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Usefulness of FDG-PET imaging for the radiotherapy treatment planning of pyothorax-associated lymphoma

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Pyothorax-associated lymphoma (PAL) is a non-Hodgkin's lymphoma developing in the pleural cavity after a long-standing history of chronic pyothorax (CP). F-18 fluorodeoxyglucose positron emission tomography (FDG-PET) imaging is a useful modality for determination of disease extent of various malignant tumors, including malignant lymphoma, but there have been no reports describing the usefulness of FDG-PET imaging in PAL. Here we report a case of PAL that relapsed after chemotherapy and was successfully treated by radiotherapy. FDG-PET imaging revealed that the tumor was localized to a soft-tissue attenuation mass behind the CP cavity in the right thorax, but did not infiltrate the CP cavity. A total dose of 40 Gy was administered to the area that included the PET-positive lesion, instead of including the entire CP cavity in the radiation field. Although computed tomography (CT) showed a residual mass, no FDG uptake was indicated by FDG-PET imaging performed just after the end of radiotherapy, and additional irradiation was not performed. No sign of relapse was found by FDG-PET imaging 3 months later. FDG-PET imaging was useful for both the planning of radiotherapy and assessing the treatment response of PAL.

Key words: pyothorax-associated lymphoma, FDG-PET, radiotherapy

INTRODUCTION

PYOTHORAX-ASSOCIATED LYMPHOMA (PAL) is a malignant lymphoma appearing in the pleural cavity with chronic pyothorax (CP) after artificial collapse therapy for pulmonary tuberculosis.[1] F-18 fluorodeoxyglucose positron emission tomography (FDG-PET) is important in the determination of the disease extent of various malignancies, including malignant lymphoma.[2] It may be used not only as a staging tool, but also as a planning tool for radiotherapy. Here we report a case of PAL that relapsed after chemotherapy and was successfully treated by radiotherapy. FDG-PET was useful for definition of the target volume in the planning of radiotherapy.

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CASE REPORT

A 78-year-old man who had received artificial collapse therapy for pulmonary tuberculosis when he was 27 years old visited the clinic to receive treatment for hypertension, and showed incidentally abnormal findings on chest radiograph. He was referred to a local general hospital. Chest computed tomography (CT) demonstrated a huge mass shadow that connected to the cavity associated with CP in the lower lobe of the right lung (Fig. 1). Transbronchial lung biopsy revealed findings of diffuse large B-cell lymphoma, and the patient was diagnosed with PAL. He was treated with 8 courses of CHOP comprised of cyclophosphamide, doxorubicin, vincristine, and prednisolone, and near complete response was achieved (Fig. 2).

Four months later, however, the patient was diagnosed with recurrence, and was referred to our hospital. Chest CT showed the emergence of a soft-tissue attenuation mass behind the CP cavity in the right thorax (Fig. 3a), and serum soluble interleukin-2 receptor (sIL-2R) level was

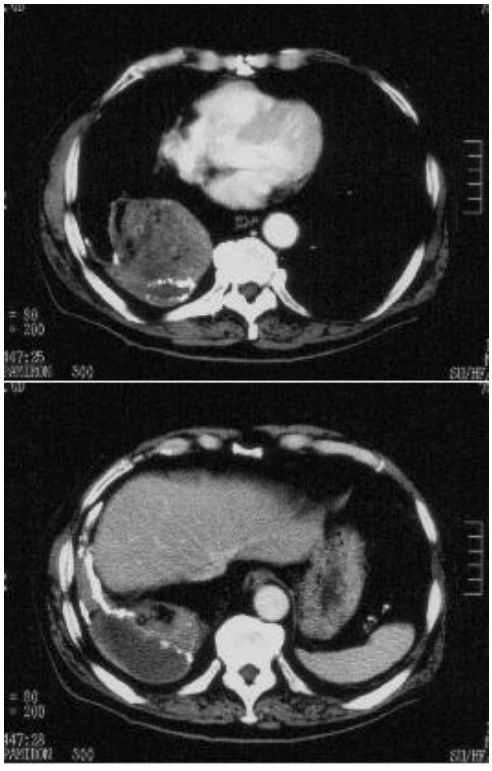

Fig. 1 Pretreatment enhanced chest CT showing a huge mass shadow connected to the CP cavity in the lower lobe of the right lung.

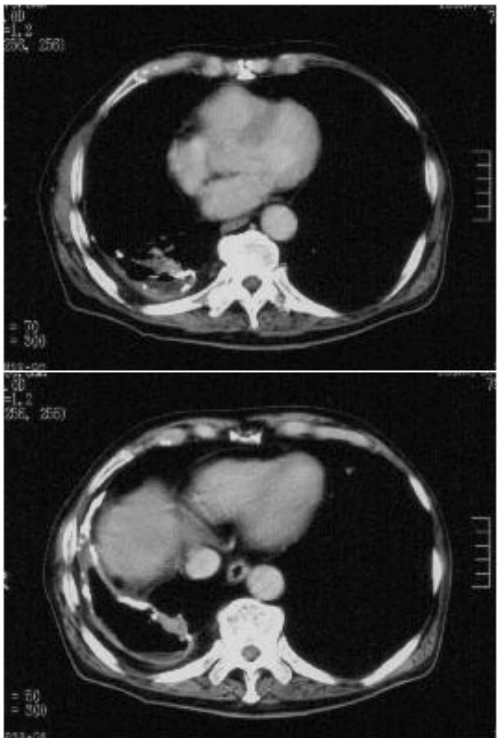

Fig. 2 Enhanced chest CT performed after 8 courses of CHOP therapy revealed that the mass had almost disappeared.

elevated to 988 U/m*l* (normal range 135–483). To evaluate the extent of the disease, FDG-PET imaging was performed using a Siemens EXACT HR+ scanner (Siemens-CTI, Knoxville, TN, USA), which revealed tumor uptake only at the back of the right thorax (Fig. 3b). There was also low FDG uptake at the left, above the tumor uptake, which was due to volume loss of the lower lobe of the right lung. The patient was treated with external beam irradiation because he had already been treated with 8 courses of CHOP and the lesion was localized to the right thorax. FDG-PET images were fused with those of CT slices using fusion software (Dr. View 5.3.0; Asahi Kasei Information Systems, Tokyo, Japan). Fusion images revealed that FDG uptake was localized to the soft-tissue attenuation mass behind the CP cavity in the right thorax (Fig. 3c), but did not infiltrate the CP cavity, and we defined this lesion as representing the gross tumor volume (GTV) used for radiotherapy treatment planning. The clinical target volume (CTV) included the GTV plus regions of possible microscopic spread (10 mm). The planning target volume encompassed the CTV plus a 10-mm margin. The external beam irradiation was delivered with parallel opposed portals and oblique fields using a 10 MV photon beam. The radiation dose was 40 Gy to the lesion. The dose per fraction was 2 Gy, 5 fractions per week. V_{20}, the total lung volume exceeding 20 Gy, was 3%. No severe side effects were observed during the treatment period.

Chest CT and FDG-PET imaging were performed at 2 days and 5 days, respectively, after the radiotherapy. Although CT showed a residual mass (Fig. 4a), no FDG uptake was shown by FDG-PET imaging (Fig. 4b). The serum sIL-2R level decreased to 625 U/m*l*. Three months after the treatment, chest CT and FDG-PET imaging were again performed, and no sign of relapse was shown. CT showed a reduction of the tumor size (Fig. 5a), and FDG-PET imaging showed no FDG uptake (Fig. 5b). The serum sIL-2R level decreased to 538 U/m*l*.

DISCUSSION

PAL is a non-Hodgkin's lymphoma (NHL) developing in the pleural cavity after a long-standing history of CP. It is reported that about 90% of the cases are diffuse large B-cell lymphoma, and the 5-year survival rate is about 20%.[1] Standard treatment for PAL has not been established, and PAL is often treated like ordinary NHL, though the prognosis is poor.

Excepting sporadic case reports, there have only been a few reports on radiotherapy of PAL, and it is unclear whether the entire CP cavity should be irradiated. Aruga et al. reported that seven patients with PAL received radiotherapy and none of them showed recurrence in the CP cavity, regardless of whether the radiation fields encompassed the whole CP cavity or not, and one patient whose radiation field encompassed the entire CP cavity

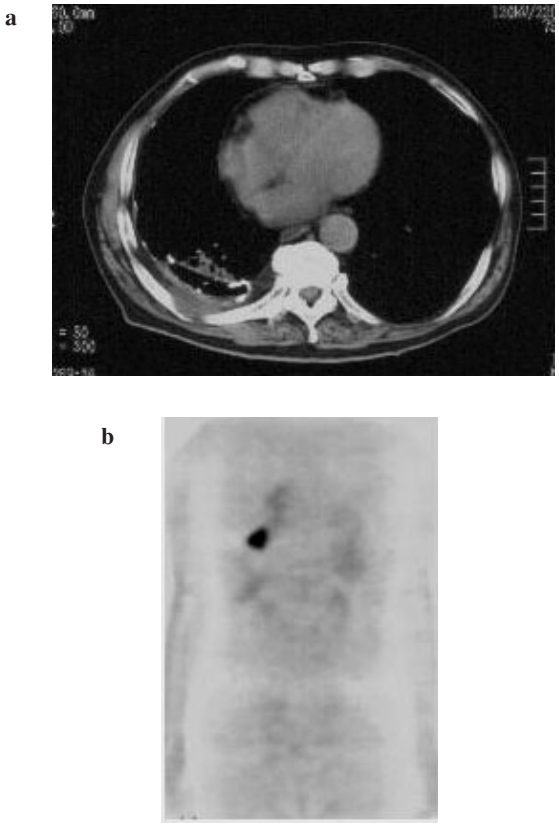

Fig. 3 Chest CT and FDG-PET imaging performed prior to radiotherapy. (a) Plain chest CT showed the emergence of a soft-tissue attenuation mass behind the CP cavity in the right thorax 4 months after chemotherapy. (b) Coronal FDG-PET imaging revealed tumor uptake only at the back of the right thorax. Low FDG uptake due to volume loss of the lower lobe of the right lung was also seen at the left, above the tumor uptake. (c) Fusion PET and CT images revealed that FDG uptake was localized to the soft-tissue attenuation mass behind the CP cavity in the right thorax.

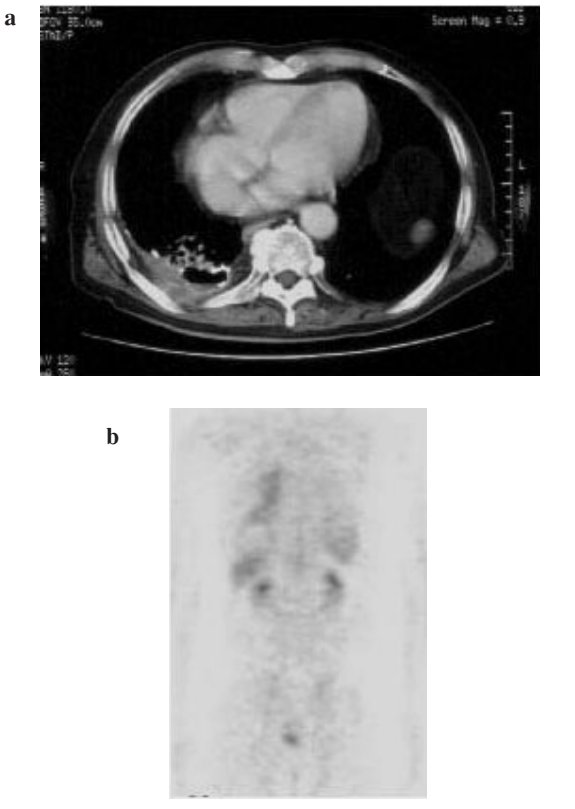

Fig. 4 Chest CT and FDG-PET imaging performed at 2 days and 5 days, respectively, after radiotherapy. (a) Enhanced chest CT showing a residual mass. (b) No intensive FDG uptake was shown by coronal FDG-PET imaging.

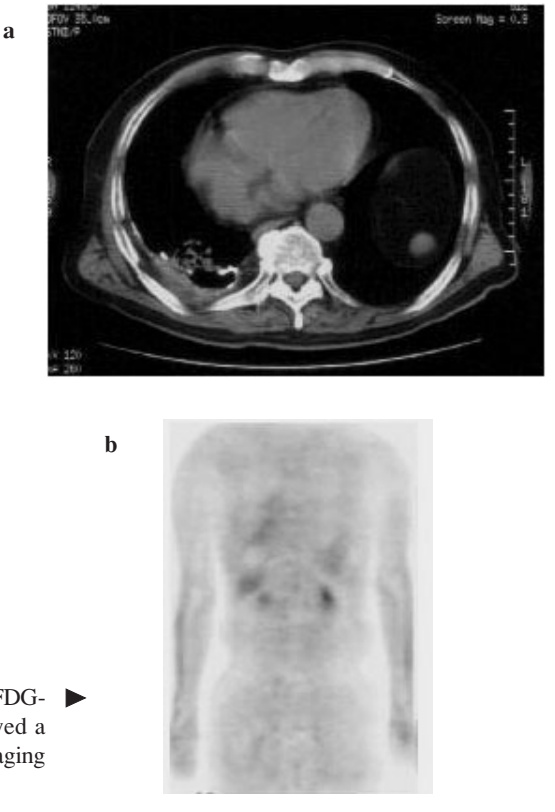

Fig. 5 Three months after the radiotherapy, chest CT and FDG-PET imaging were performed. (a) Plain chest CT showed a reduction in the size of the mass. (b) Coronal FDG-PET imaging showed no intensive FDG uptake. ▶

succumbed to fatal pneumonia.[3] Although inclusion of the entire CP cavity in the radiation field may prevent treatment failure, it also would lead to wide irradiation of the normal lung. V_{20} has been correlated with the development of pneumonitis.[4,5] Graham et al. reported no incidence of pneumonitis for V_{20} of less than 22%.[5] In the present case, V_{20} was only 3% because only the soft-tissue attenuation mass behind the CP cavity showing FDG uptake was irradiated, whereas if the entire CP cavity was irradiated, V_{20} would have increased to 26%.

Some reports have shown the usefulness of gallium-67 (^{67}Ga) scintigraphy for the diagnosis and assessment of treatment response of PAL.[3,6] To our knowledge, there have been no reports describing the usefulness of FDG-PET imaging in PAL. However, FDG-PET imaging has become a reliable method for staging and monitoring the therapy response in lymphoma, and has been found superior to ^{67}Ga scintigraphy.[2] Spaepen et al. reported that there were no false-positive results and only 11 false-negative results on 93 PET scans performed as posttreatment evaluation of NHL.[7] Zinzani et al. also performed extensive analysis of the reliability of PET after induction treatment in patients with Hodgkin's disease and agressive NHL, and reported that there were no false negative results among the 75 PET scans performed.[8] Patients with lymphoma often have a residual mass after completion of therapy. However, if there is no FDG uptake in the residual mass, recurrence is unlikely. Nonetheless, this does not exclude minimal residual disease. In the present case, however, a residual mass was shown by CT after radiotherapy of 40 Gy, and additional irradiation was not performed because no FDG uptake was seen in the residual mass, and no sign of relapse was found by FDG-PET imaging 3 months later. This case report has the limitation that the follow-up period was only 3 months after the patient finished radiotherapy. Thus, the possibility of relapse, particularly occurring outside the radiation field, cannot be denied because the patient was treated by radiotherapy alone. It is uncommon to evaluate the therapy response immediately after the end of radiotherapy; however, in the present case, from the perspective that treatment interruption should be avoided in order to maintain the treatment effect, we evaluated the treatment effect just after radiotherapy to be ready to perform additional irradiation if necessary.

In conclusion, this case suggested that FDG-PET imaging may be useful for both the planning of radiotherapy and the assessment of the treatment response of PAL.

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