

¹⁸F-FDG PET/CT and contrast enhanced CT in differential diagnosis between leiomyoma and gastrointestinal stromal tumor

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Abstract

In a 49 years old woman a large abdominal tumor was diagnosed by abdominal ultrasound. Dynamic contrast-enhanced computed tomography (CECT) showed a large tumor with minute calcification and poor contrast enhancement in the left abdominal cavity. The fluorine-18 fluorodeoxyglucose positron emission tomography/computed tomography (¹⁸F-FDG PET/CT) scan showed low ¹⁸F-FDG uptake in the tumor. The SUV max (early image) was 1.90, and that of the delayed image was 2.86. A gastrointestinal stromal tumor (GIST) was suspected. Tumor resection revealed that it was a leiomyoma originating in the major curvature of the stomach. *In conclusion*, the findings of low ¹⁸F-FDG uptake on ¹⁸F-FDG PET and poor contrast enhancement on CECT in a gastric submucosal tumor suggested of a gastric leiomyoma rather than GIST.

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Introduction

Fluorine-18 fluorodeoxyglucose positron emission tomography/computed tomography (¹⁸F-FDG PET/CT) is useful for estimating staging, local recurrence, and distant metastases, and also for tracking the effects of therapy for malignant tumors. However, ¹⁸F-FDG accumulates in granulomatous diseases such as sarcoidosis and tuberculosis, inflammatory diseases, and benign tumors such as colonic adenoma [1-3]. Leiomyoma is one of the benign tumors in which ¹⁸F-FDG accumulates. To our knowledge, ¹⁸F-FDG uptake in extragastric leiomyoma has not been reported. We describe an unusual case of ¹⁸F-FDG accumulation in a large extragastric leiomyoma and compare it with the contrast enhanced CT findings.

Case Report

A 49 years old woman exhibited abnormal findings on the greater curvature of the stomach during an upper GI tract for cancer screening, and she went to a local hospital. She underwent abdominal ultrasound and endoscopy, and an intra-abdominal tumor was detected. She was then referred to Kurume University Hospital. The usual blood tests, immunology and serology tests, and biochemical tests showed no abnormal findings. Tumor markers (CEA and CA19-9) were within normal ranges. She had no abnormal findings on her physical examination and no important disease in her past history. Dynamic contrast-enhanced computed tomography (CECT) was performed which made the diagnosis of an intra-abdominal tumor in the left abdominal cavity with little calcification, clear boundaries and poor contrast enhancement (Figure 1). An integrated full-ring PET/CT scanner (Gemini-GXL 16; Philips Medical Systems, Inc., Cleveland, OH, USA) was used for data acquisition. Before ¹⁸F-FDG injection, the patient fasted for 4 hours to maintain serum glucose concentrations below 120mg/dL. She was permitted to drink sugar-free liquids. Prior to the examination, she drank 500mL of water to accelerate renal ¹⁸F-FDG elimination. Her blood glucose level was 103mg/dL. She was administered 260MBq (4.44MBq/kg) of ¹⁸F-FDG via the antecubital vein. Whole-body imaging was performed at approximately 60 min after ¹⁸F-FDG injection. Transmission and emission images of the areas from the level of the auditory meatus the mid-thigh

were acquired in the supine position. Transmission scans were performed using attenuation correction with CT.

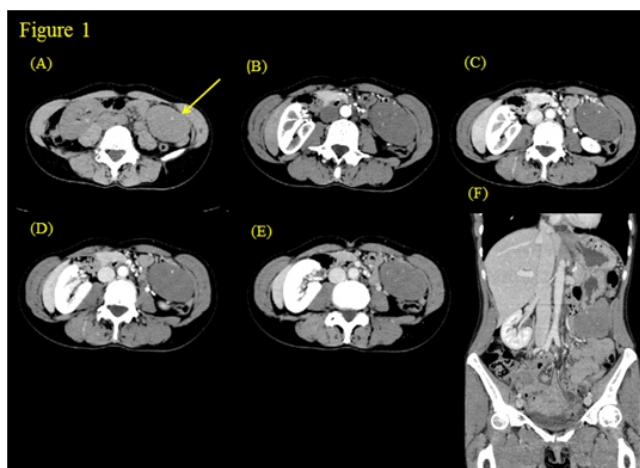


Figure 1. Dynamic contrast-enhanced computed tomography showed a minute calcified tumor lesion with clear boundaries and poor contrast enhancement (67x45mm) in the left abdominal cavity [(A) Non-contrast enhanced CT, (B) Dynamic 1st, (C) Dynamic 2nd, (D) Dynamic 3rd, (E) Dynamic 4th (F) coronal image].

The obtained transmission and emission images were reconstructed using the 3D line of the response-row-action maximum likelihood algorithm (3D-LOR-RAMLA; Philips, Eindhoven, The Netherlands). The total PET examination time for the whole body images was approximately 30min. Delayed imaging was performed at approximately 120min after ^{18}F -FDG injection. The ^{18}F -FDG-PET/CT scan revealed ^{18}F -FDG uptake in the intra-abdominal tumor (Figure 2)

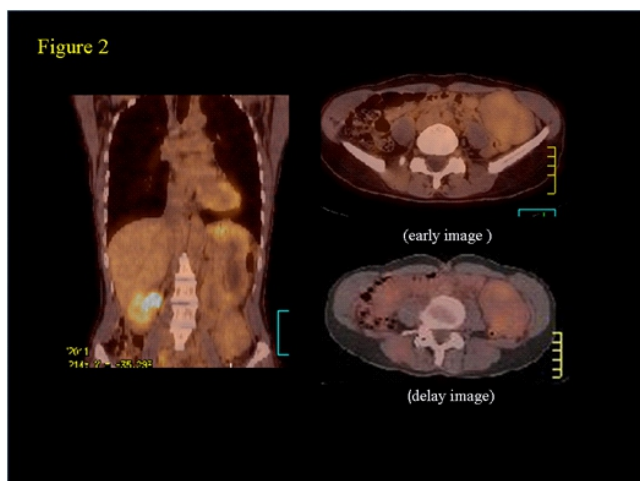


Figure 2. ^{18}F -FDG PET/CT showed ^{18}F -FDG uptake in the tumor in the left abdominal cavity. The SUVmax in the early phase was 1.90 and in the delayed image was 2.86.

The maximum standardized uptake values (SUV max) were 1.90 (early image) and 2.86 (delayed image). Endoscopic ultrasound (EUS) was performed, and a heterogeneous hypoechoic mass was found growing on the outside wall of the stomach (Figure 3). This tumor included partial calcification. A gastric submucosal tumor, especially GIST, was suspected by these imaging findings. Partial

resection of the stomach was performed. A hard, whitish tumor including a capsule grew outside of the major curvature of the stomach, and the postoperative histopathology finding diagnosed leiomyoma, on the basis of a smooth muscle actin (SMA) positive findings along with negative findings for c-kit, CD34 and S100 protein (immunohistochemical staining), and Ki-67, less than 2% (Figure 4). Her general condition after the operation was good, and she was discharged from our hospital.

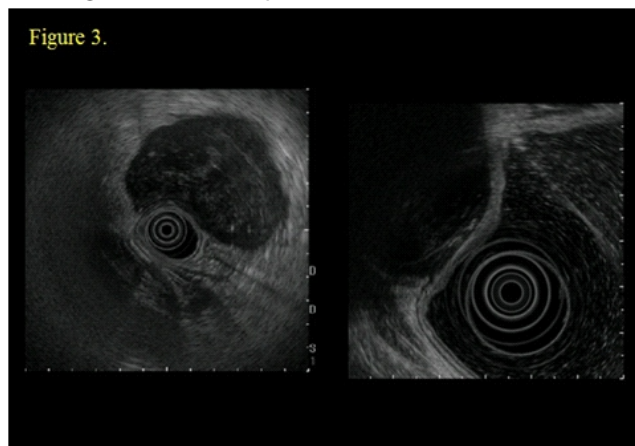


Figure 3. Endoscopic ultrasound showed a heterogeneous hypoechoic mass growing on the outside wall of the stomach.

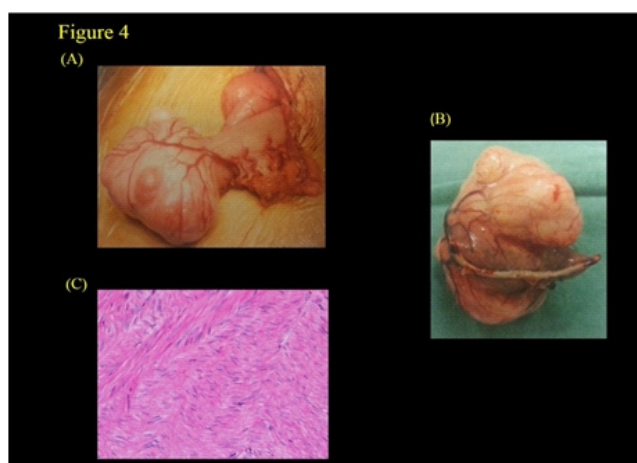


Figure 4. A hard, whitish tumor (70x45mm) including its capsule is shown outside of the stomach (A,B). Hematoxylin and eosin (HE) staining showed fascicular spindle cell proliferation (C).

Discussion

Gastric leiomyoma is a gastrointestinal mesenchymal tumor (GIMT) that originates from muscular propria or lamina muscularis mucosae of the stomach. Gastric leiomyomas represent approximately 2.5% of gastric neoplasms, and the peak age range for gastric leiomyoma is 50 to 59 years [4]. In most cases, there are no common specific symptoms or clinical signs of gastric leiomyoma. This tumor is detected incidentally during upper GI tract for cancer screening or endoscopy. When certain symptoms are present, bleeding

and abdominal discomfort are frequent. Gastric leiomyoma is preferentially located on the gastric body and antrum [5]. Typical forms of gastric leiomyoma are endogastric and intramural types, the exogastric type is less common (approximately 18.8%) [5]. Immunohistochemistry is useful for making a differential diagnosis of GIST. The immunohistochemical diagnostic pattern of GIST is positive for both c-kit and CD34, and that of gastric leiomyoma is positive for SMA and negative for c-kit and CD34 [6]. Endoscopic tumor resection and wedge resection are usual treatment procedures for gastric leiomyoma.

The imaging diagnosis of gastric leiomyoma is often difficult. Recently, Lee et al (2007) have suggested that CECT is useful for making a differential diagnosis between GIST and gastric leiomyoma [7]. They also have shown that the common type of gastric leiomyoma is the endogastric type, the tumor margin is lobular or smooth, the average tumor diameter ranges from 13-37mm and that the contrast enhancement of gastric leiomyoma on CECT is poor and lower than that of normal liver parenchyma [7]. Okten et al (2012) have reported that the tumor margin of gastric leiomyoma is smooth, the average tumor diameter is 20mm (range 12-35mm), the contrast enhancement of gastric leiomyoma on CECT is homogeneous and poor, and that EUS detects a homogeneous hypo-echoic area [8]. On the other hand, the tumor margin of GIST is lobular or smooth, the average tumor diameter is 43mm (range 32-57mm), the contrast enhancement of CECT is heterogeneous and strong, and the EUS detects a heterogeneous hypo-echoic area [8]. Calcification, cystic degeneration, necrosis, and hemorrhage are common imaging findings of GIST, while calcification is rarely found in gastric leiomyoma (approximately 4%) [9].

It has been reported that ^{18}F -FDG PET uptake in leiomyomas in the uterus, rectum, lung, and esophagus is positive [10-13]. The ^{18}F -FDG uptake mechanism in leiomyoma has been investigated in patients with uterus myoma, and ^{18}F -FDG findings of rectal or pulmonary leiomyomas have been reported as case reports [11-13]. To our knowledge, the ^{18}F -FDG uptake findings of gastric leiomyoma have not been investigated in detail. Recently, the differences of CT and ^{18}F -FDG PET findings between esophageal leiomyoma and GIST were investigated in 19 patients [10]. In that report, strong ^{18}F -FDG uptake was observed in all patients with GIST, and the mean value of SUVmax was 16 (range 10-20) [10]. Meanwhile, mild ^{18}F -FDG uptake was observed in about 34% of all esophageal leiomyoma patients, and mean SUVmax was 2.3 (range 0-7.1). These results suggest that ^{18}F -FDG PET is effective for making a differential diagnosis between esophageal GIST and esophageal leiomyoma [10]. Park et al (2011) have suggested that SUVmax was positively correlated with Ki-67 expression, tumor size, mitotic count, and National Institute of Health (NIH) classification, and that the prediction for the risk of malignancy has a sensitivity 85.7% and specificity 94.7% using a cutoff value of 3.94 SUVmax [14]. In this case, GIST was suspected before the operation because of the imaging finding of an extragastric heterogeneous large tumor with calcification. At the same

time, however, the findings of poor contrast enhancement on CECT and low ^{18}F -FDG uptake were observed in this case. On the basis of previous reports, gastric leiomyoma should have been considered at first, rather than GIST. Thus, ^{18}F -FDG PET may be a complementary tool for evaluating the grade of malignancy of gastric submucosal tumors. In previous reports regarding ^{18}F -FDG-PET/CT and leiomyoma originating from other organs, ^{18}F -FDG uptake in the uterus myoma and pulmonary region was low because the mean SUV max was 2.34 ± 0.75 for uterus myoma and 1.3 for lung myoma. On the other hand, other authors have suggested that the ability to evaluate the malignancy of ^{18}F -FDG-PET/CT is limited because of high ^{18}F -FDG uptake in degenerative myoma, cellular leiomyoma, stromomyoma of the uterus, and of rectal leiomyoma (SUVmax 8.6 for rectal leiomyoma) [12, 13, 15, 16]. The usefulness of ^{18}F -FDG-PET/CT for evaluating the malignancy of gastric submucosal tumors should be investigated with more cases.

The authors declare that they have no conflicts of interest.

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El Greco, Domenikos Theotokopoulos, Crucifixion with Virgin, Magdalene, St. John and Angels, c.1600. Oil on canvas, 312x169cm, Prado, Madrid.