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Ga-67 tumor scan in malignant diffuse mesothelioma —Comparison with CT and pathological findings—

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Malignant diffuse mesothelioma is characterized by more difficult diagnosis and worse prognosis than other pleural tumors. In the Department of Thoracic Surgery, Hyogo Medical Center for Adults, 11 patients underwent panpleuropneumonectomy for this disease between January, 1988 and March, 1993. In 7 of these cases, Ga-67 scans were obtained before the operation.

To clarify the factors affecting Ga-67 uptake in the pleural tumor, we compared Ga-67 uptake on the involved side of the thorax with CT and the pathological findings of the tumor. Regarding the use of Ga-67 scan imaging for the diagnosis of this disease, a number of related findings must be considered, such as an encircled wide Ga-67 uptake in the thickened pleural involvement and a diffuse slight Ga-67 uptake on the affected side with very slight involvement of the pleura. When the involved pleural thickness was over 6 mm, a definite correlation was found between the degree of Ga-67 uptake and the macroscopic thickness of mesothelioma in resected specimens. Thickness of the pleura on CT images demonstrates the real tumor thickness in the case of thickened involvement but in the case of thin involvement the real thickness of active mesothelioma could not be identified. No definite correlation was found between the degree of Ga-67 uptake and the histological type, or among microscopic findings, such as the extent of tumor parenchyma, interstitial volume and tumor vascularity.

Our results suggest that the Ga-67 scan is very useful for revealing the extent of pleural involvement, especially when this involvement is more than 6 mm thick.

Key words: malignant diffuse mesothelimoa, Ga-67 scan, CT findings, pathological findings

INTRODUCTION

MALIGNANT DIFFUSE MESOTHELIOMA is difficult to diagnose, but is becoming increasingly prevalent throughout the world.[1] In the diagnosis of this disease, chest X-rays and CT scans are routinely obtained,[2–4] along with further examinations such as pleural biopsy,[5] cytology of the pleural effusion and determination of the presence of acid mucopolysuccharide[6] in the pleural effusion. The use of Ga-67 scans in the diagnosis of this disease has been investigated by numerous authors.[7–10] No previous report has compared Ga-67 uptake and pathological findings in resected specimens.

In this paper, we discuss the mechanism of Ga-67 uptake on the affected side of the involved pleura by comparing CT findings and resected specimen pathological findings.

MATERIALS AND METHODS

The subjects were 7 patients undergoing panpleuropneumonectomy for malignant diffuse mesothelioma. Two of these cases were of sarcoma, 3 were of the epithelial type, and 2 were of the mixed type. The Ga-67 scan was performed 72 hours after i.v. injection of Ga-67 citrate at a dose of 111 MBq. The average interval between

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Table 1 The findings of chest radiograph, CT and Ga-67 images

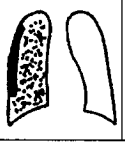
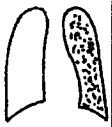
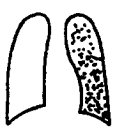
cases	1. 68M	2. 52M	3. 44M	4. 70M	5. 67M	6. 55F	7. 42M
Chest Radiograph							
CT							
Ga-67							

Table 2 Relationship between Ga-67 scan findings and pathological findings

cases	1. 68M	2. 52M	3. 44M	4. 70M	5. 67M	6. 55F	7. 42M
Ga-67 scan							
Pathological findings							
Histological type	Sarcoma type	Sarcoma type	Epithelial type	Epithelial type	Epithelial type	Mixed type	Mixed type
Thickness of pleura (mm)	12.0 ~ 17.0	1.0 ~ 6.0	2.5 ~ 5.0	23.0 ~ 28.0	0.5 ~ 1.0	6.0 ~ 17.0	10.0 ~ 27.0
Parenchymal volume	+	++	++	++	++	++	+++
Interstitial volume	+++	++	+	+	+	++	+
Vascularity	++	+++	++	++	+	++	+

Ga-67 scan and operation was 2 weeks. Ga-67 scan images were obtained in the anterior and posterior projections by means of a scinticamera (GCA-90A-EZ, Toshiba, Japan) with a medium energy collimator. CT scans (TCT-900S, Toshiba, Japan) were obtained to evaluate the pleural thickness and pleural effusion. The thickness of the affected pleura was measured on resected specimens. The extent of the pleural involvement and Ga-67 uptake were compared. To clarify the mechanism of Ga-67 uptake in the tumor, the extent of tumor parenchyma, interstitial space and tumor vascularity were also measured. Each of these items was classified by one pathologist (Dr. Sashikata) into one of 3 categories: slight (+), moderate (++), severe (+++).

RESULTS

1) Comparative study of the findings of chest radiograph, CT scan and Ga-67 scan (Table 1)

When pleural thickening was present on the lateral, apical or mediastinal side on chest X-ray, compatible pleural thickening on CT and marked Ga-67 uptake in this area were recognized (in cases 1, 4, 6 and 7). Massive or moderate pleural effusion at the lung base on chest X-ray masked the real pleural involvement (in cases 2, 5, 6 and 7). In the case of pleural effusion in the space between the involved thickened parietal pleura and thin visceral pleura accompanied by adjacent lung collapse, it was rather difficult to identify the real pleural involvement (in case 7). Furthermore, thin pleural density on the CT image, with or without pleural effusion, did not necessarily indicate specific pleural thickening in this disease.

Compared to the CT findings, the Ga-67 scan image

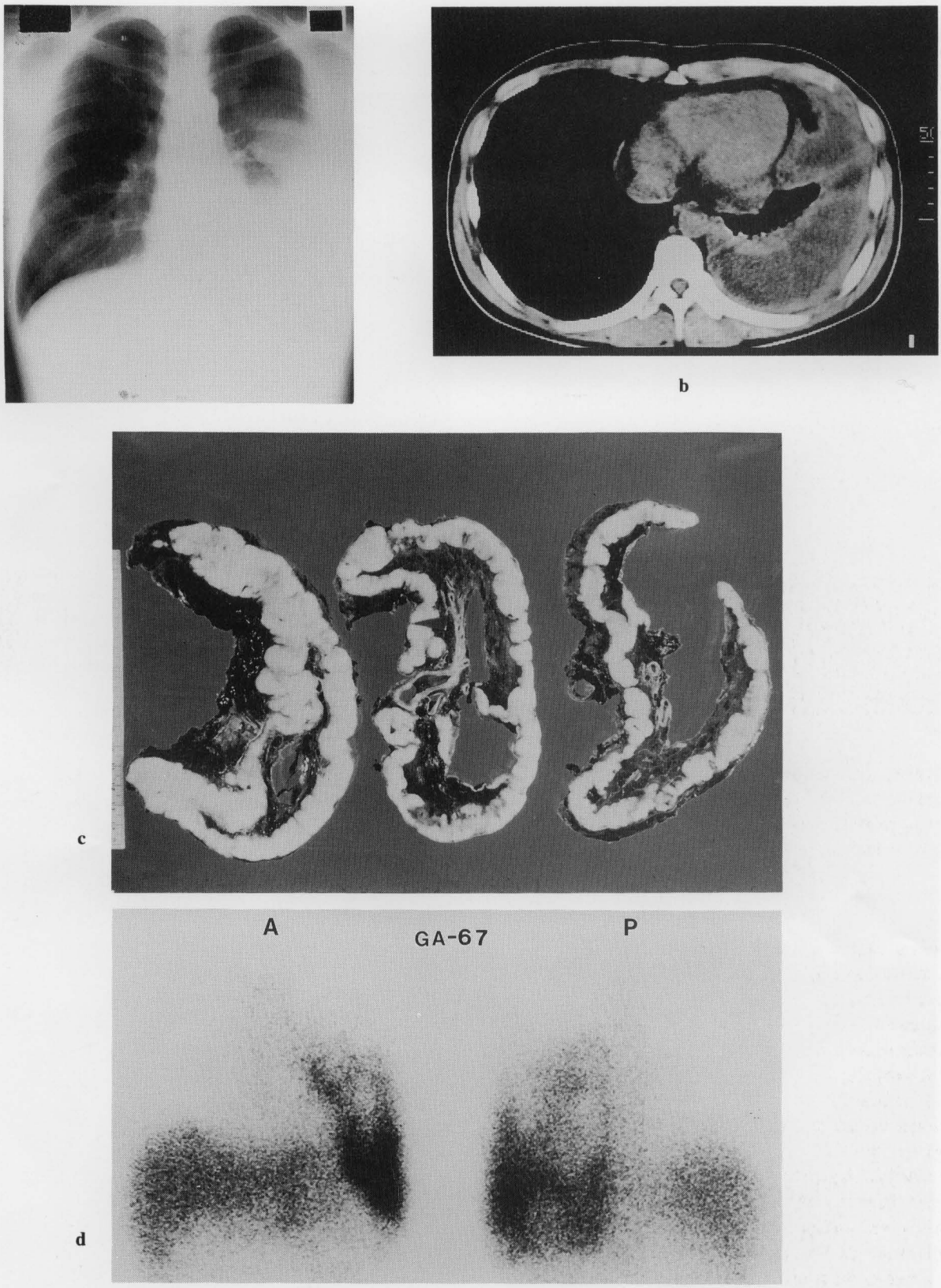
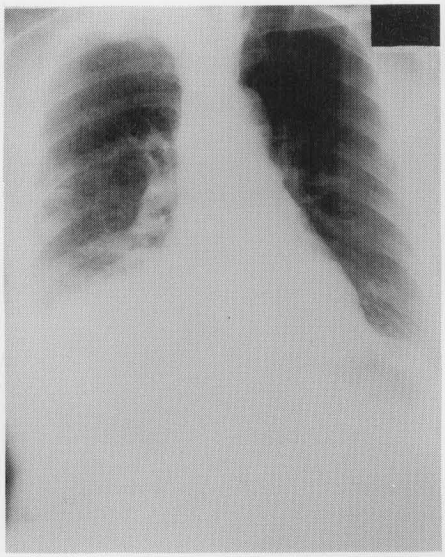
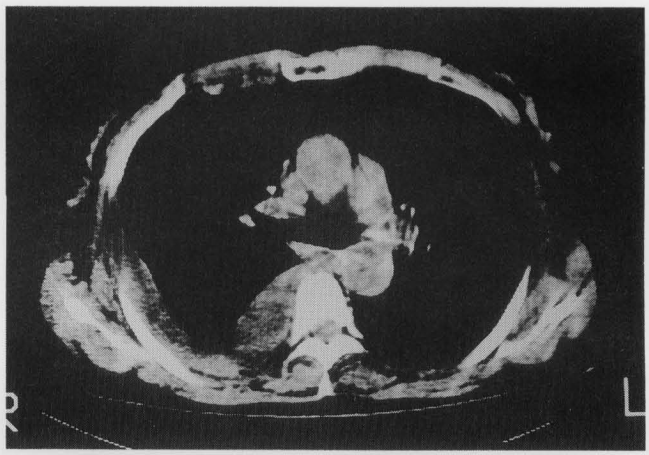


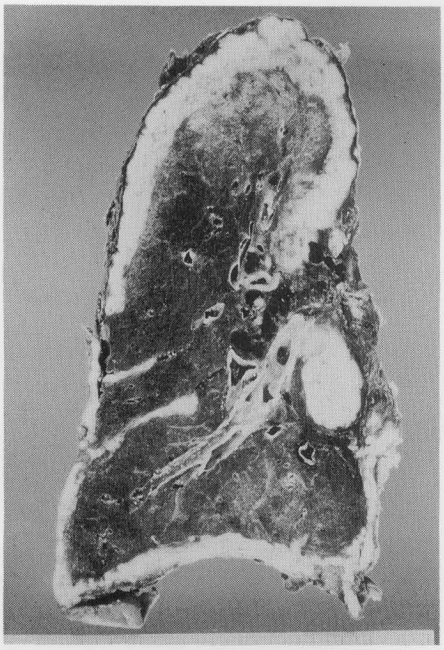
Fig. 1 A case of left malignant diffuse pleural mesothelioma (mixed type), 42 y.o. male (case 7). Pleural thickness: 10–27 mm. a) Chest radiograph: Chest radiograph shows massive left pleural effusion. b) CT: CT image shows diffuse pleural thickening and massive pleural effusion. c) Macroscopic findings of resected specimen (cross section): Diffuse 10–30 mm thickened pleural involvement is seen. d) Anterior and posterior Ga-67 images: Ga-67 scan images show diffuse Ga-67 uptake in the left middle and lower lung fields.



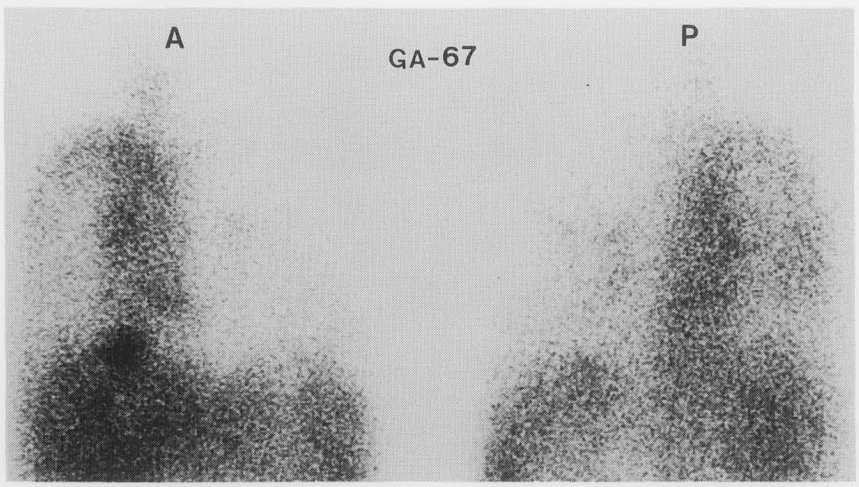
a



b



c



d

Fig. 2 A case of right malignant diffuse pleural mesothelioma (mixed type), 55 y.o. female (Case 6). Pleural thickness: 6–17 mm.
a) Chest radiograph: Chest radiograph shows slight right pleural effusion and pleural thickening in the right apex.
b) CT: CT image shows 5–15 mm thickened pleura with slight pleural effusion.
c) Macroscopic findings of resected specimen (coronal section): Coronal section photo shows diffuse pleural involvement of 5–20 mm thickness.
d) Anterior and posterior Ga-67 scan images: Ga-67 scan images show a typical Ga uptake in the right apical region extending to the mediastinal and lateral lung field.

showed specific involvement of malignant mesothelioma. Encircled Ga-67 uptake and diffuse slight Ga uptake were important findings in this disease.

2) Relationship between Ga-67 scan findings and pathological findings (Table 2)

A positive Ga-67 scan was obtained in 5 of 7 cases.

In case 5 (epithelial type), there was pleural involvement to a depth of only 1 mm and the Ga-67 scan was negative. Another negative Ga-67 scan was seen in case 2 (sarcoma type), in which the thickness of the pleura was 1–6 mm. In almost of the pleura involved in this case, pleural thickness was not more than 3 mm. But in case 3 (epithelial type), even though the affected pleural thickness was only 2.5–5.0 mm, a slightly positive Ga-67 scan was obtained.

The other 5 cases (1 sarcoma type, 2 epithelial type and 2 mixed type) had a pleural thickness greater than 6 mm and gave positive Ga-67 scans. As the thickness of the pleural involvement increased, Ga-67 uptake increased. As shown in Table 2, no definite correlation was found among the degree of Ga-67 uptake, histological type, extent of tumor parenchyma, interstitial volume and tumor vascularity.

3) Case presentation

Case 7 N.M. 42 y.o. male (mixed type)

The chest radiograph showed massive left pleural effusion (Fig. 1a). The CT image at the level of the lower lung field showed diffuse pleural thickening and massive pleural effusion between thickened parietal and visceral pleura (Fig. 1b). It was difficult to differentiate between the adjacent collapsed lung and thickened pleura.

Photos of cross section slices of the middle to lower lung fields of the left resected specimen showed diffuse 20–30 mm thickened pleural involvement, which was prominent in the lower lung field (Fig. 1c). Anterior and posterior Ga-67 scan images revealed encircled positive Ga-67 uptake in the left middle and lower lung fields. This Ga-67 scan image clearly showed the pleural involvement of this disease.

Case 6 K.K. 55 y.o. female (mixed type)

A chest radiograph showed mild pleural effusion and pleural thickening in the right apex and right lower lung field (Fig. 2a). A CT image at the level of the main bronchus showed 5–15 mm thickened pleura along the posteromedial and posterolateral chest walls. At this CT level slight pleural effusion was observed (Fig. 2b). A coronal section photo of the right hilar region of a resected specimen showed diffuse pleural involvement 5–20 mm thick (Fig. 2c). Localized 20 mm sized pleural involvement in the middle mediastinal region was recognized. Anterior and posterior Ga-67 scan images revealed typical encircled positive Ga-67 uptake in the whole right upper lung field extending to the mediastinal pleura. Ga-67 uptake at the site of diaphragmatic pleural involvement was rather difficult to interpret because of overlapping physiological Ga-67 accumulation in the liver. But in this case localized Ga-67 uptake in the anterior lower mediastinal side of the pleura was seen, which corresponded to 20 mm sized pleural involvement in the resected specimen. From Ga-67 scan images, whole pleural involvements were easily recognized.

DISCUSSION

Malignant mesothelioma is a relatively rare disease, whose occurrence is gradually increasing. The prognosis of this disease remains poor with a 50% mean survival rate of 6–12 months for untreated cases and 18–24 months for cases treated by means of combined sequential panpleuropneumonectomy and chemotherapy.[11–13] A chest radiograph is obtained to check for pleural thickening or pleural effusion, and in the case of the former, CT examination is performed to determine the site and extent of pleural thickening and pleural effusion.[2–4] Other examinations generally follow, including pleural biopsy,[5] cytological examination of the pleural effusion, quantification of hyaluronic acid or acid mucopolysuccharide in the pleural effusion.[6] In the present series, we added Ga-67 scan.

Nakano[9] reported that all 11 patients with malignant pleural mesothelioma had an abnormal thoracic Ga-67 accumulation. Six of these had diffuse accumulation over the entire involved hemithorax, and 5 had localized uptake. Diffusely increased uptake over the entire involved hemithorax is the most characteristic Ga-67 scan findings in this disease. All Ga-67 scans were positive in cases of pleural involvement over 10 mm deep on the CT images. In cases with less than 10 mm thick involvement, slight diffuse Ga-67 uptake was observed. For management of this disease, CT is the first imaging method. CT has high sensitivity for the detection of the pleural thickening, pleural effusion and disease beyond the parietal pleura. Sometimes it is difficult to identify diaphragmatic and infradiaphragmatic invasion. It is also difficult to differentiate between interlobar effusion and fissure involvement.[3] On the other hand, Ga scan is a valuable noninvasive technique for differentiation between benign and malignant pleural thickening, with involvement over 6 mm deep. Sensitivity is relatively low but specificity is high.

To clarify Ga-67 uptake in diffuse malignant mesothelioma, important factors are thought to be thickness of the involved pleura and tumor viability. The latter depends on the extent of tumor cell, interstitium and tumor vascularity. In our series, in the resected specimens after pleuropneumonectomy, we studied the relationship between the Ga-67 uptake and the pathological macroscopic and microscopic findings. In 3 of 7 cases with under 5 mm thick involved pleura, one case showed a slight diffuse ^{67}Ga uptake. This is useful information for the diagnosis

of thin involvement of this disease. In the other 2 cases of negative Ga-67 uptake, almost all involved pleura thickness was under 3 mm. The other Ga-67 scan pattern was an encircled highly positive Ga-67 uptake, which corresponded to over 6 mm thick involved pleura. This series comprised a limited number of histologically examined cases, and no definite correlation was made between the Ga-67 uptake and histological type, or the internal structure of the tumor. No definite relationships among them were observed.

Our results suggest that the Ga-67 scan is very useful for revealing the extent of pleural involvement, especially when this involvement is more than 6 mm thick. (The authors are grateful to Mr. John Gelblum for his critical reading of this manuscript.)

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