Low b-value diffusion-weighted imaging and echo planar T2-weighted imaging in assessment of hepatic metastases from neuroendocrine tumors

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Purpose

Low b-value diffusion-weighted imaging has recently emerged as an interesting alternative to standard fast spin echo sequences in assessment of the liver, with some authors demonstrating improved conspicuity of lesions and increased sensitivity for detection of hepatic metastases. The reasons for this are not entirely clear: one possibility is that much of the difference could be explained by the use of an echo planar T2 sequence with less magnetization transfer effects, and that T2 shine-through in diffusion-weighted images is responsible for the sensitivity improvement rather than the addition of slight diffusion weighting. We investigated this possibility by comparing lesion-liver contrast to noise ratios on low b-value diffusion- weighted images (b=100) and b = 0, T2-weighted images in 17 patients with neuroendocrine tumor metastases.

Methods

27 lesions in 17 patients with liver metastases from neuroendocrine tumors were evaluated using DWI and spin echo-echo planar pulse sequences (SE-EPI) with the following parameters: TR 2500 ms, TE 82 ms, 250 kHz receiver bandwidth, 7 mm slice thickness, gap of 1 mm, 160x256 imaging matrix, 2 excitations, parallel imaging (ASSET) with acceleration factor of 2, and b-value 100 s/mm^2 for DWI and a b-value of 0 for T2 weighted EPI. SNR and CNR measurements were obtained by drawing region of interest over lesions, adjacent normal liver tissue, and background noise (Fig. 1). CNR was obtained by dividing the difference in lesion and liver signal intensity by the standard deviation of the background noise. SNR was obtained by dividing lesion or liver signal intensity by the standard deviation of background noise.

Results

Average values for lesion-liver CNR, lesions SNR, and liver SNR are listed below. All differences between DWI and SE-EPI values were significant using a paired t test ($p < 0.001$). On average, DWI images had a 45% improvement in lesion-liver CNR in comparison to SE-EPI images.

	Average lesion-liver CNR	Average lesion SNR	Average liver SNR
DWI	26.2 $\pm$ 15	37.4 $\pm$ 42	11.2 $\pm$ 8
SE-EPI	19.8 $\pm$ 15	28.5 $\pm$ 23	8.8 $\pm$ 7

Discussion

Results indicate that the addition of low b value diffusion weighting improves lesion-liver CNR in comparison to b=0 T2-weighted EPI in this group of patients with neuroendocrine metastases. Interestingly, SNR values also improved for both lesion and liver with the addition of diffusion weighting. These results suggest that diffusion weighting offers additional benefit beyond the performance of an echo planar T2-weighted sequence. Echo planar low b-value diffusion weighted sequences remain limited by significant susceptibility artifact near the diaphragm and adjacent to gas-filled bowel loops, and by low SNR relative to multiple excitation FSE sequences.

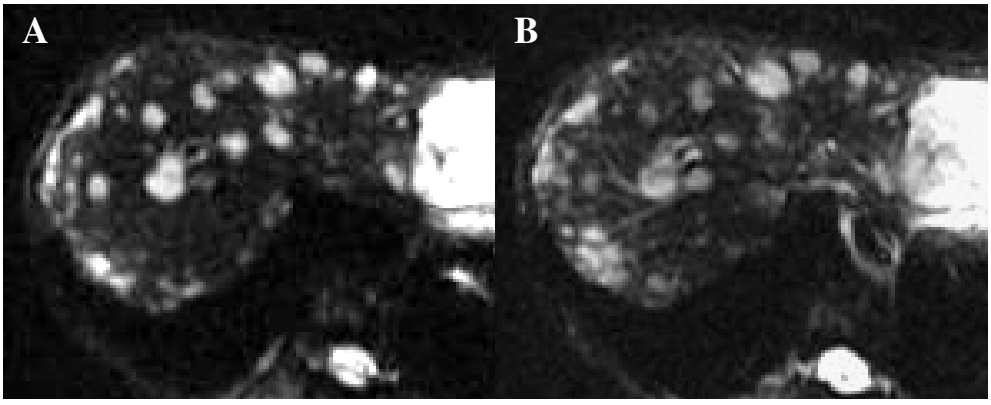

Fig. 1. Low b-value diffusion weighted (A) and spin echo EPI images (B) in patient with neuroendocrine metastases. Representative lesions were selected for CNR measurements, and adjacent normal liver was selected for determination of CNR and SNR values.