

Respiratory triggered diffusion weighted MR imaging of the liver

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Purpose:

Diffusion weighted magnetic resonance imaging (DWI) of the liver can be used in the evaluation of focal and diffuse liver disease [1, 2]. One significant limitation is the image quality, as the sequences are susceptible to artefacts originating from respiration, making breath-hold imaging necessary. Multiple breath-holds are needed to acquire multiple b-values resulting in slightly different slice positions for each b-value, which has negative influence on the calculation of the apparent diffusion coefficient (ADC). Respiratory triggering has been shown to significantly increase image quality in abdominal imaging [3]. Therefore, aim of this study was to implement a respiratory triggered echo-planar-imaging (EPI) based DWI sequence and in a first step to evaluate image quality and contrast parameters of focal liver lesions in comparison to a T2-weighted turbo spin-echo (TSE) sequence.

Materials and Methods:

Prospective evaluation of 4 healthy volunteers and 8 consecutive patients (with a total of 16 liver lesions) who were referred for MR imaging of the liver. All scans were performed at 1.5 Tesla (Magnetom Avanto, Siemens Medical Solutions) applying the prospective acquisition correction (PACE) technique for respiratory triggering to the following two sequences: T2w TSE sequence with fat saturation (384 x 384 matrix, axial slice orientation, TR 1xrespiratory cycle, TE 80, 30 slices, 5 mm thick, 260-Hz/pixel bandwidth); diffusion weighted EPI sequence with b values of 50, 300 and 600 seconds / mm² (192 x 192 matrix, axial slice orientation, TR 1xrespiratory cycle, TE 69, 30 slices, 5 mm thick, 1730-Hz/pixel bandwidth). Integrated parallel imaging was applied to both sequences using the generalized autocalibrating partially parallel acquisition (GRAPPA) algorithm with an acceleration factor of 2 (24 reference lines). The liver-spleen and the liver-lesion contrast were determined in the quantitative evaluation. In the qualitative assessment, two readers rated the depiction of focal liver lesions, level of motion artefacts and overall image quality on a 5-point scale (highest level: 1; lowest level: 5).

Results:

The liver-spleen contrast evaluation for the TSE, the b50, b300 and b600 images was 0.34, 0.42, 0.44 and 0.42, respectively. The liver-lesion contrast for the TSE, the b50, b300 and b600 images was 0.42, 0.53, 0.42 and 0.26. The depiction of focal liver lesions (12 cysts, 3 hemangiomas, 1 focal nodular hyperplasia) was rated higher for b50 (1.0), on the same level for the b300 (2.75) and lower on the b600 (3.88) compared to the TSE (3.0). Motion artefacts were rated on the same level for both sequences and all b-values. Overall image quality was assessed with 1.67 (TSE), 2.17 (b50), 3.0 (b300) and 3.92 (b600).

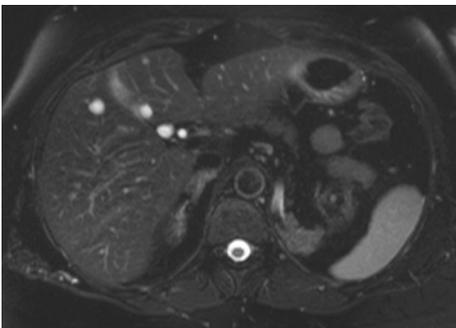


Figure 1

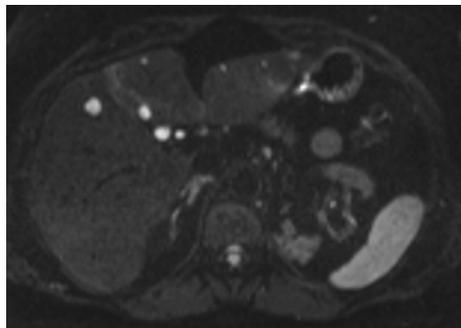


Figure 2

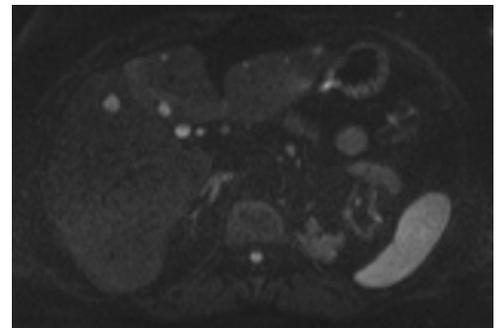


Figure 3

Figures 1-4: 42 year old male with multiple liver cysts. 1 respiratory triggered T2w TSE sequence. Respiratory triggered DWI with a b-value of 50 (2), 300 (3), and 600 (4) seconds / mm². The relatively high level of depiction of anatomic details and the liver lesions on DWI is remarkable.

Conclusions:

Respiratory triggered EPI based DWI with PACE is feasible since good image quality and good liver-lesion contrast can be achieved. A further evaluation with respect to detection and characterization of focal liver lesions is warranted. Even at higher b-values (300, 600) image quality is reasonable making DWI applicable to the evaluation of diffuse liver disease.

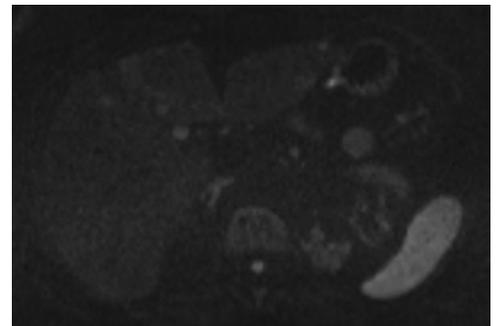


Figure 4

References:

- [1] Moteki T, Horikoshi H, Oya N, Aoki J, Endo K. Evaluation of hepatic lesions and hepatic parenchyma using diffusion-weighted recorded turboFLASH magnetic resonance imaging. *J Magn Reson Imaging* 2002; 15:564-572
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- [3] Klessen C, Asbach P, Kroencke TJ, et al. Magnetic resonance imaging of the upper abdomen using a free-breathing T2-weighted turbo spin echo sequence with navigator triggered prospective acquisition correction. *J Magn Reson Imaging* 2005, 21:576-582