Triple Arterial Phase Dynamic MR Imaging of the Whole Liver for Detection of Small Hypervascular Hepatocellular Carcinoma: Preliminary Study Using LAVA at 3-T

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Introduction: Recently, several investigators have assessed the usefulness of multiarterial phase dynamic MR imaging for detection of hypervascular hepatocellular carcinomas (HCCs) [1-3]. The purpose of this study was to explore the efficacy of triple arterial phase dynamic MR imaging of the whole liver to detect small hypervascular HCCs in patients with cirrhosis or chronic hepatitis using LAVA (Liver Acceleration Volume Acquisition) at 3-T.

Materials and Methods: Nine patients with 19 small hypervascular HCCs (less than 3 cm in diameter) were included in the study. Chronic hepatitis or cirrhosis was related to hepatitis B viral infection (n=7) and alcohol abuse (n=2). The diagnosis of HCC was made as follows: Two lesions in two patients were confirmed by operation. One lesion in one patient was confirmed by biopsy. Sixteen lesions in 6 patients were confirmed by at least two imaging modalities among CT during arterial portography (CTAP), CT during hepatic arteriography (CTHA), and iodized-oil CT after transcatheter arterial chemo-embolization. As part of multiphasic contrast-enhancement dynamic MR imaging, triple arterial phase imaging of the whole liver during a single breath-hold (about 28 sec) was performed on a 3-T unit with LAVA. The imaging parameters were as follows: axial; TR/TE, 3.5/1.5 ms; TI, 5.0 ms; flip angle, 15; matrix, 270 x 160; slice thickness, 4.4 mm. Array spatial sensitivity encoding technique (ASSET, the GE implementation of SENSE) was automatically employed, and the phase acceleration was 2.5 Ph. Zero fill Interpolation Processing (ZIP x 2) was used and thus a total of 80 sections covering the whole liver were acquired during 9 sec (one phase). After obtaining unenhanced images, multiphasic (triple arterial phase, triple portal phase and one equilibrium phase) contrast-enhancement dynamic MR imaging of the entire liver was performed (gadopentetate dimeglumine: 0.1mmol/kg, 3ml/sec), and fluorotrigger was used to start the scan. The signal intensity (SI) of the lesions and liver were measured on images of phase 1 to 4. The contrast ratio (CR, the ratio of SI of lesion/liver) was calculated. Friedman test was used to compare the CR of phase1 to 4 and 1 to 3.

Results: Optimal images of triple arterial phases were obtained in all patients (Fig. 1-3). Eight lesions have the highest CR on images of phase 1, eight lesions on phase 2 and three lesions on phase 3. The CR of phase1 to 4 was 1.27±0.49, 1.41±0.53, 1.13±0.37, and 0.96±0.28, respectively (Fig. 4). The CRs were significantly different among phase 1 to 4 ($p < .01$) and phase 1 to 3 ($p < .05$).

Discussion: Most small HCCs lack unique characteristics, and because of fibrotic or the various inflammatory changes in the cirrhotic liver, the detection of small HCCs is difficult. Our results suggested that small hypervascular HCCs have different type of enhancement pattern. Early enhancement and rapid central washout were the common findings even during the arterial dominant phase. With increased spatial and temporal resolution, triple arterial phase dynamic MR imaging using LAVA was expected to detect more small hypervascular HCCs compared with conventional single arterial phase dynamic MR imaging. It was suggested that hypervascular HCCs could be demonstrated on at least one of the three dynamic arterial phase images and may minimize the loss of patients' not holding breath.

Conclusion: The enhancement of the small hypervascular HCCs relative to the liver were different among the three dynamic arterial phase images. Therefore, triple arterial phase dynamic MR imaging using LAVA at 3-T is a promising method for improving the detection of the small hypervascular HCCs in patients with cirrhosis or chronic hepatitis.

References: [1] Yoshioka H, et al. JMRI 2002; 16: 259-266. [2] Ito K, et al. AJR 2004; 183: 699-705. [3] Mori K, et al. AJR 2005; 184: 63-69.

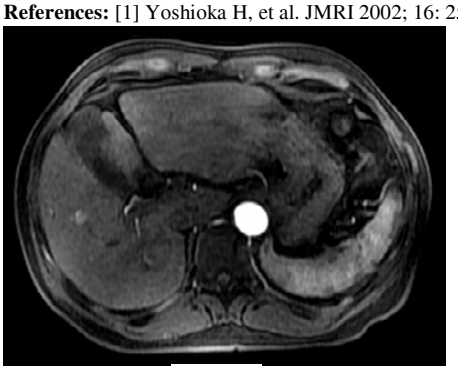

Fig. 1

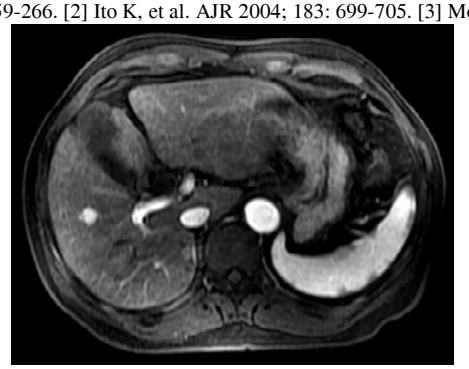

Fig. 2

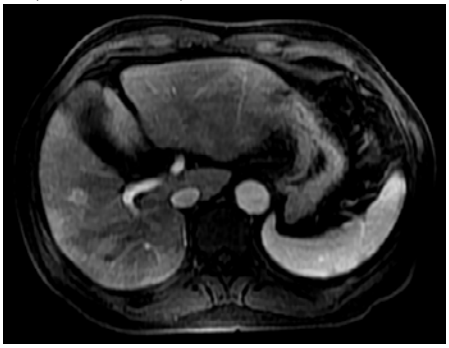

Fig. 3

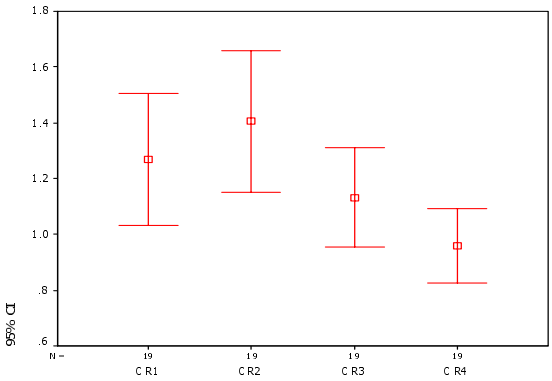

Fig. 4

Fig. 1 phase 1 (early triple arterial phase) image shows a lesion with slight enhancement.

Fig. 2 phase 2 (middle triple arterial phase) image shows the lesion was obvious with intense enhancement.

Fig. 3 phase 3 (late triple arterial phase) image shows central washout of the lesion.

Fig. 4 CR1-4 refers to the CR of phase1-4, respectively.