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Colorectal Cancer Recurrence in the Liver: Detection by PET

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Positron emission tomography (PET) has been successfully used in the imaging of various cancers. In this retrospective study, we examined clinical utility of PET in the imaging of liver metastasis from colorectal cancer. Results of PET were compared with those of ultrasonography (US) and contrast-enhanced computer tomography (CT) in 11 liver metastases seen in eight patients with recurrent colorectal cancer. The detection rates were 73% (8 of 11 metastases) by US, 73% (8 of 11 metastases) by CT, and 82% (9 of 11 metastases) by PET. PET correctly identified US-negative and CT-negative liver metastases. However, PET was negative in one patient with minute metastases. The findings in our preliminary study were in agreement with those of previous reports. A prospective study is warranted to determine the optimum role of PET in the management of patients with colorectal liver metastasis.

Key words : Colon cancer, Liver metastasis, Positron emission tomography (PET), ^{18}F-fluorodeoxyglucose (FDG), Glucose metabolism

INTRODUCTION

The liver is the most common site of recurrence after potentially curative surgery for colorectal cancer [6]. In general, ultrasonography (US) and computed tomography (CT) are used for the detection of liver metastasis [11]. Positron emission tomography (PET) using ^{18}F-fluorodeoxyglucose (FDG) is now available as a diagnostic tool and is used successfully in the diagnosis of various cancers [12, 13, 14]. In this retrospective study, we compared this new imaging technique with US and CT in the detection of liver metastasis in patients with recurrent colorectal cancer, and we discussed the utility of PET in the diagnosis of liver metastasis from colorectal cancer.

SUBJECTS AND METHODS

Among colorectal survey patients who underwent whole-body FDG PET in our institution between September 1994 and May 1997, eight were finally found to have recurrence in the liver. The final diagnoses were obtained by resected specimens (n=3) or clinical and radiological follow-ups (n=5). In these eight patients, the results of PET were retrospectively compared with those of US and contrast-enhanced CT (portal and venous phase). US was performed using either SSA-270A , SSA-250A (Toshiba, Tokyo), LOGIQ 500 (Yokogawa, Tokyo), or SSD-650CL (Aloka, Tokyo). US, CT and PET were performed within 2 months of each other.

Fluorine-18 was produced using an on-site medical cyclotron (CYPRIS HM-18, Sumitomo Heavy Industries, Tokyo). The PET study was carried out with ECAT EXACT 47 whole-body PET scanners (Siemens/CTI, Knoxville, TN, USA). Informed consent was obtained from all patients. Patients fasted for at least 4 hours prior to PET. Forty-five minutes after the administration of 260 to 370 MBq of FDG, emission scanning was performed from the pelvis to the maxilla for 7 minutes in each bed position. Transmission scanning for attenuation correction was performed in six

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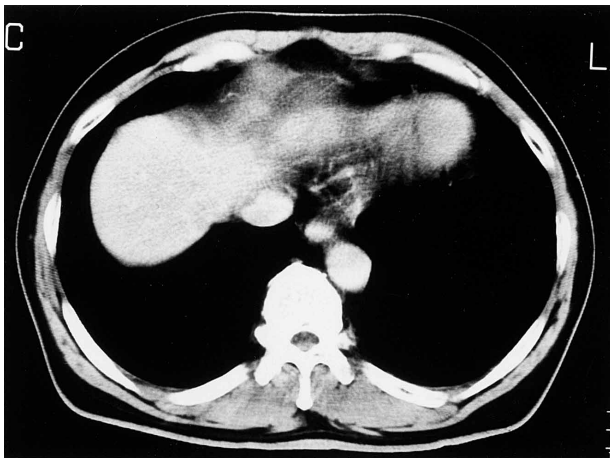
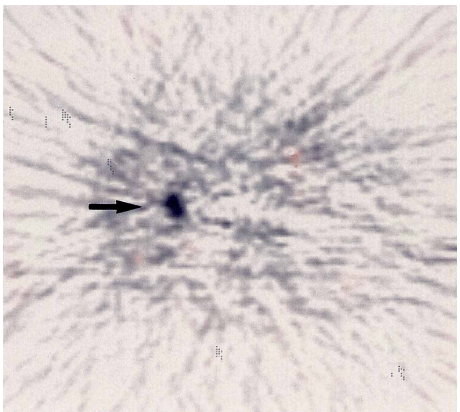
Table Patient characteristics

Patient		Liver metastasis			US	CT	PET	CEA	Methods used in
No.	Age/sex	Number	Size	Location				(N < 7 ng/ml)	measuring tumor size
1	70/M	2	1.8cm	S8	FN	TP	TP	532	CT
			2cm	S7	TP	TP	TP		
2	71/M	1	8.7cm	S4,5	TP	TP	TP	31	CT
3	58/M	1	1.5cm	S8	TP	FN	TP	85	US
4	55/M	1	10cm	S6	TP	TP	TP	2620	CT
5	68/M	1	3.2cm	S5	TP	TP	TP	2.9	Surgery
6	69/M	1	3.3cm	S4	TP	TP	TP	11.7	US
7	54/F	2	2cm	S4	TP	TP	TP	3.4	Surgery
			2.5cm	S4	TP	TP	TP		
8	50/F	2	minute	NR	FN	FN	FN	11	Surgery
			minute	NR	FN	FN	FN		

FN=false-negative, TP=true-positive, NR=not recorded



a



b

Fig. 1 (a) Liver metastasis was not discernible on a CT scan taken at the same time as the PET study although the metastasis became visible on a CT scan taken 2 months later. (b) A transaxial tomographic PET image showing high FDG uptake in the liver (arrow).

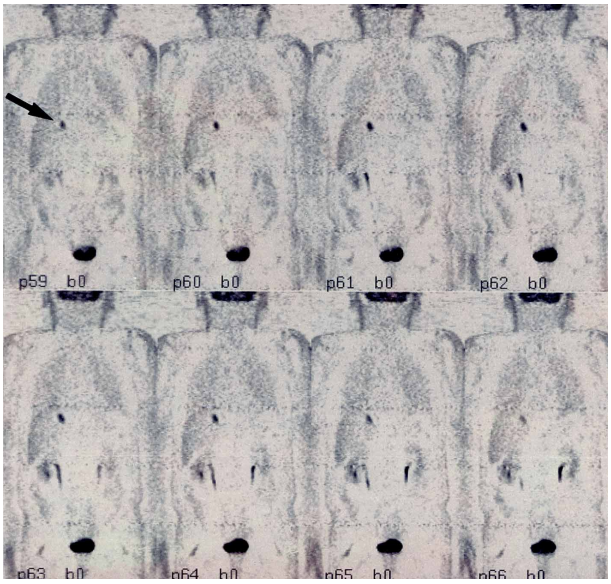


Fig. 2 Eight consecutive coronal tomographic images demonstrating high FDG uptake in the liver (arrow). High FDG uptake in the brain and urinary tract is normal.

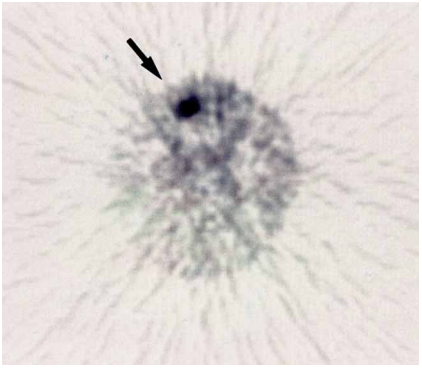


Fig. 3 A transaxial tomographic PET image showing high FDG uptake in the head that was subsequently diagnosed as tongue cancer (arrow).

patients. PET images were visually evaluated, and high FDG uptake was considered abnormal.

RESULTS

There were a total of 11 liver metastases in the eight patients, ranging in size from less than 1 cm to 10 cm in diameter. Patient characteristics are shown in the Table. In a patient (patient 1) with two metastases, US detected only one metastasis whereas CT and PET correctly identified both metastases. In a patient (patient 3) with increased serum carcinoembryonic antigen (CEA) levels, a low echoic area was recognized on US, and liver metastasis was suspected, whereas CT showed no abnormality. On PET images, high FDG uptake was evident in this patient (Figs. 1 and 2). High FDG uptake was noted in the head, and tongue cancer was found incidentally (Fig. 3). The liver metastasis was recognizable 2 months later on CT images. In another patient (patient 6) with increased serum CEA levels, PET correctly identified

liver metastasis together with unexpected peritoneal metastases.

Using PET, we missed two of the 11 metastases. In a patient (patient 8) with increased serum CEA levels, a small retroperitoneal recurrence was suspected by CT, whereas no abnormality was noted by PET. At laparotomy retroperitoneal recurrence was confirmed and resected. During surgery, two minute liver metastases were found on the surface of the liver by visual inspection, which were subsequently treated by electrocoagulation. US and CT also missed these two metastases. The final detection rates were 73% (8 of 11 metastases) by US, 73% (8 of 11 metastases) by CT, and 82% (9 of 11 metastases) by PET.

DISCUSSION

PET has been used in oncology patients since 1982 [4, 15]. In 1990, the development of whole-body scanning facilitated survey of the entire body [7], and thus accelerated the use of PET in the field of oncology due to the disseminating nature of the diseases. Many studies have shown the usefulness of FDG PET in the diagnosis of various cancers. With respect to colorectal liver metastasis, several studies on diagnosis by PET have been reported from institutions overseas [1, 2, 3, 5, 10, 15]. Our study is the first in Japan.

In our study, PET correctly identified US-negative (patient 1) and CT-negative (patient 3) liver metastases. US was negative probably due to the isoechoic nature of the tumor. CT missed the 1.5-cm metastasis at the surface of the liver and just beneath the diaphragm, while PET clearly depicted the tumor. However, PET was negative in one patient with minute metastases (patient 8). Although our study group was small, our findings are in agreement with those of previous reports.

To our knowledge, among the previously reported studies, Delbeke *et al.* [3] dealt with the largest number of patients with liver metastasis from colorectal cancer. In their study, a total of 104 liver metastases and 34 extrahepatic recurrences in 52 patients were analyzed. The sensitivity of PET was 91%, compared with 81% for CT and 97% for CT-portography. Although the sensitivity of CT-portography was high, the false-positive rate was also high. In the final analysis, PET was more accurate (92%) than CT (78%) and CT-portography (80%). When lesions measuring 1 cm or more were evaluated, the sensitivity and accuracy of PET were 99% and 98%, respectively. Furthermore, PET was more accurate (92%) than CT (71%) for detecting extrahepatic metastases. However, eight of 18 metastases less than 1 cm in size were negative by PET. The current PET scanners have obvious limitations in detecting lesions measuring less than 1 cm [1, 5]. Further development of the PET scanner is necessary to detect these small metastases.

To date, it has not been proved that early detection of recurrence improves the prognosis of colorectal cancer [8]. In selected patients, however, hepatectomy for liver metastasis prolongs survival [9]. We believe that improved patient selection may result from advances in tumor imaging.

Our preliminary study and the previous studies suggest the utility of PET in detecting hepatic metastases from colorectal cancer. A prospective study is warranted to determine the optimum role of PET in the management of patients with colorectal liver matastasis.

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