18F-Fluorodeoxyglucose Positron Emission Tomography-computed Tomography in Evaluation of Large Vessel Vasculitis

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Abstract

18F-fluorodeoxyglucose positron emission tomography-computed tomography (18F-FDG PET-CT) is a rapidly evolving hybrid imaging technique in evaluation of infection and inflammation. Usually, functional changes often precede anatomical changes. 18F-FDG PET-CT, a noninvasive diagnostic test and it is useful for the early detection of inflammation. Most of the large vessel vasculitis patients present with nonspecific signs and symptoms, which are difficult to diagnose clinically. Here, we discuss three cases of large vessel vasculitis with different clinical presentations, identified by 18F-FDG PET-CT scan.

Keywords: *18F-fluorodeoxyglucose positron emission tomography-computed tomography, aorto-arteritis, extrapulmonary tuberculosis, inflammation, large vessel vasculitis*

Introduction

Vasculitis is defined as an inflammatory condition of blood vessels which is characterized by infiltration of leukocytes into the vessel wall. According to CHCC 2012 (International Chapel Hill Consensus Conference on the Nomenclature of Vasculitides) large vessel vasculitis is defined as vasculitis affecting large arteries (aorta and its major branches) more often than other vasculitides.[1] Large vessel vasculitis comprises two different conditions namely, giant cell arteritis (GCA) and Takayasu's arteritis (TA).

In clinical practice, the diagnosis of large vessel vasculitis is a difficult task, the reason being most of the patients present with nonspecific signs and symptoms. Leukocytes which are involved in inflammation are able to express high levels of insulin-independent glucose transporters, especially GLUT 1 and GLUT 3, lead to increased 18F-FDG uptake.[2]

18F-FDG PET-CT as a hybrid imaging technique and noninvasive test, useful for the detection of inflammatory foci in vasculitis. It is able to detect early inflammation, unlike conventional anatomical imaging that identify late effects such as edema, wall thickening, arterial stenosis, and aortic dilatation. Early diagnosis of vasculitis avoids the late complications such as aneurysm formation, stenosis, and occlusion of vessel wall.[3]

Case Reports

Case 1

A 20-year-old female patient presented with fever for 2 months, associated with chills and rigors, evening raise of temperature and cough with expectoration. There was a history of vomitings for 10 days with the loss of appetite and weight loss. The patient did not respond to higher antibiotics for 7 days. Laboratory investigations revealed erythrocyte sedimentation rate (ESR) 100 mm/h, total leukocyte count was 5300 cells/cu mm, and C-reactive protein levels (CRP) >320 mg/L. Mantoux test and sputum for acid-fast bacillus (AFB) were negative. Antinuclear antibodies (ANA) were positive by indirect immunofluorescence test. Ultrasound abdomen revealed mild-to-moderate ascites and minimal left pleural effusion. Patient underwent 18F-FDG PET-CT for evaluation of fever of unknown origin.

On 18F-FDG PET-CT, maximum intensity projection (MIP) image revealed linearly increased tracer concentration in large vessels and multiple foci of increased FDG uptake in mediastinum and abdomen. Transaxial images showed increased FDG uptake in mediastinal

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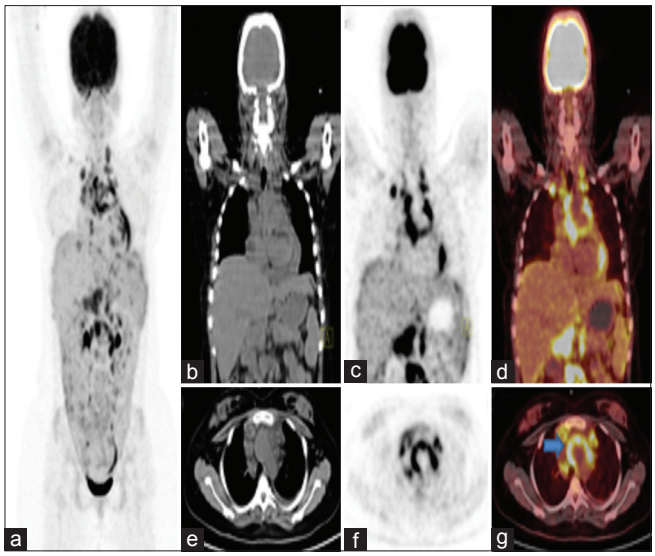

Figure 1: Case 1 - Maximum intensity projection image (a) showing linearly increased fluorodeoxyglucose uptake in mediastinum. coronal (b-d) and axial (e-g) sections of computed tomography, positron emission tomography and fused positron emission tomography-computed tomography images showing increased fluorodeoxyglucose uptake in aortic wall with maximum standardized uptake value: 11.3 (liver maximum standardized uptake value: 2.8)

lymph nodes, abdominal lymph nodes, wall of arch of aorta, thickened wall of ascending aorta, and pericardial effusion. Non-FDG avid left moderate pleural effusion and moderate ascites noted. Then, the patient was diagnosed to have disseminated extrapulmonary tuberculosis (TB) with aorto-arteritis. Treatment was started with antitubercular treatment (ATT) and low-dose steroids. Patient responded well and symptomatic improvement was seen after 3 months [Figure 1].

Case 2

A 16-year-old female patient presented with low backache and fever for 2 months, associated with evening raise of temperature, abdominal pain, loss of appetite, and weight loss. Patient was initiated on ATT and discontinued after 1 week. Laboratory investigations revealed ESR 90 mm/h, CRP 102.3 mg/L, and total leukocyte count 12,000 cells/cu mm. Sputum for AFB, urine routine microscopy, and ANA was negative. Ultrasound abdomen was normal. Barium meal follow through was suggestive of jejunitis. Patient underwent 18F-FDG PET-CT for further evaluation.

The MIP image revealed abnormal linearly increased FDG uptake involving left side of the chest, right side of the neck, and right side of the abdomen. Transaxial images showed increased FDG uptake in bilateral common carotid arteries, left subclavian artery, circumferential thickening in walls of ascending aorta, arch of aorta and at the origin of three arteries (brachiocephalic artery, left common carotid artery, left subclavian artery) from arch of aorta, and descending aorta. Increased FDG uptake noted in ileocecal junction with no morphological abnormality. It was diagnosed as TA and treatment initiated with methyl prednisolone and

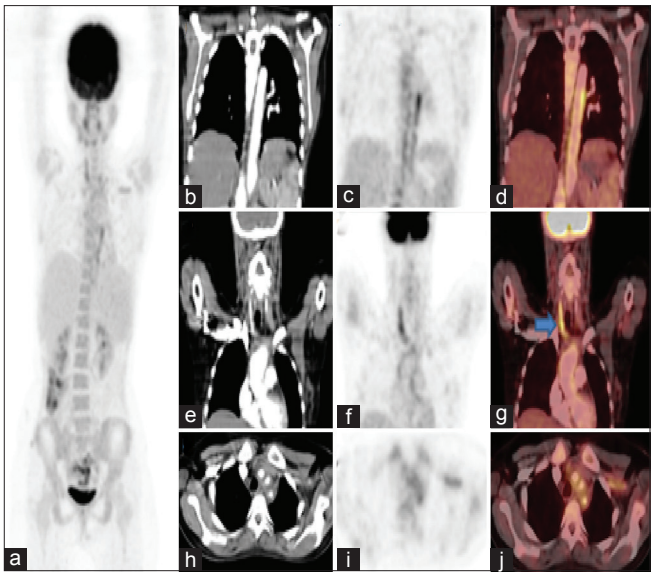

Figure 2: Case 2 - Maximum intensity projection image (a) showing linearly increased fluorodeoxyglucose uptake in the mediastinum and left side of the chest wall. Coronal (b-g) and axial (h-j) sections of contrast-enhanced computed tomography, positron emission tomography and fused positron emission tomography-computed tomography images showing increased fluorodeoxyglucose uptake in aortic wall with maximum standardized uptake value: 4.3, right common carotid artery maximum standardized uptake value: 3.7 and arch of aorta maximum standardized uptake value: 2.6 (liver maximum standardized uptake value: 1.8)

methotrexate. Patient condition ameliorated symptomatically following treatment [Figure 2].

Case 3

A 40-year-old female patient presented with tightness of chest for 15 days, history of weight loss, decreased appetite, body pains, weakness, and no history of fever. Laboratory investigations revealed ESR 118 mm/h, CRP >24 mg/L, total leukocyte count 10,100 cells/cu mm. ANA, Rheumatoid factor (RF), anti-cyclic citrullinated peptide were negative. Patient underwent contrast-enhanced CT chest that revealed mediastinal lymphadenopathy, left minimal pleural effusion, pericardial effusion, and hypodense lesions in liver. There was a clinical suspicion of malignancy and the patient was referred for 18F-FDG PET-CT.

On 18F-FDG PET-CT, MIP image revealed foci of increased FDG uptake in mediastinum. Transaxial images showed increased FDG uptake involving enlarged mediastinal lymph nodes, thickened walls of ascending aorta and arch of aorta and pericardial thickening with effusion [Figure 3]. Non-FDG avid left pleural thickening was noted. PET-CT findings were suggestive of extrapulmonary TB with aortoarteritis. Patient was treated with ATT for 9 months. Follow-up 18F-FDG PET-CT was carried out after 6 months of treatment which showed complete metabolic and morphologic response [Figure 4].

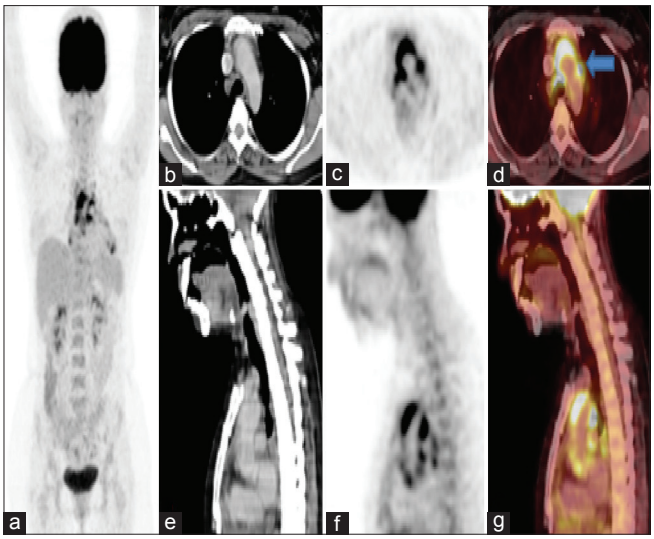

Figure 3: Case 3 (pretreatment): Maximum intensity projection image (a) showing increased fluorodeoxyglucose uptake in mediastinum. Axial (b-d) and sagittal (e-g) sections of contrast-enhanced computed tomography, positron emission tomography and fused positron emission tomography-computed tomography images showing increased fluorodeoxyglucose uptake in aortic wall with maximum standardized uptake value: 11.1, and arch of aorta maximum standardized uptake value: 9.5 (liver maximum standardized uptake value: 2.8)

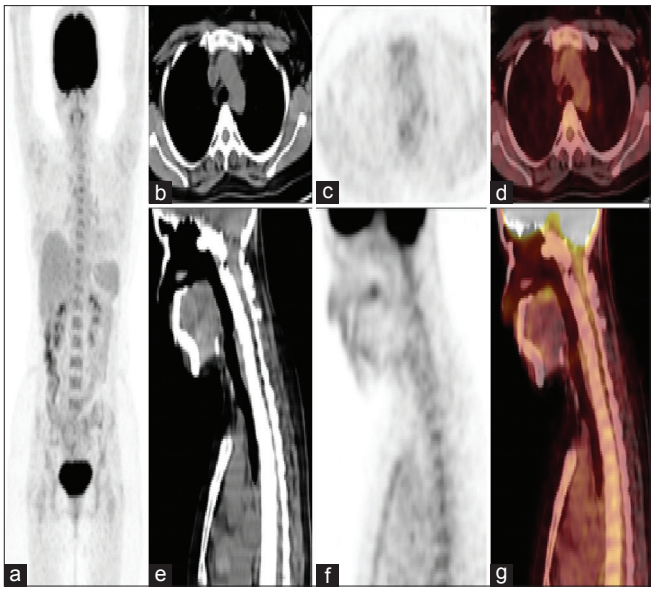

Figure 4: Case 3 (posttreatment): Maximum intensity projection image (a), axial (b-d) and sagittal (e-g) sections of computed tomography, positron emission tomography and fused positron emission tomography-computed tomography images showing no evidence of abnormal fluorodeoxyglucose uptake in aortic wall with maximum standardized uptake value: 2.6 and arch of aorta maximum standardized uptake value: 2.6 (liver maximum standardized uptake value: 2.9)

Discussion

Localization of infectious or noninfectious inflammatory foci is necessary for the early detection and appropriate patient management. Suspected large vessel vasculitis patients may present with nonspecific signs and symptoms such as fatigue, malaise, weight loss, anorexia, abnormal temperatures or night sweats, increased CRP and ESR, etc. GCA usually occurs in patients older than 50 years and often associated with polymyalgia rheumatica. TA usually occurs in patients younger than 50 years and often females are commonly affected than males. In addition to GCA and TA, aortitis may also be seen in rheumatologic disorders, other autoimmune disorders, granulomatous disorders with unspecified large vessel vasculitis, infectious vasculitis, etc.[4]

Infections may also coexist with vasculitis. Some infectious diseases such as hepatitis B and C, HIV, *Mycobacterium* TB, Epstein-Barr virus, and syphilis are most important secondary causes of vasculitis. TB is one of the most common infectious diseases. Due to granulomatous nature of both diseases, TA is commonly associated with TB. Vasculitis and TB share most of the clinical features including constitutional symptoms. Vasculitis may be caused by direct microbial invasion secondary to infections, with resultant damage to the vessel wall or immune-mediated injury. For appropriate treatment, it is necessary to evaluate secondary causes of vasculitis.[5,6]

Conventional imaging can monitor only anatomical changes and unable to detect early inflammatory changes in the involved vessel wall. Most of the cases of TA are diagnosed by image analysis (findings of stenosis, occlusion, and aneurysms) and clinical symptoms (headache, fever, arthralgia, and weight loss). It primarily involves aorta and its main branches, coronary, and pulmonary arteries. GCA predominantly involves cranial arteries (symptoms of headache, visual symptoms, jaw claudication, and polymyalgia rheumatica). It also involves aorta and its main branches.[7]

18F-FDG PET-CT is useful for the detection of infectious and inflammatory foci. As a noninvasive and operator independent diagnostic imaging method, 18F-FDG PET-CT is frequently used as a screening tool in more complex diagnostic settings, like pyrexia of unknown origin and inflammation of unknown origin.[8] Another important feature of 18F-FDG PET-CT imaging is the ability to reveal increased metabolism and functional alterations, which precedes the anatomical changes. It is useful in guiding biopsy from metabolically active vessel wall lesions.

Previous studies suggested that 18 F-FDG PET-CT is useful for the diagnosis of large vessel vasculitis, with the findings of diffuse and mild intense 18F-FDG uptake and for the assessment of response to treatment. The sensitivity and specificity of 18F-FDG PET-CT for detection of disease were 83.3% and 90%, respectively.[9]

Conclusion

18F-FDG PET-CT is a useful imaging modality in the detection of early diagnosis and extent of vasculitis in patients with suspected large vessel vasculitis. It is also useful to obtain a biopsy, monitoring therapy for better

treatment planning, evaluation of response, and for follow-up.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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