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Does T2-weighted MR imaging improve preoperative detection of malignant hepatic tumors? Observer performance study in 49 surgically proven cases

Hiroshi Kondo[a], Masayuki Kanematsu[a,*], Kyo Itoh[b], Katsuyoshi Ito[c], Yoji Maetani[b], Satoshi Goshima[a], Masayuki Matsuo[a], Naofumi Matsunaga[c], Junji Konishi[b], Hiroaki Hoshi[a], Noriyuki Moriyama[d]

[a]*Department of Radiology, Gifu University School of Medicine, 1-1 Yanagido, Gifu 501-1193, Japan*
[b]*Department of Radiology, Kyoto University Faculty of Medicine, Kyoto 606-8507, Japan*
[c]*Department of Radiology, Yamaguchi University School of Medicine, Yamaguchi 755-8505, Japan*
[d]*Department of Diagnostic Radiology, National Cancer Center Hospital, Tokyo 104-0045, Japan*

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Abstract

The purpose of our study was to determine whether or not the addition of T2-weighted fast spin-echo (SE) imaging to gadolinium-enhanced spoiled gradient-recalled-echo (GRE) imaging improves the observer performance in the preoperative detection of malignant hepatic tumors. Gadolinium-enhanced GRE and fat-suppressed T2-weighted fast SE images obtained in 49 patients with 82 surgically confirmed malignant hepatic tumors (40 hepatocellular carcinomas and 42 metastases) were retrospectively reviewed by three independent off-site observers. In the random review of images, gadolinium-enhanced GRE images were reviewed first; thereafter, T2-weighted fast SE images were added for combined review. Observer performance was evaluated with the McNemar's test and receiver operating characteristic curve analysis. For gadolinium-enhanced GRE images alone vs. combined images, sensitivities for detection were 78% vs. 79% for hepatocellular carcinomas ($P>.05$), 67% vs. 71% for metastases ($P<.05$) and 72% vs. 75% for tumors overall ($P<.05$), respectively. The Az values were 0.892 vs. 0.889 in hepatocellular carcinomas ($P>.05$), 0.797 vs. 0.828 in metastases ($P<.05$) and 0.839 vs. 0.846 in tumors overall ($P>.05$), respectively. Our results showed that the addition of T2-weighted fast SE imaging to gadolinium-enhanced GRE imaging improved the observer performance in the detection of metastases.

Keywords: Liver; Magnetic resonance; Fat-suppressed T2-weighted fast spin-echo; Gadolinium-enhanced gradient-recalled-echo

1. Introduction

Since the usefulness of MR imaging for the detection of malignant liver tumors was demonstrated in the late 1980s [1,2], researches have been making efforts to shorten examination time of MR imaging, while maintaining the diagnostic accuracy. A previous report suggested that a 10-min MR imaging examination of the upper abdomen provides sufficiently comprehensive information to replace a longer MR protocol for the purpose of increasing patient throughput and decreasing study cost [3]. Some researchers questioned the necessity of T2-weighted imaging in the detection of malignant hepatic tumors and suggested a possible omission of T2-weighted sequences from liver MR imaging protocols for the purpose of tumor detection [4–6], and others concluded that both unenhanced T1- and T2-weighted sequences were helpful for lesion characterization but increased the detection rate only minimally [7]. Although gadolinium-enhanced imaging has been playing an important role as a baseline technique in MR imaging protocols for patients with suspected liver masses or for liver transplant candidates in many centers, it may be still premature to omit or disregard T2-weighted images, which may provide additional value for tumor detection.

* Corresponding author. Tel.: +81 58 230 6439; fax: +81 58 230 6440.
E-mail address: masa-gif@umin.ac.jp (M. Kanematsu).

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T2-weighted imaging is believed to add benefits in the detection of metastasized lymph nodes or in the characterization of early-enhancing pseudolesions caused by vascular abnormality occasionally seen on gadolinium-enhanced images.

The main thrust of our study was to determine whether or not the addition of T2-weighted fast spin-echo (SE) imaging to gadolinium-enhanced gradient-recalled-echo (GRE) imaging has a complementary value in the preoperative detection of malignant hepatic tumors. For this purpose, we performed a retrospective observer performance study in 49 patients with surgically confirmed malignant hepatic tumors.

2. Materials and methods

2.1. Patients

By searching the patient database of the Department of Surgery, Gifu University Hospital, we found a total of 53 consecutive patients who underwent partial hepatectomy for malignant hepatic tumors between February 1998 and January 2000. Of them, 49 patients underwent gadolinium-enhanced MR imaging for the preoperative evaluation of hepatic tumors at the Department of Radiology within 2 weeks of the surgery. The patients were entered in this study with signature waiver in accordance with the institutional review board, and the study was performed in conformity with the guidelines of the Declaration of Helsinki [8].

Table 1
Sensitivity for detection of hepatocellular carcinomas, metastases and tumors overall

MR imaging sequence	Observer 1	Observer 2	Observer 3	Total
Hepatocellular carcinomas (n=40)				
Gd-enhanced images alone	33 (83)	32 (80)	29 (73)	94 (78)
Gd-enhanced and T2-weighted images combined	34 (85)	32 (80)	29 (73)	95 (79)
Metastases (n=42)				
Gd-enhanced images alone	26 (62)	29 (69)	29 (69)	84 (67)
Gd-enhanced and T2-weighted images combined	29 (69)	29 (69)	32 (76)	90 (71)[a]
Tumors overall (n=82)				
Gd-enhanced images alone	59 (72)	61 (74)	58 (70)	178 (72)
Gd-enhanced and T2-weighted images combined	63 (77)	61 (74)	61 (74)	185 (75)[a]

Data are the numbers of lesions assigned a score of 4 or 5. Numbers in parentheses are the sensitivity expressed as percentages.

[a] Sensitivity was significantly greater than that for gadolinium-enhanced alone ($P<.05$).

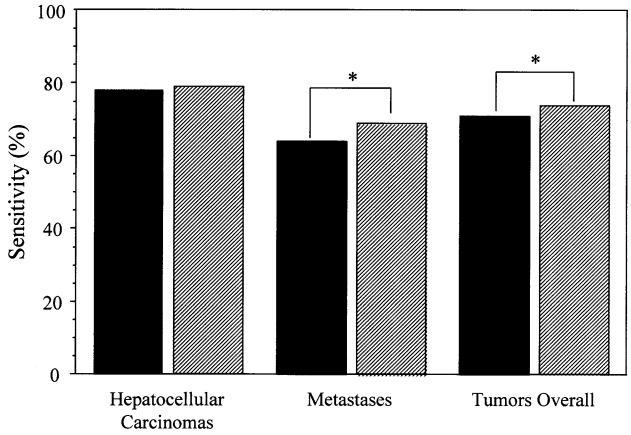

Fig. 1. The bar chart shows the mean sensitivities for detection of hepatocellular carcinomas, metastases and tumors overall on a lesion-by-lesion basis for the three observers. In metastases and tumors overall, the sensitivity was significantly higher (*$P<.05$) with combined images (striped bar) than with gadolinium-enhanced GRE images alone (black bar). There was no significant difference in sensitivity in hepatocellular carcinomas.

The 49 patients, including 34 men and 15 women ranging in age from 40 to 80 years (mean, 62 years), formed the study population. This population included 26 patients with hepatocellular carcinoma in cirrhosis and 23 with hepatic metastases from colorectal ($n=16$), gastric ($n=4$), pancreatic ($n=2$) and uterine cervical ($n=1$) carcinoma. A total of 82 malignant hepatic tumors (size range, 4–80 mm; mean, 23.5 mm), consisting of 40 hepatocellular carcinomas (size range, 5–55 mm; mean, 21.8 mm) and 42 metastases (size range, 4–80 mm; mean, 25.2 mm), were surgically and histopathologically confirmed. We performed radiographic–pathologic correlation by intraoperative ultrasonographic records done by surgeons, macroscopic and microscopic records of specimens and MR imaging findings.

In 15 of the 49 patients, hepatic cysts were noted on MR images; most of them were located outside the area of partial hepatectomy. We followed up the 15 patients in 6–12 months with MR imaging and established the diagnosis of hepatic cysts. We had no nonneoplastic pathologic conditions such as focal nodular hyperplasia, dysplastic nodule in cirrhosis, abscess or inflammatory myofibroblastic tumor in the series.

2.2. MR imaging technique

MR imaging was performed with a 1.5-T imager (Signa Horizon; General Electric Medical Systems, Milwaukee, WI, USA). All MR images were obtained in the axial plane with a phased-array multicoil for the body, section thickness of 8 mm with a 2-mm intersection gap and field-of-view of 32×24 to 29×22 cm. The MR imaging protocol included respiratory-triggered, chemical-shift-selective fat-suppressed T2-weighted fast SE imaging [3333–8500/80 (effective TR/effective TE), 512×256 matrix, echo train