VIA MEDICA

CASE REPORT

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Cardiac metastasis of lung cancer diagnosed by fluorine-18 fluorodeoxyglucose positron emission tomography/computed tomography (^{18}F-FDG PET/CT)

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ABSTRACT

Lung cancer is currently one of the most common malignancies worldwide. Among all metastatic sites of this cancer, cardiac metastases are exceptional, and long-term prognosis in these patients is very poor. ^{18}F-FDG PET/CT is a valuable imaging tool for initial staging and assessment of treatment response of various neoplasms. In the case of lung cancer, its role is clearly defined, and its effectiveness is superior to other diagnostic imaging methods. We present a rare ^{18}F-FDG PET/CT image finding in a 71-year-old man with biopsy-proven lung squamous cell carcinoma, showing increased cardiac ^{18}F-FDG uptake subsequently found to be compatible cardiac metastasis.
Keywords: cardiac metastasis, FDG, lung cancer, PET/CT

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Introduction

The most common metastatic sites in lung cancer are the nervous system, bones, liver, respiratory system, and adrenal glands [1]. Cardiac metastasis from lung cancer is rare and usually difficult to diagnose unless it causes symptoms. Most often it is discovered during assessment by fluorine-18 fluorodeoxyglucose positron emission tomography/computed tomography (^{18}F-FDG PET/CT).

We describe a case of squamous cell lung carcinoma with metastasis to the right ventricle detected by FDG-PET/CT.

Case report

A 71-year-old man, a former smoker affected by arterial hypertension, presented with a cough, left chest pain, exertional breathlessness, and a weight loss of 10 kg in 4 months. Physical examination revealed reduced chest movements on the left anterior side of the chest and decreased intensity of breath sounds on auscultation. Computed tomography (CT) of the chest showed a large heterogeneous enhancing mass lesion measuring 6.7 cm × 7.2 cm × 7.4 cm with a spiculated margin in the lower lobe of the left lung.

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Computed tomography-guided biopsy confirmed the diagnosis of poorly differentiated squamous cell carcinoma. Fluorine-18 fluorodeoxyglucose positron emission tomography/computed tomography was performed to investigate potential metastases and, in addition to a hypermetabolic lung mass in the lower lobe (SUV_{max} = 14.3), it showed (1) lesions with increased FDG uptake in the left hilar and mediastinal lymph nodes and on the left iliac wing compatible with bone metastasis, (2) an intracardiac FDG-avid mass with SUV_{max} = 11.2 measuring 3.8 cm × 6.1 cm × 3.9 cm, suggesting a right ventricle metastasis.

The patient underwent transthoracic ultrasound and cardiac magnetic resonance imaging (CMR) for further evaluation and tissue characterization of the mass. Cardiac magnetic resonance imaging imaging showed a right ventricular mass, with high-signal intensity on T2-weighted imaging, hypoperfused on first-pass perfusion relative to the myocardium, and with late gadolinium hyperenhancement. These findings were consistent with the tumor diagnosis and likely represented metastatic disease.

Our patient was treated with palliative chemotherapy and died from general deterioration of his condition 6 months after the diagnosis.

Discussion

Heart tumors are rare and difficult-to-diagnose pathologies. Most primary cardiac tumors are benign in origin, and secondary cardiac tumors are more common than primary cardiac malignancies [2]. The incidence is higher than one may expect and ranges from 2.3% to 18.3% [3]. In theory, any cancer can lead to cardiac metastases. The most common cancers are melanoma, lung, breast, esophageal, and hematological malignancies [4]. These metastases are most often located in the right heart [5]. The myocardium is the most frequently metastatically affected cardiac tissue, followed by the pericardium and then the endocardium; conduction system involvement is much less common [6]. Metastasis can reach the heart through the dissemination of cancer cells into the bloodstream, or directly via adjacent tissues; another way is propagation via the superior or inferior vena cava to the right atrium [7]. In the case of lung cancer, metastatic cells often reach the heart through the lymphatic system; they usually do not cause any symptoms and are, therefore, rarely diagnosed before death [8].

The diagnosis of metastatic cardiac tumors is often delayed due to diverse and nonspecific manifestations, especially in early stages. In more advanced stages, secondary tumors of the heart gradually lead to heart failure, conduction disorders, valve diseases, such as mitral stenosis, angina pain, Adams-Stokes syndrome, and even sudden death. Such outcomes have been reported in approximately 3% of patients with cardiac metastases [9]. Electrocardiogram (ECG) changes are non-specific; in most cases, the ECG is normal. However, the following abnormalities may be observed: low voltage, ischemia, heart blocks, and arrhythmias [10]. Imaging studies have turned out to be very useful noninvasive tools for diagnostic evaluation of cardiac metastases. According to the 2022 European Society of Cardiology (ESC) Cardio-Oncology Guidelines, in the case of cardiac metastases, imaging can assess the possibility of heart surgery and may include echocardiography, CMR, computed tomography, and FDG-PET/CT [11]. Transthoracic echocardiography (TTE) or transesophageal echocardiography is the initial imaging test to detect *cardiac metastases.* It evaluates the size, location, mobility, and extent of pericardial invasion of the tumor [12]. Cardiovascular magnetic resonance adds information about tumor size, morphology, location, extent of invasion degree, and vascularity [13]. Fluorodeoxyglucose positron emission tomography/computed tomography provides a combination of data on tumor morphology and metabolism, which is relatively objective. Additionally, FDG-PET/CT features may be useful in distinguishing malignant and nonmalignant cardiac lesions, but this remains controversial [14].

Since histopathological confirmation of the cardiac metastases in our patient was not performed, we cannot completely rule out the possibility of other diseases. The differential diagnosis excluded cardiac thrombosis or the presence of a chemotherapy catheter [11] and included other causes of malignant or benign primary cardiac tumors. Most primary cardiac tumors are benign: myxomas, rhabdomyomas, papillary fibroelastoma, fibromas, hemangiomas, lipomas, and leiomyomas [15]. Cardiac sarcoma accounts for more than two-thirds of all primary cardiac malignant tumors, and histopathological subtypes of primary cardiac sarcoma include angiosarcoma, leiomyosarcoma, liposarcoma, rhabdomyosarcoma, synovial sarcoma, fibrosarcoma muscle and undifferentiated pleural sarcoma [16].

In our patient with aggressive lung cancer, the cardiac mass was considered secondary, and treatment was initiated.

In such cases, total surgical resection remains the treatment of choice, recommended in the 2022 ESC Cardio-Oncology Guidelines, but this option was not feasible due to high postoperative morbidity and the need for adjuvant radiotherapy or chemotherapy.

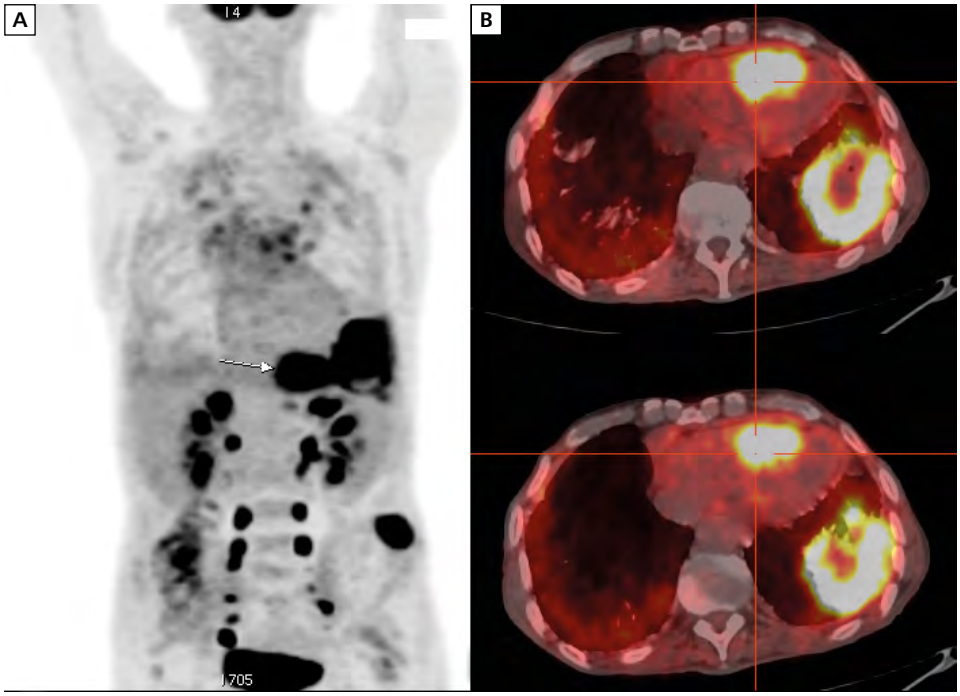

Figure 1. Fluorine-18 fluorodeoxyglucose positron emission tomography/computed tomography (^{18}F-FDG PET/CT): maximum intensity projection maximum intensity projection (MIP) (**A**), and transaxial images of the thorax (**B**), showing an intense and pathological FDG uptake in the right ventricle (white arrow in MIP)

Conventional radiotherapy is mainly used in palliative situations to bring relief to symptomatic patients [17].

The prognosis of patients with malignant cardiac tumors depends on many factors and, despite advances, remains generally *poor*, with *survival ranging* from *6* to 18 *months* after the diagnosis [18].

Conclusions

Our case demonstrates that FDG-PET/CT is an effective imaging modality for detecting rare distant metastatic sites, which can result in changing disease management. It increases chances of detecting cardiac metastases at an early stage thus facilitating adequate treatment.

Article Information and Declarations

Ethics statement

The patient's consent was obtained for the presentation of a clinical case.

Author contributions

Y.B.: article concept, writing, clinical data collection, literature data collection; S.N.O.: clinical data collection; O.A.S.: clinical data collection; A.D.: supervising and revising the article.
All authors have read and agreed to the published version of the manuscript.

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Conflict of interest

Authors declare no conflict of interest.

Supplementary material

None.

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