Characterization of focal liver lesions using ferucarbotran-enhanced liver MRI: efficacy of percentage signal intensity loss for detecting nodules within diffuse liver disease

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Introduction: Early detection of HCC is important in improving patient outcome and decision making in therapeutic strategies. Many authors reported superparamagnetic iron oxide (SPIO) enhanced magnetic resonance imaging (MRI) is effective for the differentiation of benign and malignant hepatic lesions and the percentage of signal intensity loss (PSIL) might reflect Kupffer-cell numbers in tumors. A newly developed SPIO, ferucarbotran is primarily taken up by the Kupffer cells of the liver. The purpose of our study was to determine the optimal threshold value of PSIL for the characterization of focal liver lesions among patients with diffuse liver disease.

Materials and Methods: Fifty patients with diffuse liver disease and a suspicious hepatic tumor on abdominal ultrasonography were included into our study. Among them, 30 patients were HBV positive, 16 patients were HCV positive, one patient was positive for HBV and HCV, and 3 patients had alcohol related liver disease; in total, 40 of the 50 patients had liver cirrhosis. Eventually, eight hemangiomas, three FNHs, ten dysplastic nodules, 12 wHCCs and 23 overt HCCs were included in our study. The PSIL of each lesion type was calculated using T2WI and FS-T2WI and the diagnostic performance of both imaging sequences was compared by ROC analysis.

Results: The PSILs of the benign lesions were statistically significantly higher than those of lesions from patients with overt HCC (p<0.05); however, there was no obvious significant difference between the benign lesions and lesions from patients with wHCCs (p>0.05) (Table 1; Fig. 1). Using ROC analysis, the area under the ROC curve was 0.694±0.08 for T2WI and 0.793±0.06 for FS-T2WI (Table 2.). The optimal threshold values were 35% for FS-T2WI and 45% for T2WI. The diagnostic performance of the FS-T2WI approach was superior to that of T2WI and FS-T2WI was chosen as the approach for lesion characterization in our study. With the PSIL threshold set at 35%, the sensitivity and specificity for HCC detection were 74.3% and 76.2%, respectively.

Discussion: Signal intensity changes in SPIO-enhanced MR imaging reflects Kupffer-cell numbers in HCCs and dysplastic nodules, and is useful for estimation of histological grading in HCCs. The presence of Kupffer cells in HCCs, especially in wHCC, may confuse with benign nodules in SPIO-enhanced MRI. We found overlapping PSILs in the benign lesions and wHCC (Fig. 1.). Used a threshold PSIL of 35%, the sensitivity was 87% for overt HCC, but only 50% for wHCC. According to our results, using the PSIL threshold was helpful in characterization of overt HCC for patients with diffuse liver disease. However, the PSIL of a few overt HCCs and half of wHCCs might be greater than 35% should be kept in mind.

We evaluated the efficacy of T2WI and FS-T2WI in ferucarbotran-enhanced liver MRI by ROC analysis. In our study, the diagnosis performance of the FS-T2WI was superior to the T2WI. We suggest that FS-T2W sequences should be used for calculation of lesion PSIL and characterization of focal liver lesions in ferucarbotran-enhanced MR study.

In conclusion, with ferucarbotran-enhanced FS-T2WI, a PSIL threshold of 35% for differentiation between HCC and benign hepatic nodules is recommended. This approach is useful for the characterization of overt HCC in patients with diffuse liver disease.

Table 1. Number and size, signal-to-noise ratio (SNR) on pre-/post-contrast FS-T2WI and PSIL of each type of tumors were shown. The values were depicted as mean±SD.

Diagnosis	Tumor Number	Size (cm)	SNR_{lesion}		SNR_{liver}		$PSIL_{lesion}$ (%)
			Precontrast	Postcontrast	Precontrast	Postcontrast	
Hemangioma	8	2.6±1.8	85.9±31.1	*42.0±13.3	22.8±6.3	*8.7±2.1	49.5±13.6
FNH+DN	13	2.0±0.9	31.3±15.8	*17.7±12.8	24.3±9.3	*10.3±3.8	46.1±22.1
wHCC	12	1.8±0.6	23.9±9.2	*15.9±9.8	18.7±5.1	*7.8±3.6	33.3±30.5
Overt HCC	23	2.6±1.3	37.7±17.6	**34.3±15.5	23.8±9.5	*10.9±5.2	3.5±32.7

SNR_{lesion}= SNR of lesions, SNR_{liver}=SNR of adjacent liver parenchyma
Difference between precontrast and postcontrast imaging:*p<0.05, **p>0.05

Table 2. Area under the curve (AUC) values for FS-T2WI and T2WI

	AUC value	Optimal PSIL threshold (%)	Sensitivity (%)	Specificity (%)
FS-T2WI	0.793±0.06	35	74.3	76.2
T2WI	0.694±0.08	45	77.1	66.7

T2WI, T2-weighted image; FS-T2WI, fat saturation T2-weighted imaging
PSIL, percent of signal intensity loss

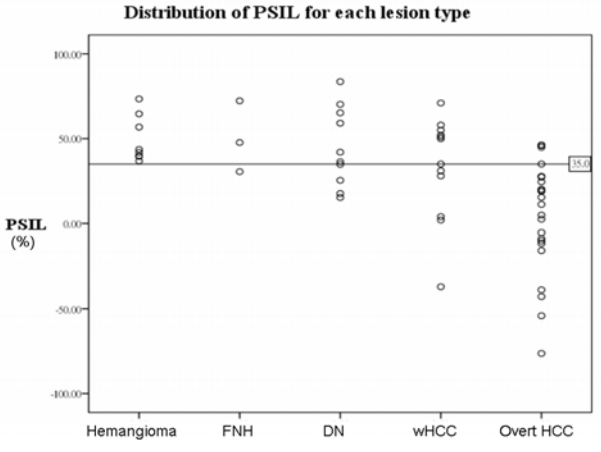

Figure 1. The distribution of PSIL for each lesion type with a reference line (35%) was shown. Overlapping PSIL between the benign lesions and wHCC was depicted and no statistical significance was found (p>0.05). In contrast, there was statistical significance between overt HCC and benign nodules (p<0.05)