

CT

1

1, 2

1, 2

1, 2

CT

CT

300 mg/mL

5

SH U 508 A 4.0 g

CT

CT

21

48

56 가

CT

6 (28%)

8

3-13 mm(, 7.2 mm)

6 가

3

6

5

3

가

CT

가

(6-9),

(7)

가

가

CT

38-80%

1

75-89%

(7-11). 가

(1-3)

가 5

39-67%

(7, 8, 10, 11)

가 3 cm

(1).

(12-16).

Blomley MJK (13)

(14)

(stimulated acoustic emission)

CT (CTAP), MRI

CT,

(6-11).

CTAP

가

81-94%

가

(acoustic pressure)

가

1

2

2001

2001 10 5

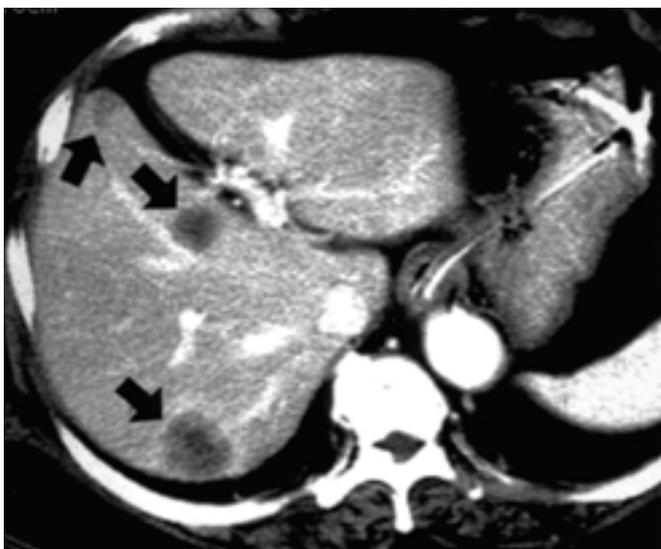
2001 11 21

5

가

(13-16).

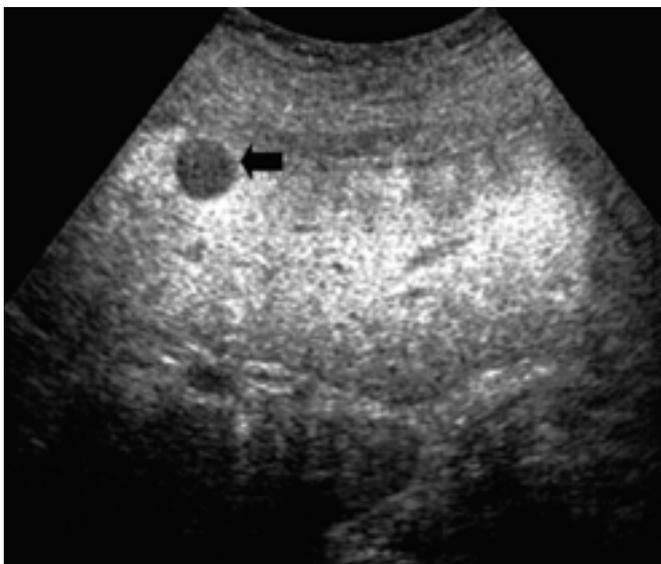
CT 70 .21 58 13 , 8 , 47-
 12 , 9
 가 가 19
 , 2 14
 가 가 19 2
 1999 9 2001 2
 105 CT 2
 33 CT CT Hispeed advantage (GE medical
 가 3 cm system, Milwaukee, Wis, U.S.A.)
 5 7 mm, 1.0-1.5
 28 , 28 7 (Iopamidol, Iopamiron 300; Bracco, Milan, Italy) 100
 , 21 mL 120 mL (Medrad, Pittsburgh, Pa,
 . 21



A



B



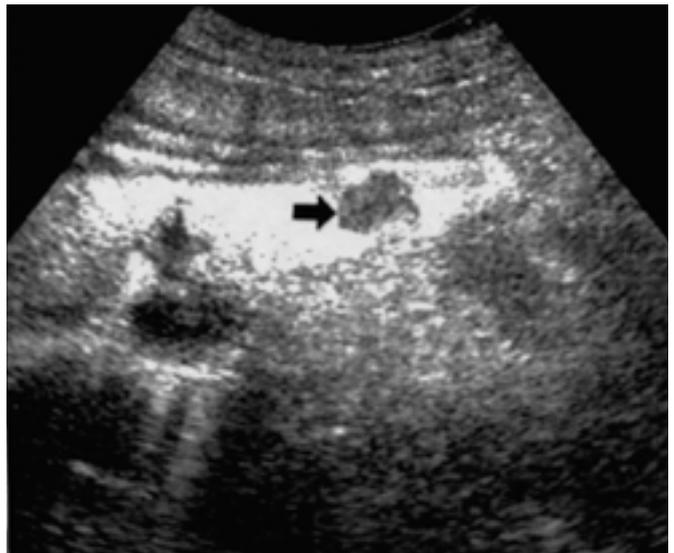
C

Fig. 1. Metastatic adenocarcinoma from rectal cancer in a 57-year-old woman.

A. Contrast-enhanced CT scan with portal phase shows three hypoattenuating nodules (arrows) in the right lobe of the liver, suggesting metastatic tumors. There is no demonstrable mass in the left lobe of the liver.

B, C. Late phase pulse inversion harmonic images obtained at five minutes after contrast injection shows metastatic masses appeared as multiple, well-defined, hypoechoic areas (arrows on **B**) in the right lobe of the liver. Note a well-defined nodule of 10 mm in diameter at the left lobe of the liver (arrow on **C**).

U.S.A.) 2.5 - 3.0 mL/sec (30) system (Radionics, Burlington, MA, U.S.A.) 18 37
 (65) 가 HDI - 5000 (ATL 4 CT 33 5
 Inc, Bothell, Washington, U.S.A.) 5 - 2 MHz . 33 5
 (freeze) ,
 1.3
 가 CT 가 ,
 SH U 508A (Levovist; Schering AG, Berlin, Germany) 4.0 g 300 mg/mL 20 - 가
 22 - 2 cc paired t - test ,
 10 mL 가 ,
 5 (sweeping)
 , 90 (capture)
 (Cine - loop) CT 21 48
 15 - 30 가 45 ,
 . CT 56
 CT 21 6 (28%) 8 가
 7.3 1 - 15 , 3 - 13 mm(, 7.2
 mm) , CT (p=0.042). CT
 2 가 PACS CT Table.
 1
 Couinaud 가 Cooled - tip RF 7 (33%) 11 (p=0.012).



A **B**
Fig. 2. Hepatic metastases from colon cancer in a 70-year-old woman.
A. Portal phase CT scan does not show any mass in the left lobe of the liver.
B. Late phase pulse inversion harmonic image obtained at five minutes after contrast injection shows metastatic mass appeared as a well-defined hypoechoic area (arrow) in the left lobe of the liver.

CT가 S3가 6, 3 (Table 2). (16). 가가 (13-16). CT가 (sinusoid) (13, 15). (6-9). MRI SPIO(superpara-magnetic iron oxide)가 56-99% (9, 11, 17). CT가 7-13 mm 5 3 11 S3 7 mm

Table 1. Number of Metastatic Tumors by Segment Detected on CT and Pulse Inversion Harmonic US

	S1	S2	S3	S4	S5	S6	S7	S8	Total
US	1	6	2	16	7	5	13	6	56
CT	1	3	3	14	7	5	11	4	48
US-CT	0	3	-1	2	0	0	2	2	8

Table 2. Effect of Results at Pulse Inversion Harmonic US on Treatment Planning

	No. of patients (%)	Treatment
US > CT	6(28)	3(5 lesions) RF ablation 3(6 lesions) Chemotherapy
US = CT	14(67)	RF ablation
US < CT	1(5)	RF ablation
Total	21(100)	

Note - > : superior to, = : equal to, < inferior to

가
 , 6 가 3 6
 , 5
 3 가
 ,
 가
 CT 가 3 - 6 mm 3
 CT ,
 가 가 CT
 , CT
 , CT 가
 ,
 CT

1. de Baere T, Elias D, Dromain C, et al. Radiofrequency ablation of 100 hepatic metastases with a mean follow-up of more than 1 year. *AJR Am J Roentgenol* 2000;175:1619-1625
2. Solbiati L, Ierace T, Goldberg SN, et al. Percutaneous US-guided radio-frequency tissue ablation of liver metastasis: treatment and follow-up in 16 patients. *Radiology* 1997;202:195-203
3. Livraghi T, Goldberg SN, Monti F, et al. Saline-enhanced radio-frequency tissue ablation in the treatment of liver metastases. *Radiology* 1997;202:205-210
4. Solbiati L, Goldberg SN, Ierace T, et al. Hepatic metastasis: percutaneous radio-frequency ablation with cooled-tip electrodes. *Radiology* 1997;205:367-373
5. Goldberg SN, Solbiati L, Hahn PF, et al. Large-volume tissue abla-

tion with radio frequency by using a clustered, internally cooled electrode technique: laboratory and clinical experience in liver metastases. *Radiology* 1998;209:371-379

6. Matsui O, Takashima T, Kadoya M, et al. Liver metastases from colorectal cancers: detection with CT during arterial portography. *Radiology* 1987;165:65-69
7. Soyer P, Bluemke DA, Hruban RH, Sitzmann JV, Fishman EK. Hepatic metastases from colorectal cancer: detection and false-positive findings with helical CT during arterial portography. *Radiology* 1994;193:71-74
8. Soyer P, Levesque M, Elias D, Zeitoun G, Roche A. Preoperative assessment of respectability of hepatic metastases from colonic carcinoma: CT portography vs sonography and dynamic CT. *AJR Am J Roentgenol* 1002;159:741-744
9. Heiken JP, Weyman PJ, Lee JKT, Balfe DM, Picus D, Brunt EM, et al. Detection of focal hepatic masses: prospective evaluation with CT, delayed CT, CT during arterial portography, and MR imaging. *Radiology* 1989;171:47-51
10. Leen E, Angerson WJ, Wotherspoon H, Moule B, Cook TG, McArdle CS. Detection of colorectal liver metastases: comparison of laparotomy, CT, US, and Doppler perfusion index evaluation of postoperative follow-up results. *Radiology* 1995;195:113-116
11. Hahspiel KD, W.Neidl KF, Eichemberher AC, Weder W. Marincek B. Detection of liver Metastases: comparison of superparamagnetic iron-enhanced and unenhanced MR imaging at 1.5 T with dynamic CT, intraoperative US, and percutaneous US. *Radiology* 1995;196:471-478
12. Cosgrove D. Why do we need contrast agents for ultrasound? *Clin Radiol* 1996;51:1-4
13. Blomley MJK, Albrecht T, Cosgrove DO, et al. Improved imaging of liver metastases with stimulated acoustic emission in the late phase of enhancement with the US contrast agent SH U 508A: early experience. *Radiology* 1999;210:409-416
14. , , . Improved imaging of hepatic metastases with delayed pulse inversion harmonic imaging using US contrast agent SH U 508A. 1999;18:372-373
15. , . 2000;19:1-7
16. Burns PN, Wilson SR, Simpson DH. Pulse inversion imaging of liver blood flow: improved method for characterizing focal masses with microbubble contrast. *Invest Radiol* 2000;35:58-71
17. Fretz CJ, Stark DD, Metz CE, et al. Detection of hepatic metastases: comparison of contrast-enhanced CT, unenhanced MR imaging, and iron oxide-enhanced MR imaging. *AJR Am J Roentgenol* 1990;155:763-770

The Detectability of Hepatic Metastases in Candidates of Radiofrequency Ablation: Comparison for Helical CT Scanning and Late-Phase Pulse-Inversion Harmonic Imaging¹

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Purpose: To compare dual-phase helical CT and pulse inversion harmonic US using microbubble contrast agents in the detection of hepatic metastases prior to radiofrequency (RF) ablation.

Materials and Methods: Twenty-one patients in whom hepatic metastases from colorectal cancer had been diagnosed by dual-phase CT scanning and who were considered to be candidates for RF ablation underwent pulse-inversion harmonic US examination. Images were obtained 5 minutes after the bolus injection of microbubble contrast agent SH U 508 A (4.0 g, 300 mg/mL). The number of metastatic tumors revealed by CT and US was determined, and the findings were statistically analysed. The influence of the results of US examination on treatment planning was also evaluated.

Results: In 21 patients, 48 metastatic lesions were detected by helical CT, and 56 lesions by US. These eight additional lesions revealed by US occurred in six patients (29%), and their diameter was 3 - 13 (mean, 7.2) mm. In three of these patients, RF ablation could not be performed, while in the other three, the additional lesions were ablated.

Conclusion: Pulse-inversion harmonic US imaging using microbubble contrast agents may depict small hepatic metastatic tumors that were not apparent at CT. US therefore appears to be useful in the planning of treatment prior to the RF ablation of hepatic metastases.

Index words : Liver, neoplasms
Liver, CT
Liver, US
Ultrasound (US), contrast agents

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