Mangafodipir trisodium (Mn-DPDP) enhanced three-dimensional MR imaging of hepatocelluar carcinoma: Correlation with histopathological findings

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Introduction

Mangafodipir trisodium (Mn-DPDP, Teslascan®, Nycomed, Oslo, Norway) is a paramagnetic hepatobiliary contrast agent that has been primarily developed for MR imaging of liver. The manganese is removed from the DPDP ligand, a vitamin B6 analog, bound to plasma proteins, and excreted into bile, resulting in prominent and prolonged T1 shortening of liver and bile ducts. Previous studies suggested that this lead to a significant increases in the signal-to-noise ratio in the liver, and increases the number of lesions that can be distinguished in comparison with the unenhanced images. Others indicated that Mn-DPDP-enhanced MR imaging depicts hepatocelluar carcinoma (HCC) not visualized with unenhanced studies. The T1-weighted gradient recalled echo or fat-suppressed spin echo sequences have been recommended for detection of focal liver tumor. The degree of tumor enhancement correlates with histological differentiation. The poorly differentiated HCC show negative enhancement, whereas the more differentiated tumors show positive enhancement.

Recent improvements of gradient technology and software have allowed implementation of thin-section three-dimensional (3D) fat-suppressed (FS)sequence during a single breathhold to cover the entire liver.

The purpose of this study is to apply breath-hold FS T1-weighted 3D gradient-echo fast low-angle shot sequence before and after administration of Mn-DPDP for surgical resected HCC and correlate with histopathological findings, including tumor differentiation.

Methods

46 patients were studies before and after the intravenous administration of Mn-DPDP during eight months period. The criterion for inclusion in this study was suspicion of at least one HCC lesion on the basis of prior ultrasound, or computed tomography. The main exclusion criterion is severe obstructive hepatobiliary disease or severe renal impairment. Histological diagnosis of the hepatic lesions were available in 40 patients with 46 HCC nodules (size 0.6cm-13 cm, average 3.8cm) and 3 regenerative nodules, 0.3 to 1.0cm.

All examinations were performed with a 1.5 Tesla MR system (Vision; Siemens, Erlangen, Germany) and a torso phased-array coil. Before Mn-DPDP administration fat suppressed T2-weighted TSE images were obtained. Breath-hold axial T1-weighted 3D FS gradient-echo fast low-angle shot (FLASH 4.6/1.8; flip angle, 10 degrees) images were then performed with a field of view of 30 cm, image matrix of 256x115, and a bandwidth of 390 Hz/pixel. The in-plane resolution is 1.47x1.17 mm. Section thickness was 160 to 200 mm and yielded a partition thickness of 2.5 mm. The mean acquisition time was 22 seconds. For all studies, anatomic coverage was defined to include the entire liver. 3D FS FLASH were repeated 20 minutes and 24 hours after the patients were given Mn-DPDP, a single intravenous infusion of 5 µmol/kg over 10-20 minutes, followed by a 5 mL flush of 0.9% sodium chloride. Maximum intensity projection (MIP) and multiplanar reformation (MPR) are used to change the image plane so that the details of tumor architecture could be displayed and correlated with histopathological findings. Two radiologists evaluated precontrast, postcontrast and delayed images for detection and characterization of tumor nodules by means of consensus. The imaging findings and tumor enhancement pattern were correlated with histopathological examination.

Results

In 46 HCC nodules, there were 19 well-differentiated, 17 moderately differentiated and four poorly differentiated lesions. 3D FS FLASH 24-hour enhanced images detected 45 HCC (97.8%), while T2-weighted TSE images, 3D FS FLASH 20-minute enhanced images and 3D FS FLASH unenhanced images detected 40 (87.0%), 40 (87.0%) and 37 (80.4%). Five well- differentiated and one moderately differentiated lesions were missed on T2 images. Six well-differentiated lesions were isosignal on 20-minute enhanced images, while all became hyperintense than the surrounding liver parenchyma on 24-hour enhanced images. No moderately differentiated or poorly differentiated lesions were undetected on enhanced images. Only one well-differentiated lesion was hypointense on 20-minute and 24-hour enhanced images. All poorly differentiated lesions showed hypointense on enhanced images, except one has spotty enhancement on 20-minute enhanced images. In histopathological correlation, no enhancement was found in areas of tumor necrosis, hemorrhage or fibrous stroma. The tumor capsule was depicted in 12 lesions. The tumor capsule invasion, internal septa, fatty component, portal vein or bile duct thrombi were well demonstrated on 3D FS FLASH enhanced images.

Discussion

Mn-DPDP enhanced 3D FS FLASH imaging depicted HCC not visualized with unenhanced studies. 3D FS FLASH images provides multiple thin sections through the entire liver during a single breath-hold with less patient motion and capability to view these volumetric acquired data both as axial and as a multiplanar display or as 3D images. The sequence is good not only for tumor detection but also has potential to characterize the various histopathological features of HCC. In conclusion, Mn-DPDP is useful for the diagnosis of HCC.

References

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