Nonfunctioning endocrine pancreatic tumor examined with $^{18}$F-FDG PET/CT

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Abstract A 71-year-old woman with type 2 diabetes mellitus complained of generalized fatigue. A 36-mm tumor in the pancreatic tail was detected with ultrasonography. The tumor was found to have marked hypervascularity with contrast-enhanced computed tomography (CT) and magnetic resonance. Combined $^{18}$F-fluorodeoxyglucose positron emission tomography and CT ($^{18}$F-FDG PET/CT) showed $^{18}$F-FDG by the tumor with a maximal standardized uptake value of 2.98 at 50 min and 3.29 at 100 min following injection of $^{18}$F-FDG. $^{18}$F-FDG PET/CT suggested no extrapancreatic spread of the tumor. The patient had no pancreatic hormone-associated symptoms. Distal pancreatectomy was performed, and a well-differentiated endocrine tumor was diagnosed. The resected specimen showed neither infiltration of adjacent structures nor metastasis to regional lymph nodes. The present case suggests that $^{18}$F-FDG PET/CT is a reliable modality for staging endocrine pancreatic tumors.

Keywords $^{18}$F-FDG PET/CT · Pancreas · Nonfunctioning endocrine tumor

Introduction

Endocrine pancreatic tumors (EPTs), or pancreatic islet cell tumors, are uncommon tumors occurring in approximately 1 of 100,000 persons [1]. EPTs are clinically categorized as functioning or nonfunctioning tumors. Owing to their inability to produce hormone-dependent symptoms, nonfunctioning EPTs are discovered incidentally or through symptoms caused by their enlargement or metastatic spread. Nonfunctioning EPTs are frequently malignant (62%–92%), but their treatment and prognosis differ significantly from those of other pancreatic tumors, such as pancreatic adenocarcinomas [1].

So far, various imaging modalities have been applied to EPTs. A few studies have reported the usefulness of $^{18}$F-fluorodeoxyglucose ($^{18}$F-FDG) positron emission tomography (PET) in the diagnosis of EPTs [2–4]. Combined $^{18}$F-FDG PET and computed tomography ($^{18}$F-FDG PET/CT) is a novel imaging method that simultaneously provides biochemical and anatomical information and is widely used for the diagnosis of various types of malignancies [5, 6]. We describe a case of nonfunctioning EPT that was examined with $^{18}$F-FDG PET/CT and discuss the possible role of $^{18}$F-FDG PET/CT in the diagnosis of this type of tumor.

Case report

A 71-year-old woman had been receiving medication (glibenclamide) for type 2 diabetes at a clinic. The patient
presented to our hospital with complaints of generalized fatigue. Physical examination showed no abnormalities. Ultrasonography (US) revealed a 36-mm, well-demarcated, round, homogeneous hypoechoic tumor in the pancreatic tail. The tumor was found to have marked hypervascularity with contrast-enhanced CT (Fig. 1) and magnetic resonance (MR). Serum levels of tumor markers, such as carcinoembryonic antigen and carbohydrate antigen 19–9, were normal. Serum levels of pancreatic hormones were normal or marginally increased; the patient had no pancreatic hormone-associated symptoms. On the basis of the results of the laboratory and imaging examinations, we suspected a nonfunctioning EPT that had to be differentiated from other hypervascular tumors of the pancreas, such as solid pseudopapillary tumor and acinar cell carcinoma.

\[18F\text{-FDG PET/CT was performed to stage the tumor. Following an overnight fast, the patient received an intravenous injection of 301 MBq of } \mathrm{^{18}}\text{F-FDG. The plasma glucose concentration was } 179 \text{ mg/dl just prior to injection; pretreatment to normalize the glucose concentration was not performed. PET/CT scans using a combined PET/CT scanner (Discovery ST, General Electric Medical Systems, Milwaukee, WI, USA) were performed 50 min and 100 min later. The } \text{^{18}}\text{F-FDG uptake by the pancreatic tumor was observed (Fig. 2). For quantitative analysis, the standardized uptake values (SUVs) were generated for each voxel (4.69 \times 4.69 \times 3.27 \text{ mm}). The maximal SUV within the pancreatic tumor was 2.98 at 50 min and 3.29 at 100 min. Areas of abnormal } \text{^{18}}\text{F-FDG uptake were also observed in the right lung and were considered to represent inflammatory lesions. } \text{^{18}}\text{F-FDG PET/CT showed that the SUV of the present tumor was similar to that of EPTs reported earlier [3] and suggested no extrapancreatic spread of the tumor, such as infiltration of adjacent structures and metastasis to regional lymph nodes or other organs.}

Distal pancreatectomy and splenectomy were performed. Histologic examination showed that the tumor was a well-differentiated EPT (Fig. 3). The resected specimen showed neither infiltration of adjacent structures nor metastasis to regional lymph nodes.

**Discussion**

Many studies have addressed the abilities of various imaging modalities, such as CT, MR, and endoscopic US, for detecting and characterizing EPTs [7–11]. CT is the most widely used imaging modality for EPTs [7–10]. A recent study has shown that the sensitivity and specificity of spiral CT for identifying nonfunctioning EPTs are 66.6% and 82.7%, respectively [7]. Furthermore, functional imaging modalities using specific tracers for the diagnosis of neuroendocrine tumors have been developed [12–14].

\[\text{^{18}}\text{F-FDG is a tracer that can be taken up by various types of tumor. Because of its utility and facility, } \text{^{18}}\text{F-FDG PET has been widely incorporated into the diagnostic procedures for malignancies [6]. However, few studies have examined the usefulness of } \text{^{18}}\text{F-FDG PET for diagnosing EPTs [2–4]. Nakamoto et al. [3] examined 19 EPTs, including nonfunctioning tumors, and have shown that the sensitivity of } \text{^{18}}\text{F-FDG PET for EPTs is comparable with that of US, CT, and MR. They have also shown that } \text{^{18}}\text{F-FDG PET has limited value in detecting small EPTs (smaller than 8 mm). Considering their reported sizes at diagnosis, many nonfunctioning EPTs might be detected with } \text{^{18}}\text{F-FDG PET and } \text{^{18}}\text{F-FDG PET/CT.}

Recent studies have found that the SUVs of EPTs are relatively low, except for those in a few cases; most EPTs have SUVs of a little less than 3 at 60 min following the injection of } \text{^{18}}\text{F-FDG [2, 3]. The SUV of the present