

Differential diagnosis between metastatic tumors and nonsolid benign lesions of the liver using ferucarbotran-enhanced MR imaging

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ABSTRACT

Purpose: To evaluate ability of ferucarbotran-enhanced MR imaging (MRI) in differentiating metastases from nonsolid benign lesions of the liver according to signal-intensity characteristics.

Materials and methods: Sixty-six consecutive patients, who had 138 focal hepatic lesions (26 cysts, 11 hemangiomas, and 101 metastases), underwent ferucarbotran-enhanced MRI. The signal-intensity pattern of each kind of lesion relative to the liver parenchyma on ferucarbotran-enhanced T2* and heavily T1-weighted gradient-echo images were assessed and categorized into the following three categories: high-intensity and iso-intensity, respectively (category A), high and low (category B), and iso- and low-intensity (category C). For category B, lesions were subdivided into two groups based on single-shot half-Fourier RARE images: category B1 (not significantly high-intensity) and category B2 (significantly high-intensity).

Results: Category A had 11 hemangiomas and 2 metastatic tumors, category B1 had 97 metastatic tumors, category B2 had 2 metastatic tumors and 9 cysts, and category C had 17 cysts. When a tumor with a signal intensity of category A was considered to be hemangioma, category B1 metastasis, and category B2 and C cyst, the diagnostic accuracy for differentiating these lesions was 97% (134/138).

Conclusion: The combination of signal-intensity pattern on ferucarbotran-enhanced T2*- and heavily T1-weighted gradient-echo MRI has ability to differentiate liver metastases from nonsolid benign lesions. However, T2-weighted single-shot half-Fourier RARE imaging should also be employed to achieve better performance.

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1. Introduction

Superparamagnetic iron oxide (SPIO) is a particulate magnetic resonance (MR) contrast agent which is selectively taken up by the reticuloendothelial system (i.e., Kupffer's cells within the liver) [1]. Numerous studies have demonstrated that SPIO-enhanced MR imaging can improve detection and characterization of focal liver lesions [2–7]. T2 or T2*-weighted sequences are usually acquired after SPIO administration to exploit the T2* value shortening of liver parenchyma [2–7]. In addition, due to the fact that SPIO also shortens the T1 value of liver parenchyma (but not that of tumors which do not contain Kupffer's cells), heavily T1-weighted gradient-echo sequences are also obtained to maximize focal liver lesion detection [8,9].

In the assessment of patients suspected of having metastatic liver tumor, it is sometimes difficult to differentiate solid malignant tumors from nonsolid benign lesions, such as hemangiomas and cysts. A previous study has reported that a combination of the relative signal-intensity pattern of focal liver lesions on T2*- and heavily T1-weighted gradient-echo images using ferumoxides, one of SPIO contrast agent, can help in the differential diagnosis between solid metastatic tumors and nonsolid benign lesions [10]. In recent years, an additional SPIO contrast agent (ferucarbotran) has been introduced in clinical practice. Ferucarbotran has several differences compared to previously available ferumoxides, such as the possibility of intravenous bolus injection. In addition, $r1$ and $r2$ values at 1.5 T of ferumoxides (23.9 and 98.3 $\text{mM}^{-1} \text{s}^{-1}$, respectively) are different from those of ferucarbotran (9.5 and 230 $\text{mM}^{-1} \text{s}^{-1}$, respectively) [11,12]. Moreover, these two SPIO particles show different uptake in the liver dependent on their size. Thus, there may be some difference between ferucarbotran and ferumoxides in the diagnostic ability.

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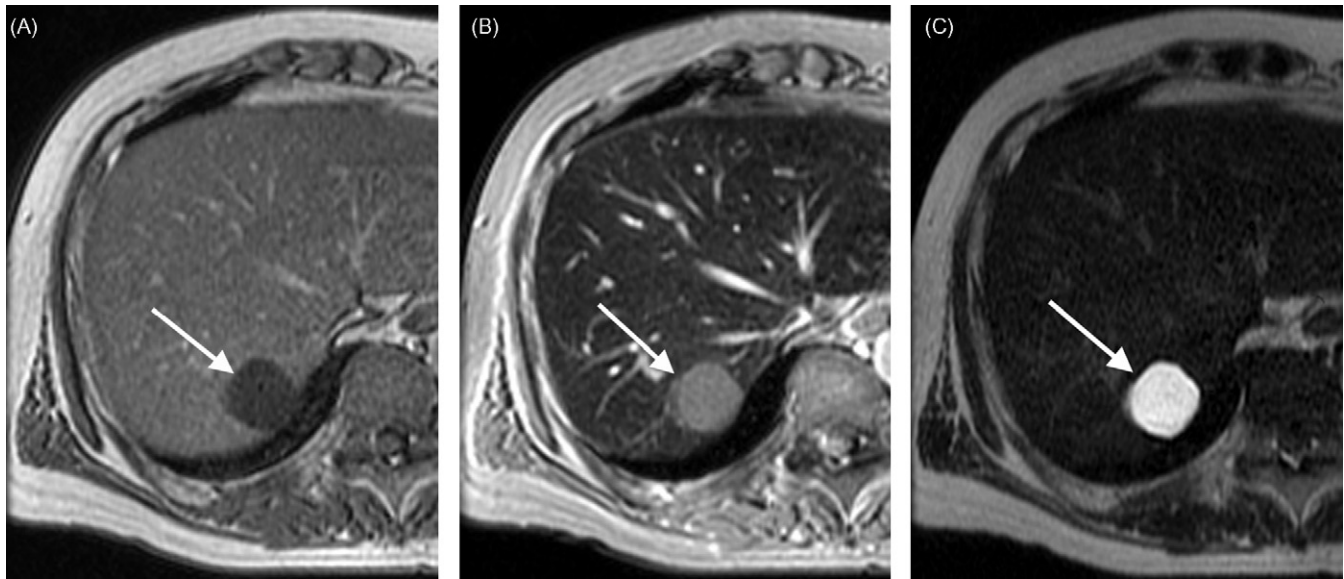


Fig. 1. Cyst in 57-year-old woman (category B2). (A) Ferucarbotran-enhanced heavily T1-weighted gradient-echo image shows it as low-intensity (arrow) relative to the liver parenchyma. (B) Ferucarbotran-enhanced T2*-weighted gradient-echo image shows cyst as high-intensity relative to the liver parenchyma. (C) Ferucarbotran-enhanced T2-weighted single-shot half-Fourier RARE image shows cyst as marked high-intensity (arrow) relative to the liver parenchyma.

Previous studies reported that SPIO-enhanced MR imaging (MRI) with ferucarbotran was efficient for characterization of focal liver lesions [13,14]. However, to our knowledge, no study has yet investigated the value of combined T2*- and heavily T1-weighted gradient-echo ferucarbotran-enhanced MR imaging in the differential diagnosis between solid metastatic tumors and nonsolid benign lesions. The purpose of our study was to evaluate the ability of ferucarbotran-enhanced MRI to differentiate solid metastatic tumors from nonsolid benign lesions of the liver on the basis of the signal-intensity characteristics.

2. Materials and methods

2.1. Patient population

Between May 2003 and July 2006, 107 consecutive patients without chronic hepatitis or liver cirrhosis under-

went ferucarbotran-enhanced MRI to confirm the presence of tumor, which were suspected on the basis of findings on contrast-enhanced CT or ultrasonography. Of the 107 patients, 66 (36 men and 30 women) had 138 focal hepatic lesions more than 8 mm in diameter, which consisted of 26 cysts, 11 hemangiomas, and 101 metastatic tumors. These 66 patients constituted the final study population. Mean patient age was 60 years (range, 16–86 years). Seventeen patients had only benign lesions (hemangiomas and cysts). The remaining 49 patients contained liver metastases originated from the following primary tumors: colon and rectal cancer ($n=27$), pancreatic cancer ($n=3$), gastric cancer ($n=4$), esophageal cancer ($n=4$), gastrointestinal stromal tumor ($n=4$), duodenal cancer ($n=1$), ovarian cancer ($n=1$), colon carcinoid ($n=1$), yolk sac tumor of mediastinum ($n=1$), breast cancer ($n=1$), thyroid cancer ($n=1$), paraganglioma ($n=1$) and hepatic tumor ($n=1$). One patient had double cancer: gastric cancer and esophageal cancer. All patients gave their informed consent to

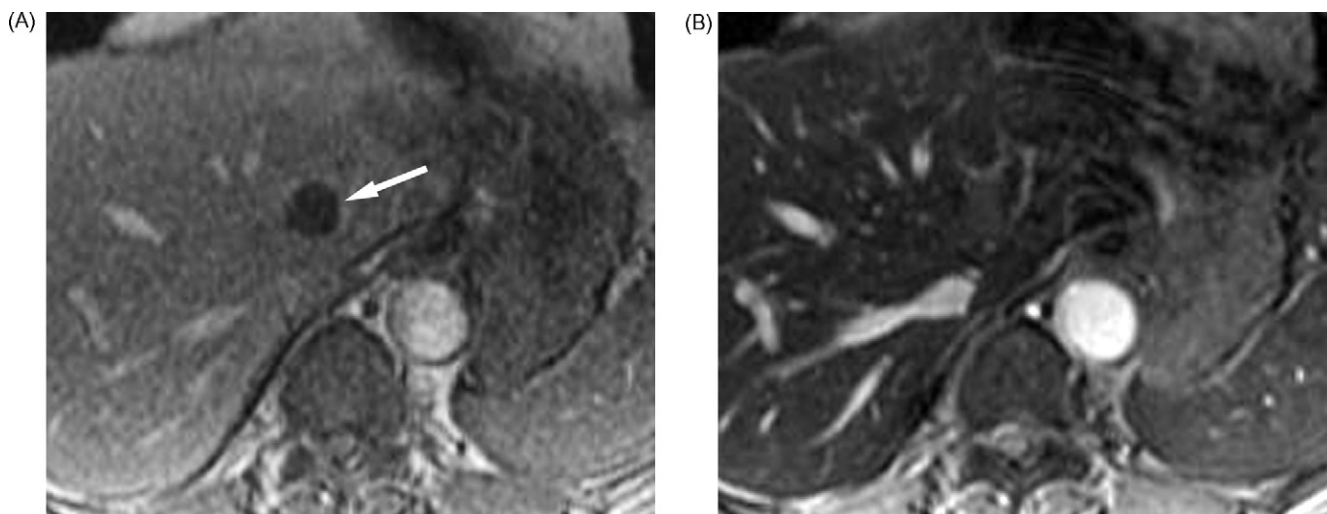


Fig. 2. Cyst in 59-year-old man (category C). (A) Ferucarbotran-enhanced heavily T1-weighted gradient-echo image shows it as low-intensity (arrow) relative to the liver parenchyma. (B) Ferucarbotran-enhanced T2*-weighted gradient-echo image shows cyst as iso-intensity relative to the liver parenchyma.

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