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FDG-PET in a case of multiple bone metastases of gastric cancer

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F-18 2-fluoro-2-deoxy-D-glucose (FDG) positron emission tomography (PET) is useful for surveys to detect bone metastasis because of its greater specificity than bone scintigraphy. However, FDG-PET is also known to yield false-positive results in acute fractures and inflammatory lesions, and distinguishing between benign and malignant lesions is difficult, even when semiquantitative methods are used. We report a case of multiple bone metastases of gastric cancer. One of the bone lesions that was positive for FDG uptake was benign, suggesting that FDG-PET can yield false-positive results.

Key words: FDG-PET, Tc-99m HMDP bone scintigraphy, bone metastasis

INTRODUCTION

FDG-PET is widely recognized as useful for staging malignant tumors and searching for recurrent and metastatic lesions, and it is also said to be more specific and more useful for detecting bone metastases than bone scintigraphy, which is highly sensitive but has low specificity.[1–3] However, FDG-PET also results in false-positives, because FDG accumulation reflects glucose metabolism, and glucose is also taken up by benign lesions, such as inflammatory lesions and acute fracture lesions. We report a case of multiple bone metastases of gastric cancer in which FDG-PET visualized a benign bone lesion in addition to multiple metastatic bone lesions, indicating the need for a comprehensive diagnosis taking into account the MRI and clinical findings as well as the FDG-PET findings.

CASE REPORT

A 55-year-old woman complained of bilateral hip joint pain and general malaise during follow-up 19 months after surgery for stomach adenocarcinoma and was admitted to our hospital for further evaluation. Thoracoabdominal CT scans demonstrated multiple enlarged mediastinal and abdominal lymph nodes, and FDG-PET was performed for a systemic search. The patient fasted for more than 4 hours before receiving an intravenous injection of 250 MBq of F-18 FDG and voided 50 minutes after the injection. At 60 minutes after the injection 23-second transmission scans and 2.5-minute emission scans were obtained from the upper thigh to the neck with a high-resolution dedicated system (Allegro; Philips/ADAC, Cleveland, USA) with 56 cm axial field of views and resolution of 4 mm (axial) × 4 mm (in-plane) in full width at half maximum and a 3-dimensional acquisition mode. The acquisition data were reconstructed using a segmented attenuation correction and a 3-Dimension Raw Action Maximum Likelihood Algorithm (3D-RAMLA) method. Abnormally increased accumulation of FDG was observed in several bones, including the patient's painful right acetabulum and left femoral head and her painless fifth lumbar vertebra (L5), left iliac bone close to the sacroiliac joint, right scapula, and left ribs, and in several mediastinal and abdominal lymph nodes (Fig. 1). The mean standardized uptake value (SUV mean) of FDG at the individual bone accumulation sites ranged from 2 to 3. Since multiple bone metastases were suspected, bone scintigraphy (Fig. 2) was performed, but abnormal accumulation was noted only in the right hip joint. MRI was subsequently performed to make the differential diagnosis of the lesions that had taken FDG (Fig. 3). Both T1- and T2-weighted images revealed

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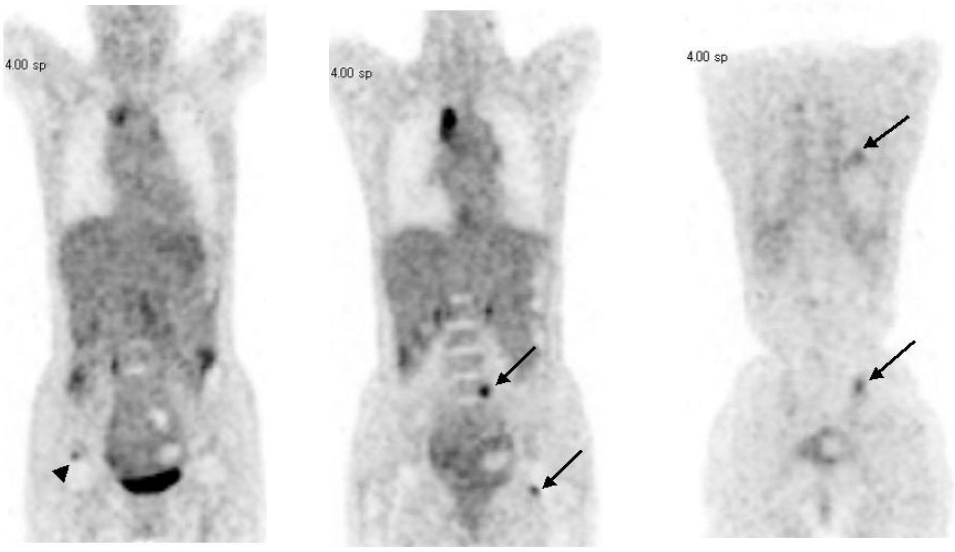


A B C

Fig. 1 FDG-PET performed 60 minutes after intravenous injection of 250 MBq of FDG. Coronal-section images were acquired in the dorsal direction in the following order: A, B, C. Arrows point to bone metastases, and the arrowhead points to signs of osteoarthritis. A: FDG uptake by the acetabulum of the right hip joint and by the mediastinal lymph nodes. B: FDG uptake by metastases to the left side of the fifth lumbar vertebra and the medial aspect of the left femur. C: FDG uptake by the left sacroiliac joint and left dorsal ribs.

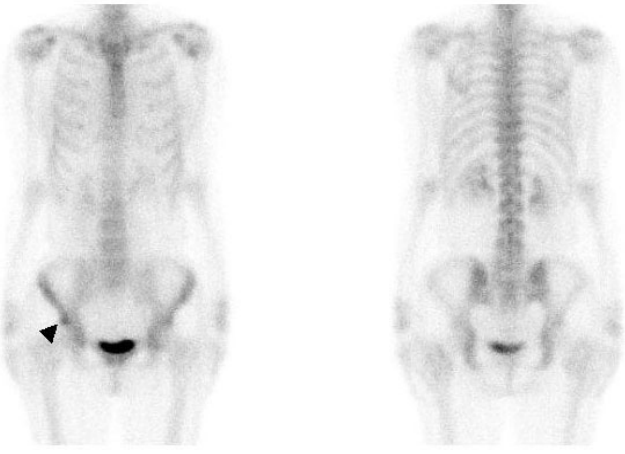


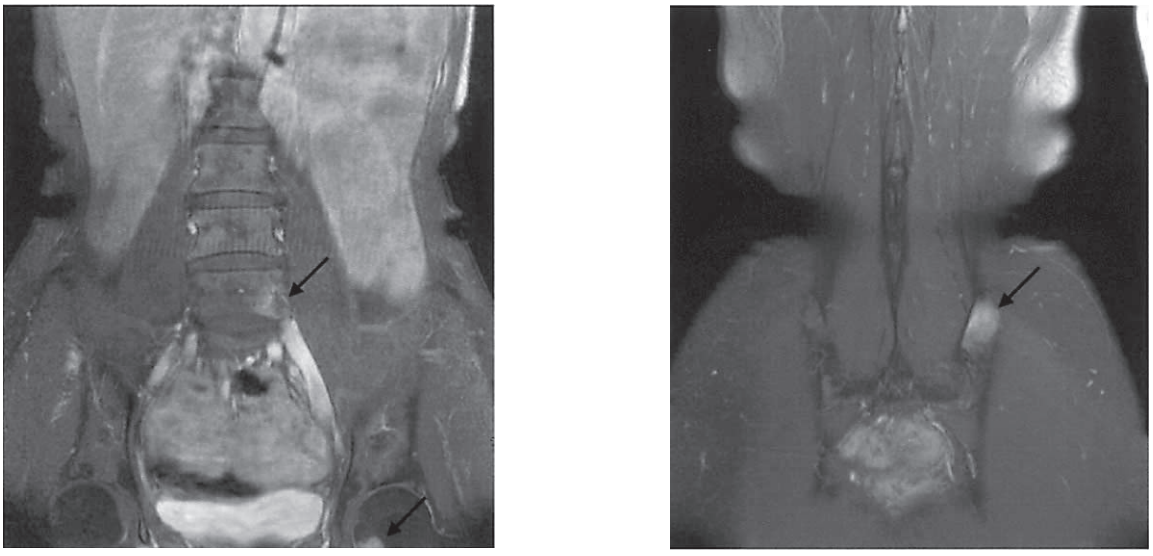
Fig. 2 Anterior and posterior whole-body bone scans performed 2 hours after administration of 740 MBq of Tc-99m-HMDP. None of the bone metastases were detected by bone scintigraphy, and the mild increase in uptake in the right hip joint (*arrowhead*) seen in the anterior image represents coxarthrosis.

lesions suggestive of bone metastasis. The images had lower signal intensity than normal bone marrow and were enhanced on the left side of L5, in the left femoral head, and left iliac bone, but there were no abnormal signals suggestive of bone metastasis around the right hip joint. The uptake in the right hip joint together with the plain X-ray and CT findings in the hip joint suggested osteoarthritis. In the follow-up study of the right hip joint over a period of about eight months, there was no increase in FDG-accumulation despite the absence of treatment, and bone metastasis was not suspected.

The patient is receiving systemic chemotherapy for the multiple lymph node and bone metastases. The left hip joint is still painful, and we are considering radiation therapy to treat it.

DISCUSSION

FDG-PET is said to have high specificity and sensitivity, and it has been widely used to stage various malignant



A B

Fig. 3 Coronal fat-suppression MRI images (in the order: A and B, in the dorsal direction). Arrows indicate bone metastases. A: The left side of the fifth lumbar spine and the left femoral head exhibit contrast enhancement suggestive of bone metastases. B: The left sacroiliac joint shows a contrast effect suggestive of a similar metastasis.

tumors and to search for recurrent and metastatic lesions. FDG-PET has also been reported to be more useful than bone scintigraphy in lung cancer[1] and breast cancer[2] patients. A comparative study of bone scintigraphy and FDG-PET in breast cancer[3] yielded a sensitivity, specificity, and accuracy for bone scintigraphy of 77.8%, 80.9%, and 80.3%, respectively, as opposed to 77.7%, 97.6%, and 94.1%, respectively, for FDG-PET. These findings indicated that FDG-PET has higher specificity, thereby making it more useful than bone scintigraphy, which frequently gives false-positive results. However, there have also been reports that FDG PET is not always useful for demonstrating osteoblastic metastases of prostate cancer[4] and breast cancer,[5] possibly because of the lower volumes of viable tumor with high glucose metabolism in osteoblastic metastases.[6]

Since bone scintigraphy depends on an osteoblastic bone reaction of tumor cells, abnormal accumulation does not reflect tumor metabolism per se, whereas FDG-PET accumulation clearly demonstrates glucose influx into tumor cells.

Many reports have described the high specificity of FDG-PET for bone metastases, but FDG has also been reported to be taken up by benign lesions, such as fractures in the acute phase[7,8] and synovitis.[9] Differentiation of these lesions from bone metastases on the basis of the SUV index is theoretically possible, and high SUV values (>2.5) generally suggest malignancy, but high SUV values have also been reported in benign lesions.[8,9] Indeed, there was little difference between the SUVs of the multiple metastases in our case. It is difficult to differentiate benign lesions from malignant lesions on the basis of SUV values alone, because benign lesions, such as fractures and inflammation in the acute phase, metabolize large amounts of glucose like bone metastases.

Multiple sites of bone accumulation of FDG-PET in cancer-bearing patients, like in the patient reported here, tend to be interpreted exclusively as indicating bone metastasis, however, simultaneous uptake by benign lesions can occur. Comprehensive diagnosis based on a combination of FDG-PET, MRI, CT, bone scintigraphy, and clinical findings seems necessary when considering treatment.

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