a hepatic cyst. Axial MR images with (A) SPIO-enhanced 3.0 T MEDIC (182/9, 30° flip angle) and (B) FISP sequences (126/9, 30° flip angle). A small cyst (7mm) is clearly seen on A, but not on B. Note the decreased level of artifact at liver parenchyma on A compared with that on B. This lesion was detected by only one observer on FISP, but was detected by all three observers on MEDIC.

A.  B.