Time-resolved Three-dimensional Contrast-enhanced Dynamic MR Imaging of the Whole Liver with a Parallel Imaging Technique

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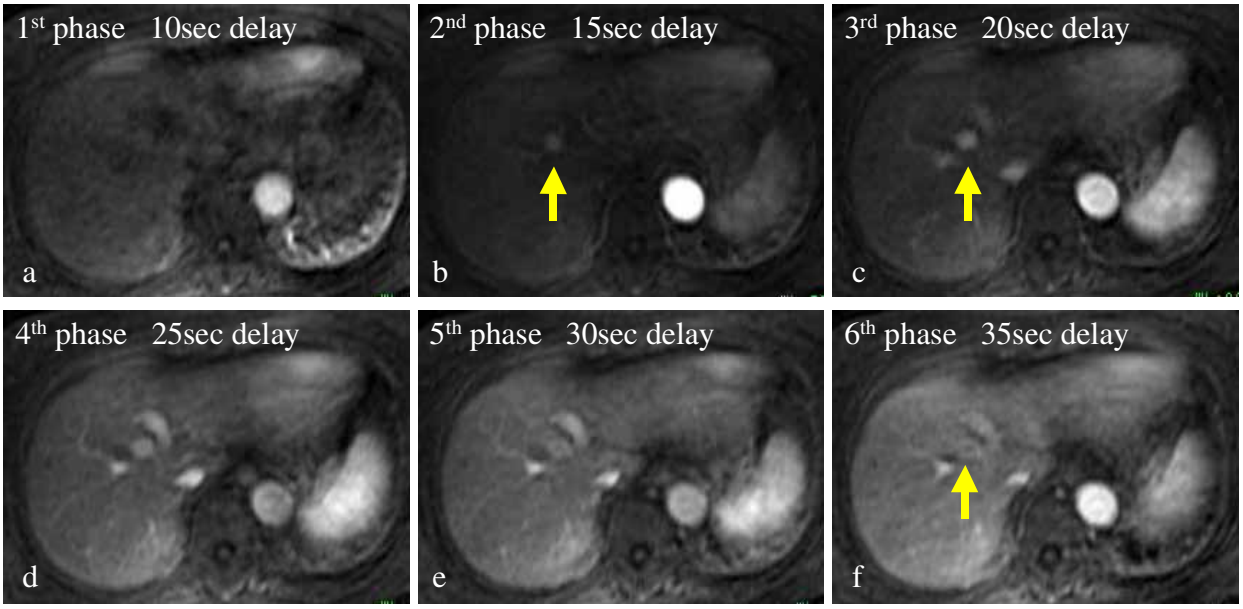
Purpose: The purpose of this study was to evaluate the clinical feasibility of time-resolved three-dimensional contrast-enhanced dynamic MR imaging of the whole liver with a parallel imaging technique during a single breath hold, and to assess the utility of continuous imaging from early-arterial through late-arterial phase and of subtraction imaging for detecting hypervascular hepatocellular carcinomas (HCCs).

Materials and Methods: The study population included 82 patients with cirrhosis or chronic hepatitis who had a total of 51 HCCs. All patients underwent time-resolved three-dimensional contrast-enhanced dynamic MR imaging of the whole liver with a parallel imaging technique using 3D enhanced fast spoiled gradient echo sequence with fat suppression (TR/TE/TI=3-4/1.1/15) during the single breath-hold as a part of routine liver MR studies. A total of 40 sections covering the whole liver were acquired during 5 seconds. Imaging was started 10 seconds after the start of bolus injection of contrast materials, and repeated 6 times during a single breath-hold of 30 seconds for continuous multiphasic imaging from early-arterial through late-arterial phase. Each patient received 0.2ml/kg of gadolinium-chelate with an injection rate of 3-4ml/sec.

Result: Each patient was successfully scanned in two consecutive breath-holds of 30 seconds, with a 15-second breathing pause between the breath-holds. This generated 12 phases with 480 images in 85 seconds from early-arterial phase through late-arterial phase and from early portal phase through late-portal phase. Enhancement of the aorta appeared at first (n=40), second (n=41), or third (n=1) phase (mean; 1.5 phase). Early arterial enhancement of HCCs was captured at second (n=31), third (n=14), or fourth (n=6) phase (mean; 2.5 phase). Lesion enhancement of HCC was declined by the seventh phase in all patients. Rapid central washout and perilesional corona enhancement were observed at the fourth-sixth phase in 51 HCCs. Homogeneous enhancement of the liver with enhancement of hepatic veins were present in the tenth phase in all patients.

Conclusion: Time-resolved three-dimensional contrast-enhanced dynamic MR imaging of the whole liver with a parallel imaging technique during a single breath hold allows the capture of the distinct arterial and portal phases, obviating the use of timing bolus or contrast detection methods for dynamic MR imaging. This technique also shows promise for elucidating and quantifying the arterial phase enhancement of hypervascular HCCs, and has a potential to evaluate transitional hemodynamics of hypervascular HCCs during the early-arterial through early-portal phase due to excellent temporal resolution.



Hypervascular HCC with Rapid Central Washout and Corona Enhancement.
(a)-(f) First to sixth phase images obtained with time-resolved three-dimensional contrast-enhanced dynamic MR imaging of the whole liver with a parallel imaging technique during a single breath hold. Enhancement of the aorta appeared at the first phase. Hypervascular HCC starts to show early enhancement in the second phase (arrow in b). The lesion is more clearly seen in the third phase (arrow in c), and then shows rapid central washout and peritumoral corona enhancement in the fifth and sixth phases (arrow in f).