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Name of Journal: *World Journal of Clinical Cases*

Manuscript NO: 82614

Manuscript Type: CASE REPORT

Pancreatic Neuroendocrine Tumor Detected by Technetium-99m Methoxy-2-isobutylisonitrile Single Photon Emission Computed Tomography/Computed Tomography: A Case Report

99mTc-MIBI SPECT/CT for Pancreatic NET

Chang-Jiang Liu, Hua-Jun Yang, Yan-Chun Peng, De-Yu Huang

Abstract

BACKGROUND

Pancreatic neuroendocrine tumors (NETs) account for about 1%–2% of pancreatic tumors and about 8% of all NETs. Computed tomography (CT), magnetic resonance imaging, and endoscopic ultrasound are common imaging modalities for the diagnosis of pancreatic NETs. Furthermore, somatostatin receptor imaging is of great value for diagnosing pancreatic NETs. Herein, we report the efficacy of technetium-99m methoxy-2-isobutylisonitrile (^{99m}Tc -MIBI) single photon emission CT (SPECT)/CT for detecting pancreatic NETs.

CASE SUMMARY

A 57-year-old woman presented to our hospital with a 1-day history of persistent upper abdominal distending pain. The distending pain in the upper abdomen was aggravated after eating, with nausea and retching. Routine blood test results showed a high neutrophil percentage, low leukomonocyte and monocyte percentages, and low leukomonocyte and eosinophil counts. Amylase, liver and kidney function, and tumor markers alpha-fetoprotein, carcinoembryonic antigen, and cancer antigen (CA) 125, CA72-4, CA19-9, and CA153 were normal. Abdominal plain CT showed a mass, with multiple calcifications between the pancreas and the spleen. The boundary between the mass and the pancreas and spleen was poorly defined. Contrast-enhanced CT revealed that the upper abdominal mass was unevenly and gradually enhanced. ^{99m}Tc -MIBI SPECT/CT revealed that a focal radioactive concentration, with mild radioactive concentration extending into the upper abdominal mass, was present at the pancreatic body and tail. The ^{99m}Tc -MIBI SPECT/CT manifestations were consistent with the final pathological diagnosis of pancreatic NET.

CONCLUSION

^{99m}Tc -MIBI SPECT/CT appears to be a valuable tool for detecting pancreatic NETs.

Key Words: [Neuroendocrine Tumors](#); [Pancreas](#); Tc-99m-Methoxy-2-isobutylisonitrile; Single Photon Emission Computed Tomography; X-Ray Computed Tomography; Case Report

Liu CJ, Yang HJ, Peng YC, Huang DY. Pancreatic Neuroendocrine Tumor Detected by Technetium-99m Methoxy-2-isobutylisonitrile Single Photon Emission Computed Tomography/Computed Tomography: A Case Report. *World J Clin Cases* 2023; In press

Core Tip: Neuroendocrine tumors (NETs) are rare. The gastroenteropancreatic tract is the most common site for NETs. Pancreatic NETs account for about 1%–2% of pancreatic tumors and about 8% of all NETs. Endoscopic ultrasound, CT, and MRI are common imaging modalities for the diagnosis of pancreatic NETs. In addition, somatostatin receptor imaging is of great value for the diagnosis of pancreatic NETs. We experienced a case of pancreatic NET detected by technetium-99m methoxy-2-isobutylisonitrile (^{99m}Tc-MIBI) single-photon emission CT (SPECT)/CT. The ^{99m}Tc-MIBI SPECT/CT manifestations were consistent with the final pathological diagnosis of pancreatic NET.

INTRODUCTION

Neuroendocrine tumors (NETs) are relatively rare tumors arising from cells in the diffuse neuroendocrine system, occurring mainly in the gastroenteropancreatic (GEP) tract and lungs ^[1]. The GEP tract is the most common site for NETs ^[2]. Pancreatic NETs account for about 1%–2% of all pancreatic tumors ^[3] and about 8% of all NETs ^[4]. The diagnostic ⁵imaging modalities for pancreatic NETs include computed tomography (CT), magnetic resonance imaging (MRI), endoscopic ultrasound, and somatostatin receptor imaging ^[5]. However, the application of technetium-99m methoxy-2-isobutylisonitrile (^{99m}Tc-MIBI) single photon emission CT (SPECT)/CT for detecting pancreatic NET has not been reported.

CASE PRESENTATION

Chief complaints

A 57-year-old woman presented with upper abdominal distending pain lasting 1 day.

History of present illness

The patient had persistent pain that was aggravated after eating, accompanied by nausea and retching. Her abdominal CT findings revealed an upper abdominal tumor originating from the spleen or pancreas. Therefore, ³ she was admitted to the hospital for further examination and treatment.

History of past illness

The patient underwent traumatic abdominal exploratory surgery more than 30 years ago.

¹

Personal and family history

The patient had no specific personal or family history.

Physical examination

An old surgical scar with a longitudinal length of about 6 cm was observed on the upper abdomen. A mass was palpable in the left-upper abdomen, which was hard, poor in mobility, and slightly tender.

Laboratory examinations

Routine blood test results showed a high neutrophil percentage, low lymphocyte and monocyte percentages, and a low eosinophil count. Routine urine and stool test results were normal. The levels of electrolyte sodium, chlorine, calcium, and magnesium were normal. Amylase, liver and kidney function, and ² tumor markers alpha-fetoprotein, carcinoembryonic antigen, carbohydrate antigen (CA) 125, CA72-4, CA19-9, and CA153 were also normal.

Imaging examinations

Plain CT and contrast-enhanced CT of the abdomen: Abdominal plain CT showed a mass with multiple calcifications between the pancreas and the spleen. The boundary between the mass and the pancreas and spleen was poorly defined (Figure 1). The maximum cross section of the mass was about 9.0 cm×8.6 cm. Contrast-enhanced CT revealed that the upper abdominal mass was unevenly and gradually enhanced (Figure 2).

Abdominal ^{99m}Tc -MIBI SPECT/CT: ^{99m}Tc -MIBI SPECT/CT was performed 5 days after contrast-enhanced CT imaging. Scanning began 30 min after the injection of 740 MBq of ^{99m}Tc -MIBI. Abdominal ^{99m}Tc -MIBI SPECT/CT was performed using a PRECEDENCE SPECT/CT (Philips Medical Systems, Eindhoven, the Netherlands) system. CT scanning was performed in a spiral mode over the entire abdomen at 250 mAs per slice, 120 Kv, and with a slice thickness of 3.0 mm. Immediately after CT scanning, SPECT acquisition of the abdomen was performed. The SPECT system was equipped with low-energy, high-resolution parallel-hole collimators. The SPECT acquisition followed an elliptical orbit, with a step-and-shoot acquisition of 64 angles over 360° (180° per detector) and an acquisition time of 20 s per frame. The SPECT data were reconstructed with attenuation correction from CT acquisition and iterative reconstruction via AutoSPECT Pro software with astonish, four iterations and 16 subsets. The ^{99m}Tc -MIBI SPECT/CT fused images were processed using Fusion Viewer (version 2.1) procedures. The SPECT slice thickness was the same as that of CT.

The ^{99m}Tc -MIBI SPECT/CT images showed the presence of a focal radioactive concentration, with mild radioactive concentration extending into the upper abdominal mass, at the pancreatic body and tail (Figure 3).

FINAL DIAGNOSIS

The pathology of the pancreatic lesion indicated a well-differentiated pancreatic NET by hematoxylin and eosin staining (Figures 4 and 5). The pathology of the spleen showed

normal spleen cells by ²hematoxylin and eosin staining (Figure 6). Immunohistochemical analysis showed that the tumor cells were positive for insulinoma-associated protein 1, synaptophysin, and cluster of differentiation 56 (Figure 7). The Ki-67 (marker of proliferation Ki-67) proliferative index was assessed at 10% (Figure 8).

TREATMENT

Two days after ^{99m}Tc-MIBI SPECT/CT, the pancreatic body and tail, the upper abdominal mass discovered by CT (the mass with multiple calcifications between the pancreas and the spleen), and the spleen were excised. During the operation, a pancreatic lesion was seen to expand outward and extend into the spleen. This was inconsistent with the abdominal CT findings.

OUTCOME AND FOLLOW-UP

The patient was followed up 35 days after surgery. She complained of dull pain in her upper abdomen. Abdominal CT results showed encapsulated effusion in the surgical area (Figure 9), with no obvious abnormality in the remaining area. The patient's condition improved after ultrasound-guided closed abdominal drainage.

DISCUSSION

Pancreatic NETs are often divided into functional and nonfunctional pancreatic NETs. The majority of pancreatic NETs are nonfunctional [5]. The symptoms of a nonfunctional pancreatic NET include abdominal or back pain, nausea, vomiting, pancreatitis, and obstructive jaundice [5]. Patients with functional pancreatic NETs often present with symptoms caused by hormone production of the tumor, leading to an early diagnosis [6].

Endoscopic ultrasound, CT, and MRI are common imaging modalities for the diagnosis of pancreatic NETs. In addition, somatostatin receptor imaging is of great value for the diagnosis of pancreatic NETs [7], but the method is not easily available in our hospital.

More than 90% of well-differentiated GEP NETs express somatostatin receptors [8]. Functional imaging technique of gallium-68 dota-octreotate (^{68}Ga -DOTATATE) positron emission tomography (PET)/CT uses radiolabeled somatostatin analogs to localize NETs. Research showed that the sensitivity of ^{68}Ga -DOTATATE PET/CT was about 95% for detecting pancreatic NETs [7]. Unlike ^{68}Ga -DOTATATE, $^{99\text{m}}\text{Tc}$ -MIBI is a nonspecific tumor imaging agent. However, compared with ^{68}Ga -DOTATATE PET/CT, $^{99\text{m}}\text{Tc}$ -MIBI SPECT/CT is a relatively cheap and easily available imaging modality. Herein, we present a case of pancreatic NETs detected by $^{99\text{m}}\text{Tc}$ -MIBI SPECT/CT.

$^{99\text{m}}\text{Tc}$ -MIBI is a lipophilic univalent cationic agent. Driven by cytoplasmic and mitochondrial transmembrane potential gradients, $^{99\text{m}}\text{Tc}$ -MIBI penetrates reversibly into the cytoplasm and concentrates in mitochondria [9]. In one study, there were greater electrical gradients from outside the cell to the mitochondria in carcinoma cells than in normal epithelial cells, and the uptake of $^{99\text{m}}\text{Tc}$ -MIBI increased tenfold in carcinoma cells [9].

$^{99\text{m}}\text{Tc}$ -MIBI SPECT/CT may be a useful tool for detecting lymph node and lung metastases in patients with differentiated thyroid carcinoma [10]. Additionally, $^{99\text{m}}\text{Tc}$ -MIBI SPECT can be used to differentiate benign from malignant solitary pulmonary nodes and thyroid nodes [11,12]. Lu *et al.* [13] reported a case of mediastinal typical carcinoid tumor detected by $^{99\text{m}}\text{Tc}$ -MIBI SPECT/CT.

Our patient was a 57-year-old woman, with symptoms that started 1 day previously. The age for the occurrence of pancreatic NETs is equivalent to the mean age (57-58 years) previously identified for this type of tumor [5]. The patient's abdominal plain CT showed a mass with multiple calcifications between the pancreas and spleen. The boundary between the mass and pancreas and spleen was poorly defined. These findings indicated that the tumor might have originated from the spleen or pancreas. Contrast-enhanced CT revealed that the mass was unevenly and gradually enhanced. This indicated the possibility of a malignant tumor. However, $^{99\text{m}}\text{Tc}$ -MIBI SPECT/CT showed the presence of a focal radioactive concentration, with mild radioactive concentration extending into the upper abdominal mass, at the pancreatic

body and tail. This finding strongly suggested that the upper abdominal mass originated from the pancreas. The CT manifestations of the pancreatic tissue corresponding to the focal radioactive concentration were solid and homogenous. A previous study reported that pancreatic NETs tended to appear as solid and homogenous lesions on CT imaging [7]. In our case study, the ^{99m}Tc -MIBI SPECT/CT manifestations were consistent with the final pathological diagnosis of pancreatic NET.

CONCLUSION

^{99m}Tc -MIBI SPECT/CT appears to be valuable for diagnosing pancreatic NETs. However, subsequent large-sample studies are needed to confirm this finding.

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