Annals of Nuclear Medicine Vol. 20, No. 8, 553–556, 2006

^{18}F-FDG PET/CT findings of a right subphrenic foreign-body granuloma

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We report a case of an 85-year-old woman with a foreign-body granuloma which accumulated ^{18}F-fluorodeoxyglucose (FDG). Unenhanced computed tomography showed a hyperdense mass with a hypodense rim in the right subphrenic space. FDG PET/CT images showed intense FDG uptake in the hypodense rim and little FDG uptake in the center of the mass, showing a ring-shaped appearance. The fusion imaging of FDG PET/CT represented the metabolic features of the foreign-body granuloma. When a ring-shaped FDG uptake is noted in the abdomen of a patient with a history of abdominal surgery, a foreign-body granuloma should be included in the differential diagnosis.

Key words: FDG, PET, foreign body, granuloma, retained surgical sponge

INTRODUCTION

RETAINED SURGICAL SPONGES can cause aseptic granulomas that may remain asymptomatic for many years.[1] The radiological findings of these foreign-body granulomas have been reported.[1–4] They are also called gossypibomas[2] or textilomas.[4] ^{18}F-fluorodeoxyglucose (FDG) PET or PET/CT findings of foreign-body granulomas have been reported.[5–13] We describe the FDG PET/CT finding of a foreign-body granuloma in the right subphrenic space.

CASE REPORT

An 85-year-old woman with a history of hypertension and hypercholesterolemia was admitted for the acute onset of dysarthria. Fifteen years before, she had undergone cholecystectomy for gallstones. On admission, general physical examination and routine laboratory data were normal. Neurological examination showed right facial paralysis without facial sensory abnormality. She was alert and oriented. There was no motor or sensory deficit in the limbs. Head MRI revealed an infarct in the left corona radiata. The patient was treated conservatively.

The routine chest radiographs showed local elevation of the right diaphragm, suggesting a hepatic or subphrenic mass. Therefore an abdominal CT was performed for further examination. The unenhanced CT revealed a well-defined, hyperdense and ovoid mass with a hypodense (lower than the density of the normal liver parenchyma) rim in the right subphrenic space. These CT findings suggested a benign neoplasm, such as a hematoma or foreign-body granuloma. However, a malignant tumor could not be ruled out.

FDG PET was performed using a PET/CT system (GE Discovery ST, GE Medical System Milwaukee, WI). A whole body scan was acquired 1 hr after the intravenous administration of FDG (3.7 MBq/kg body weight). The transaxial FDG PET images (Fig. 1A) showed a ring-shaped appearance with intense FDG uptake surrounding the photon-deficient central portion. The PET/CT fusion images (Fig. 1B) revealed that the rim-shaped FDG uptake corresponded to the hypodense rim and the photon-deficient area corresponded to the heterogeneously hyperdense area on CT (Fig. 1C).

A US-guided core needle biopsy was performed in order to arrive at a definitive histological diagnosis. The sonogram showed an ovoid mass with hyperechoic components casting acoustic shadows (Fig. 1D). Histological examination revealed a granuloma with artificial materials indicating fragments of retained surgical sponges with giant-cell reaction, confirming the diagnosis of foreign-body granuloma (Fig. 1E). No malignant cells were seen. Surgical removal of the mass was recommended, but the patient refused further surgical intervention.

Received April 17, 2006, revision accepted July 10, 2006.

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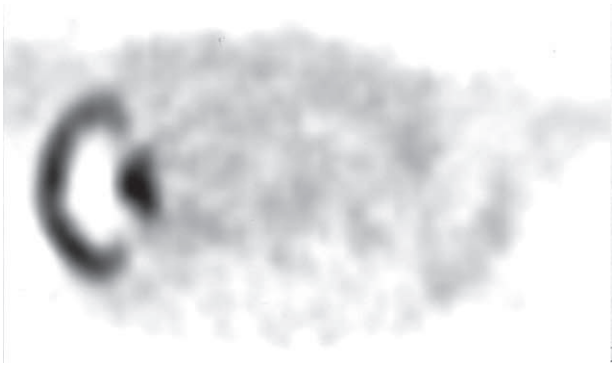

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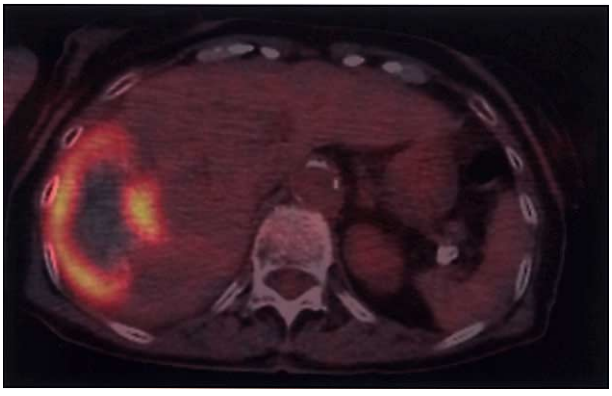

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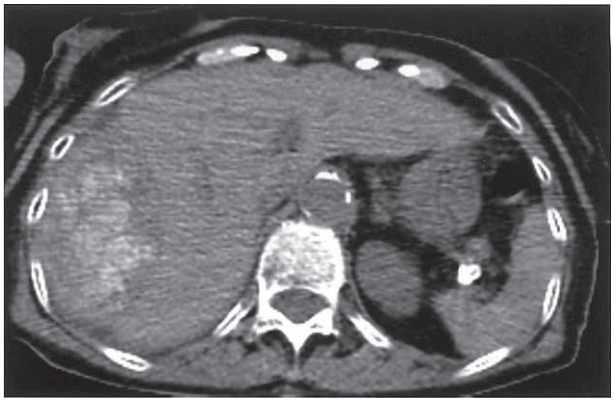

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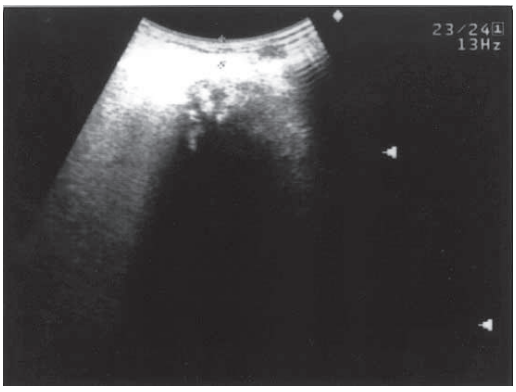

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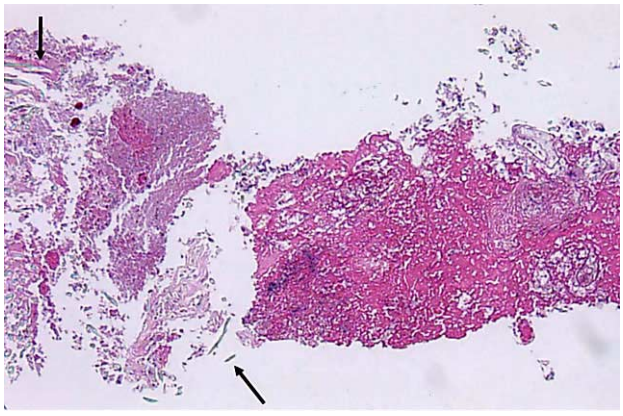

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Fig. 1 An 85-year-old woman with a foreign-body granuloma in the right subphrenic space. The transaxial FDG PET image (A) shows a ring-shaped uptake. The transaxial PET/CT fusion image (B) reveals that FDG accumulates in the hypodense rim and does not accumulate in the highdense structures inside on the unenhanced CT image (C). The sonogram shows an ovoid mass with hyperechoic components casting a strong posterior acoustic shadow (D). Microscopic section of the biopsy specimen (HE stain × 4) shows necrotic and fibrinous tissue including inflammatory cells with some artificial materials indicating fragments of sponges (E, *arrows*).

The patient was discharged 2 weeks after the onset with persisting mild right facial paralysis.

DISCUSSION

Retained foreign bodies after surgery are most frequently surgical sponges, gauze, or towels.[1] There are two types of foreign body reaction in pathology.[14] One is an aseptic fibrinous reaction that creates adhesion and encapsulation, resulting in a foreign-body granuloma and the patients are asymptomatic. The other variety of response is an exudative reaction leading to abscess formation or fluid collection.

Various reports in the literature describe the radiologic findings of the retained surgical sponges. CT is the method of choice in the evaluation of the retained surgical sponges.[1–4,15] Although the typical spongiform pattern with gas bubbles is the most characteristic CT sign for retained surgical sponges, another sign associated with the condition is an inhomogeneously dense mass with a capsule that shows marked enhancement after administration of contrast material. The mass may contain a hyperdense area that is likely to be a trapped clot within the sponges.[1–4]

In our case, the unehnanced CT images showed an inhomogeneously hyperdense mass with a hypodense rim. There were no gas bubbles in the center of the mass. Although the inner heterogeneous high-density may

represent a trapped clot within the sponges, the most characteristic CT feature for retained surgical sponges, namely the spongiform pattern with gas bubbles, was not demonstrated. Therefore we were not able to make the correct diagnosis on the basis of the unenhanced CT findings.

Sonographic appearances of retained surgical sponges are widely variable.[1,3,15] They can be cystic with coarse internal echoes, complex, or solid, and may represent foci of high echoes casting acoustic shadows due to gas or calcification. In our case, the sonographic findings showed a hyperechoic mass with acoustic shadow in the absence of gas or calcification. Wane et al. also reported a case of a retained surgical sponge in the abdomen without gas or calcification that showed a hyperechoic area with acoustic shadow on sonogram.[15]

FDG PET is based on the differential uptake of FDG by metabolizing cells and it is transported into cells on the basis of their rate of glycolysis. Because of the increased avidity of neoplastic cells for glucose, FDG accumulates at higher rates in tumor cells than in nonneoplastic cells. PET scans can visualize active neoplastic lesions as areas of focal hypermetabolism.[16] However, lymphocytes, macrophages, neutrophils, and fibroblasts also avidly take up FDG, particularly under activation conditions.[17] Thus, it is not surprising that FDG accumulates in many types of inflammatory disease such as sarcoidosis and tuberculosis.[18]

The FDG PET findings of intraabdominal foreign body granulomas caused by retained surgical sponges or gauze have been reported, and revealed uneven FDG uptake at the periphery and no FDG uptake in the center of the granuloma.[5–8] These FDG PET findings accurately reflected the histopathological features of these foreign-body granulomas; the ring-shaped FDG uptake represented the thick wall with an aseptic fibroblastic reaction and complete encapsulation, and the central "nidus" without FDG uptake represented the cavity packed with blood clots and the sponge.

The FDG PET findings of a Teflon-induced foreign body granuloma have also been reported in 4 cases, all of which revealed focal, intense and homogeneous FDG uptake in the granuloma.[9–11] The FDG PET findings of a paraspinal textiloma also revealed high focal homogeneous FDG uptake.[12] Aide et al. reported that remote inguinal mesh prostheses induced focal FDG uptake because of persistent foreign body reaction.[13]

The FDG PET/CT findings of our patient showed the same findings as the reported case of intraabdominal foreign body granulomas.[5–8] The fusion images showed that the ring-shaped FDG uptake of the mass corresponded to the hypodense rim on CT which might represent a fibrous capsule, showing the metabolic features of this foreign-body granuloma. An abscess, chronic expanding hematoma or post surgical hematoma has been shown to have ring-shaped FDG uptake.[19–21] The aseptic inflammatory tissue reaction due to implant wear in total hip arthroplasty caused high FDG uptake in the inflammatory soft tissues around the prosthesis neck as well as within the joint capsule, and the FDG PET images showed ring-shaped FDG uptake in these patients.[22] Although ring-shaped FDG uptake is atypical of malignant tumors, malignant lymphoma with central necrosis or hemorrhage also showed a ring-shaped uptake.[23]

In conclusion, FDG PET may show ring-shaped FDG uptake in a foreign-body granuloma. The fusion images of FDG PET/CT are useful for demonstrating metabolically active and non-active lesions of a foreign-body granuloma. Although foreign body granulomas such as a Teflon-induced foreign body granuloma may show a focal homogeneous FDG uptake, when a ring-shaped uptake of FDG is noted in the abdomen of a patient who has previously undergone abdominal surgery, a foreign-body granuloma should be included in the differential diagnosis.

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