Quintuple Arterial Phase Gd-EOB-DTPA enhanced dynamic MR imaging with Interleaved Stochastic Trajectories for hepatocellular carcinoma

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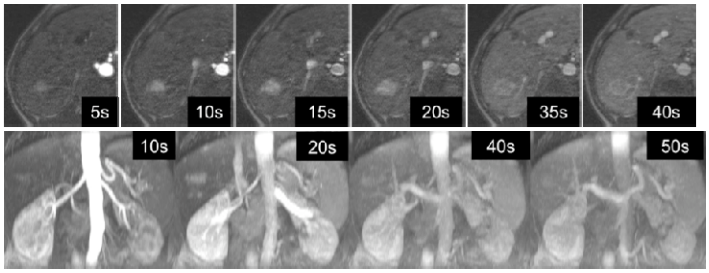
BACKGROUND AND PURPOSE: Gd-EOB-DTPA is a new hepatobiliary MRI contrast agent, detection and characterization of liver tumors. This compound is taken up by the hepatocytes and is equally excreted renal and biliary in humans. Dynamic and accumulation phase imaging can also be performed after bolus injection of Gd-EOB-DTPA. Time-resolved MR angiography (MRA) offers the combined advantage of large anatomic coverage and hemodynamic flow information. We applied parallel imaging and time-resolved imaging with stochastic trajectories (TWIST) to perform Gd-EOB-DTPA enhanced dynamic MRI for hepatocellular carcinoma. We obtained quintuple arterial phase dynamic MR imaging and time resolved MR angiography simultaneously. The purpose of this study was to describe and validate the use of time resolved Gd-EOB-DTPA enhanced MRI for the noninvasive assessment of hemodynamics and hepatocytes functional information of hypervascular hepatocellular carcinoma.

MATERIAL AND METHODS: Forty-one patients with hypervascular hepatocellular carcinomas underwent quintuple arterial phase imaging of the whole liver using time-resolved angiography with interleaved stochastic trajectories (TWIST) sequence. A 10-mL bolus of Gd-EOB-DTPA was administered at 3 mL/s, followed by a 20-mL saline flush. The sequence had a temporal resolution of 8.7 seconds, interpolated to 4.9 seconds, with 5 sequential arterial and 6 sequential portal data sets obtained. Magnetom Avanto1.5T (Siemens) with the Tim (Total imaging matrix) coil was used. Test bolus or fluoroscopic triggering was used to time the start of a contrast enhanced dynamic sequence. Imaging parameters were the following: TR, 2.7 ms; TE, 1.1 ms; flip angle, 25°; matrix, 256*165; 60 partitions; acceleration factor, 2. TWIST relies on partial k-space undersampling, with emphasison more frequent sampling of the center of k-space (Region A, which governs image contrast), relative to the periphery of k-space (Region B, which governs fine image detail). Values of A: 35% and B: 50% were used for TWIST MRI in our series.



HCC in S5: At 10 seconds, the contour of the tumor is clearly visible. At 15 seconds, the adjacent liver starts to enhance. At 40 seconds, contrast material is washed out of the tumor, and the corona enhancement is visible. At 50 seconds, portal venous system is clearly visualized without arterial contamination.

Image Evaluation: 1) Dynamic MRI images were evaluated for diagnostic confidence on a 5-point scale (1: poor, 2: fair, 3: satisfactory, 4: good, 5: excellent). Artifacts hindering interpretation were noted. 2) The transition of enhancement between the HCC lesion and adjacent liver on time resolved MR images were interpreted. 3) Time resolved MRA images were evaluated for the degree of arterial contamination of the portal venous systems. Degrees of arterial contamination were defined using a three-point scale: 1, poor; 2, good; 3, excellent.

RESULTS: 1) Overall MR image qualities were as follows: excellent (n=10, 24%), good (n=11, 27%), satisfactory (n=8, 20%) and fair (n=12, 29%). Significant artifacts of whole arterial phase images were not noted in any patient. 2) Corona enhancement was seen in 9 of 41 cases (22%). 3) MRA image qualities were as follows: excellent (n=34, 83%), good (n=7, 17%).

CONCLUSION: Time-resolved MRA with the TWIST sequence and parallel imaging provides sufficient temporal resolution to assess the transition of enhancement between the HCC lesion and adjacent liver and the hemodynamics of arterial and portal systems. It can provide dynamic information noninvasively and rapidly, and delivers consistently pure arterial phase imaging.

This can be used in combination with contrast injection to provide dynamic clinical information, including the evaluation of abnormal vascular anatomy as well as tumor vascular hemodynamics, and liver perfusion measurements.