Black-blood-EPI sequences with parallel imaging for detection of focal liver lesions - Comparison to a standard T2-weighted sequence

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Abstract

Rationale and Objectives:

Diffusion-weighted EPI-sequences for liver-MRI have been widely investigated for characterization of focal liver lesions with help of ADC-calculations [1]. However, their role as morphologic sequences for detection of lesions due to the black-blood-effect, the good lesion-to-liver contrast and the fast acquisition has not been elucidated properly. The aim of the present study is to evaluate the feasibility of a diffusion-weighted black-blood (BB)-EPI sequence with parallel imaging (iPAT) for detection of focal liver lesions in comparison to an un-enhanced standard T2-weighted sequence in patients with known or suspected liver lesions.

Methods:

20 patients with known or suspected focal liver lesions underwent a diffusion-weighted fat-saturated single-shot BB-EPI sequence with complete suppression of intrahepatic venous signal (TR 2200 ms, TE 50 ms, b-value = 50 s/mm², 2 averages, 18 seconds breath-hold, Matrix 192x162) and a standard fat-saturated T2-w sequence (TR = 2800; TE = 107, 1 average, 3 x 17 seconds breath-hold, Matrix 320x320) with 6mm slices thickness on a 1.5 T MRI-system (Magnetom Avanto, Siemens Medical Solutions). Both sequences used parallel imaging (iPAT) with an acceleration factor of 2. Overall image quality and degree of artifacts were compared with help of a five-point scale with 5 being the most desirable score. The detection rate and the level of confidence with regard to lesion detection were evaluated for both sequences in comparison to a contrast-enhanced (gadolinium and /or SPIO) MR examination, which was used as the standard-of-reference.

Results:

The diffusion-weighted BB-EPI sequence showed significantly ($p<0.05$) improved overall image quality and fewer artifacts in comparison to the T2-w sequence. Sensitivity for lesion detection was superior in the BB-EPI-sequence. The level of confidence for the detection of focal liver lesion was also superior for the BB-EPI sequence in comparison to the T2-w sequence. The results are summarized in table 1.
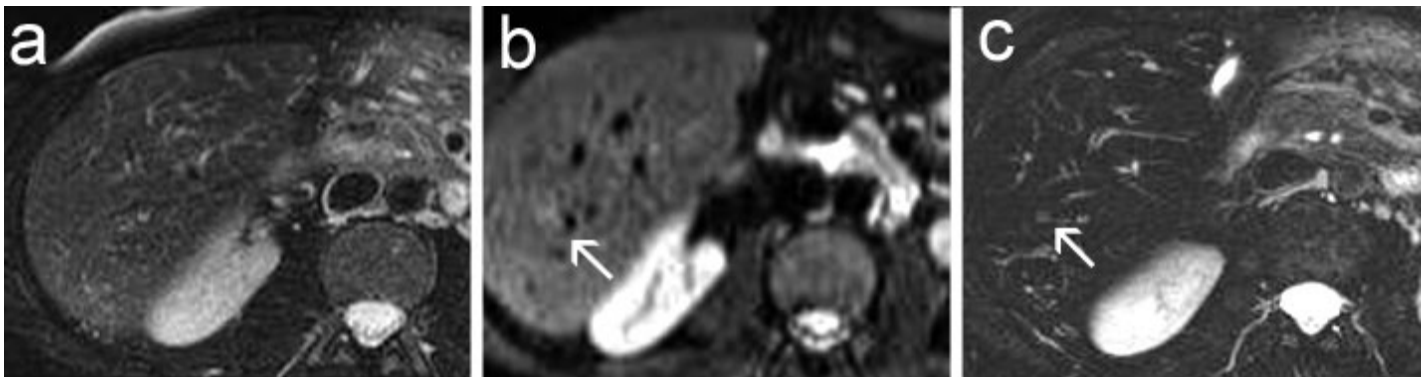
Figure 1: Unenhanced standard T2-w FSE (a) and diffusion-weighted BB-EPI sequence (b) in a female patient with breast cancer. The tiny metastasis in segment 8 (arrow) of the liver is only visible in the diffusion-weighted BB-EPI sequence as a bright spot. c shows the confirmation in the SPIO-enhanced T2-w FSE sequence, where the lesion can be appreciated due to the marked signal loss in the adjacent liver parenchyma.

Conclusion:

Diffusion-weighted BB-EPI sequences within a single breath-hold for liver-imaging are feasible with parallel imaging and show excellent image quality. They might contribute to easy and confident lesion detection in comparison to T2-w sequences. Especially the black-blood effect with dark signal in the vessels helps to distinguish small lesions in the periphery from tiny lesions; however, the number of false positive findings is slightly increased, so that detected lesions should be verified in the contrast-enhanced sequences.

Table 1	Image quality	Respiratory artifacts	Detected lesions	Level of confidence	True-positives	False-positives	Sensitivity
BB-EPI	4,10	4,15	39	3,9	34	5	83%
Standard-T2-w	3,50	3,30	27	3,2	25	2	61%

Literature:

1. Ichikawa T et al., 1998. Diffusion-weighted MR imaging with a single-shot echoplanar sequence: detection and characterization of focal hepatic lesions AJR 170(2):397-402.