

SPIO administration may increase the conspicuity of malignant liver nodules on Diffusion weighted imaging

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Purpose – To compare the lesion-to-liver signal intensity ratio on diffusion weighted (DW) images acquired before and after administration of ferumoxides (SPIO).

Introduction – DW images in the liver are usually obtained with intermediate to long TR and intermediate to long TE and therefore have T2 as well as diffusion weighting. DW imaging is considered one of the most sensitive techniques for detection of small (<=5mm) malignant nodules in the liver. However, some malignant liver nodules may have similar apparent diffusion coefficient (ADC) and T2 relaxation as liver and so may be difficult to detect on DW images (1). At last year's ISMRM we showed that SPIO administration increases the observed ADC of liver parenchyma, possibly because SPIO-induced susceptibility accentuates the effect of diffusion gradients in causing hepatic parenchymal signal loss (2). SPIO also preferentially reduces the T2 of liver parenchyma. We hypothesized that administration of SPIO would increase the lesion to liver signal intensity on DW images by preferentially decreasing the T2 of liver relative to the malignant nodules and also by preferentially increasing the ADC of the liver.

Materials and Methods - This investigation was a retrospective, HIPAA compliant, single center study, which was approved by the local IRB. Eleven patients (6 men, 5 women; mean age, 53 years; range, 35–72 years) with clinically proven focal malignant liver lesion were included. Subjects underwent transverse breath-hold single-shot echo-planar DW MR imaging before and after SPIO administration (ferumoxides, Feridex®; Advanced Magnetics, Cambridge MA, USA, for Berlex Laboratories). Subjects were scanned supine using an eight-element phased-array coil centered over the liver on a 3T GE Twin Speed (Milwaukee, WI) with 40 mT/m gradient strength. Fat-saturated DW images were acquired with b-values of 0 and 500 sec/mm²; TR/TE 3500/50 msec; 128x160 matrix; 300-480 mm field of view; 8-mm slice thickness without gaps; two signals averaged; and parallel imaging acceleration factor 2. A trained observer placed three co-localized oval regions of interest (ROIs) (100-300 mm²) within the nodule and adjacent liver, while excluding intrahepatic vessels and artifacts. The signal intensity and ADC of the focal lesion and adjacent liver were measured before and after administration of SPIO. The ADC in each ROI was calculated according to the following formula: $ADC = -(\ln S_{500} - \ln S_0) / 500$, where S_{500} and S_0 were the mean signal intensities on images acquired with b-values of 500 and 0 sec/mm², respectively. To objectively test the improved lesion conspicuity on post SPIO DW images, the ratios of the lesion signal intensity and liver signal intensity were computed. A non-parametric, Wilcoxon signed rank, test was used to compare the lesion-to-liver signal intensity ratios before and after SPIO administration.

Results – Figure 1 shows signal intensity of the lesion and liver at b=0 and b=500 before and after administration of SPIO. The signal intensity of the lesions and liver decrease after SPIO administration on DWI images with b=0. On DW images with b=500, the signal intensity of the lesions increase after SPIO administration while the signal intensity of the liver decreases. Figure 2 shows the lesion to liver ratio on DW images before and after SPIO administration. There is a trend toward increase in the lesion to liver ratio on DWI obtained after SPIO administration however it is not significant (p< 0.07). ADC values of liver before and after SPIO (1.63 vs. 1.61) did not change significantly. ADC values of lesion before and after SPIO (1.43 vs. 0.98) showed decrease in lesion ADC following SPIO administration. DW images before and after SPIO administration (Figure 3) shows a focal recurrence in a treated hepatocellular carcinoma; notice the increased conspicuity following administration of SPIO.

Conclusion – In this small pilot study we see a trend in support of our hypothesis that SPIO administration increases lesion to liver signal intensity. However larger studies are needed to confirm this trend.

References

1. Bruegel M. Eur radiol 2008;18:477-485.
2. Shiehorteza M. ISMRM 2008

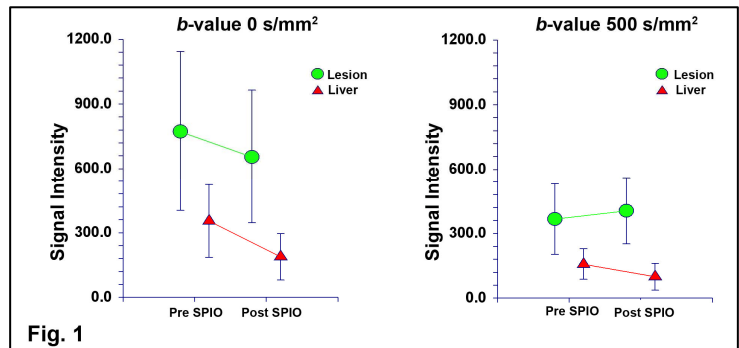


Fig. 1

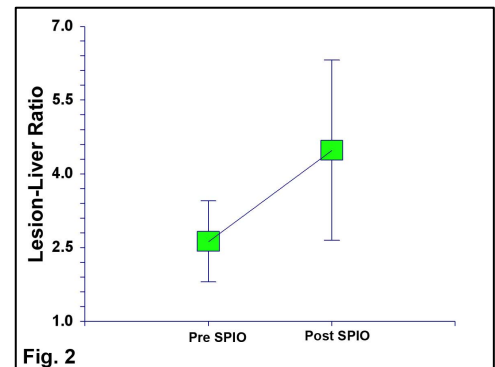


Fig. 2

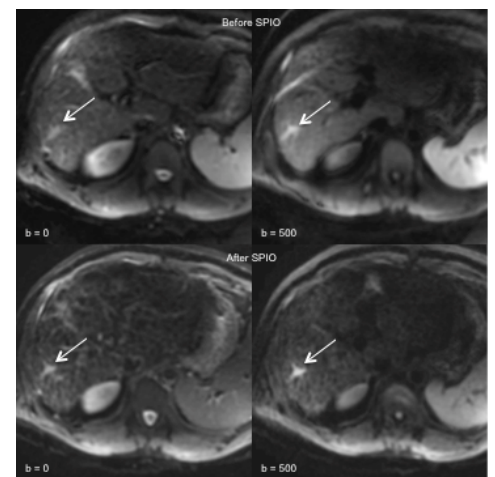


Fig. 3