Small Hypervascular Hepatocellular Carcinoma: Diagnostic Value of Portal and Equilibrium Phase on Dynamic MR Imaging in the Cirrhotic Liver

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Background

Most HCCs are hyperintense compared to the liver in the arterial phase, and hypointense in the portal-venous or equilibrium phases of dynamic magnetic resonance imaging (MRI). For small lesions, their hypervascularity appears rather homogeneous in the imaging studies. Meanwhile, pseudolesions including small non-tumorous arterioportal shunts, which are not infrequently demonstrated in the cirrhotic liver, also show a homogeneous arterial hypervascularity. Depending on the structural distortion consisted of fibrosis and regeneration of the advanced cirrhotic liver and the direction of the imaging plane, these hypervascular pseudolesions used to be a diagnostic challenge in the assessment of small HCCs. Meanwhile, the "washout" of contrast material on portal or equilibrium phase for the arterially hypervascular lesion looks specific for the diagnosis of HCC during the dynamic CT. In the daily practice, such hypoattenuation densities with or without peripherally enhancing pseudocapsule appearance are generally used to characterize the hypervascular HCCs distinguished from the rather isointense pseudolesions on portal or equilibrium phase images. Depending on the difference from CT using iodinated contrast agent, we assumed that the duration of hepatic arterial circulation for the smaller volume of concentrated contrast agent in MRI would affect the portal phase imaging feature, and the purely extracellular gadolinium contrast agent not absorbed in the hepatocytes might affect the equilibrium phase imaging appearance of the small hypervascular HCCs.

Purpose

To determine the value of portal and equilibrium phase imaging for differential diagnosis of hypervascular hepatocellular carcinomas (HCCs) from benign hypervascular lesions during IV contrast-enhanced dynamic MRI in the advanced cirrhotic liver.

Materials and Methods

MRI was performed with a 1.5-T unit (Vision; Siemens, Erlangen, Germany) with a phased-array multi-coil. T2-weighted images were obtained by multishot turbo spin-echo sequences (TR range/effective TE = 3540-4000/138, echo train length = 29) with chemically selective pre-pulse for fat-suppression. In all cases, a double-echo chemical shift gradient-echo technique (TR = 140 msec, TE = 2.7 msec for opposed-phase and 5.3 msec for in-phase with 90° flip angle; matrix, 128 x 256; field-of-view, 240 x 320 mm2) was performed before and after injection of 15 mL of gadopentetate dimeglumine (Magnevist; Schering, Berlin, Germany) with a 3 mL/sec injection speed through the antecubital vein followed by saline flush. An 8-10mm slice thickness with a 1.6-2 mm intersection gap was used for 15 axial sections during a 19-21 second acquisition time encompassing the entire liver during a single breath-holding period. Three-phase (arterial [AP], portal [PP], and 5-minute equilibrium phase [EP]) contrast-enhanced dynamic imaging was performed. The delay time for arterial and portal phase imaging was determined after the test-bolus examination and before dynamic imaging. A total of 143 small (> 5 mm and ≤ 20 mm) hypervascular lesions (HCCs, n=69; benign, n=74) in 53 cirrhotic patients, most of them had B-viral macronodular cirrhosis, were subjected for a retrospective analysis of their signal intensities (hypo-, iso-, hyperintense) on PP and EP phase images of three-phased dynamic MRI by two independent observers. The presence of perilesional rim enhancement reflecting pseudocapsule on PP or EP was also determined.

Results

The interobserver agreement was excellent in evaluating EP images ($\kappa = 0.833$), while it was good in PP images ($\kappa = 0.777$) and also good in determining the presence of pseudocapsule enhancement ($\kappa = 0.742$) between the two observers. The signal intensity on EP and the presence of pseudocapsule could significantly differentiate HCCs from benign conditions ($P < 0.001$), however, the differential value was limited in PP imaging ($P > 0.1$). For subcentimeter lesions, the sensitivity of PP, EP hypointensity, and pseudocapsule were lower than those of the larger lesions (11.3%, 29.0%, and 17.7% versus 26.3%, 55.3%, and 36.8%) (see chart). Among the positive predictive values (PPVs) of different imaging features and size ranges, the PPV of delayed phase hypointensity in the lesions ranged from 6 mm to 10 mm showed lowest value (60%) when all the other PPVs were larger than 77%. After exclusion of T2-weighted hyperintense lesions, which highly suggest HCCs only by precontrast imaging, over all sensitivity and positive predictability showed limited values for these three dynamic imaging features.

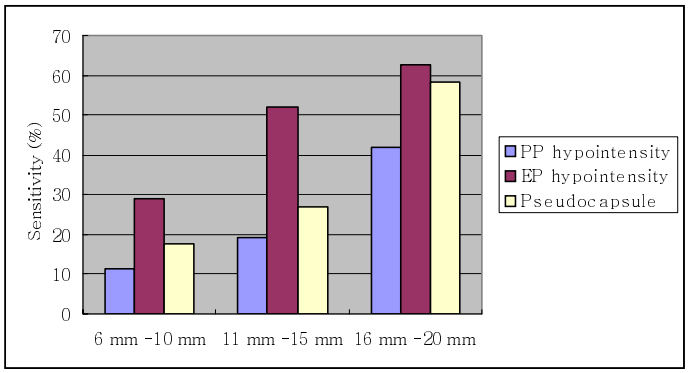

Table. Sensitivity, specificity, positive & negative predictive values for diagnosis of small hypervascular HCCs by three MRI features after exclusion of T2-weighted hyperintense lesions.

Parameter	Sensitivity	Specificity	PPV	NPV
Portal phase	8.3	96.9	55.6	69.6
hypointensity	(5/60)	(126/130)	(5/9)	(126/181)
Equilibrium phase	25.0	87.7	48.4	71.7
hypointensity	(15/60)	(114/130)	(15/31)	(114/159)
Pseudocapsule	8.3	97.7	62.5	69.8
	(5/60)	(127/130)	(5/8)	(127/182)

Data are percentage values and numbers in the parentheses are the number of summated small hypervascular lesions determined by two observers

Conclusion

In the characterization of smaller hypervascular lesions, the overall diagnostic performance of portal phase imaging was degraded comparing to the equilibrium phase imaging. In a practical manner, except the T2-weighted hyperintense lesions, the value of portal phase hypointensity or pseudocapsule appearance is very limited for diagnosis of small hypervascular HCCs in the advanced cirrhotic background of the liver.