

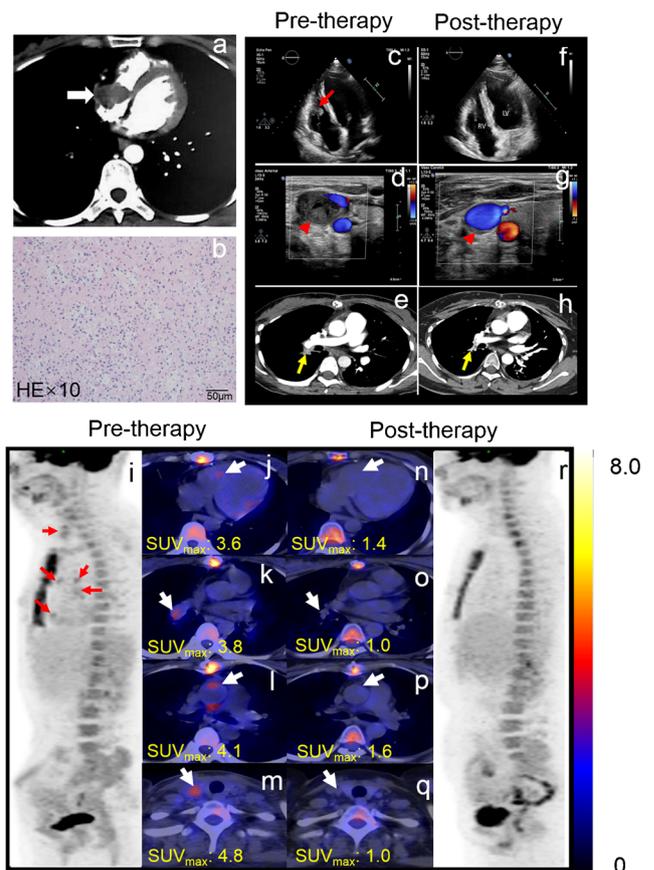


## Multiple cardiovascular involvements in Behçet's disease: unique utility of $^{18}\text{F}$ -FDG PET/CT in diagnosis and follow-up

Xiao-Ying Xi<sup>1</sup> · Wei Gao<sup>2</sup> · Xiao-Juan Guo<sup>3</sup> · Wei Jiang<sup>2</sup> · Yuan-Hua Yang<sup>4</sup> · Juan-Ni Gong<sup>4</sup> · Min-Fu Yang<sup>1</sup>

Received: 2 April 2019 / Accepted: 17 May 2019 / Published online: 3 June 2019  
© Springer-Verlag GmbH Germany, part of Springer Nature 2019, corrected publication 2019

A 33-year-old woman visited another hospital with complaints of fever and cough one month previous. Contrast-enhanced computed tomography (CT) revealed a thrombus-like mass in the right atrium (Fig. a). She then received a median sternotomy for the resection of the right atrial mass. Post-surgery pathology showed inflammatory necrosis combined with white thrombus (Fig. b; indicates inflammatory necrosis). One week after surgery, she had relapsed fever and cough and newly developed hemoptysis. She was referred to our hospital. Echocardiography demonstrated a hypochoic mass in the right ventricle, highly suggestive of thrombus (Fig. c). Color Doppler ultrasound showed a  $4.2 \times 0.4$ -cm thrombus adherent to the wall of the right jugular vein (Fig. d). Pulmonary CT angiography showed mild dilation of the interlobar trunk of the right pulmonary artery with local thrombosis (Fig. e) and multiple stenosis and occlusion in bilateral pulmonary arteries. In addition, the patient reported that she had suffered recurrent oral and genital ulcerations for about one year. Finally, she was clinically diagnosed with



This article is part of the Topical Collection on Image of the Month.

✉ Juan-Ni Gong  
juannigong2018@126.com

✉ Min-Fu Yang  
minfuyang@126.com

<sup>1</sup> Department of Nuclear Medicine, Beijing Chaoyang Hospital, Capital Medical University, 8th Gongtinanlu Rd, Chaoyang District, Beijing 100020, China

<sup>2</sup> Department of Ultrasound, Beijing Chaoyang Hospital, Capital Medical University, Beijing, China

<sup>3</sup> Department of Radiology, Beijing Chaoyang Hospital, Capital Medical University, Beijing, China

<sup>4</sup> Department of Respiratory and Critical Care, Beijing Chaoyang Hospital, Capital Medical University, 8th Gongtinanlu Rd, Chaoyang District, Beijing 100020, China

Behçet's Disease (BD) according to the international criteria for BD (ICBD) [1]. Thereafter,  $^{18}\text{F}$ -fluorodeoxyglucose (FDG) positron emission tomography (PET)/CT was performed for further evaluation of the cardiovascular involvement. To suppress physiological myocardial  $^{18}\text{F}$ -FDG uptake, a combined strategy was employed including: (1) a two-meal diet of high fat and low carbohydrates; (2) a prolonged fast of

18 h; and (3) unfractionated heparin (50 IU/kg) intravenous administration 15 min before FDG injection. Increased  $^{18}\text{F}$ -FDG uptake was observed in the mass of the right ventricle (Fig. j), multiple pulmonary artery lesions (Fig. k; only indicates right interlobar trunk), ascending aorta (Fig. l) and right jugular vein (Fig. m). Due to the multiple organ involvements, a combination of 60 mg/day of prednisone, 100 mg/day of thalidomide and 0.4 ml/12 h of heparin was initiated. The follow-up  $^{18}\text{F}$ -FDG PET/CT (Fig. n–r), performed 4 months later, showed a significant decrease in the  $^{18}\text{F}$ -FDG uptake in all of the aforementioned lesions. The follow-up echocardiography and color Doppler ultrasound revealed a complete resolution of the right ventricle thrombus (Fig. f) and an obvious shrink of the right jugular vein thrombus (Fig. g). Also, the multiple pulmonary artery lesions were improved in different degrees on pulmonary CT angiography (Fig. h; indicates the recovery of the vascular dilation in the right interlobar artery and reduction of thrombus).

BD is an inflammatory disease involving multi-organ and multi-system with unknown etiology [2]. Although intracardiac thrombus (ICT) is rare, it is associated with high mortality and serious complications. This report, to the best of our knowledge, is the first to evaluate the ICT in BD using  $^{18}\text{F}$ -FDG PET/CT. Our findings demonstrated that the ICT of BD can be resolved through drug therapy, and surgical resection might not be indicated in ICT with intense inflammatory process. In addition, our case showed an intense  $^{18}\text{F}$ -FDG uptake in the pulmonary artery and other vessels with a standardized uptake value (SUV) higher than those reported before [3–5]. Compared with our previous study [6], the maximum SUV of the thrombus in this case of BD (3.8) was significantly higher than that of the conventional pulmonary artery thrombus (1.1–3.2). Therefore,  $^{18}\text{F}$ -FDG PET may be a useful imaging tool in determination of the inflammatory process of vascular thromboembolism. CT and magnetic resonance imaging have the advantages of displaying anatomical and structural information, and ultrasound is sensitive in detecting peripheral vascular damage [7, 8]. Compared with these modalities,  $^{18}\text{F}$ -FDG PET displays the inflammatory process and is suitable for the evaluation of lesion activity and therapeutic response. In summary,  $^{18}\text{F}$ -FDG PET/CT is useful in BD with cardiovascular involvement for activity estimation, differential diagnosis and therapeutic evaluation.

## Compliance with ethical standards

**Conflict of interest** All the authors declare that they have no conflict of interest.

**Informed consent** Written informed consent was obtained from the patient for the anonymous use of patient clinical, imaging, and histologic data. All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

## References

1. International Team for the Revision of the International Criteria for Behçet's disease (ITR-ICBD), Davatchi F, Assaad-Khalil S, Calamia KT, Crook JE, Sadeghi-Abdollahi B, et al. The international criteria for Behçet's disease (ICBD): a collaborative study of 27 countries on the sensitivity and specificity of the new criteria. *J Eur Acad Dermatol Venereol.* 2014;28:338–47.
2. Sakane T, Takeno M, Suzuki N, Inaba G. Behçet's disease. *N Engl J Med.* 1999;341:1284–91.
3. Cho SB, Yun M, Lee JH, Kim J, Shim WH, Bang D. Detection of cardiovascular system involvement in Behçet's disease using fluorodeoxyglucose positron emission tomography. *Semin Arthritis Rheum.* 2011;40:461–6.
4. Trad S, Bensimhon L, El Hajjam M, Chinet T, Wechsler B, Saadoun D.  $^{18}\text{F}$ -fluorodeoxyglucose-positron emission tomography scanning is a useful tool for therapy evaluation of arterial aneurysm in Behçet's disease. *Joint Bone Spine.* 2013;80:420–3.
5. Loh H, Yung G, Bui C, Mansberg R, Comsa M. Pulmonary artery aneurysm with false-positive FDG PET in a patient with Behçet disease. *Clin Nucl Med.* 2010;35:286–8.
6. Xi XY, Gao W, Gong JN, Guo XJ, Wu JY, Yang YH, et al. Value of  $^{18}\text{F}$ -FDG PET/CT in differentiating malignancy of pulmonary artery from pulmonary thromboembolism: a cohort study and literature review. *Int J Cardiovasc Imaging.* 2019; <https://doi.org/10.1007/s10554-019-01553-5>.
7. Uzun O, Akpolat T, Erkan L. Pulmonary vasculitis in Behçet disease: a cumulative analysis. *Chest.* 2005;127:2243–53.
8. Löffler C, Hoffend J, Benck U, Krämer BK, Bergner R. The value of ultrasound in diagnosing extracranial large-vessel vasculitis compared to FDG-PET/CT: a retrospective study. *Clin Rheumatol.* 2017;36:2079–86.

**Publisher's note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.