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Case Report

Not everything that shines is gold, normal uptake in crista terminalis on FDG PET/CT masquerading as a tumor thrombus approaching right heart ☆

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ARTICLE INFO

Article history:
Received 5 September 2023
Revised 25 October 2023
Accepted 26 October 2023

Keywords:
Crista terminalis
18F-FDG PET/CT
Transthoracic echocardiography
Transesophageal echocardiography
Standardized uptake values (SUV)

ABSTRACT

The crista terminalis is a structure found in the right atrium, traversing along the posterolateral wall between the superior vena cava and the inferior vena cava. In some cases, the physiologic activity of F-18 FDG in crista terminalis can be mistakenly identified as a malignant mass, as was the situation in our case. Therefore, it is essential to have a thorough understanding of benign/physiologic uptake in normal anatomical structures and their variants when interpreting cardiac imaging. In this report, we present the case of a 79-year-old female patient who had recently been diagnosed with breast cancer. An 18F-FDG (fluorodeoxyglucose) PET/CT scan imaging assessment as part of staging revealed intense metabolic activity in the right atrium corresponding to prominent soft tissue. Subsequent assessment using transesophageal echocardiography (TEE) ultimately confirmed the diagnosis of a prominent crista terminalis, which is a normal anatomical variant.

Introduction

The right atrium (RA) is the cardiac chamber with 4 openings; orifice for superior vena cava (SVC), inferior vena cava (IVC), coronary sinus, and atrioventricular orifice. Crista terminalis forms a ridge in the right atrium dividing the atrium into a trabeculated right atrial appendage and non-trabeculated sinus venosus [1]. There is wide variation in the size of crista terminalis and the way of visualization can vary in different imaging modalities [2,3]. A prominent crista terminalis can be detected in approximately 40% of population and is more common in women [3].

If an incidental finding is detected in the cardiac chambers during the cross-sectional imaging modalities, transthoracic echocardiography (TTE) serves as the primary modality

☆ 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.2023.10.068

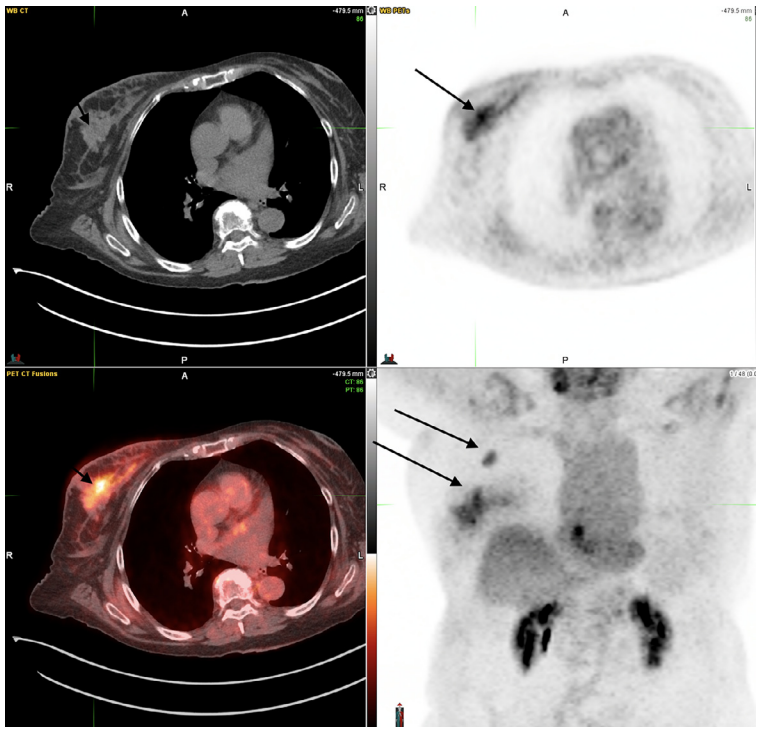

Fig. 1 – 18F-FDG PET/CT demonstrating hypermetabolic mass (arrow) depicting biopsy-proven primary malignancy. Top left image is axial CT, top right image is axial FDG PET, bottom left image is fused axial CT and FDG PET image, and bottom right image is maximal intensity projection (MIP) FDG PET image.

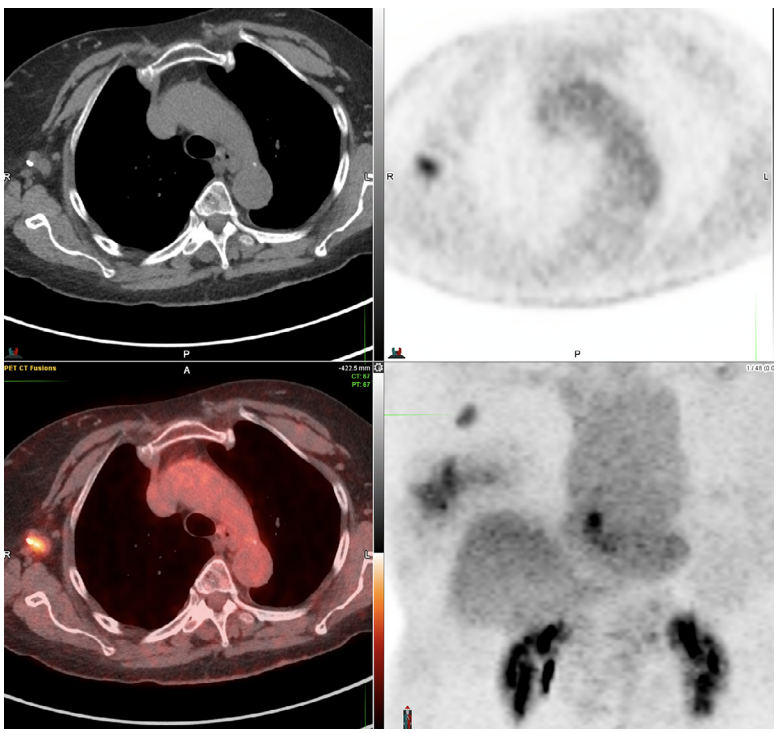

Fig. 2 – 18F-FDG PET/CT demonstrating hypermetabolic right axillary lymph node depicting biopsy-proven nodal metastatic disease. Top left image is axial CT, top right image is axial FDG PET, bottom left image is fused axial CT and FDG PET image, and bottom right image is maximal intensity projection (MIP) FDG PET image.

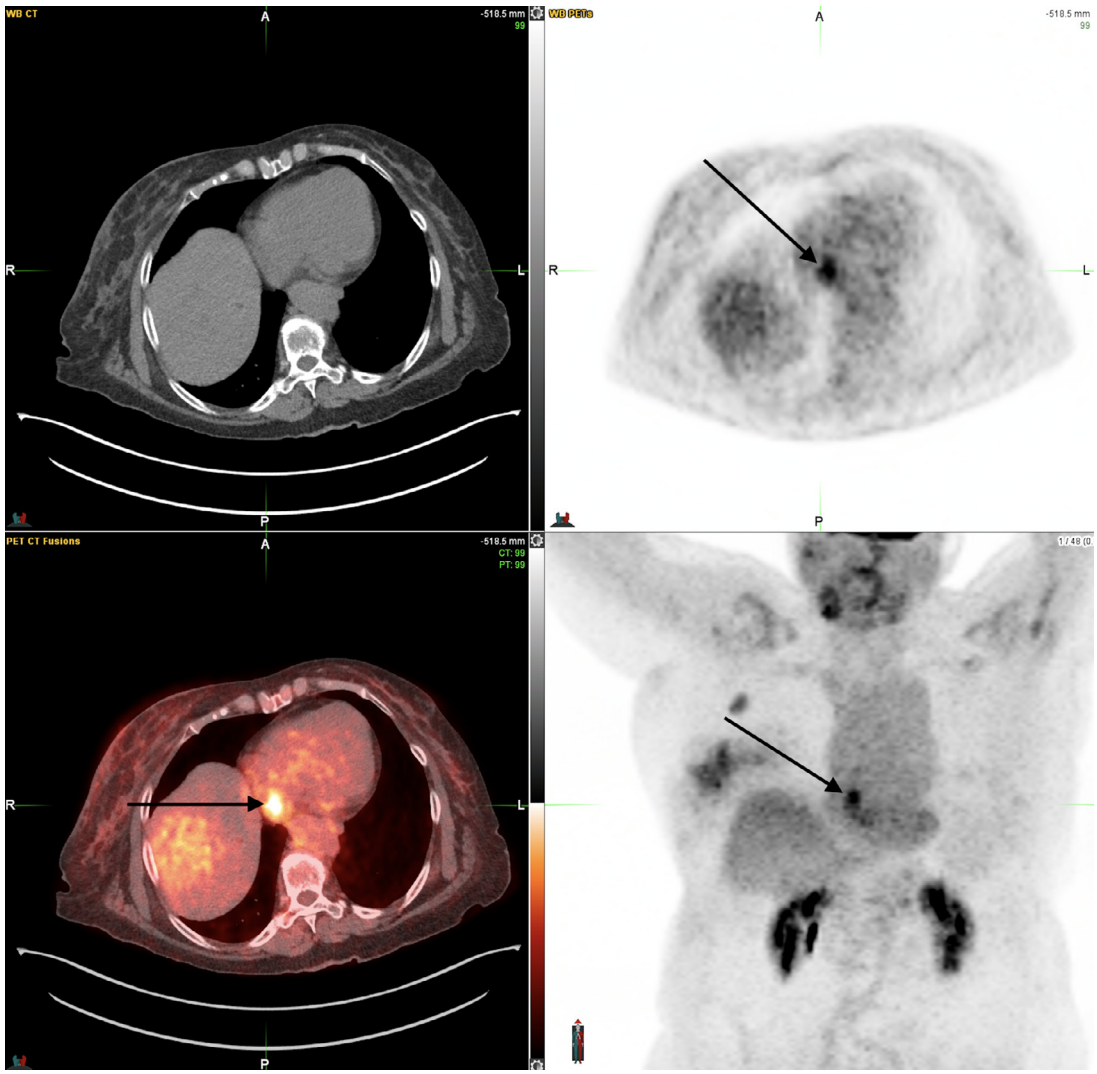

Fig. 3 – 18F-FDG PET/CT demonstrating hypermetabolic focus at the junction of inferior vena cava and right atrium (arrow). Top left image is axial CT, top right image is axial FDG PET, bottom left image is fused axial CT and FDG PET image, and bottom right image is maximal intensity projection (MIP) FDG PET image.

for further assessment. In cases where TTE results are inconclusive or the need for further interventions, transesophageal echocardiography (TEE) is indicated.

Here, we present a case of suspicious uptake in the area of the right atrium and IVC in a patient with breast carcinoma undergoing 18F-FDG PET-CT scan which turned out to be benign in etiology. Our aim is to create awareness of this pattern of uptake so that it can be considered as a differential diagnostic possibility in the given setting, appropriate imaging work-up can be performed to confirm it and avoid implications of false-positive diagnosis of metastatic disease.

Case presentation

A 79-year-old female patient with a newly diagnosed right-sided stage IIIA ER/PR/HER2 (+/+/-) invasive ductal carcinoma was referred for 18F-FDG PET/CT for staging and as a baseline exam prior to neoadjuvant therapy. The patient's medical history included dementia, multiple cerebrovascular accidents resulting in residual right-side hemiparesis, along with incidents of pulmonary embolism (PE). Her current medication regimen involved anastrozole, statin, quetiapine, valproic acid, risperidone, trazodone and enoxaparin. The 18F-FDG PET/CT scan showed worrisome focal FDG uptake in the IVC extending to the right atrium, measuring SUV max 7.5 (Figs. 1-4), suspicious for a tumor thrombus, leading to the decision to admit her for further investigation using TTE and TEE. The subsequent diagnostic evaluation involved a computed tomography angiography (CTA) chest/abdomen/pelvis (Fig. 5) without evidence of PE or a mass and TTE which revealed the presence of a mass within the RA and IVC, concerning clot in transit (Fig. 6). This finding prompted a TEE, which led to the diagnosis of prominent crista terminalis attached to posterior

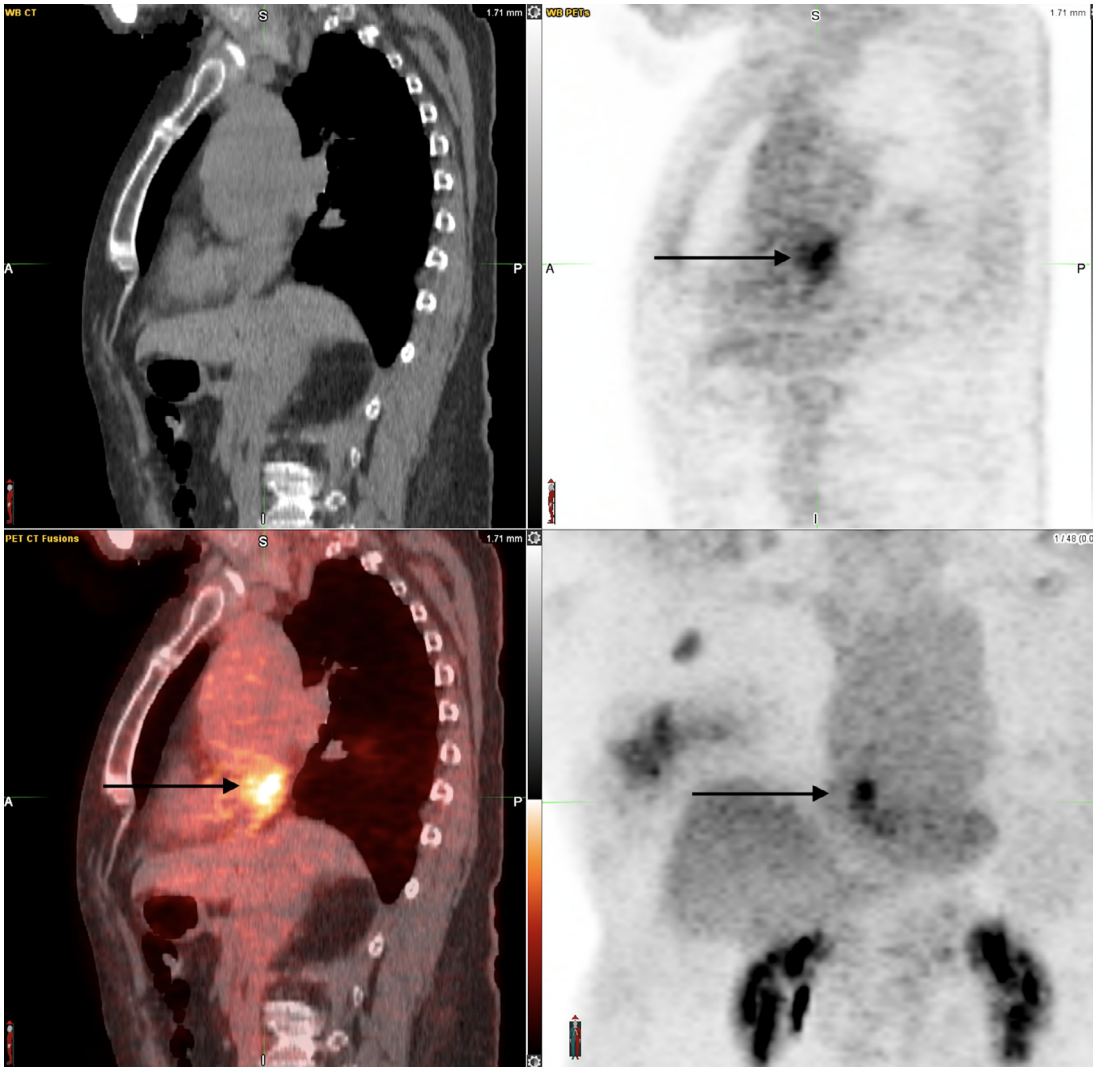

Fig. 4 – 18F-FDG PET/CT demonstrating hypermetabolic focus at the junction of inferior vena cava and right atrium (arrow). Top left image is sagittal CT, top right image is sagittal FDG PET, bottom left image is fused sagittal CT and FDG PET image, and bottom right image is maximal intensity projection (MIP) FDG PET image.

wall of the right atrium (Fig. 7). Following the diagnostic procedures, the patient was discharged home.

Discussion

Cardiac tumors are infrequent, with metastatic cardiac involvement being more prevalent than primary cardiac tumors. Among those, melanoma, lung, and breast cancer are the most common types of cancer that can lead to intracardiac metastasis [4].

Echocardiography is one of the key imaging modalities when there is a suspicion of a cardiac tumor. Although TTE is typically the initial choice for assessment due to its ease of use and noninvasiveness, TEE offers advantages over TTE because of its closer proximity to the heart and lack of interference from the chest wall or lungs [5].

18F-FDG PET/CT serves as a potent diagnostic tool for both staging and monitoring therapy in various types of cancer. Increased glucose metabolism is a hallmark of malignant cells across a wide range of cancers, making FDG uptake a highly sensitive indicator for determining the presence and extent of these tumors [6]. Nevertheless, it is important to note that elevated 18F-FDG uptake is not specific for malignancy and can be observed in various settings, including but not limited to inflammatory and infectious processes, postoperative remodeling, and as is the case we're discussing here, even as a normal variant.

18-F FDG PET can help with the differentiation of benign and tumor thrombus based on metabolic activity. In the study involving 20 patients with cardiac tumors who underwent PET/MRI, the analysis of PET and MRI separately revealed that the SUV max was notably higher in patients with malignant tumors when compared to those with benign thrombi [7]. In a study conducted by Rahbar et al. [8], a mean SUV max

Fig. 5 – CT angiogram of the chest demonstrating no filling defect at the junction of inferior vena cava and right atrium (arrow). The left image is axial CT, middle image is sagittal CT and right image is coronal CT. There is an incidental simple cyst in the left lobe of the liver (curved arrow).

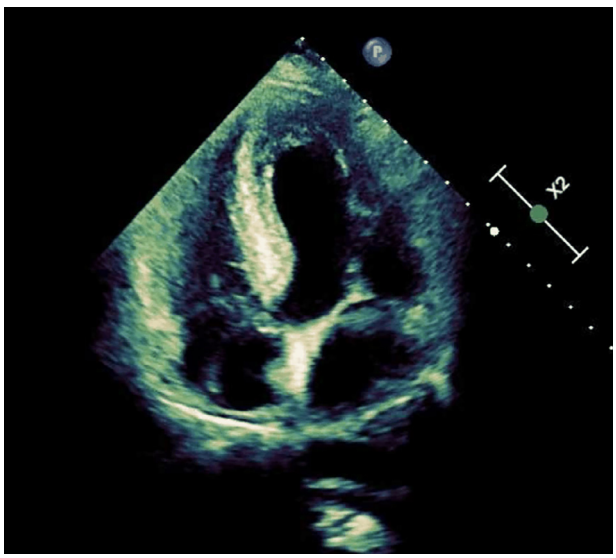

Fig. 6 – Transthoracic echocardiogram demonstrating right atrial echodensity, possible thrombus in the appropriate clinical setting.

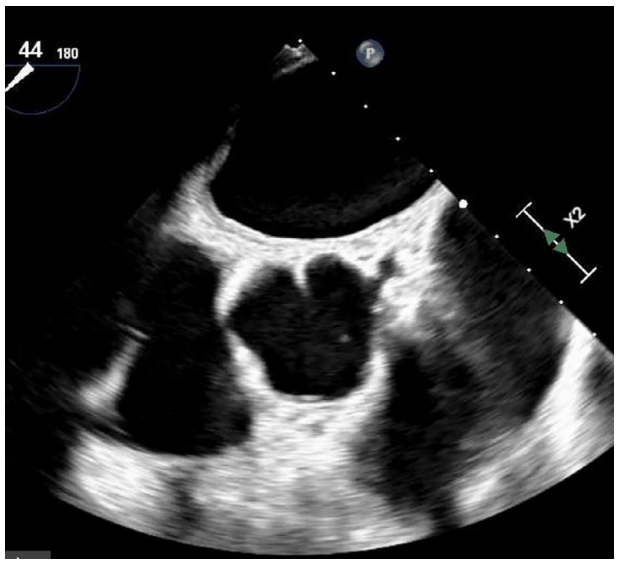

Fig. 7 – Transesophageal echocardiogram demonstrating a prominent crista terminalis in the right atrium.

cutoff value of 3.5 was used to distinguish between benign and tumor thrombi. It is important to highlight that physiological myocardial uptake can vary, which introduces potential challenges in 18-F FDG PET/CT imaging. In our case, we documented an SUV max of 7.5 within the RA, which exceeded the threshold for malignant tumor thrombus, supporting the decision to admit her to the hospital. However, it was later determined to be due to a prominent crista terminalis, demonstrating that specific SUV thresholds may not always provide definitive indications.

Conclusion

Our case highlights the importance of recognizing normal/benign physiologic uptake in the anatomical variations of the heart, thereby preventing costs of often unnecessary additional imaging procedures, anxiety to the patients/referring physicians, and delays in definitive therapies. Consideration of this entity in the differential diagnosis would be helpful even in circumstances when the imaging findings are indeter-

minate. In these instances, imaging work-up can be pursued with the most definitive imaging study (TEE in this case) to avoid costs and delays from multiple imaging studies before arriving at the appropriate diagnosis.

Patient consent

Informed consent has been provided by the patient.

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