Radiology Case Reports 19 (2024) 4549–4553

Available online at www.sciencedirect.com

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journal homepage: www.elsevier.com/locate/radcr

Case Report

Visualization of cranial giant cell arteritis with [^{18}F]FDG PET/CT: A case report ☆

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ARTICLE INFO

Article history:
Received 1 June 2024
Revised 13 July 2024
Accepted 15 July 2024

Keywords:
FDG positron emission tomography
Giant cell arteritis
Temporal arteritis
Vasculitis
Standardized uptake value
Temporal artery biopsy

ABSTRACT

Giant cell arteritis is a form of large vessel vasculitis which can present with nonspecific symptoms, and if left untreated can cause significant morbidity and/or death. Early diagnosis and management are therefore paramount. The use of [^{18}F]FDG PET/CT in the evaluation of giant cell arteritis has increased in recent years, with newer generation PET scanners capturing the historically elusive cranial vessel inflammation in active vasculitis. We present a case of giant cell arteritis which was suspected on conventional imaging modalities, and subsequently evaluated with [^{18}F]FDG PET/CT which revealed marked vascular inflammation involving both cranial and other large vessels.

Introduction

Giant cell arteritis (GCA) is a large vessel vasculitis that primarily affects branches of the internal and external carotid artery, or the aorta and its thoracic branches. The clinical manifestations of GCA often lack specificity, presenting with symptoms such as headache, fatigue, visual disturbance, chest pain, and weight loss [1,2]. Peak incidence of GCA approximately occurs between the ages of 70 and 80 years, and symptoms among the elderly may mimic those of other medical conditions. Consequently, GCA is prone to misdiagnosis, despite being the predominant form of vasculitis within this demographic [2,3].

GCA can present with serious and sometimes life-threatening sequelae requiring prompt treatment, occasionally requiring surgical intervention. Although temporal artery biopsy (TAB) remains the established diagnostic benchmark for GCA, its invasive nature warrants careful consideration and is usually undertaken at a stage when the disease is advanced [2,4]. Moreover, reliance on arterial tissue sampling may yield inconsistent results [5]. Imaging offers a less

☆ Competing Interests: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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https://doi.org/10.1016/j.radcr.2024.07.074

invasive and more comprehensive vascular analysis, potentially providing a more reliable method for GCA detection and enabling early corticosteroid treatment [2,4].

In inflammatory processes, [^{18}F]FDG PET detects increased glucose uptake in macrophages, fibroblasts and granulocytes, with increased cell membrane expression of total GLUT1 transporters [6]. In addition to imaging of vasculitis, [^{18}F]FDG PET/CT has been increasingly used for imaging other inflammatory and rheumatological pathologies, such as assisting in distinguishing between Polymyalgia Rheumatica, Spondyloarthritis and elderly-onset rheumatoid arthritis [7]. There has also been some early assessment of the utility of PET/MRI in investigating vasculitis [8]. Historically the visualization of cranial vessels (especially the temporal arteries) on [^{18}F]FDG PET/CT has proven challenging, due to the adjacent high background physiological metabolic activity of the brain and the relatively small size of the vessels involved.

We present a case in which the diagnosis of GCA affecting both large vessels and cranial vessels was made in a 76 year old male following a series of imaging studies, including [^{18}F]FDG PET/CT, without histological confirmation of diagnosis. The initial suspicion of GCA was raised on an MRI of the pituitary fossa performed for evaluation of an unrelated pituitary lesion, and treatment was subsequently commenced prior to onset of symptomatology. This case highlights the role of [^{18}F]FDG PET/CT in the diagnosis of GCA, and demonstrates the ability of current generation PET scanners to image the cranial vasculature.

Case presentation

A 76-year-old male presented for investigation of an incidental pituitary lesion identified on CT head. He had a background of long-standing ventricular ectopy managed conservatively, chronic obstructive pulmonary/airways disease, obstructive sleep apnea, and prostate cancer under investigation. The patient underwent an elective MRI of the pituitary fossa, which demonstrated moderate to severe stenosis in the clinoid and ophthalmic segments of the left internal carotid artery (ICA) and mild stenosis of the clinoid and ophthalmic segments of the right ICA with associated circumferential arterial wall enhancement. There was also diffusely reduced calibre of the imaged V3 and V4 segments of both vertebral arteries, with reduced vertebral and basilar artery flow signal on the time of flight angiogram, and associated arterial wall enhancement on the post contrast study. Serology performed at this time revealed elevation of C-Reactive Protein (160 mg/L, normal range <5 mg/L) [9]. Other serological markers including Anti-Cyclic Citrinullated Peptide, Rheumatoid Factor, Anti-double stranded DNA (anti-dsDNA), Cytoplasmic Anti-Neutrophil Cytoplasmic Antibodies (c-ANCA) and Perinuclear Anti-Neutrophil Cytoplasmic Antibodies (p-ANCA) were all within normal limits.

Subsequent CT Angiogram of the head and neck revealed multifocal severe stenosis in bilateral vertebral arteries, left ophthalmic artery attenuation, left common carotid artery wall thickening and bilateral axillary artery circumferential wall thickening, with overall appearances strongly suggestive of vasculitis.

[^{18}F]FDG PET/CT was performed shortly following this study. Imaging was performed with the Siemens Biograph Vision 600 camera system (Siemens Healthcare Pty Ltd, Victoria, Australia). About 307 MBq of FDG (weight adjusted dose) was injected intravenously and the patient was imaged from head to toes after an uptake time of 60 minutes. Visual and semiquantitative analysis was performed using Syngo. Via software (version VB60A) (Siemens Healthineers/Siemens Healthcare GmbH, Erlangen, Germany).

This study demonstrated increased vascular FDG uptake at multiple arterial sites involving the clinoid parts of internal carotid arteries bilaterally, the vertebral arteries, bilateral subclavian and axillary arteries and more distal arteries; all similar to or above background physiological liver activity, compatible with active vasculitis. The patient was subsequently commenced on a regimen of high dose Prednisolone by a rheumatologist, which he remains on to date. A temporal artery biopsy was not performed given the lack of significant symptomatology/morbidity at the time of diagnosis. The patient will be commenced on a steroid weaning regimen should follow-up investigations reveal remission of disease (Figs. 1–3).

Discussion

Giant cell arteritis is the most common vasculitis in the elderly population, characterized by a spectrum of nonspecific symptoms including headaches, malaise, fatigue, and visual disturbance. If left untreated, GCA poses an increased risk of severe complications. Acute ophthalmic complications often require urgent corticosteroid administration to avoid permanent blindness. Long-term complications include the development of thoracic aortic aneurysms and arterial stenosis [2,10]. Different patterns of vascular involvement are recognized within the spectrum of GCA, with cranial GCA affecting vessels such as the carotid and vertebral arteries and their branches (including the temporal arteries) and large vessel GCA affecting larger caudal vessels such as the aorta and subclavian arteries. There is significant overlap in disease presentation, with 70% of patients presenting with features of both patterns [11,12].

Temporal arterial biopsy (TAB) is considered the gold standard for GCA diagnosis. However, this approach is invasive and typically performed surgically, often at a stage when cardiothoracic disease has progressed to a point necessitating surgical intervention. TAB carries and inherent risk of complications and may yield false negative results due to sampling limitations, with a false negative rate of 15% up to 40% [4]. An earlier GCA diagnosis with greater reliability and less invasive techniques would facilitate the initiation of corticosteroid therapy prior to surgical intervention.

The American College of Rheumatology/ACR criteria established in 1990 were devised for the diagnosis of giant cell arteritis (GCA), requiring a positivity threshold of 3 out of 5 criteria: age > 50 years, elevated erythrocyte sedimentation rate, headache, clinical temporal artery abnormality (e.g. tenderness/decreased pulse) and abnormal temporal artery biopsy

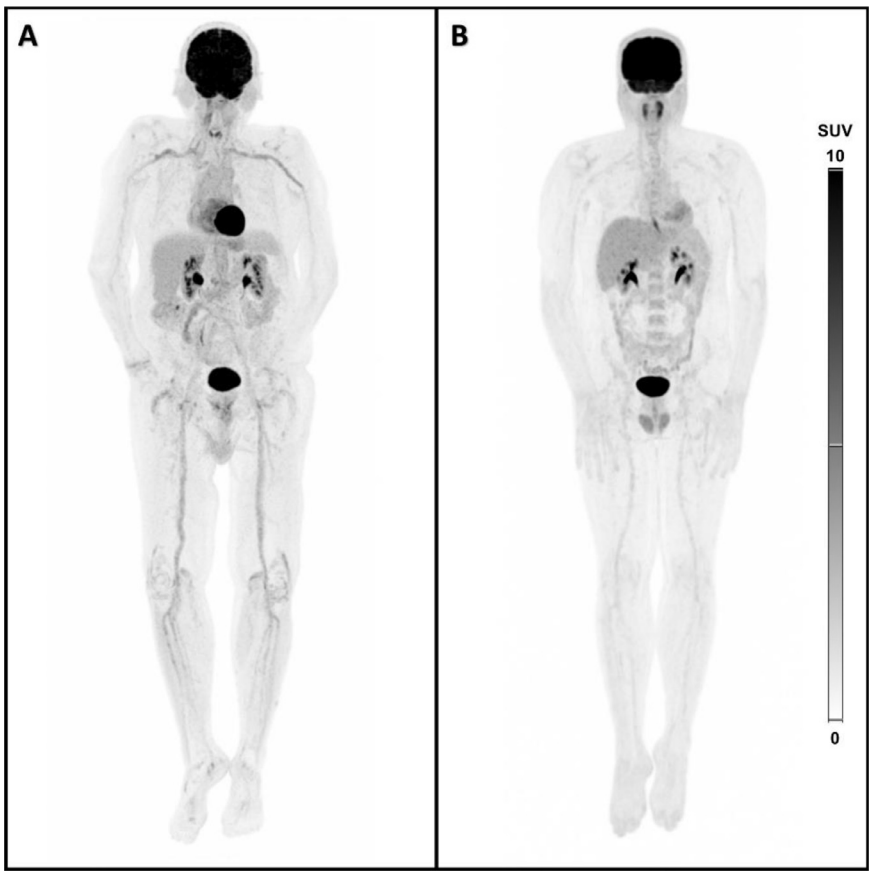

Fig. 1 – [^{18}F]FDG PET/CT Anterior maximum intensity projection images of our patient (A) compared to a patient with normal vascular FDG uptake (B). This image highlights the increased activity in bilateral subclavian and axillary arteries. Increased uptake in bilateral femoral arteries is notable however may represent atheromatous disease in this age group.

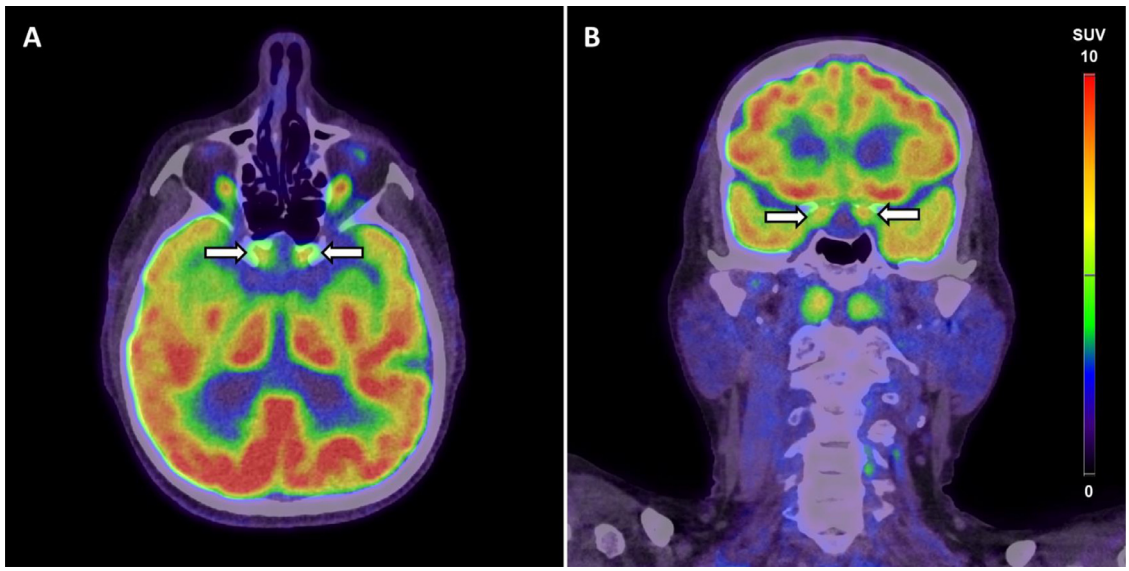

Fig. 2 – [^{18}F]FDG PET/CT axial (A) and coronal (B) images demonstrating increased FDG activity in the clinoid segments of bilateral internal carotid arteries (arrows) (SUVmax 7.8 on the left, and 7.5 on the right).

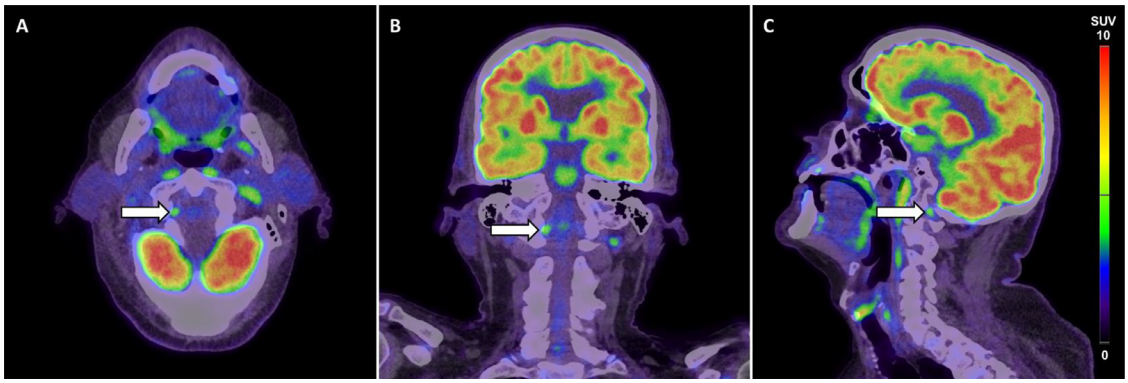

Fig. 3 – [^{18}F]FDG PET/CT axial (A), coronal (B) and sagittal (C) images demonstrating increased FDG activity in the right vertebral artery at the junction of the V3 and V4 segments (arrows) (SUVmax 4.8).

(TAB) [13]. However, their primary objective lies in distinguishing GCA from other vasculitides, and are deemed less suitable for routine clinical application [4,14].

A meta-analysis comprising 6 studies assessing [^{18}F]FDG PET/CT for GCA diagnosis revealed an aggregated sensitivity of 80% and specificity of 89%. Additionally, the negative predictive value of FDG PET imaging for GCA was high at 88% [10]. In Australia [^{18}F]FDG PET/CT currently serves as an alternative to histology for diagnostic confirmation and authorization of government subsidized treatment of GCA with Tocilizumab [15].

In routine clinical practice cranial GCA is typically assessed with ultrasound or MR Angiography, while large vessel GCA is assessed with CT angiography, MR angiography or [^{18}F]FDG PET/CT [16]. Historically, FDG PET has been considered a poor tool for visualization of cranial vessel inflammation due to spatial resolution limitations and the relatively high physiological FDG uptake in the adjacent brain [17,18]. However newer generation PET scanners can often adequately assess these vessels as a result of improvements in camera sensitivity and spatial resolution [16]. PET also avoids the need for intravenous contrast and associated risks. Nienhuis et al. performed a retrospective case-control study of 24 cranial GCA patients (confirmed by TAB) and found the sensitivity and specificity of [^{18}F]FDG PET/CT in detecting vasculitis of intracranial vessels to be 83% and 75% respectively [18]. Nielsen et al. performed a similar study of 44 patients and found sensitivity and specificity of 82% and 100% respectively, and a high inter-observer reliability with a Fleiss Kappa of 0.82 [19]. The diagnostic accuracy and reproducibility of a GCA diagnosis on [^{18}F]FDG PET/CT can be increased by using objective and semi-objective diagnostic criteria. These include vascular uptake higher than the liver (sensitivity of 83%, specificity of 91%), and aorta-to-liver ratio with value higher than or equal to 1.03 (sensitivity 69%, specificity 92%) [20].

Limitations of [^{18}F]FDG PET/CT for the diagnosis of GCA (and inflammation imaging generally) include radiation exposure, limited availability and relatively high cost. GCA can also be difficult to distinguish from other inflammatory pathologies such as idiopathic arteritis, IgG4 disease, severe atherosclerosis and peri-aortitis [21]. Furthermore, FDG uptake is demonstrably attenuated by high dose corticosteroid treatment after 3 days, which can pose a logistical challenge regarding the appropriate timing of imaging [1,17,22]. In our case, PET imaging was performed prior to commencing high dose prednisone, thus allowing adequate visualization of vasculitis.

Conclusion

[^{18}F]FDG PET/CT is emerging as a promising tool in the evaluation of cranial vasculitis, with newer generation scanners potentially offering a noninvasive diagnosis of this historically elusive entity.

Patient consent

A written and informed consent was obtained from the patient for publication of this case report.

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