F18-FDG PET/CT Diagnoses Vasculitis after a Negative Indium-111 Leukocyte Scan

JING WANG, MD; DON C. YOO, MD; ELIZABETH H. DIBBLE, MD

ABSTRACT

We present a case of a 38-year-old man with a prior episode of fever of unknown origin (FUO) four years ago who presented with acute severe dull nonradiating abdominal pain centered in the epigastric region associated with nausea and vomiting. Bloodwork showed a normal leukocyte count but elevated erythrocyte sedimentation rate of 26 and elevated C-reactive protein of 40; syphilis titers and anti-neutrophil cytoplasmic antibodies (pANCA and cANCA) were negative. CT angiogram (CTA) of the abdomen and pelvis showed diffuse medium vessel vascular inflammation. Indium-111 labeled leukocyte scan did not show evidence of infection and, specifically, no evidence of infectious vasculitis. Subsequent F18-FDG PET/CT scan showed diffuse uptake in the mesenteric vasculature in the area of abnormality seen on prior contrast-enhanced CT and confirmed the diagnosis of vasculitis, subsequently deemed by rheumatology to be most consistent with segmental arterial mediolysis.

INTRODUCTION

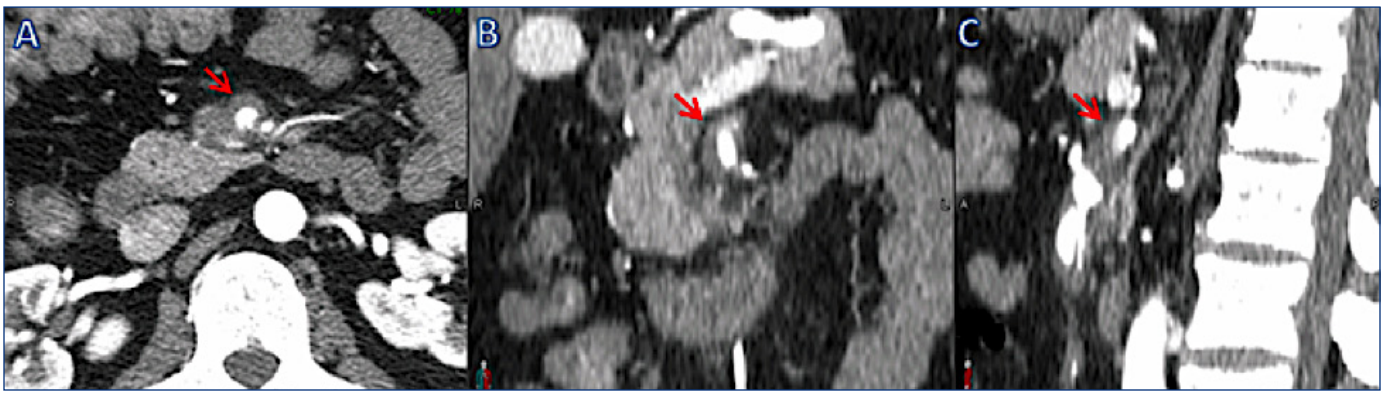
F18-FDG PET/CT is primarily used for oncologic imaging; however, mechanisms of F18-FDG uptake by tumor cells that leads to their visualization on F18-FDG PET/CT – increased expression of facultative GLUT transporters and increased expression of glycolytic enzymes[1-3] – also occur in inflammatory and granulation tissues.[4] Because of this, F18-FDG PET/CT is being used increasingly to evaluate infectious and inflammatory conditions. We present a case that illustrates the use of F18-FDG PET/CT in the workup of infection and inflammation, specifically, in a young man with vasculitis.

CASE REPORT

A 38-year-old man with a prior episode of fever of unknown origin (FUO) four years ago presented to the emergency department with 10/10 abdominal pain associated with nausea and vomiting. The abdominal pain started 1 day ago, was centered in the epigastric region and was nonradiating, better lying down, and worse sitting up. Bloodwork showed a normal leukocyte count but elevated erythrocyte sedimentation rate of 26 and elevated C-reactive protein of 40; syphilis titers and anti-neutrophil cytoplasmic antibodies (pANCA and cANCA) were negative.

CT angiogram (CTA) of the abdomen and pelvis showed diffuse inflammation and thickening of the superior mesenteric artery (SMA) wall and its branches (medium-sized vessels) (**Figure 1**) highly suspicious for vasculitis. In addition, the patient had pseudoaneurysms of the SMA and an acute SMA dissection. The differential diagnosis included segmental arterial mediolysis, connective tissue disease, and infectious and inflammatory vasculitides. The patient had no family history or other signs of connective tissue disease.

Figure 1. Axial (A), coronal (B), and sagittal (C) images from abdomen/pelvis CTA show diffuse inflammation and thickening of the superior mesenteric artery (SMA) wall (red arrows) and its branches highly suspicious for vasculitis.



The patient had recently completed a course of steroids for poison ivy and thus was mildly immune compromised; in addition, the apparent distribution of involvement together with pseudoaneurysms and dissection are unusual for inflammatory vasculitides. 111-Indium labeled leukocyte study was performed to evaluate for infectious vasculitis. The study was normal (**Figures 2 and 3**).

Subsequent CTA of neck and chest (not shown) was performed to assess for evidence of a larger vessel vasculitis and was negative.

Because of the negative neck and chest CTA and negative labeled leukocyte scan, F18-FDG PET/CT was performed to assist in diagnosis, evaluate extent of involvement, and help decide whether to initiate immunosuppressive agents. PET/CT images showed diffuse increased uptake in the mesenteric vasculature, and more focal intense uptake in the SMA in the area of abnormality seen on prior contrast-enhanced CT (**Figure 4**). The patient was diagnosed with diffuse inflammatory vasculitis, not otherwise specified, and started on corticosteroids. His abdominal pain improved, and he was discharged with outpatient rheumatology follow-up. Upon further genetic testing and clinical evaluation, rheumatology deemed the diagnosis most likely segmental arterial mediolysis.

Figure 2. Anterior (left image) and posterior (right image) whole body planar images from 111-Indium labeled leukocyte scan were normal.

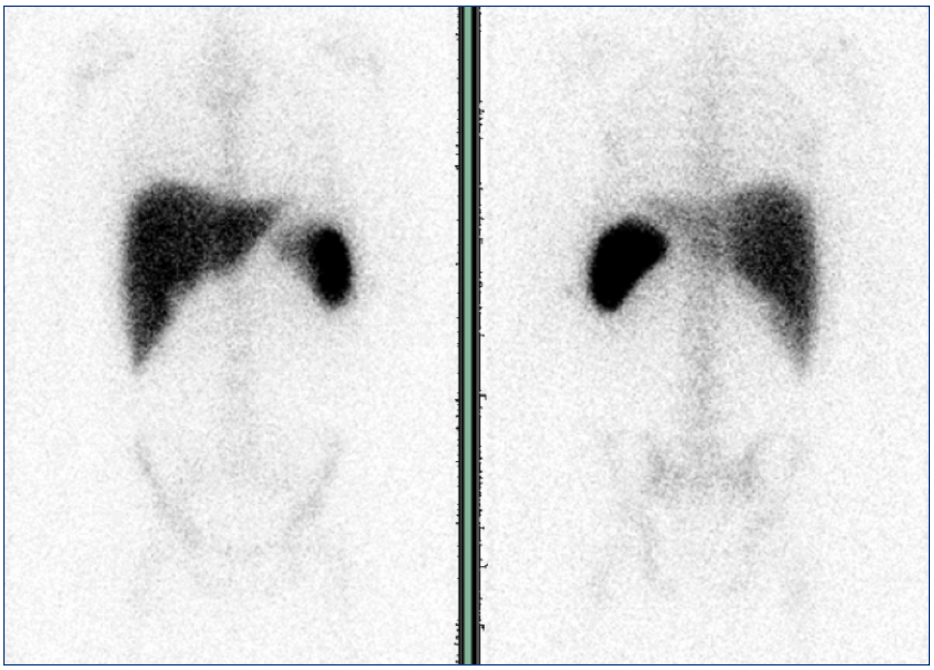


Figure 3. Maximum intensity projection Indium-111 labeled leukocyte scan image (A) and axial, coronal, and sagittal Indium-111 labeled leukocyte SPECT, (B-D, respectively) and fused SPECT/CT images (E-G, respectively) show no increased uptake in the region of the SMA (red arrows) in the area of abnormality seen on prior contrast-enhanced CT.

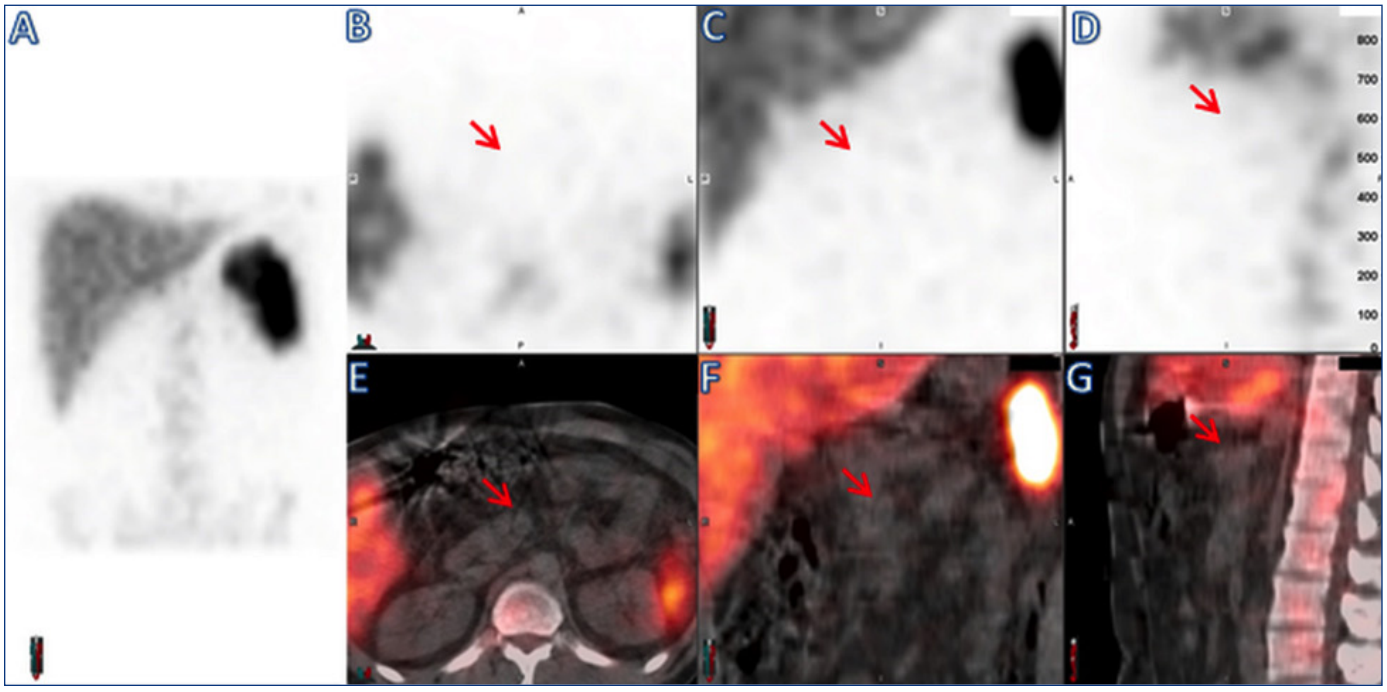
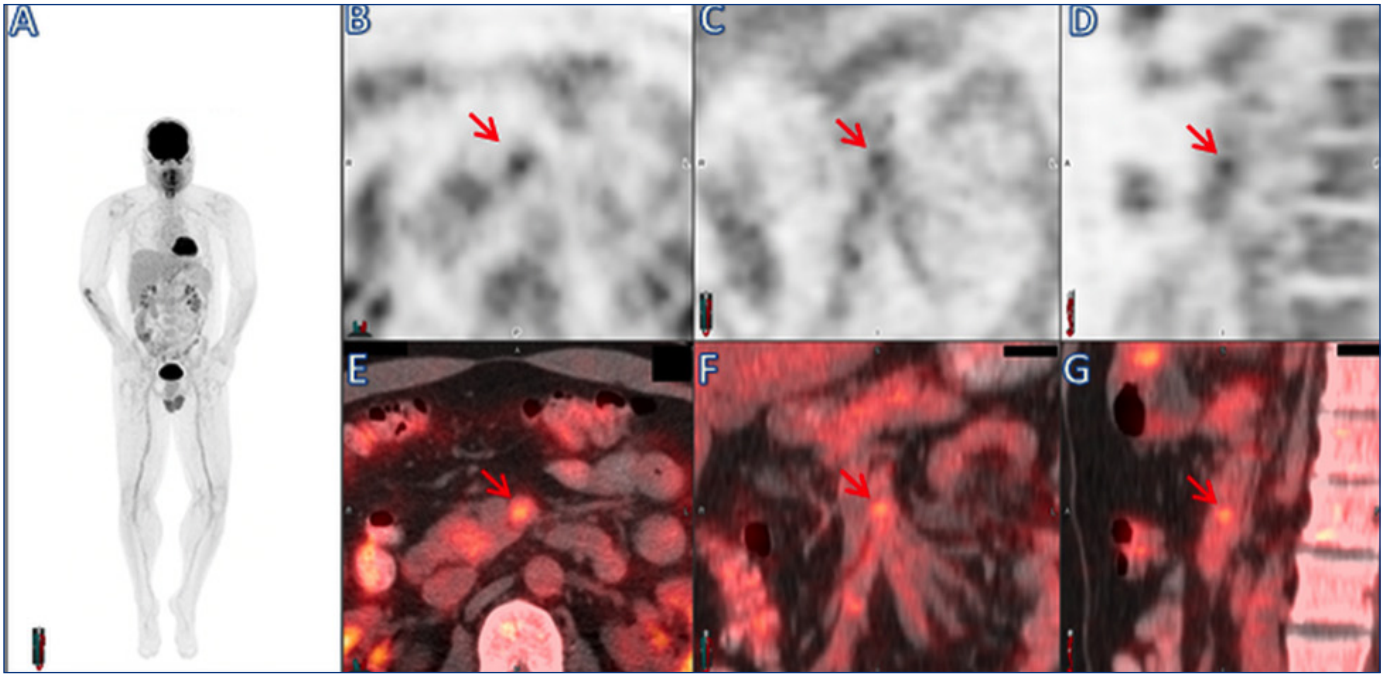


Figure 4. Because of the negative CTA and labeled leukocyte scan, F18-FDG PET/CT was performed to assist in diagnosis, evaluate extent of involvement, and help decide whether to initiate immunosuppressive agents. Whole body MIP F18-FDG PET (A) and axial, coronal, and sagittal PET (B-D, respectively) and fused PET/CT (E-G, respectively) images demonstrate diffuse increased uptake in the mesenteric vasculature, and more focal intense uptake in the SMA (red arrows) in the area of abnormality seen on prior contrast-enhanced CT.



DISCUSSION

F18-FDG PET/CT has a sensitivity for vasculitis ranging from 77%–92%[4,5] versus Indium-111 tagged leukocyte scintigraphy's sensitivity of 25%.[6] In addition, F18-FDG uptake correlates with elevated levels of inflammatory markers[7,8] and can detect metabolic abnormalities in vessels prior to morphologic changes visible on conventional anatomic imaging.[9,10] In a study evaluating FUO, F18-FDG PET/CT had a sensitivity of 86% while Indium-111 leukocyte scintigraphy had a sensitivity of 20%.[11] F18-FDG PET/CT performed at the time of this patient's prior episode of FUO may have prevented a hospital admission. In addition to assisting with diagnosis, F18-FDG PET/CT can evaluate progression and treatment response in vasculitis.[12]

F18-FDG PET/CT can also yield cost benefits relative to labeled leukocyte scintigraphy. While labeled leukocyte scintigraphy and F18-FDG PET/CT can both detect infection and inflammation, the radiopharmaceutical cost for a single dose of radiolabeled leukocytes is approximately seven times more expensive than the cost of a single dose of F18-FDG.[13]

Segmental arterial mediolysis (SAM) is a rare cause of vasculitis that is not considered a true inflammatory vasculitis; rather, inflammatory cells are inconsistently present and considered secondary to the disease itself.[14] SAM is defined by disruption of the arterial medial layer. SAM typically is not as diffuse as was this patient's vasculitis; however, aneurysms and dissections are common, as is medium sized artery involvement. The uptake on F18-FDG PET/CT is likely due to the secondary inflammation caused by disruption of the arterial medial layer.

CONCLUSION

F18-FDG PET/CT is useful in the workup of infectious and inflammatory conditions and, specifically, can be helpful in diagnosing vasculitides including the rare vasculitis segmental arterial mediolysis.

References

1. Ak I, Stokkel MP, Pauwels EK. Positron emission tomography with 2-[18F]fluoro-2-deoxy-D-glucose in oncology. Part II. The clinical value in detecting and staging primary tumours. J Cancer Res Clin Oncol. 2000;126(10):560-74.
2. Pauwels EK, Sturm EJ, Bombardieri E, Cleton FJ, Stokkel MP. Positron-emission tomography with [18F]fluorodeoxyglucose. Part I. Biochemical uptake mechanism and its implication for clinical studies. J Cancer Res Clin Oncol. 2000;126(10):549-59.
3. Whiteside TL. The role of immune cells in the tumor microenvironment. Cancer Treat Res. 2006;130:103-24.
4. Meller J, Sahlmann CO, Scheel AK. 18F-FDG PET and PET/CT in fever of unknown origin. J Nucl Med. 2007;48(1):35-45.
5. Zerizer I, Tan K, Khan S, et al. Role of FDG-PET and PET/CT in the diagnosis and management of vasculitis. Eur J Radiol. 2010;73(3):504-9.

6. Chen CC, Kerr GS, Carter CS, et al. Lack of sensitivity of indium-111 mixed leukocyte scans for active disease in Takayasu's arteritis. J Rheumatol. 1995;22(3):478-81.
7. Balink H, Veeger NJ, Bennink RJ, et al. The predictive value of C-reactive protein and erythrocyte sedimentation rate for 18F-FDG PET/CT outcome in patients with fever and inflammation of unknown origin. Nucl Med Commun. 2015;36(6):604-9.
8. Basu S, Zhuang H, Torigian DA, Rosenbaum J, Chen W, Alavi A. Functional imaging of inflammatory diseases using nuclear medicine techniques. Semin Nucl Med. 2009;39(2):124-45.
9. Treglia G, Mattoli MV, Leccisotti L, Ferraccioli G, Giordano A. Usefulness of whole-body fluorine-18-fluorodeoxyglucose positron emission tomography in patients with large-vessel vasculitis: a systematic review. Clin Rheumatol. 2011;30(10):1265-75.
10. Vaidyanathan S, Patel CN, Scarsbrook AF, Chowdhury FU. FDG PET/CT in infection and inflammation--current and emerging clinical applications. Clin Radiol. 2015;70(7):787-800.
11. Seshadri N, Sonoda LI, Lever AM, Balan K. Superiority of 18F-FDG PET compared to 111In-labelled leucocyte scintigraphy in the evaluation of fever of unknown origin. J Infect. 2012;65(1):71-9.
12. Tezuka D, Haraguchi G, Ishihara T, et al. Role of FDG PET-CT in Takayasu arteritis: sensitive detection of recurrences. JACC Cardiovasc Imaging. 2012;5(4):422-9.
13. Dibble EH, Yoo DC, Noto RB. Role of PET/CT in Workup of Fever without a Source. Radiographics. 2016;36(4):1166-77.
14. Baker-LePain JC, Stone DH, Mattis AN, Nakamura MC, Fye KH. Clinical diagnosis of segmental arterial mediolysis: differentiation from vasculitis and other mimics. Arthritis Care Res (Hoboken). 2010;62(11):1655-60.

Authors

Jing Wang, MD, The Warren Alpert Medical School of Brown University, Providence, RI.

Don C. Yoo, MD, Department of Diagnostic Imaging, The Warren Alpert Medical School of Brown University/Rhode Island Hospital, Providence, RI.

Elizabeth H. Dibble, MD, Department of Diagnostic Imaging, The Warren Alpert Medical School of Brown University/Rhode Island Hospital, Providence, RI.

Correspondence

Elizabeth H. Dibble, MD
Department of Diagnostic Imaging
Rhode Island Hospital
593 Eddy Street
Providence, RI 02903
401-444-5184, x297
Fax 401-444-5017
edibble@lifespan.org