

Fluorine-18-Fluorodeoxyglucose Positron Emission Tomography in Technetium-99m-Hydroxymethylenediphosphate Negative Bone Tumors

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CASE REPORTS

We have encountered two cases of bone tumors with high ^{18}F -fluorodeoxyglucose (FDG) uptake and negative $^{99\text{m}}\text{Tc}$ -HMDP bone scintigraphy, including a patient with myeloma and a patient with a metastatic bone tumor from esophageal cancer. Bone scintigraphy with a $^{99\text{m}}\text{Tc}$ -phosphate complex reflects osteoblastic activity in the bone tissue surrounding the tumor, whereas the accumulation of FDG is associated with the metabolic activity of the tumor itself. An FDG-PET study can therefore be used as a complementary study for the detection and follow-up of bone tumors when a $^{99\text{m}}\text{Tc}$ -phosphate bone scintigram is negative.

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Bone scintigraphy with $^{99\text{m}}\text{Tc}$ -phosphate complexes is widely used for the examination of both primary and metastatic tumors of bone because of its high sensitivity (1,2). However, some tumors are negative with bone scintigrams (3–5). Fluorine-18-2-fluoro-2-deoxy-D-glucose (FDG) accumulates in many malignant tumors (6–10), including lesions in bone (11–13). We report two cases of bone tumors with high FDG uptake but negative bone scintigraphy.

METHODS

The FDG-PET studies were performed with the Headtome III (Shimadzu Corp. and Akita Noken, Japan) (14) and five contiguous slices were obtained 45 min after the injection of FDG (185 MBq). The acquisition time was 15 min. The tumor-to-muscle ratio was used as an index of FDG accumulation.

A whole-body bone scintigram was also obtained starting 4 hr after an intravenous injection of 740 MBq of $^{99\text{m}}\text{Tc}$ -hydroxymethylenediphosphate (HMDP) with a scintillation camera (GCA901A/WB, Toshiba, Japan).

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Patient 1

A 44-yr-old man was admitted to our hospital for evaluation of an abnormal chest x-ray. The chest radiograph and x-ray CT demonstrated an osteolytic lesion with an expansile margin in the right 3rd rib (Fig. 1A). The FDG-PET image revealed a marked accumulation in the tumor (Fig. 1B) with a tumor-to-muscle ratio of 7.5. The bone scintigram with $^{99\text{m}}\text{Tc}$ -HMDP showed no abnormality (Fig. 1C). After the PET study, a needle biopsy was performed and the histopathological diagnosis of myeloma was confirmed.

Patient 2

A 57-yr-old man was admitted to our hospital for radiotherapy to a right-neck lymph node metastasis originating from esophageal cancer. After the completion of radiotherapy, an FDG-PET study was performed to evaluate the response to radiotherapy. FDG-PET demonstrated a decreased accumulation in the right-neck tumor compared with that before radiotherapy (Fig. 2A). The tumor-to-muscle ratio decreased from 11.6 to 3.8. However, high FDG accumulation was seen in the left neck. The tumor-to-muscle ratio of the left-neck mass was 8.7. X-ray CT revealed a metastatic lesion in the 6th cervical spine (Fig. 2B). A bone scintigram with $^{99\text{m}}\text{Tc}$ -HMDP showed no abnormality (Fig. 2C).

DISCUSSION

Bone scintigraphy with $^{99\text{m}}\text{Tc}$ -phosphate complex is widely used for examination of tumors in bone because of its high sensitivity (1,2). Most malignant lesions in bone have an increased accumulation of $^{99\text{m}}\text{Tc}$ -phosphate complex due to the increased osteoblastic activity or hyperemia of the bone tissue around the tumor (15). However, there are some bone tumors that result in a negative bone scintigram (3–5). Multiple myeloma is known to be one bone tumor with a negative bone scintigram (3). It has been suggested that the bone scintigram is negative because myeloma cells produce an osteoclast-activating factor which promotes bone resorption without osteoblastic change (16). The patient with myeloma that we studied

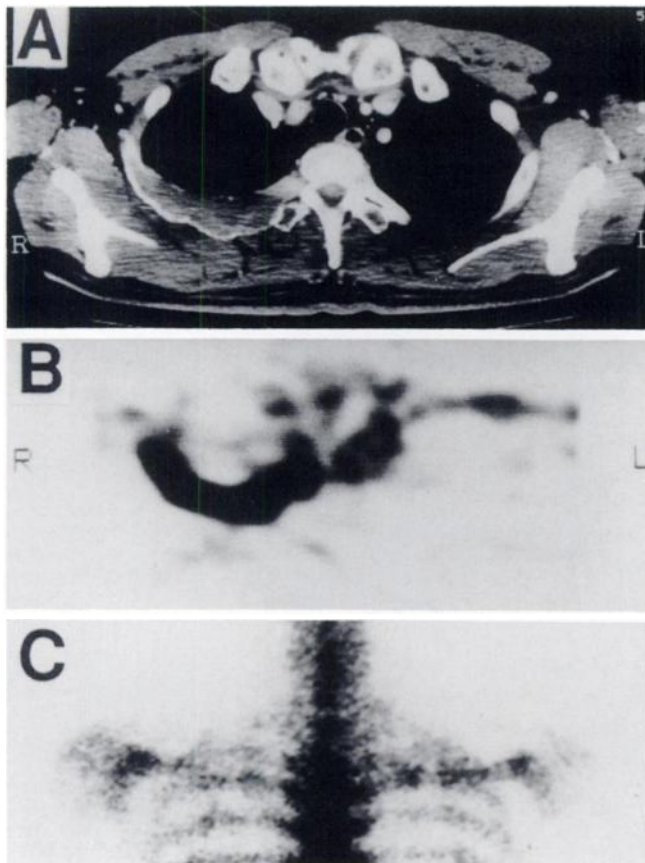


FIGURE 1. A 44-yr-old man (Patient 1) with myeloma in the right 3rd rib. (A) X-ray CT showed an expansile lesion in the right 3rd rib. (B) FDG-PET at the same level showed a high accumulation in the tumor. (C) Technetium-99m-HMDP bone scintigram showed no abnormality.

had a negative bone scan with ^{99m}Tc -HMDP, but the lesion demonstrated increased metabolic activity with FDG.

Most bone metastases show an increased uptake of ^{99m}Tc -phosphate complex (1,2). However, the bone scintigram in our patient with a metastatic lesion in the cervical spine from esophageal cancer showed no such abnormality. A highly destructive bone tumor may result in minimal osteoblastic activity and show no significant radionuclide accumulation (5). When the tumor grows very rapidly or is highly destructive, the bone tissue surrounding the tumor may not be able to react sufficiently enough to increase its osteoblastic activity (17). It is also possible that the tumor produces some humoral factors which promote bone destruction and depress the osteoblastic activity (12).

FDG has been reported to accumulate in many kinds of human malignant tumors (6–10), including bone tumors (11–13). Kern et al. first reported the usefulness of FDG-PET for bone tumor imaging (11), and several reports have suggested a correlation between the uptake of FDG and histological grading (12,13). We have encountered a high accumulation of FDG in myeloma and metastatic bone tumor from esophageal cancer. It is possible that FDG accumulation in myeloma is due to increased

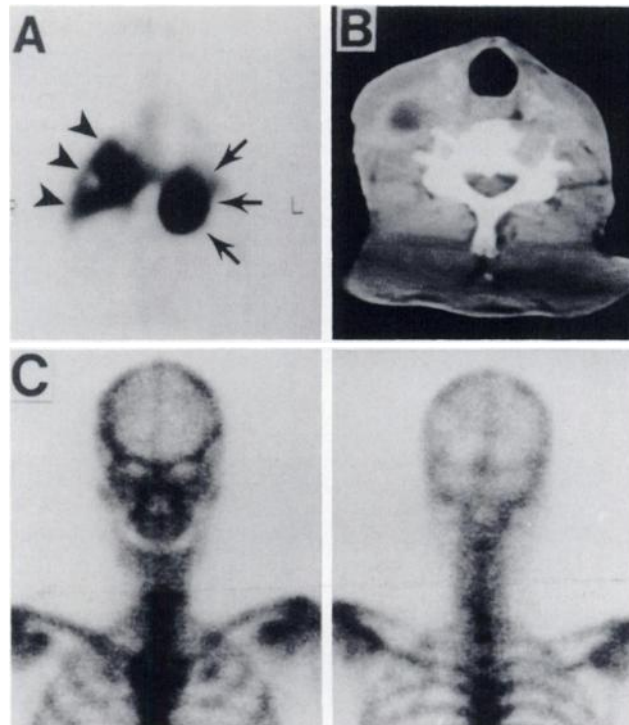


FIGURE 2. A 57-yr-old man (Patient 2) with a metastatic bone tumor in the 6th cervical spine and postirradiated right-neck lymph node metastases. (A) The FDG-PET image showed a decreased accumulation in the right neck mass (arrowheads) and a high accumulation in the left side of the 6th cervical spine (arrows). (B) X-ray CT at the same level showed a mass in the right neck and destruction in the vertebral body of the 6th cervical spine with an extension of the mass to left side. (C) Technetium-99m-HMDP bone scintigram showed no abnormality in the cervical spine.

metabolic activity of the myeloma and is similar to other hematological malignancies, such as lymphoma (9). The accumulation of FDG in primary esophageal cancer has been reported (10), and the same mechanisms may be responsible for increased accumulation in its metastases. Our case may thus reflect the rapid growth and highly invasive features of the tumor.

In this report, we presented two patients with bone tumors having a high FDG accumulation but a negative bone scintigram. The bone scintigram with ^{99m}Tc -phosphate complex reflects the osteoblastic activity of the surrounding or remaining bone tissue, whereas the accumulation of FDG is associated with the metabolic activity of the tumor itself. An FDG-PET study can be used as a complementary study for the detection and follow-up of bone tumors when ^{99m}Tc -phosphate bone scintigraphy is negative. For this purpose, whole-body FDG-PET will be particularly useful.

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Correction

Due to a production error, in the December 1992 issue of the Journal, the authors for the article, "c-erbB2 Protein Overexpression in Breast Cancer as a Target for PET Using Iodine-124-Labeled Monoclonal Antibodies" (pages 2154-2160) were listed incorrectly. The corrected list is as follows: M. Adel Bakir, Suzanne Eccles, John W. Babich, Nighat Aftab, Jennifer Styles, Christopher J. Dean, Richard M. Lambrecht and Robert J. Ott.