'Non-defect' of arterial enhancing rim on hepatobiliary phase in 3.0T Gd-EOB-DTPA-enhanced liver MRI: distinguishing hepatic abscess from metastasis

Poster No.: C-1273
Congress: ECR 2013
Type: Scientific Exhibit
Keywords: Liver, MR, Comparative studies, Abscess, Metastases
DOI: 10.1594/ecr2013/C-1273

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Purpose

There have been no reports outlining the most decisive radiologic findings to differentiate hepatic abscess from hepatic metastasis using Gd-EOB-DTPA-enhanced 3.0T MRI. The purpose of this study was to evaluate imaging findings of hepatic abscess in Gd-EOB-DTPA-enhanced liver MRI and verify the most useful feature for differentiation of abscess from metastasis, both of which show arterial rim enhancement.
Methods and Materials

Patients

Among patients who underwent Gd-EOB-DTPA-enhanced liver MRI from March 2008 to December 2011, there were 40 and 150 patients diagnosed with hepatic abscess and metastasis, respectively. 21 abscesses in 19 patients and 19 metastases in 13 patients composed our study group and all the lesions showed rim enhancement on arterial phase. Diagnosis was confirmed using surgery, percutaneous needle biopsy, needle aspiration, or imaging follow-up. Eight patients with abscess had primary malignant lesions in colorectum (n = 7) or common bile duct (n = 1). In 13 patients with metastasis, the primary malignant lesions were colorectum (n = 7), breast (n = 3), stomach (n = 2), or uterine cervix (n = 1).

MRI Examinations

MRI was performed using a 3.0-T unit (Magnetom Trio a Trim; Siemens, Erlangen, Germany) with a combination of a body matrix coil and a spinal matrix coil (TIM coil). Baseline MR images were acquired with the following parameters: fat suppressed respiratory triggered T2-weighted turbo spin-echo sequence (TR/TE of 3500-5000/70-85, echo train length 10, 140° flip angle, matrix of 202 × 320, 3-mm slice thickness); breath-hold T2-weighted turbo spin-echo sequence (2500-4500/103, 140° flip angle, matrix of 202 × 320, 5 mm slice thickness); T2-weighted HASTE sequence (400-500/100-150, 150° flip angle, matrix of 166 × 256, 3 mm slice thickness); and a breath-hold T1-weighted fast low-angle shot sequence (TR 172, TE 2.50 [in-phase]/1.22 [out-of-phase], 65° flip angle, matrix of 208 × 256, signal average of one, and two acquisitions, 5-mm slice thickness). Dynamic imaging (volumetric interpolated breath-hold examination, VIBE; Siemens, Erlangen, Germany) was performed after intravenous injection of 0.1 mL/kg Gd-EOB-DTPA-based contrast medium (Primovist, Bayer Schering Pharma). Arterial dominant phase was taken using the bolus tracking method. The portal, equilibrium, and hepatobiliary phases were also acquired at 60 seconds, 120 seconds, and 20 minutes from the start of Gd-EOB-DTPA injection, respectively. Contrast media was administered using an automated injector (Spectris MR; Medrad Europe, Maastricht, The Netherlands) at a rate of 1 mL/s through an antecubital vein and flushed with 25 mL saline solution. Diffusion-weighted MR was performed in the axial plane with tri-directional diffusion gradients using three b values, 50, 500, and 1000 sec/mm2, within the same acquisition, with trace (average) images assessed. Voxel-based ADC maps were also acquired by calculation on a commercial workstation using a monoexponential fit.

Image Analysis
Two radiologists independently reviewed the arterial, and hepatobiliary phase Gd-EOBDTPA-enhanced MR images. They were informed that this study included only abscess and metastasis but were blinded to the final diagnoses of the lesions. On hepatobiliary phase, by comparing the outer diameter of the lesion with that of arterial phase using electronic calipers, they assessed the appearance of the rim of arterial enhancement in the hepatobiliary phase and visually classified the signal intensity of the rim into: 1) defect zone (same or lower signal intensity than the central portion), 2) gray zone (higher signal intensity than the central portion and lower signal intensity than the surrounding liver parenchyma, and 3) uptake zone (same or higher signal intensity than the liver parenchyma. (Figs. 1, 2).

Statistical Analysis

Between abscess and metastasis, statistical differences in signal intensities on MR images were analyzed with Pearson X2 test. Significant differences were defined as p values less than 0.05. Statistical analyses were performed with the SPSS software package (SPSS version 12.0 for Microsoft Window; SPSS Inc., Chicago, IL, USA).
**Fig. 1:** The example of image analysis. With the electronic caliber, we assessed how the portion of arterial enhancement (A) showed in hepatobiliary phase. (B)

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**Fig. 2:** On hepatobiliary phase, the signal intensity of the rim was classified into same or lower than central low signal intensity of the mass (so-called defect zone, A), higher than the central portion and lower than the surrounding liver parenchyma (so-called gray zone, B), and same or higher than liver parenchyma (so-called uptake zone, C). The asterisks indicate arterial enhancing peripheral portions.

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Results

Arterial Enhancing Rim on Hepatobiliary Phase (Table 1)

An arterial enhancing rim in 3 abscesses (3/21 = 14.3%) and 15 metastases (15/19 = 80.0%) showed a 'defect zone' in the hepatobiliary phase (Figs. 3 and 4). Six abscesses (6/21 = 28.6%) and no metastasis (0/19 = 0%) showed a 'gray zone', (Figs. 5 and 6) and 12 abscesses (12/21 = 57.1%) and 4 metastases (4/19 = 21.1%) showed an 'uptake zone'. No metastasis showed higher signal intensity of the arterial enhancing rim than that of the adjacent liver parenchyma. The frequency of showing 'non-defect zone' (gray and uptake zone) in the rim of arterial enhancement on hepatobiliary phase was significantly higher in abscess (18/21 = 85.7% of abscesses, 4/19 = 21.1% of metastases, p = 0.000).
Table 1: The number in parentheses indicates a percentage. a To determine the difference between the two groups in each finding, comparisons using Pearson X² test were performed separately, and each p-value was calculated.

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Fig. 3: Liver metastasis of a 47-year-old female who has breast cancer. Arterial (A) and hepatobiliary phase (B) of Gd-EOB-DTPA enhanced MRI show the rim of arterial enhancement appears iso to lower signal intensity than the central portion. ('defect zone')

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**Fig. 4:** Liver metastasis of a 54-year-old male who has colon cancer. Arterial (A) and hepatobiliary phase (B) of Gd-EOB-DTPA enhanced MRI show the rim of arterial enhancement appears same signal intensity to the central portion. (‘defect zone’) © Radiology, Korea University Guro Hospital - Seoul/KR
Fig. 5: Liver abscess of a 49-year-old female on Gd-EOB-DTPA enhanced MRI of arterial phase (A) and hepatobiliary phase (B). The rim that shows enhancement on arterial phase appears higher signal intensity than the central portion and lower signal intensity than the surrounding liver parenchyma. (‘gray zone’)

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**Fig. 6:** Arterial phase (A, C) and hepatobiliary phase (B, C) of Gd-EOB-DTPA enhanced MRI show two abscesses of a 69-year-old male. In both lesions, the portions of arterial enhancement appear higher signal intensity than the central portion and lower signal intensity than the surrounding liver parenchyma on hepatobiliary phase. ('gray zone')

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Conclusion

In conclusion, on hepatobiliary phase of Gd-EOB-DTPA-enhanced liver MRI, the rim of hepatic abscess, which was enhanced on arterial phase, remained enhanced ('non defect') as compared with the central portion of low signal intensity. This feature can be used to differentiate abscess from the most common malignant lesion of the liver, metastasis, which showed low signal intensity of the rim like the central defect on hepatobiliary phase. This is mainly due to a difference between inflammatory granulations of abscess and viable metastatic tumor cells. It may be especially meaningful when evaluating patients with primary malignancy.
References


