The role of gadoxetic acid-enhanced MR imaging in characterizing atypical hepatocellular carcinoma in dynamic CT studies

Chen-Te Chou[1,2] and Ran-Chou Chen[3]

[1]Radiology, Chang-Hua Christain Hospital, Chang-Hua, Taiwan, Taiwan, [2]Biomedical Imaging and Radiological Science, National Yang-Ming Medical University, Taipei, Taiwan, Taiwan, [3]Biomedical Imaging and Radiological Science, National Yang-Ming Medical University, Taiwan, Taiwan

Purpose

The most recent recommendations by the American Association for the Study of Liver Diseases (AASLD) state that a diagnosis of HCC can be made if a mass larger than 1 cm shows typical features of HCC (hypervascularity in the arterial phase and washout in the venous/delayed phase) on CT or MR study. However, some HCCs, such as well-differentiated HCCs may present atypical features in dynamic studies. These atypical HCCs are diagnostically challenging in our daily practice.

Gadoxetic acid (Gd-EOB-DTPA) is a liver-specific MR imaging contrast medium with combined perfusion/hepatocyte-selective properties and has been demonstrated to increase the detection of focal liver lesions and to provide differential diagnostic information. To the best of our knowledge, the efficacy of gadoxetic acid in characterizing atypical HCCs has yet to be properly elucidated. The purpose of this study was to evaluate the efficacy of GD-EOB-DTPA-enhanced hepatocyte-phase imaging in characterizing HCCs with atypical enhancing pattern in CT dynamic studies.

Materials and Methods

This study was approved by the institutional review board of our hospital. The inclusion criteria for atypical HCC enhancing tumors were: a) tumor size ≥1.0 cm; b) tumors showed atypical enhancing HCC pattern in dynamic studies; c) only the largest three tumors were enrolled for study for patients with multiple nodules. 71 patients with 112 nodules were enrolled in this study. Clinical characteristics of the 71 patients are shown in Table 1. The evaluation of the 112 nodules with standard of reference revealed 33 DNs and 79 HCCs. All imaging results were independently analyzed using visual assessment by the two radiologists who were blinded to the clinical information and final diagnosis. Enhancing patterns in dynamic CT studies, tumor size, signal intensity on precontrast T1WI/T2WI, enhancement patterns among MR dynamic studies, and signal intensity on hepatocyte-phase imaging were determined.

Results

Excellent agreement of inter-observer agreement between the two reviewers was noted (Table 2). As shown in Table 3, tumor size, T2W hyperintensity, T1W hypointensity, atypical enhancing pattern in MR dynamic study and hypointensity on hepatocyte-phase image showed a significant difference between atypical HCCs and dysplastic nodules. The diagnostic performances of the MR characteristics were demonstrate in Table 4. Only one nodule showed a typical HCC enhancing profile in dynamic MR studies but hyperintensity in hepatocyte-phase imaging. The relationship between HCC histological grading and MR characteristics was shown in Table 5. Only 13 atypical enhancing HCCs in dynamic CT studies also showed atypical features in gadoxetic acid-enhanced hepatocyte-phase imaging.

Table 1. Clinical characteristics of the 71 patients with hepatic nodules which depicted atypical AASLD HCC enhancing patterns during dynamic CT study

	Total patient number (n=71)
Age (mean±SD)	59.5±9.3
Gender	
Male	53
Female	18
Underlying liver disease	
HBV	36
HCV	22
HBV+HCV	2
Alcoholic	2
Cryptogenic	9
Child-Pugh class	
A	63
B	6
C	2
Alpha-fetoprotein	
normal (< 20 ng/mL)	45
abnormal (≥ 20 ng/mL)	26

SD=standard deviation; HBV=hepatitis B virus; HVC=hepatitis C virus; HCC=hepatocellular carcinoma; AASLD= American Association for the Study of Liver Diseases

Table 3. MR characteristics of the 112 nodules showing atypical AASLD HCC enhancing pattern during CT dynamic study are shown.

MR imaging	HCC (n=79)	DN (n=33)	*P* value
Tumor size (cm)	2.1±0.9	1.5±0.4	<0.001
T2WI			
Hyper	48	4	<0.001
Iso/Hypo	31	29	
T1WI			0.012
Iso/Hyper	50	29	
Hypo	29	4	
Fatty metamorphosis			0.547
Yes	12	3	
No	67	30	
Typical HCC enhancing pattern on MRI			0.01
Yes	13	0	
No	66	33	
Hepatocyte phase			< 0.001
Hypo	66	5	
Hyper-/Iso	13	28	

T2WI=T2 weighted imaging; T1WI=T1 weighted imaging; HCC=hepatocellular carcinoma; DN=dysplastic nodule; Hyper=hyperintense; Iso=isointense; Hypo=hypointense; AASLD= American Association for the Study of Liver Diseases; Value was depicted as mean ± standard deviation

Table 2. The inter-observer difference for the study nodules on CT and MR imaging

	Kappa value
MR imaging	
T2WI	0.881±0.061
T1WI	0.821±0.046
Fatty metamorphosis	0.846±0.045
Typical HCC enhancing pattern on MRI (AASLD)	0.868±0.064
Hepatocyte phase	0.906±0.041
CT imaging	
Arterial enhancement	0.858±0.052
Washout	0.837±0.052

T2WI=T2 weighted imaging; T1WI=T1 weighted imaging; AASLD= American Association for the Study of Liver Diseases

Table 4. Diagnostic performance of the MR characteristics in differentiation of hepatocellular carcinoma (HCC) from dysplastic nodule is shown.

MR imaging	Sensitivity	specificity	PPV	NPV	Accuracy
Tumor size (threshold determined at 1.7cm)	59.5 %	84.9 %	89.8 %	44.4 %	67.0 %
Hyperintensity on T2WI	60.8 %	87.9 %	92.3 %	48.3 %	68.8 %
Hypointensity on T1WI	38.0 %	87.9 %	88.4 %	37.2 %	52.7 %
Typical HCC enhancing pattern on MRI	16.5 %	100 %	100 %	33.7 %	41.1 %
Hypointensity on hepatocyte-phase	83.5 %	84.9 %	93.0 %	68.3 %	83.9 %

T2WI = T2-weighted imaging; T1WI = T1-weighted imaging; PPV= Positive predictive value; NPV = Negative predictive value

Table 5. MR characteristics of the different histological grade HCCs which showed atypical AASLD enhancing pattern during dynamic CT study.

MR imaging	Histological grade of HCCs (n=79)		
	wHCC (n=28)	mHCC (n=38)	pHCC (n=13)
T2WI			
Hyper	8	27	13
Iso/Hypo	20	11	0
T1W			
Hyper/Iso	22	24	4
Hypo	6	14	9
Fatty metamorphosis			
Yes	10	2	1
No	18	36	12
Typical HCC enhancing pattern on MRI			
Yes	2	9	2
No	26	29	11
Hepatocyte phase			
Hypo	19	34	13
Iso/Hyper	9	4	0

T2WI = T2 weighted imaging; HCC = hepatocellular carcinoma; DN = dysplastic nodule; Hyper = hyperintense; Iso = isointense; Hypo = hypointense; AASLD = American Association for the Study of Liver Diseases; wHCC = well-differentiated HCC; mHCC = moderately-differentiated HCC; pHCC = poorly differentiated HCC.

Conclusion

Additional information for differential diagnosis and higher diagnostic performance were achieved using gadoxetic acid-enhanced hepatocyte-phase T1WI to characterize atypical HCCs from DNs. Use of a gadoxetic acid-enhanced MR study with hepatocyte-phase imaging instead of conventional gadolinium-enhanced MR study for high HCC risk patients with focal liver lesion showing atypical enhancing profile in a dynamic CT study is recommended.