Characterization of cirrhotic nodules with gadoxetic acid-enhanced MR imaging: the efficacy of hepatocyte-phase imaging

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Purpose:

Nodular lesions against a background of cirrhosis are diagnostically challenging in daily practice. Dynamic imaging represents an obligatory tool for characterization of focal liver lesions. Gadoxetic acid is a more recently developed liver-specific MR imaging contrast medium with combined perfusion and hepatocytes-selective properties. The purpose of our study was to evaluate the efficacy of hepatocyte-phase in characterization of cirrhotic nodules with gadoxetic acid enhanced MRI.

Materials and Methods:

The study was approved by the institutional review board of our hospital. 38 patients with liver cirrhosis and histologically proven lesion were prospectively enrolled in this study. A total of 66 nodules within the 38 patients were found. The evaluation of standard of reference revealed 15 dysplastic nodules, 7 well-differentiated HCCs, 44 moderately differentiated HCCs. MR imaging was performed with a 1.5-T MR scanner and all patients received a 0.025 mmol/kg dose of gadoxetic acid. Two image sets (set A and set B) were prepared in which set B consisted of all of the images of set A plus a contrast-enhanced hepatocyte-phase FS-T1WI. Characterization of nodules based on the following criteria. A tumor presenting with the following characteristics was considered as HCC: first, arterial enhancement followed with washout on the dynamic MR images; second, hyperintense on T2WI/FS-T2WI; third, hypointense on 20 min delayed hepatocyte-phase FS-T1WI. Qualitative analysis of the lesions was compared with the adjacent liver parenchyma was performed. Quantitative analysis of the tumors on the dynamic study and the hepatocyte-phase were recorded. Statistical differences for both imaging sets were compared by the McNemar test. A paired t-test was used to confirm the difference in the SNR/CNR for the precontrast/postcontrast imaging. A Kappa statistic was used to evaluate the interobserver difference.

Results:

An excellent agreement of inter-observer agreement between the two reviewers was noted in the imaging set A (k=0.83) and the set B (k=0.90). The imaging features of the 66 tumors are shown in Table 1 and enhancing pattern is shown in Table 2.The SNR/CNR of each lesion type is shown in Fig, 1. There were 12 (12/44) mHCCs and 6 (6/7) wHCC showed atypical HCC enhancing profile in dynamic study. There were only 4 mHCC showed heterogeneous and one wHCC showed homogeneous enhancement in hepatocyte-phase imaging. There were 7 additional HCC diagnosed by the imaging set B compared to the imaging set A (Fig. 2). All the 15 benign nodules were considered to be benign cirrhotic nodules by the both imaging set A and set B. The diagnostic performance of the imaging set B is significantly higher than the imaging set A in characterization of focal liver lesion among cirrhotic liver (P=0.016). In compared with the adjacent liver parenchyma, the mean SNRs/CNRs of mHCC were significantly increased in arterial phase and significantly decreased in portal, venous and hepatocyte phases (P<0.05). The mean SNRs/CNRs of wHCC were significantly decreased in hepatocyte phase (P<0.05), but no significant difference in the other phases (P>0.05). The mean SNRs/CNRs of DN showed no significant difference in dynamic study and hepatocyte-phase (P>0.05).

Table 1. Tumor Size, numbers, relative signal intensity in precontrast T1W and T2W images of the 66 nodules

Pathologic findings	Tumor No.	Size (cm)	T1WI			T2WI		
			Iso	Hyper	Hypo	Iso	Hypo	Hyper
mHCC	44	3.4± 2.1	4	10	30	2	5	37
wHCC	7	2.2± 0.9	3	4	0	1	6	0
DN	15	1.6± 0.3	7	8	0	9	6	0

T1WI, T1-weighted imaging; T2WI, T2-weighted imaging; HCC, hepatocellular carcinoma; mHCC, moderately differentiated HCC, wHCC, well differentied HCC, DN, dysplastic nodule; Iso, isointense; Hyper, hyperintense; Hypo, hypointense.

Table 2. Enhancement patterns on Premovist-enhanced dynamic studies and delayed hepatocystic phase of the 66 nodules

Pathologic findings	Tumor No.	Dynamic study				Hepatocyte phase			
		Arterial phase		Washout					
		+	-	+	-	Iso	Hypo	Homo/ Hyper	Hetero/ Hyper
mHCC	44	40	4	32	12	0	40	0	4
wHCC	7	2	5	1	6	0	6	1	0
DN	15	0	15	0	15	6	0	9	0

HCC, hepatocellular carcinoma; mHCC, moderately differentiated HCC, wHCC, well differentied HCC, DN, dysplastic nodule; Iso, isointense; Hyper, hyperintense; Hypo, hypointense; Homo, homogenous; Hetero, heterogenous.

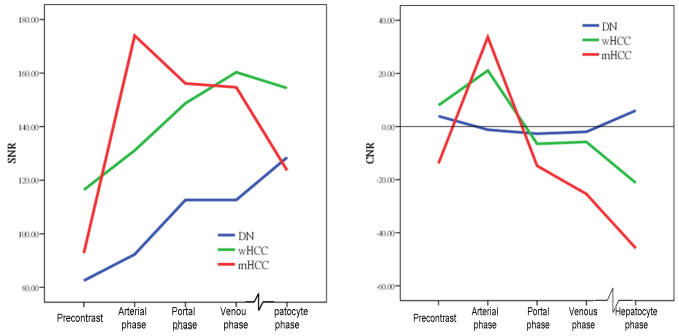

Fig1. a) The changes of SNR for each lesion type on the dynamic study and hepatocyte-phase imaging after administration of gadoxetic acid were presented. b) The change of the lesion-to-liver CNRs on the dynamic study and hepatocyte-phase imaging.

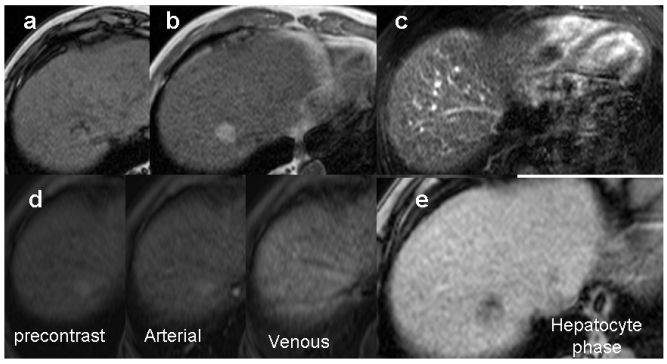

Fig2. A 58 y/o male with a well differentiated HCC at S8 underwent liver biopsy. a,b) Dual echo T1WI showed a nodule with fatty metamorphosis at S8 of liver. c) The lesion showed isointense on T2WI. d) The lesion showed no obvious enhancement in arterial phase or washout in venous phase. e) The lesion showed hypointense in hepatocyte-phase imaging.

Conclusion

Additional information for differential diagnosis is achieved using gadoxetic acid-enhanced hepatocyte-phase T1WI for characterization of malignant versus benign cirrhotic nodules. Combination of gadoxetic acid-enhanced dynamic study and hepatocyte-phase T1WI could provide better diagnostic performance than dynamic study only in characterization of focal liver lesion among cirrhotic liver.