A Small Breast Cancer Detected by PET

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A small breast cancer was detected by positron emission tomography (PET) in an asymptomatic individual. Physical examination, mammography and magnetic resonance imaging all failed to identify the tumor. Treatment was partial resection of the breast. Based on the resected specimen, the tumor was 6 mm in diameter. Although previous studies have shown PET to be highly sensitive for the detection of primary breast cancer, detectability of tumors smaller than 1 cm is uncertain. Our case suggests the potential utility of PET for the early detection of primary breast cancer.

Key words: breast cancer - positron emission tomography (PET) - [18F]fluorodeoxyglucose (FDG) - glucose metabolism - early detection

INTRODUCTION

Because of limited spatial resolution, positron emission tomography (PET) using [18F]fluorodeoxyglucose (FDG) is thought to have low sensitivity for detecting lesions smaller than 1 cm in diameter. In breast cancer, for example, a tumor can be clearly depicted with FDG PET, but most such reported lesions have been larger than 1 cm (1). However, we discovered a small breast cancer by PET in an asymptomatic individual. The tumor was 6 mm in diameter. We present the case and discuss the potential utility of PET.

CASE REPORT

An apparently healthy 45-year-old woman underwent a whole-body PET study as a part of our cancer screening program (2). She gave her informed consent beforehand and fasted for 5 h before the study, which was performed using an ECAT EXACT 47 whole-body PET scanner (Siemens/CTI, Knoxville, TN, USA). Forty-seven axial slices were obtained in a field of view of 16.2 cm; the spatial resolution (FWHM) was 6 mm in the transaxial plane and 5.4 mm in the axial plane. Forty-five minutes after administration of 260 MBq of FDG, an emission scan of 7 min from the pelvis to the maxilla was acquired at each bed position. The patient was examined in the supine position. Transmission scans for attenuation correction were not obtained. On the PET images, focal FDG accumulation was easily recognized in the right breast, suggesting a breast carcinoma (Fig. 1).

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Abbreviations: PET, positron emission tomography; FDG, [18F]fluorodeoxyglucose; US, ultrasonography; FNAC, fine-needle aspiration cytology

Figure 1. (a) High FDG uptake is noted in the right breast (arrow) on six consecutive transverse PET images. (b) A small FDG accumulation is again demonstrated (arrow) on four consecutive coronal tomographic images.
Figure 2. An ultrasonographic image obtained after the PET study displays a low echoic area measuring 4 mm in diameter.

Figure 3. According to the cut surface of the resected specimen, the tumor is 6 mm in diameter (arrow heads).

Ultrasonography (US) of the breast is a routine examination and is performed by experienced technologists with a 7.5 MHz annular array transducer (Model SSA 250A, Toshiba, Tokyo, Japan). Ultrasonographic screening in this patient immediately prior to the PET study identified no abnormality, whereas US re-examination after the PET study revealed a small lesion (Fig. 2). The tumor was not palpable. The patient was referred to a university hospital for further evaluation and underwent mammography and contrast-enhanced magnetic resonance imaging. Both studies, however, failed to identify the breast lesion. Surgery was decided upon and partial resection of the breast gland was carried out. Lymph node dissection was not performed. The freshly resected tumor was 6 mm in diameter (Fig. 3). On histological sections after fixation and staining, the tumor was 3 mm. Histopathologically, the tumor mass was composed of atypical cells arranged in a tubular or cribriform manner; the nuclei were enlarged and round. No invasion to the surrounding stroma was detected. The tumor was diagnosed as a non-invasive ductal carcinoma (intraductal carcinoma) (Fig. 4).

Table 1. PET results for the tumors smaller than 1 cm

<table>
<thead>
<tr>
<th>Study</th>
<th>PET results (mm)*</th>
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<tbody>
<tr>
<td>Crowe et al. (1994) (5)</td>
<td>9 [1]</td>
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<tr>
<td>Scheidhauer et al. (1996) (6)</td>
<td>4–10 [3]</td>
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<tr>
<td>Bombardieri et al. (1996) (8)</td>
<td>7–9 [3]</td>
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<tr>
<td>Palmedo et al. (1997) (9)</td>
<td>8 [1]</td>
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*Numbers of tumors studied are given in brackets.

DISCUSSION

With PET, high sensitivity (92%), specificity (97%) and accuracy (92%) have been achieved for the diagnosis of primary breast cancer (3). However, most previous studies have involved breast masses larger than 1 cm in diameter (4). Detection of small breast cancer is thought to be limited owing to a partial volume effect and few reports are available with regard to the detectability of primary breast cancers smaller than 1 cm in diameter (Table 1). Only a few tumors smaller than 1 cm have been reported to be visualized with PET and the lower limit in two reports was 4 mm (6,10). However, the reported measurements were via a pathological section in one study (10) and the measurement methods were not described in the other (6). Surgical specimens contract during fixation and staining; the resulting pathology sections are smaller than the fresh specimens. In our case, the surgical specimen was 6 mm and the pathology specimen was 3 mm in
diameter. This case and others suggest that primary breast cancers smaller than 1 cm can be identified by PET. Although this patient had undergone a PET study 9 months earlier, abnormal FDG uptake was not recognized even in retrospective analysis. This indicates a size limitation with PET imaging for detecting small breast cancer.

Currently, the combination of physical examination, mammography and fine-needle aspiration cytology (FNAC) is the standard diagnostic approach (12). However, both physical examination and mammography were negative in our case. Since US screening prior to the PET study failed to detect the small lesion, the tumor would have been missed without PET. Following observation of the high FDG uptake, US re-examination disclosed a small low echoic lesion. However, the lesion was too small to be characterized by US. In such a case, FNAC may be the next best step. The sensitivity and specificity of FNAC are variable according to reports and it is not sufficiently accurate either to rule out the existence of cancer or to ascertain its presence (12). Furthermore, cancer cell spillage cannot always be avoided in the aspiration tract. This may cause problems if partial resection is chosen as a surgical treatment. In our patient, FNAC was deliberately avoided and partial resection was performed. Our case showed that PET may provide information for the characterization of even small breast lesions and may contribute to the management of small breast tumors.

The detectability of breast cancer by PET does not depend solely on tumor size. A study using transplantable tumors showed that the principal sites of FDG uptake were viable cancer cells and that the degree of FDG uptake depends on tumor cellularity (13). In our case, cancer cells were rather densely packed in a small amount of fibrous connective tissue and neither necrosis nor granulation was present. Furthermore, lesions toward the body surface are more clearly depicted on non-attenuation-corrected images (14) that were used in the imaging of our case.

Previous studies have shown that PET is sensitive in the diagnosis of primary breast cancer. However, false-positive PET findings may occur in inflammatory lesions and the specificity has not been fully determined in a large number of benign lesions, including fibrocystic diseases and fibroadenomas. Therefore, reported results should be considered preliminary and PET is still not a substitute for tissue diagnosis. In conclusion, our experience and previous reports demonstrate that PET has potential in the diagnosis of small breast cancers even smaller than 1 cm in diameter.

References