Al^{18}F-NOTA-octreotide outperforms ^{18}F-FDG in identifying rare renal metastases from pancreatic neuroendocrine tumor

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Abstract

We presented a case involving a 56-year-old man who had been experiencing shoulder and back pain for over a year, with extensive bone metastases revealed by a bone scan. To identify the primary source of these issues, the patients underwent a fluorine-18-fluorodeoxyglucose (^{18}F-FDG) positron emision tomography/computed tomography (PET/CT) scan, which indicated moderate uptake in the right renal soft mass and low uptake in multiple osteolytic lesions. Pathological examination and immunohistochemical staining of the renal mass supported the diagnosis of neuroendocrine tumors. Subsequently, a novel somatostatin receptor imaging agent, Al^{18}F-NOTA-octreotide (^{18}F-OC), was performed to further investigate the source of metastatic lesions and to stage the tumor. The ^{18}F-OC scan revealed a high-uptake lesion in the pancreatic head, as well as additional lymph node and bone metastases lesions. Compared to ^{18}F-FDG, the ^{18}F-OC demonstrated superior imaging capabilities and a significantly higher tumor-to-background ratio in neuroendocrine neoplasms, which contributed to improving the staging and treatment management.

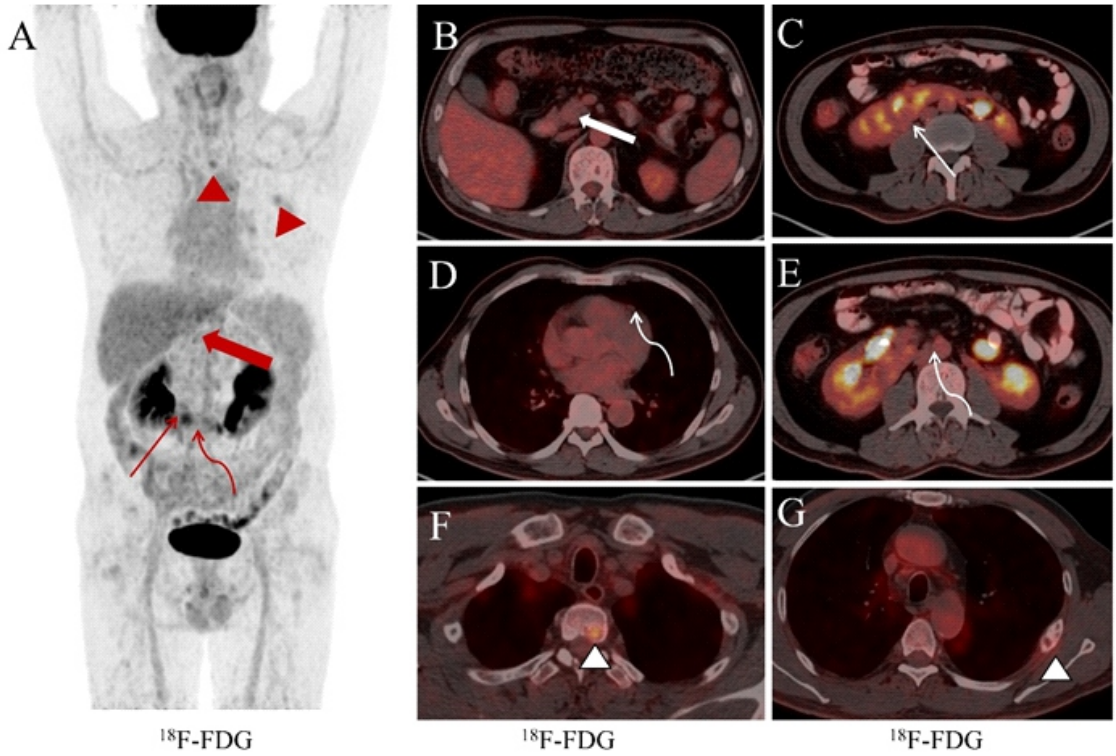

Figure 1. A 56-year-old man was admitted to the hospital with persistent shoulder and back pain for more than a year. A bone scan performed as part of this evaluation revealed widespread bone metastasis. Subsequently, the fluorine-18-fluorodeoxyglucose (^{18}F-FDG) positron emission tomography/computed tomography (PET/CT) scan was requisitioned to pinpoint the primary source of the disease. The maximum intensity projection (MIP) imaging (A) showed a moderate uptake enhancement in the right renal (linear arrow) and low uptake in multiple bone lesions (arrowheads). The axial fused PET/CT revealed a soft tissue density mass in right kidney with moderate uptake (maximum standardized uptake value (SUVmax): 8.6; as denoted by linear arrow in C), multiple osteolytic lesions in the thoracic vertebrae and left ribs with low uptake (SUVmax: 3.8; arrowheads in F-G) and low uptake in the head of the pancreas (SUVmax: 2.4; block arrow in B), and almost no uptake in lymph nodes near the pericardium and abdominal aorta (curve arrow in D-E). Interestingly, the ^{18}F-FDG PET/CT scan revealed the existence of a horseshoe kidney (curve arrow in A). Based on this imaging finding, renal and bone lesions are suspected to the invasions of multiple myeloma, while pancreatic and lymph node lesions are considered as physiological or inflammatory reactions. Subsequently, the patient underwent a biopsy of the right renal lesion, which the histopathology and immunohistochemistry supported the diagnosis of a neuroendocrine tumor.

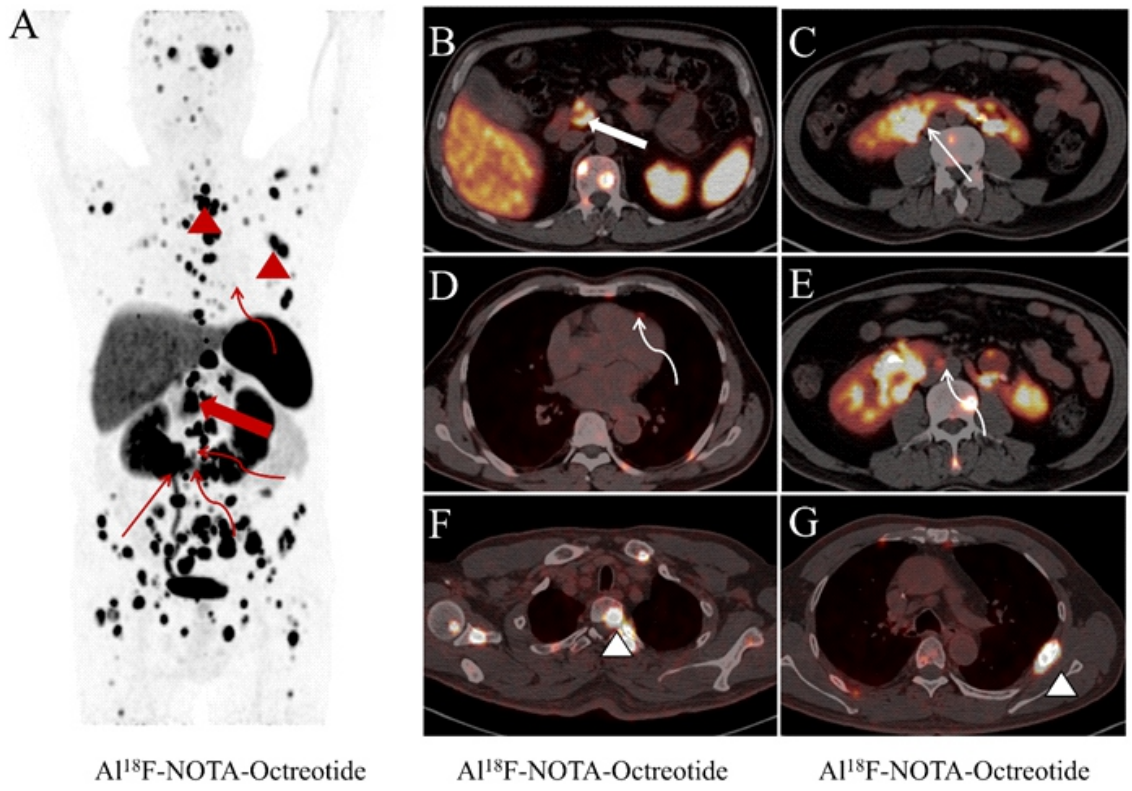

Figure 2. The Al^{18}F-NOTA-octreotide (^{18}F-OC) PET/CT scan was subsequently performed to further investigate the primary lesion and stage of the neuroendocrine tumor (NET). As presented in MIP imaging (A), the ^{18}F-OC revealed a greater number of extra high uptake lesions with higher tumor-to-background ratio than ^{18}F-FDG (Table 1). The axial fused ^{18}F-OC PET/CT revealed an intense octreotide uptake in the head of the pancreas with an SUVmax of 18.3 (indicated by block arrow: B) and right renal mass with an SUVmax of 32.7 (linear arrow: C), and multiple osteolytic increased uptake lesions with an SUVmax of 47.6 (arrow heads: F-G). Furthermore, the ^{18}F-OC identified additional lymph node metastasis in parapericardial and para-aortic with an SUVmax of 9.7 (curve arrow: D-E). These findings strongly suggested the presence of the pancreatic neuroendocrine tumor with multiple metastases. Radiolabeled somatostatin analogs (SSA) represent a favorable option for molecular imaging and radionuclide therapy for most differentiated NET [1]. Recently, a promising SSA tracer labelled with ^{18}F, namely ^{18}F-OC, has been introduced for somatostatin receptor (SSTR) imaging as a new valuable alternative to ^{68}Ga-labelled DOTA-peptides, which already have an established use in clinical practice [2-5]. In this case, ^{18}F-OC has exhibited outstanding performance in detecting the primary NET lesion and renal metastases lesion, with high uptake values and a remarkable tumor-to-background ratio. This case highlights that ^{18}F-OC is superior to ^{18}F-FDG in identifying primary foci and staging of NET, as it can effectively detect a great number of lymph nodes and bone metastasis [6]. The majority of NET originate from the gastrointestinal tract (55%) and the lung (30%), with the liver being the most common site of metastasis. However, renal metastasis is extremely rare [7]. Nevertheless, although uncommon, when ^{18}F-FDG shows a moderate increase uptake in the renal mass along with multiple bone metastases, the neuroendocrine tumors should also be considered as a potential differential diagnosis. Fluorine-18-OC PET/CT proved to have an important role in the evaluation of NET patients and it may effectively give a significant contribute to diagnosis and staging.

Table 1. *The comparison of ^{18}F-FDG and Al^{18}F-NOTA-octreotide in patients with pancreatic neuroendocrine tumor.*

Lesion Site	^{18}F-FDG		Al^{18}F-NOTA-octreotide	
	SUVmax	TBR	SUVmax	TBR
Pancreas	2.4	0.7	18.3	9.1
Renal metastases	8.6	5.5	32.7	23.5
Bone metastases	3.8	0.5	47.6	38.4
Lymph nodes metastases	no uptake	NA	9.7	0.5

SUVmax: maximum standardized uptake value; TBR: tumor-to-background ratio; NA: not available.

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