

Contribution of ^{18}F -FDG PET/CT in the Staging of Pancreatic Solid Pseudopapillary Neoplasms: A Case Report

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Abstract

Solid pseudopapillary neoplasm (SPN) is an extremely rare pancreatic epithelial neoplasm with low malignancy that affects mainly young females. It is characterized by a good prognosis, even in the presence of metastases. SPNs have a particular avidity for ^{18}F -fluorodeoxyglucose (^{18}F -FDG). Nonetheless, there are very few papers in the literature on the use of ^{18}F -fluorodeoxyglucose positron emission tomography/computed tomography (^{18}F -FDG PET/CT) in the diagnosis and staging of SPNs. A 23-year-old woman presented to our attention with gastric outlet obstruction due to a bulky solid pseudopapillary neoplasm of the pancreatic head. A ^{18}F -FDG PET/CT showed a marked ^{18}F -FDG uptake at the pancreatic head with no abnormal metabolic activity in other abdominal organs. Given the particular avidity for ^{18}F -FDG, SPNs can be easily recognized on ^{18}F -FDG PET/CT. However, this exam is not useful in differentiating this neoplasm from other malignant pancreatic solid lesions, but it could give a contribution to the staging by the ability to identify potential metastases or recurrences.

Keywords: Solid Pseudopapillary Neoplasm, Pancreas, Staging, Positron Emission Tomography, Fluorodeoxyglucose

1. Introduction

Solid pseudopapillary neoplasm (SPN) of the pancreas is an extremely rare epithelial tumor (1, 2). The first cases of SPN were described by Frantz in 1959. Since then, these lesions have been identified with different names until 2010 when the World Health Organization (WHO) defined SPN as a "low malignant epithelial neoplasm" and eliminated the term tumor (1-3).

Since the first description, a lot has been understood about the clinic, diagnosis, therapy and prognosis of this neoplasm; nevertheless, the etiology has still not been fully understood (1). SPNs are very rare pancreatic tumors, accounting for approximately 0.2% - 2.7% of all exocrine pancreatic tumors, although with recent improvements in imaging the incidence increased up to 5% - 6% of all pancreatic tumors diagnosed, mainly affecting females (female-male ratio of 8:1) and young patients (between 28.5 and 36.8 years) (1, 2). SPNs have a good prognosis, even in the presence of distant metastases (1, 2).

Endoscopic ultrasound (EUS), computed tomography (CT) and magnetic resonance imaging (MRI), have increased the diagnosis of these lesions, often identified as incidentalomas (1, 4, 5). However, in order to make a bet-

ter characterization of the primary lesion, staging and differential diagnosis with other and more fearsome pancreatic lesions (ductal adenocarcinoma, neuroendocrine tumor), to better determine the best treatment strategy, ^{18}F -fluorodeoxyglucose positron emission tomography/computed tomography (^{18}F -FDG PET/CT) can be of great help to the clinician based on a particular avidity of SPNs for ^{18}F -FDG (6-9). Nonetheless, there are very few papers in the literature on the use of ^{18}F -FDG PET/CT in the diagnosis and staging of SPNs (6).

We present the case of a young woman who presented to our attention with gastric outlet obstruction caused by a massive pancreatic SPN whose pre-operative staging was achieved thanks to the contribution of ^{18}F -FDG PET/CT.

2. Case Presentation

We present the case of a 23-year-old Caribbean woman who arrived in the emergency department complaining of abdominal discomfort, nausea, difficult digestion, and recurrent vomiting for approximately six months. She had a personal history of bariatric surgery (laparoscopic sleeve gastrectomy performed in 2014) after which she had a weight loss of 34 kg. Initially, the current symptoms were

considered to be related to the important weight loss and as sequel of the bariatric surgery. The patient denied any drug intake.

On admission, the patient presented with normochromic skin (no jaundice and no anemia), high blood pressure, heart rate in the normal range, and body mass index (BMI) of 20.47. The abdomen was flat without tenderness, pain or signs of peritonism. In palpation, we found the presence of a mass in the epimesogastric regions that seemed fixed to nearby tissues. Her laboratory tests were normal, including tumor and inflammatory markers. Abdomen US showed a capsulated, hypo-isoechoic pancreatic lesion of 98 mm × 67 mm. After administration of intravenous contrast (SonoVue®), the mass showed rapid enhancement and slow wash-out, with hypo-anechoic central area. Abdomen CT scan (Figure 1), after administration of intravenous contrast and oral intake of water, showed a mass of the pancreatic head of 84 mm × 77 mm × 80 mm with distorsion of the first and second duodenal portion, which did not appear fully distensible after the transit of liquid and a dislocation of the vascular structures (portal vein, inferior cava vein, and right renal vein). No suspected lesions to other abdominal viscera were identified. Endoscopic ultrasound-guided fine-needle aspiration (EUS-FNA) and cytologic examination were performed with a diagnosis of papillary aggregates of epithelioid cells with mild anisokaryosis and cytoplasmic vacuolation, intra and extra hyaline globules were identified. In immunohistochemistry, cells were positive for β -catenin, CD10, CD56, progesterone receptors, cyclin1 and negative for cytokeratin, chromogranin and synaptophysin.

All the collected data came out in favor of the diagnosis towards SPN but after multidisciplinary assessment, on the basis of the significant size of the lesion, it was decided to perform a ¹⁸F-FDG PET/CT (Figure 2) in order to identify potential metastases. The exam showed a massive area of pathological fixation of the radiopharmaceutical (SUVmax 10) in correspondence to the pancreatic head lesion described on CT and US. In addition, there was an accumulation of radiopharmaceutical in the stomach related to the scars of previous surgery. However, there was no evidence of further hypercaptations attributable to metastasis.

After complete staging, a pancreaticoduodenectomy was performed (Figure 3). Histological examination of the surgical specimen confirmed the diagnosis of SPN (Figure 4). The clinical course was uneventful, and the patient was discharged 24 days after surgery. After 12 months of follow-up she is in excellent clinical condition with no evidence of recurrence or metastasis.

3. Discussion

To date, referring to several articles in the current literature about the diagnosis and staging of pancreatic SPNs, we can see how the almost exclusively cited exams are EUS and CT/MRI, while ¹⁸F-FDG PET/CT has only been reported rarely (in 2005, Lee et al. were the first to describe the hyperaccumulation of ¹⁸F-FDG in SPN) (1, 6-9).

SPN is generally a benign lesion; however, it almost always shows glucose hypermetabolism on PET scans (whether the lesion is benign or malignant), a feature that distinguishes malignant tumors (9). As in our case, the massive lesion of the pancreatic head, albeit with benign histological features, showed a hyperaccumulation of radiopharmaceutical (SUVmax 10) in agreement with the results in different case reports/case series (SUVmax range 2.6 to 42.8) (6-11).

As suggested by several authors, this particular avidity for ¹⁸F-FDG of SPN could be dependent on some of its histopathological features, such as a high cellular density, rich mitochondria, and its hypervascular nature (6-10). Dong et al. hypothesized that among SPNs greater hyperaccumulation of ¹⁸F-FDG characterized those with a higher solid component than those with a less solid component, probably for two main reasons, first, the cystic-necrotic component shows low ¹⁸F-FDG uptake and second, the cellular component has a lower density than a lesion with little or no cystic-necrotic component (8). In full agreement with this hypothesis is our case, in which the lesion showed a low cystic-necrotic component despite the considerable size, and a marked solid cellular component.

The molecular mechanisms involved in glucose uptake in SPN are not clearly understood (11). As reported by Guan et al., glucose transporter-1 (Glut-1) and hexokinase-II (HK-II) play key roles in the uptake and trapping of ¹⁸F-FDG. However, poor expression of GLUT-1 and moderate expression of HK-II in SPN cells have been reported (9). Furthermore, from the analysis of their data, they revealed no incidence of gender and age on SUVmax value as well as a poor correlation between SUVmax and the size of the lesion (9). However, in a recent study, Kim et al. showed that SPN expressed differences in ¹⁸F-FDG uptake considering lesions of various T stages. T1-staged lesions showed moderate uptake compared to the intense uptake expressed by T2-T3-staged lesions (7). This is in contrast with what was previously reported by Dong et al. who assumed that small SPNs are more likely to show an intense ¹⁸F-FDG uptake when they have a smaller cystic component (8). Furthermore, Kim et al. have pointed out that SPN had a ¹⁸F-FDG uptake significantly higher than pancreatic ductal adenocarcinoma after size adjustment (comparing two different lesions of the same size) and that this relatively higher glu-

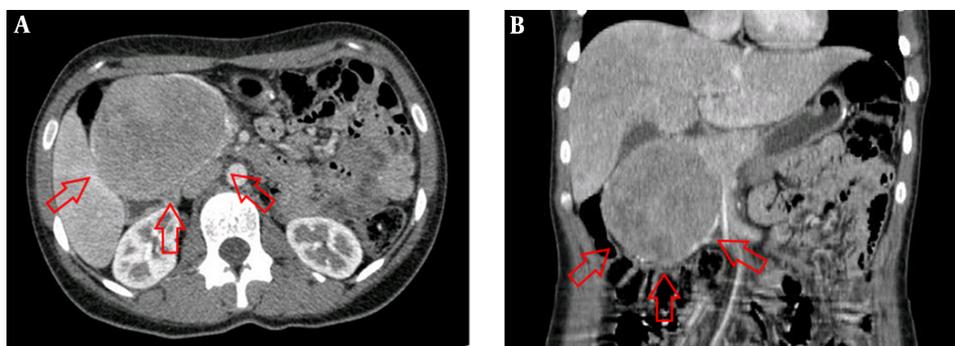


Figure 1. Abdomen CT scans. A, Axial and B, Coronal images show a bulky lesion (84 mm × 77 mm × 80 mm) of the pancreatic head, circumscribed, encapsulated, with a predominantly solid component and clear areas of internal hemorrhage (red arrows).

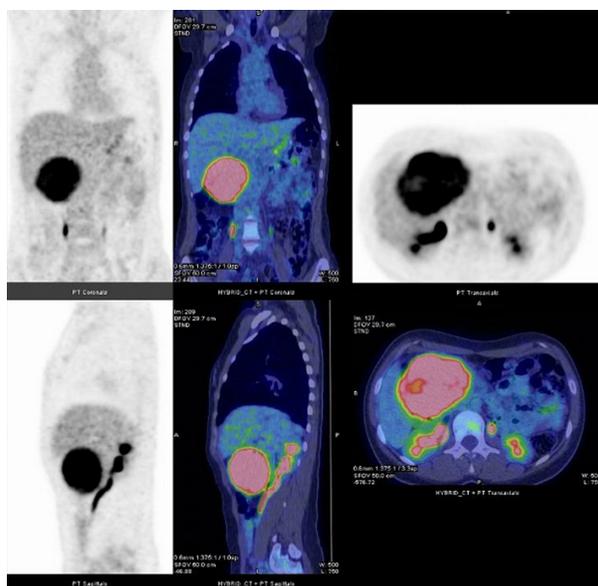


Figure 2. ¹⁸F-fluorodeoxyglucose positron emission tomography/computed tomography (¹⁸F-FDG PET/CT): The images show a well-circumscribed area with a strong ¹⁸F-FDG uptake (SUVmax 10), corresponding to the lesion of the pancreatic head highlighted on abdomen CT.

cose metabolic activity, is probably the result of high SPN cellularity, as already advocated by Guan et al. (7, 9).

PET scan is increasing its acceptance as a valid tool in the differential diagnosis and staging of pancreatic tumors, along with CT and MRI (which have always been the first imaging choices in primary diagnosis). We can find high SUVmax values even in the presence of other histological types of pancreatic solid lesions (1-3). Indeed, ¹⁸F-FDG PET/CT, in addition to identifying almost all cases of SPN with a SUVmax value > 2.6 is able to detect other pancreatic solid lesions such as pancreatic adenocarcinoma (PAC) and pancreatic neuroendocrine tumor (PNET). However, in some occasions, the latter ones, may present a low SUVmax

value that results in a poor ¹⁸F-FDG uptake, as in the case of small size PAC with low cellular density and/or high fibrous content, or as in well-differentiated PNET (9). These two histologic types can show SUVmax values < 2.6 in 14% and 21.4%, respectively (9). Discriminating between an SPN, a PAC or a PNET is of extreme importance for the clinician and the patient given the good prognosis that SPN could have, after resection of the primary tumor and/or recurrent lesions and/or metastatic lesions in case of malignancy. Nevertheless, we cannot differentiate these pancreatic solid lesions from SPN based only on SUVmax values > 2.6 (9).

Some authors have looked for a possible correlation

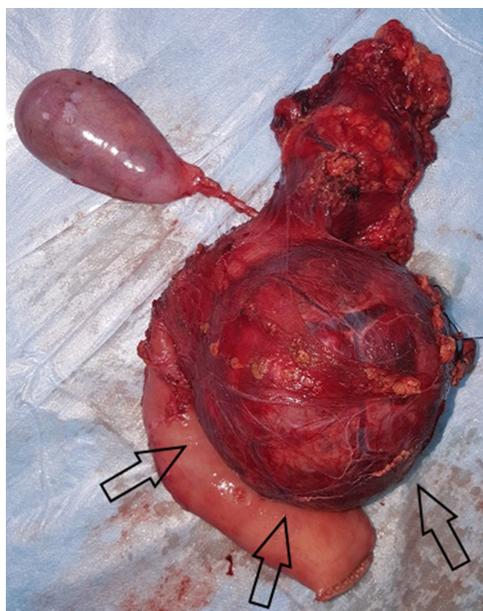


Figure 3. Intraoperative image: Surgical specimen after pancreaticoduodenectomy in which we can note the known encapsulated lesion of the pancreatic head (black arrows).

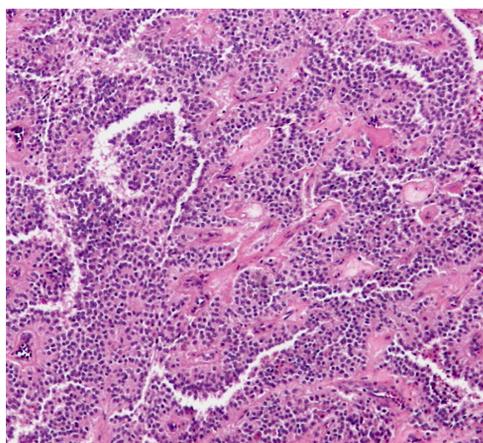


Figure 4. Histological examination: The image shows the characteristic pseudopapillary architecture with a strong and thickly packed cellular component, characterized by eosinophilic granular cytoplasm.

between SUVmax and histological characteristics of malignant SPNs. However, while some have identified an increase uptake of ^{18}F -FDG in tumors with features of malignancy (microscopic venous and perineural invasions) when compared to those without such features, others have detected a low ^{18}F -FDG uptake in SPNs with local invasion unlike those lacking this feature (6-11). Nakamoto et al. reported that the diagnostic accuracy of PET in the

differentiation between malignant and benign pancreatic lesions could be increased by using an additional delayed scan, because the first showed a steady increase of ^{18}F -FDG uptake, while the latter showed a decrease uptake of ^{18}F -FDG (10). However, the limited data did not suggest an advantage in the differentiation between benign and malignant SPNs by evaluating SUVmax of early and delayed scans (10). On the other hand, there are interesting conclusions of previous studies that have shown that a high proliferation index or positive Ki-67 could be correlated with potentially malignant SPN and that they had a very strong ^{18}F -FDG uptake in contrast to those with low proliferation index or Ki-67 negative that showed a low ^{18}F -FDG uptake (8).

Finally, in a few cases of SPN with distant metastasis (liver and mesentery) studied with ^{18}F -FDG PET/CT, an intense ^{18}F -FDG uptake of metastatic lesions was detected, therefore the authors concluded that ^{18}F -FDG PET/CT may be useful in the identification of undiagnosed SPN metastases (6-9).

In conclusion, the current report showed that SPNs, given the particular avidity for ^{18}F -FDG, can be easily recognized on ^{18}F -FDG PET/CT, as reported in the few studies in the literature. However, we believe that this exam is not specifically useful in differentiating this neoplasm from other malignant pancreatic solid lesions, as emerged from our case. ^{18}F -FDG PET/CT could give a valid contribution to staging by the ability to identify potential metastases or recurrences, but it was not possible to prove it. Further studies on large series are needed to better understand the biological features of SPNs in order to reach guidelines for diagnosis, staging, and treatment.

Footnotes

Authors' Contributions: Study concept and design, Maurizio Zizzo; acquisition of data, Maurizio Zizzo, Lara Ugoletti, and Carolina Castro Ruiz; analysis and interpretation of data, Maurizio Zizzo and Vincenzo De Biasi; drafting of the manuscript, Maurizio Zizzo and Claudio Pedrazzoli; critical revision of the manuscript for important intellectual content, Maurizio Zizzo and Vincenzo De Biasi; administrative, technical, and material support, Stefano Bonacini, Michele Panebianco, and Alessandro Giunta; study supervision, Claudio Pedrazzoli.

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