Use of iron sensitive T2* MR imaging as a novel method to diagnose hepatocellular carcinoma
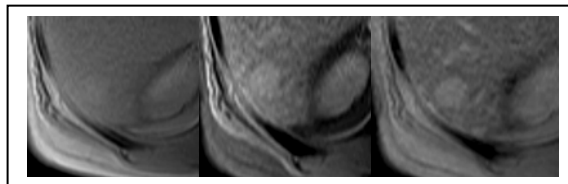
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Introduction: Gadolinium enhanced MRI is highly accurate in the identification of hepatocellular carcinoma (HCC) (1,2). However, patients with reduced renal function are at risk for developing Nephrogenic Systemic Fibrosis (NSF) following gadolinium contrast administration (3). Patients with poor renal function are also at risk for acute renal failure from iodinated contrast used in CT (4), therefore, an MRI technique which does not require gadolinium would be a preferred imaging method. Hepatic iron deposition is increasingly being recognized as a common finding in cirrhosis (5,6) and MRI has the ability to detect iron (7,8). As HCC does not demonstrate the same degree of iron uptake as the liver (9), iron sensitive sequences should allow HCC to be differentiated from normal liver parenchyma. In this study, we evaluated a novel method for identifying HCC with an iron sensitive breath-hold multi-echo gradient echo sequence using gadolinium enhanced images as the reference standard.

Methods: 32 consecutive patients for liver MRI (17 male, 15 female, mean age 59 years) were evaluated in this HIPPA compliant retrospective study with all studies performed at 1.5T (Avanto, Siemens Medical Solutions). The MR protocol utilized breath-hold axial imaging including T1, T2 FS, an iron sensitive multi-echo GRE sequence (T2*), and multi-phase gadolinium enhanced imaging (CE). All images including the T2* sequence (TR 169, TE 4.8-28.7 (5 echoes), slice thickness 10mm, FOV 380 x 400, 15 slices, acquisition time 44 seconds) were viewed on our institutional PACS system. A non-contrast dataset including the T1, T2 FS, and T2* sequences was presented to a single, blinded observer for analysis. All liver lesions were recorded and also characterized as benign or malignant. 2 weeks later, the same observer viewed a contrast-enhanced dataset (T1, T2 FS, CE) and again assessed all liver lesions.

2 cm HCC in the posterior right lobe. The lesion becomes increasing apparent on progressively longer TE (left to right)

Results: Of the 32 consecutive patients, there were 9 HCC in 6 patients, 10 benign lesions (3 hemangiomas, 7 cysts), and 19 patients with no liver lesions. Average HCC size was 2.8 cm (range 2.0-4.3 cm). Detection rate of the 19 liver lesions was 74%. On a per patient basis, the technique demonstrated 100% sensitivity for HCC, although there was 78% sensitivity on a per lesion basis. The results are summarized in Table 1. There was a significant difference in the mean T2* value of HCC and benign hepatic lesions (HCC = 33.5, benign lesions (cysts and hemangiomas) 53.1, p = .015).

Conclusion: An iron sensitive sequence such as a multi-echo GRE sequence (T2*) may have utility as a non-contrast MR sequence for the identification of HCC in patients with cirrhosis. Additionally, it may be a novel method to identify HCC in patients who are contraindicated for gadolinium.

Table 1: Performance of non-contrast dataset for HCC

N = 32	Sens.	Spec.	PPV	NPV	Accuracy
Identification of HCC (per patient)	100%	96%	86%	100%	97%
Identification of HCC (per lesion)	78%	88%	88%	78%	82%

Discussion: At the current time, liver MR is nearly universally performed with gadolinium contrast as there are no non-contrast MR sequences that have equal diagnostic accuracy for HCC. In this study, a non-contrast MR protocol including a multi-echo GRE sequence (T2*) was able to demonstrate a good overall accuracy for HCC compared with contrast enhanced MR. Use of this sequence in routine protocols may improve the overall performance of liver MR and it may be an appropriate surrogate for contrast enhanced sequences in patients contraindicated for gadolinium.

References:
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