CASE REPORT

FDG-PET/CT for diagnosis and follow-up of vasculitis

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Abstract : We report three cases of vasculitis evaluated by FDG-PET/CT. Vasculitis is defined as inflammatory changes and necrosis in the aterial wall. The patients presented with non-specific symptoms such as fever up or elevated inflammatory markers. FDG-PET/CT clearly demonstrated intense FDG uptake in vessel walls. A 72-year-old female patient with a one month history of pyrexia had abnormal laboratory data suggesting an inflammatory process. FDG-PET/CT was very useful for the diagnosis of vasculitis. Steroid therapy was introduced. Normalization of laboratory data and symptomatic improvement correlated with normalization of FDG uptake in the vessels. J. Med. Invest. 54 : 345-349, August, 2007

Keywords **:** *FDG-PET/CT, vasculitis, arteritis, inflammation, therapy monitoring*

INTRODUCTION

Vasculitis is defined as inflammation and necrosis with leukocytic infiltration of the vessel wall. Reactive pathological damage to the wall and surrounding tissues is also seen (1). Some patients with vasculitis present with non-specific symptoms including fever, weight loss and elevated erythrocyte sedimentation rate (ESR) or C-reactive protein (CRP). Traditionally, nuclear medicine investigation of a patient with fever or inflammatory reaction of unknown focus has been done by ^{67}Ga-citrate scintigraphy. It is known that ^{18}F-fluorodeoxy glucose (FDG) accumulates in both malignant cells and inflammatory tissue. It is also reported that FDG-PET is superior to ^{67}Ga-citrate scintigraphy in detecting an inflammatory focus (2). As FDG accumulates in normal organs such as the brain, myocardium, liver and bowel, the lack of a specific anatomical location sometimes leads to equivocal PET findings. Within the last 5 years, PET/CT has almost replaced PET-alone system. PET/CT system can produce metabolic images and anatomic images in a single session with a good coregistration. PET/CT improves the anatomic localization of abnormalities identified by PET and reduces the number of false-positive studies by accurate identification of the physiologic accumulation of FDG in normal organs.

We report three patients with vasculitis demonstrating abnormal FDG uptake in the arterial wall with FDG-PET/CT.

FDG-PET/CT protocol and image interpretation

The patients were required to fast for 6 hours and avoid strenuous work or exercise for 24 hours before the PET/CT scan. After intravenous administration of 3.7 MBq/kg FDG, the patients were asked to stay on bed rest in a separated booth. All patients were examined with a PET/CT scanner (Aquiduo, Toshiba, Japan) 1 hour after FDG injection. They were imaged from the top of the head to the middle of thigh. Imaging time was approximately 20 min. The attenuation-corrected PET image, non-attenuation-corrected PET image and CT image were reviewed, and the attenuation-corrected PET image and CT image were coregistered using AqueriasNET viewer (TeraRecon, Inc).

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CASE REPORTS

Case 1 (Fig. 1)

A 77-year-old female with heart failure was admitted to our hospital. She had low blood pressure in her upper extremities bilaterally and elevated CRP (4.1 mg/dl, normal <0.3 mg/dl). ^{67}Ga-citrate scintigraphy did not show any abnormal finding. FDG-PET/CT scan demonstrated intense FDG uptake in the walls of the thoracic aorta, abdominal aorta, carotid arteries and iliac arteries. Contrast-enhanced CT images showed thickened vascular walls. Stenosis of the subclavicular arteries due to thickened wall caused the low blood pressure in her arms. Large-vessel vasculitis was confirmed by laboratory data and FDG-PET/CT and CT findings. Steroid therapy was started. On follow up CT, thickened wall remained and inflammatory markers were unstable.

Case 2 (Fig. 2)

A 72-year-old female presented with a one month history of fever. Laboratory tests showed elevated C-reactive protein (CRP) of 12.63 mg/dl and erythrocyte sedimentation rate (ESR) of 40 mm/h (normal range 3-15 mm/h). The diagnosis of vasculitis was confirmed by PET/CT and 30 mg/day of prednisolone (PSL) was started. One month later, symptoms had improved and abnormal uptake in the arterial wall disappeared on repeated FDG-PET/CT.

Case 3 (Fig. 3)

A 32-year-old female was referred with an 8-month of fever of unknown origin (FUO). She presented with general fatigue and elevated inflammatory markers (CRP 5.1 mg/dl, ESR 70mm/h). FDG-PET/CT showed increased FDG uptake in the thoracic aorta and its branches (brachiocephalic artery and carotid arteries), which suggested vasculitis and contrast-enhanced CT was recommended. Contrast-enhanced CT demonstrated thickened arterial wall, corresponding to intense FDG uptake. These clinical findings confirmed the diagnosis of vasculitis. Her symptoms improved and laboratory data normalized with the administration of steroids. On follow up CT, no remarkable change was seen in thickened arterial wall.

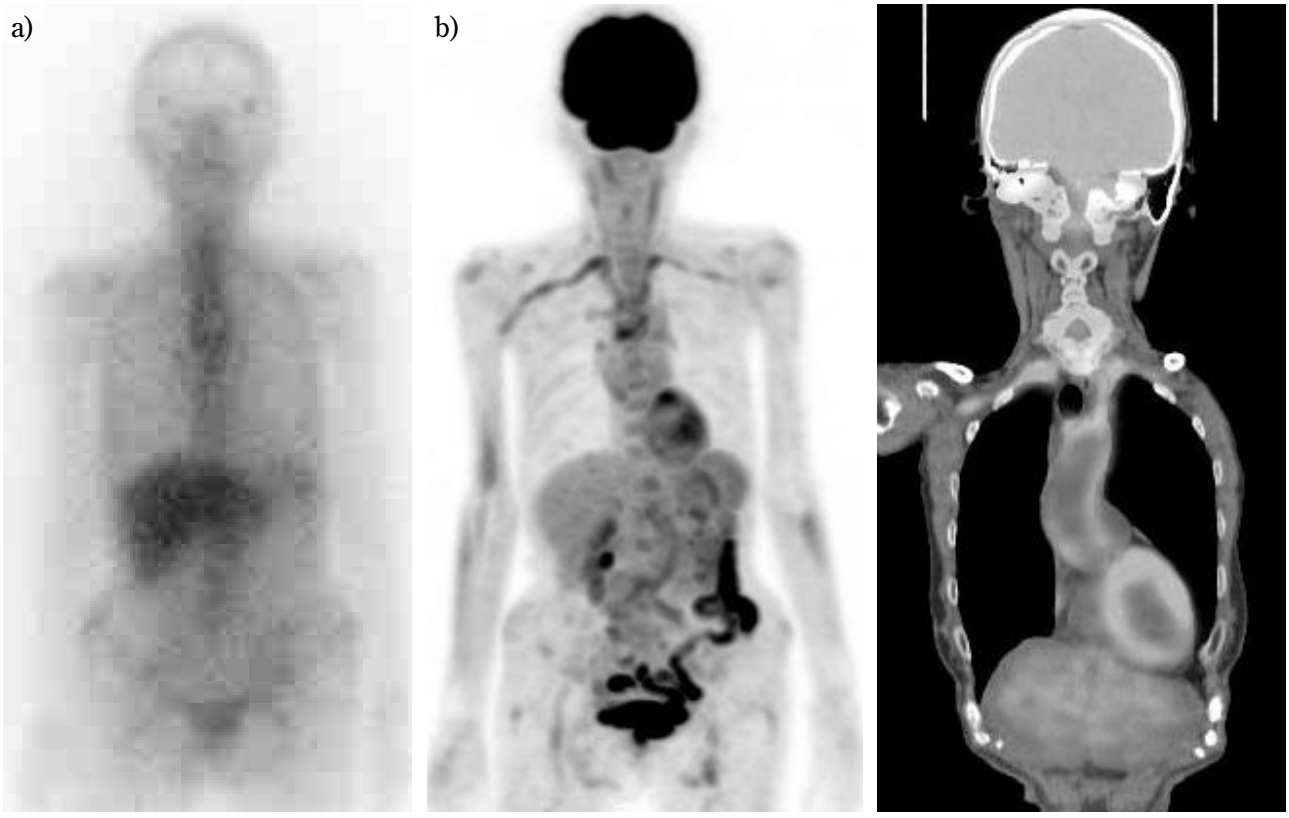

Fig. 1. A 77-year-old female. a) ^{67}Ga-citrate scintigraphy shows no abnormal uptake. b) MIP image of FDG-PET. c) MPR image of PET/CT. FDG-PET/CT scan demonstrated intense FDG uptake in the walls of the thoracic aorta, abdominal aorta, carotid arteries and iliac arteries.

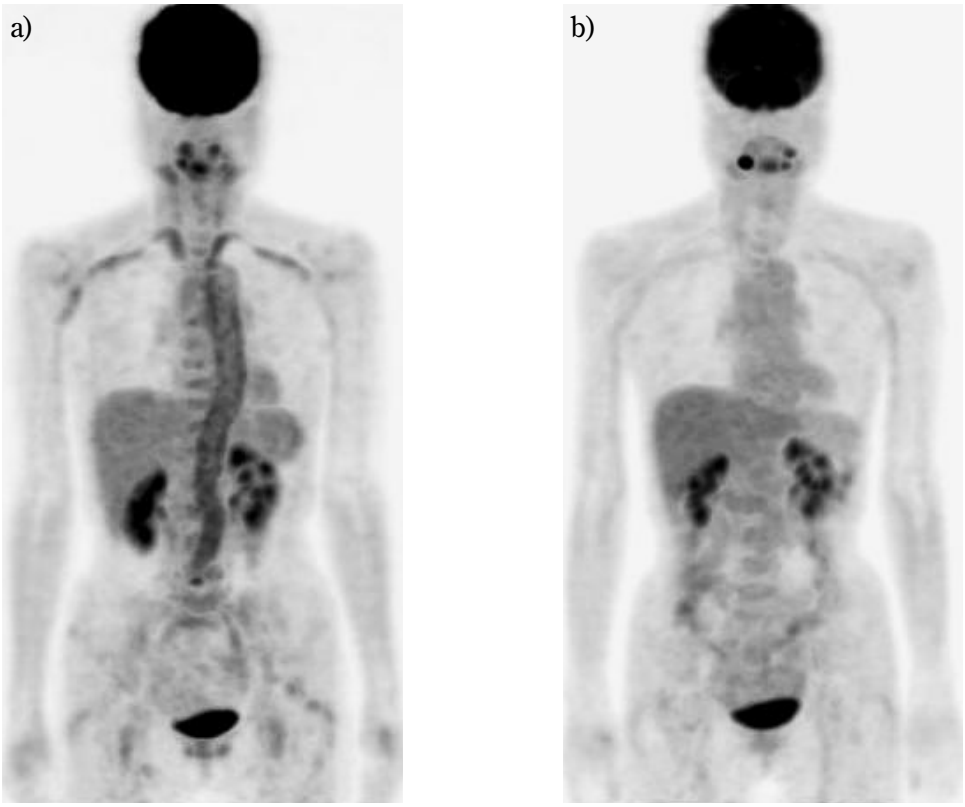

Fig. 2. A 72-year-old female. a) FDG-PET image. The diagnosis of vasculitis is confirmed. b) FDG-PET image after steroid therapy. Abnormal uptake in the arterial wall disappeared on repeated FDG-PET.

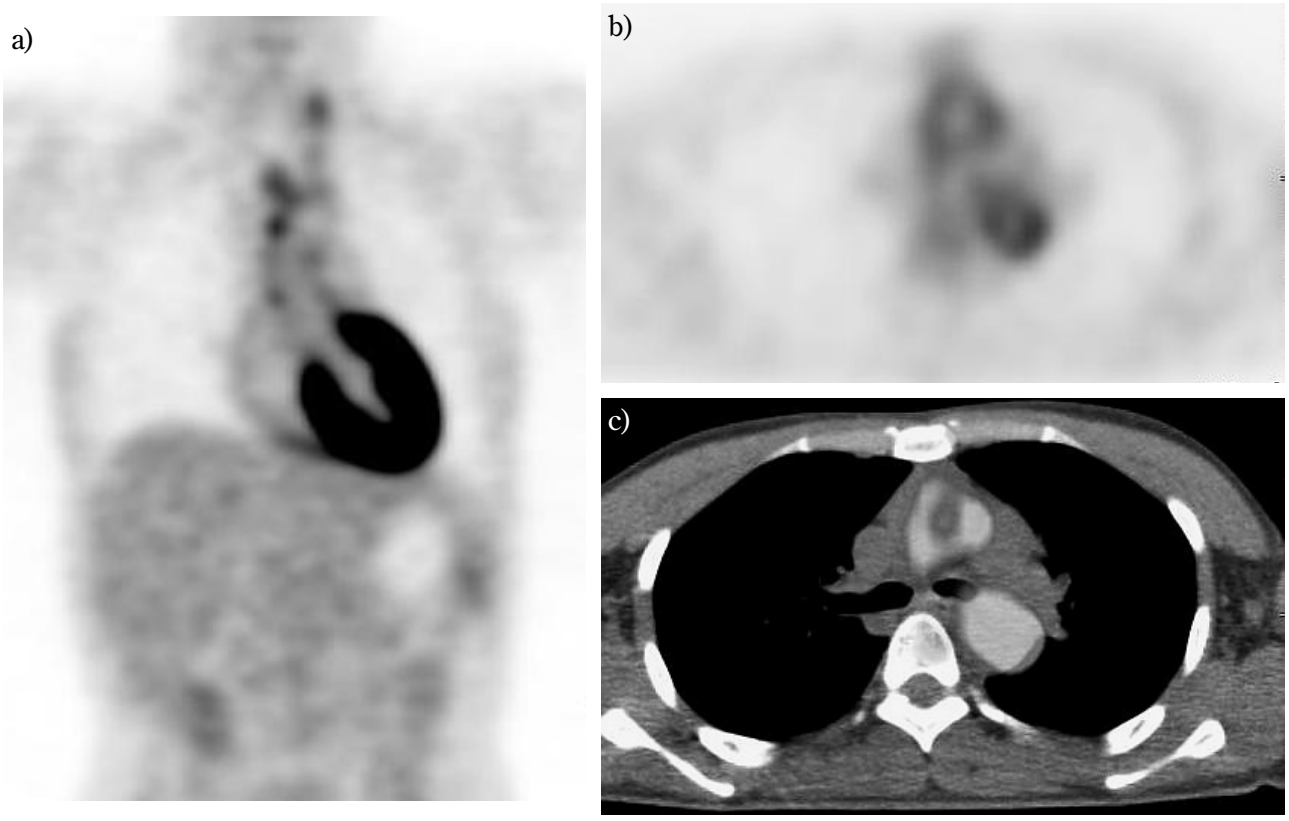

Fig. 3. A 32-year-old female. a) Coronal view of FDG-PET. b) Axial view of FDG-PET. c) Axial view of PET/CT image. FDG-PET/CT shows increased FDG uptake in the thoracic aorta and its branches (brachiocephalic artery and carotid arteries)

DISCUSSION

Vasculitis is classified into three types according to vessel size. The common large-vessel vasculitides are giant cell arteritis (GCA) and Takayasu disease. Large-vessel vasculitis is considered to be the cause in about 17% of all FUO patients (3, 4). ^{67}Ga-citrate had been considered to be a good tracer to investigate these patients, but the spatial resolution of ^{67}Ga scintigraphy is not sufficient. One of our patient was examined by ^{67}Ga scintigraphy, which showed no abnormal uptake in the arterial walls. Blockmans first reported the use of FDG-PET to investigate GCA patients (5). FDG accumulates in inflammatory tissue due to the over-expression of glucose transporter (GLUT, mainly GLUT-1, 3) and over-production of glycolytic enzymes in inflammatory tissue. FDG-PET is highly effective in detecting vasculitis anywhere in the body and has high sensitivity (77-100%) and specificity (89-100%) (6-10). If using PET-alone system, FDG uptake are often considered to be equivocal because of the lack of anatomical localization. There have been some literatures that reported coregistration of PET and contrast-enhanced CT images with image fusion software (8, 11). Intense FDG uptake clearly correlated with thickened and well-enhanced arterial wall on CT. Meller, *et al.* reported that FDG-PET images identified more vascular regions than MRI did (12). The misregistration of metabolic and anatomic images is sometimes problematic. In our cases, we could evaluate both the activity of arterial inflammation and anatomical localization with minimal misregistration using PET/CT system.

Assessment of the response to therapy has a central role in patient management. For the patients with vasculitis, ESR or CRP is commonly used to assess response to steroid therapy. CT and MRI frequently show residual abnormal findings even after symptoms have completely resolved and sometimes show discrepancies with laboratory data. FDG accumulation in the arterial wall reflects vasculitis activity, and correlates well with blood inflammatory markers. In our follow up PET/CT examination, normalization of FDG uptake clearly correlated with clinical improvement and normalization of laboratory findings. Some patients with vasculitis have nonspecific symptoms and proper diagnosis at an early stage with PET/CT allows early treatment, which will lead to a better patient outcome.

PET/CT has the potential to diagnose and monitor the response to therapy both in malignant tumors and inflammatory diseases by integrating anatomic and metabolic images.

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