

## Diffusion-Weighted Imaging: Diagnostic Value in the Assessment of Intrahepatic Metastases of Hepatocellular Carcinoma

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### Background

Early detection of hepatocellular carcinoma (HCC) is one of the most important aims of magnetic resonance imaging (MRI) of the liver. During the imaging of newly developed primary focal lesions in patients with high risk factors for HCC development, a “wait and see” strategy has been generally accepted for subcentimeter lesions regardless of the tumoral vascularity. For the lesions suggesting intrahepatic metastases, the presence of tiny subcentimeter lesions has a great impact on imaging studies due to the high incidence of tumor recurrence after resection or locoregional therapy. Differing from the imaging approach for the primary lesions, however, the diagnostic strategy for such small advanced lesions is yet to be discussed. In the past decade, diffusion-weighted imaging (DWI) has been applied in liver MRI. In the present study, the usefulness of DWI in the assessment of small HCCs regarded to be intrahepatic metastases was compared with conventional dynamic MRI.

### Purpose

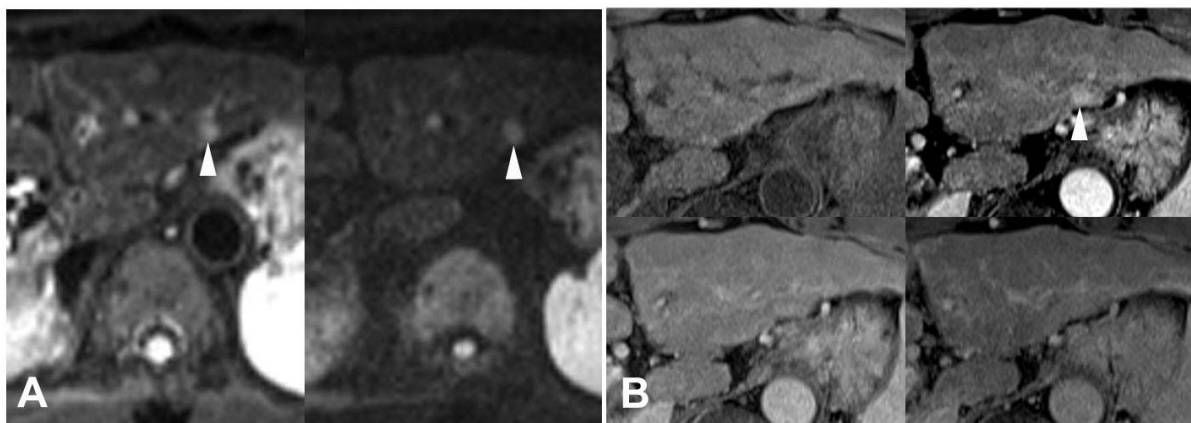
To determine the diagnostic value of DWI in the MRI assessment of intrahepatic metastases from HCC.

### Materials and Methods

MRI was performed using a 1.5-T system (Magnetom Avanto; Siemens, Erlangen, Germany). After obtaining breathhold T2-weighted turbo spin-echo (TSE) images (TR = 3020 ms, TE = 109 ms, echo train length = 13) and double-echo chemical shift gradient-echo sequence (TR = 100 ms, TE = 2.0/4.2 ms, flip angle 70°), dynamic contrast-enhanced imaging was obtained using a 3D gradient echo (GRE) sequence (VIBE; Siemens) in the axial plane (TR = 4.4 ms, TE = 2.1 ms, flip angle = 10°, matrix = 448 x 224, FOV = 271x379 mm, slice thickness = 5 mm, slice spacing = 2.5 mm, slices = 72) during a 20 s breath-holding period. DWI was performed using a single-shot spin-echo echo planar MRI (EPI) sequence by applying three different b factors of 50, 400 and 800 s/mm<sup>2</sup>. Other technical parameters were: TR = 1000 ms, TE = 69 ms, matrix = 128x192, FOV = 308x379 mm, slices = 27 (9 slices for each b factor), thickness = 6 mm, interslice gap = 30%, average = 2, bandwidth = 1735 Hz/pixel, acquisition time = 22 s. Parallel imaging algorithms (GRAPPA) with an acceleration factor = 2 was added to reduce acquisition time. The sequence was obtained within a single breath-holding period for the upper half of the liver and another single breath-holding period for the lower half of the liver, and a total of 18 slices were acquired in a liver for each b factor. ADC maps regarding isotropic images were automatically acquired and all mean ADCs of the lesions and background liver were measured on those maps. To improve the signal-to-noise ratio and for patients' convenience, DWI under free-breathing was alternatively performed. Imaging parameters different from the above breath-holding sequence were as follows: TR = 3,900 ms, TE = 75 ms, matrix = 156x192, slices = 78 (26 slices for each b factor), thickness = 6 mm with interslice gap = 20%, average = 4. In 11 patients with multifocal, small intrahepatic metastatic foci of advanced HCC, a total of 65 lesions (≥1 cm, n = 27; <1 cm, n = 38) were subjected for a comparative analysis of hepatic MRI consisted of static and gadolinium-enhanced dynamic imaging before and after additional DWI by two independent observers.

### Results

For lesions of 1 cm or larger, all 27 lesions (100%) were simultaneously detected and there was no significant difference in the overall ability to characterize the malignancy between DWI and dynamic MRI: 89% versus 78% ( $p>0.05$ ). For the 38 subcentimeter lesions, 37 (97%) and 29 (76%) were detected on DWI and dynamic MRI, respectively ( $p=0.008$ ). DWI could more easily characterize their signal intensity pattern of malignancy than dynamic MRI: 79% versus 53% ( $p=0.023$ ).



**Figure A** 67-year-old woman with a HCC in right lobe of liver accompanied with gross portal vein invasion of right lobar branch.

**A:** Spin-echo echo-planar DWIs using b value of 50 s/mm<sup>2</sup> (left) and 800 s/mm<sup>2</sup> (right) show a well-defined hyperintensity nodule (arrowheads) regardless of the

degrees of diffusion-weighting due to decreased motion of water molecules, suggesting malignancy.

**B:** Dynamic imaging by 3D gradient echo technique shows a hypervascular lesion (arrowhead) on arterial phase image (upper right). However, there is no distinguishable lesions on the pre-contrast (upper left), portal phase (lower left) and delayed phase (lower right) images, and can not exclude the possibility of hypervascular pseudolesion on the gadolinium-enhanced dynamic imaging.

### Conclusion

DWI is superior to dynamic MRI in the detection and characterization of small (<1 cm) lesions and can be added to strengthen the accuracy in the MRI assessment of intrahepatic metastases of HCCs. DWI could overcome the inherent drawbacks of dynamic MRI for the hypervascular pseudolesions or obscured tumoral vascularities by the perfusional changes in the background parenchyma serve as a complementary tool for patients examined by dynamic MRI.