Clinical Case Report

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Identification of multiple cardiac metastases from nonsmall-cell lung cancer by ^{18}F-FDG PET/CT

A case report

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Abstract

Introduction: Multiple cardiac metastases from nonsmall-cell lung cancer are extremely rare. Multiple cardiac metastases detected by ^{18}F-fluorodeoxyglucose positron-emission tomography/computed tomography (^{18}F-FDG PET/CT) have not been previously reported.

Patient concerns: A 53-year-old man was admitted to the hospital with left back pain for 1 month.

Diagnoses: A contrast-enhanced computed tomography (CECT) scan showed a moderately enhancing mass with a necrotic area in the upper left lobe of the lung and a filling defect in the interventricular septum. Two-dimensional transthoracic echocardiography identified a mass attaching to the endocardial surface of interventricular septum. ^{18}F-FDG PET/CT showed multiple intense ^{18}F-FDG uptakes in the cardiac region. Nonsmall-cell lung cancer was confirmed by histopathologic examination of the mass in the upper left lobe of the lung.

Intervention: The patient was treated with Gemcitabine chemotherapy.

Outcomes: After 18 months of follow-up, the patient achieved stable disease status according to the Response Evaluation Criteria In Solid Tumors guidelines.

Lessons: Our case demonstrates that ^{18}F-FDG PET/CT is a sensitive and feasible imaging modality to diagnosis multiple cardiac metastases.

Abbreviations: CECT = contrast-enhanced computed tomography, ^{18}F-FDG PET/CT = ^{18}F-fluorodeoxyglucose positron-emission tomography/computed tomography, MRI = magnetic resonance imaging, SUV = standard uptake value.

Keywords: cardiac metastasis, ^{18}F-fluorodeoxyglucose, nonsmall-cell lung cancer, positron-emission tomography/computed tomography

1. Introduction

Cardiac metastases are very rare, but more frequent than primary cardiac tumors.[1] About one-third (36%) of all metastatic cardiac tumor cases originate from lung cancer.[2] Even though they can cause some symptoms, cardiac metastases frequently stay asymptomatic in the initial stage of the disease and therefore remain undetected.[3] A few reports showed that ^{18}F-fluorodeoxyglucose positron-emission tomography/computed tomography (^{18}F-FDG PET/CT) scan was useful in detection of cardiac metastases from various primary malignancies.[4–7] However, multiple cardiac metastases detected by ^{18}F-FDG PET/CT have not been previously reported. Herein, we present a case of increased ^{18}F-FDG uptake of primary nonsmall-cell lung cancer with multiple cardiac metastases on PET/CT.

2. Case report

A 53-year-old man presented with left back pain for 1 month. Laboratory investigation revealed increased C-reactive protein (CRP) and elevated erythrocyte sedimentation rate. The results of serum tumor markers showed raised carcinoma antigen 125, squamous cell carcinoma antigen, cytokeratin 19 fragment antigen 21-1 (CYFRA21-1), and ferritin (Table 1).

A contrast-enhanced computed tomography (CECT) scan showed a moderately enhancing mass with a necrotic area in the upper left lobe of the lung and a filling defect in the interventricular septum suggestive of tumor.

A staging ^{18}F-FDG PET/CT scan (Discovery STE; General ElectricHealthcare Technologies, Waukesha, WI) was performed 1 hour after the injection of 286.38 MBq (7.74 mCi) of ^{18}F-FDG with a blood glucose level of 5.9 mmol/L. The PET/CT images demonstrate tracer concentration at the mass in left lung, left pelvic lymph node, and multiple cardiac lesions (Fig. 1). Axial fused PET/CT image showed intense ^{18}F-FDG uptake (SUV_{max}: 13.41) in the cardiac region corresponding to the hypodense lesion on axial CECT image and elevated pathologic ^{18}F-FDG uptake (SUV_{max}: 2.86) in the left ventricular corresponding to a small tumor with soft-tissue density which was slightly less

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Table 1

Laboratory investigation results.

Test	Result	Reference range
C-reactive protein	27.7 mg/L	0–8 mg/L
Erythrocyte sedimentation rate	52 mm/h	0–15 mm/h
Carcinoma antigen 125	68.1 U/mL	0–35 U/mL
Squamous cell carcinoma antigen	4.2 ng/mL	0–1.5 ng/mL
Cytokeratin 19 fragment antigen 21-1 (CYFRA21-1)	9.45 ng/mL	0–2.08 ng/mL
Ferritin	414.4 ng/mL	21.80–274.66 ng/mL

enhanced by contrast medium than normal myocardium on CECT. No abnormal finding was showed in the right atrium on CECT. However, there was intense focal ^{18}F-FDG uptake (SUV_{max}: 5.28) in the right atrium detected on axial PET/CT image.

Two-dimensional transthoracic echocardiography only identified a large well-delineated mass (2.9×2.8 cm) attaching to the endocardial surface of interventricular septum (Fig. 2). And left ventricular function was preserved.

A CT-guided needle biopsy was performed on the mass in the upper left lobe of the lung. Based on histologic findings, a diagnosis squamous cell cancer of the left lung was made. Therefore, the patient was diagnosed as having nonsmall-cell lung cancer with multiple cardiac metastases.

The patient was treated with Gemcitabine chemotherapy. After 18 months, the follow-up CECT scan revealed the patient achieved stable disease status according to the Response Evaluation Criteria In Solid Tumors (RECIST) guidelines.

Informed consent was obtained from the patient for publication of this report and accompanying images.

3. Discussion

During recent decades, incidence of cardiac metastatic disease has increased due to the prolonged survival of patients with cancer and the increased prevalence of the disease in the general population.[8] However, the frequency of cardiac metastases is generally underestimated. One reason is that most cardiac metastases are clinically silent and diagnosed accidentally during staging investigation. Another reason is that cardiac metastases may evade detection in CT due to motion artifacts.

The CT is the most commonly available technique commonly used for initial staging in patients with cancers. CECT shows higher spatial and temporal resolution imaging of cardiac lesions. However, it is difficult to visualize right heart masses by CT even CECT because routine chest CECT is typically performed with a single-infusion contrast bolus protocol.[9] In this case, the right

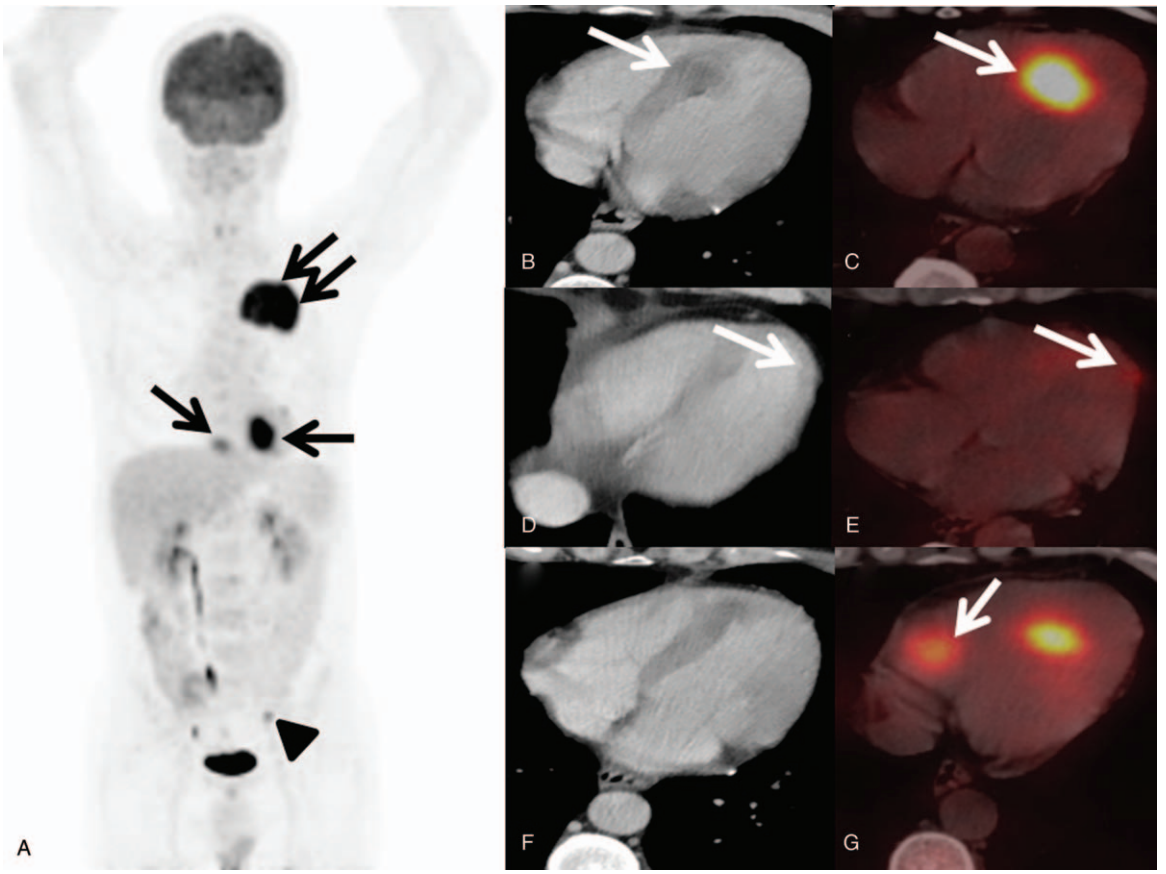

Figure 1. MIP image (A) showed tracer concentration at the primary site in left lung (double arrows), left pelvic lymph node (arrowhead), and multiple cardiac lesions (arrows). A contrast-enhanced computed tomography (CECT) scan (B) showed a filling defect in the interventricular septum suggestive of tumor (arrow). Axial fused positron-emission tomography/computed tomography (PET/CT) image (C) showed intense ^{18}F-fluorodeoxyglucose (^{18}F-FDG) uptake in the cardiac region corresponding to the hypodense lesion on axial CECT image (arrow). Axial PET/CT slice showed elevated pathologic ^{18}F-FDG uptake in the left ventricular corresponding to a small tumor which was slightly less enhanced by contrast medium than normal myocardium on CECT (D and E, arrow). No abnormal finding was showed in the right atrium on CECT (F). However, there was intense focal ^{18}F-FDG uptake in the right atrium detected on axial PET/CT image (G, arrow).

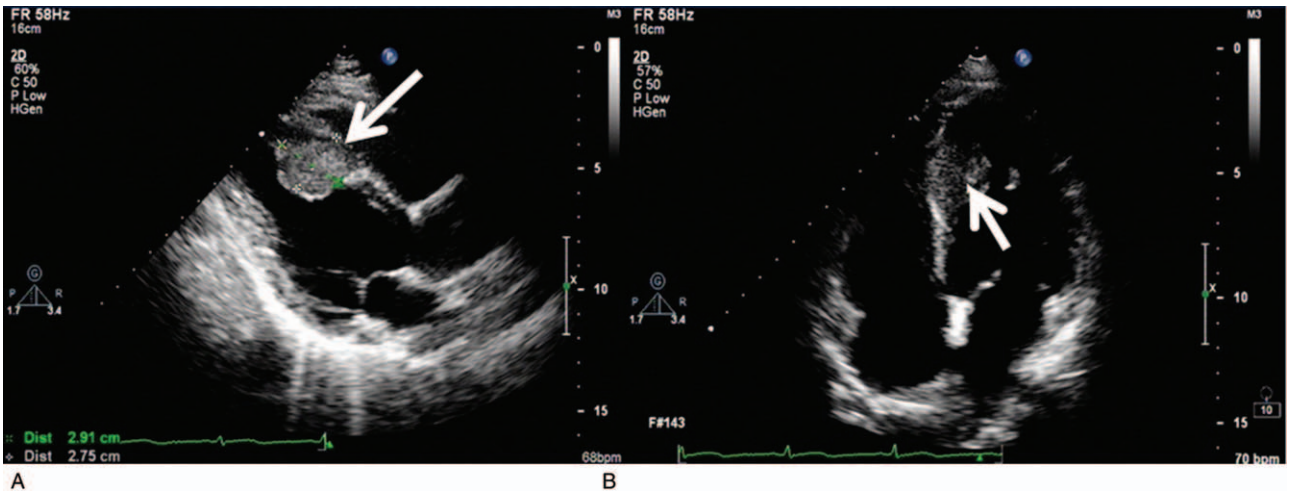

Figure 2. Two-dimensional echocardiography (A and B) only identified a large well-delineated mass attaching to the endocardial surface of interventricular septum (arrow).

atrium metastasis which was clearly visualized on ^{18}F-FDG PET/CT was overlooked on CECT.

Two-dimensional transthoracic echocardiography is also a useful noninvasive technique to diagnose cardiovascular disease. But the echocardiography is usually nonspecific in patients with cardiac lesion. Another limitation of 2-dimensional echocardiography is that the technique is depended on patient's hemodynamic profile and on operator experience. In this case, the small tumor in the left ventricular was missed by 2-dimensional echocardiography.

Magnetic resonance imaging (MRI) has become a highly valuable technique for assessing cardiac masses. Compared with other imaging techniques, MRI offers higher temporal and spatial resolution and additional tissue characterization. Moreover, MRI does not expose patients to ionizing radiation. Some studies have demonstrated that cardiac MRI can provide better detection and tissue characterization in the assessment of cardiac metastasis.[10,11] However, cardiac MRI remains less available than CT or echocardiography. The major limitation of MRI is the contraindication in patients with intracardiac defibrillators or pacemakers. Another limitation is that many cardiac MRI sequences require electrocardiographic gating or breath holds to achieve adequate image quality.

There are also known limitations of ^{18}F-FDG PET/CT. The main possible shortcoming to ^{18}F-FDG PET/CT has been false-positive results from inflammation and infection, which also reveal increased ^{18}F-FDG accumulation. However, ^{18}F-FDG PET/CT have the advantage of detecting metastases at unusual sites accurately with its ability for whole body fusion imaging. In addition, some studies demonstrated ^{18}F-FDG PET/CT can not only be used for the localization and confirmation of tracer uptake in myocardium, but also can be used to monitor response to treatment.[6,12]

In most of the reported cases of cardiac metastasis, the metastatic tumor was located in the right ventricle. To the best of our knowledge, we present the first case demonstrating multiple cardiac metastases from nonsmall-cell lung cancer identified by ^{18}F-FDG PET/CT. The ^{18}F-FDG PET/CT imaging is an advantageous modality assisting with the diagnosis of cardiac metastases and could find more lesions.

Author contributions

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