FDG-PET and Chemotherapy for Successful Diagnosis and Treatment of Cardiac Metastasis from Non-Small Cell Lung Cancer

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Abstract

Non-small cell lung cancer was metastasized at the septal side of right atrium in 59-year-old woman who had undergone surgery for lung cancer 11 years ago. The cardiac metastasis was found by whole-body 18F-fluoro-deoxy-glucose positron emission tomography/computed tomography (FDG-PET/CT), and cytologically confirmed by myocardial aspiration biopsy with right heart catheterization. The patient was treated with 4 cycles of carboplatin/pemetrexed followed by maintenance therapy with pemetrexed. The metastatic cardiac tumor shrank, and the atrioventricular (AV) block in ECG was improved. In this case, FDG-PET and chemotherapy were valuable for diagnosis and treatment of cardiac metastasis from non-small cell lung cancer.

Key words: non-small cell lung cancer, adenocarcinoma, cardiac metastasis, FDG-PET, chemotherapy, atrioventricular block


Introduction

Metastasis to the heart is estimated at about 10% of malignant tumors (1). Butany et al. reported that metastatic cardiac tumors of lung cancer origin represent in 33.5% of all metastatic cardiac tumor cases, and the most common histological type in lung cancer origin subset is adenocarcinoma accounting for 33.7% (2). In spite of the high incidence, cardiac metastasis is often diagnosed only at autopsy. Due to the advances in chemotherapy and/or radiotherapy, the incidence of cardiac metastasis is increasing (1). However, there are few data about the most appropriate management of cardiac metastasis. We show a case of the cardiac metastasis at the septal side of right atrium from non-small cell lung cancer diagnosed by 18F-fluoro-deoxy-glucose positron emission tomography/computed tomography (FDG-PET/CT) and successfully treated with chemotherapy.

Case Report

A 59-year-old woman, never smoker, received right middle lobectomy followed by adjuvant chemotherapy because of non-small cell lung cancer (adenocarcinoma) 11 years previously. The disease relapsed in her brain two years previously and was treated with tumor resection followed by whole brain radiotherapy. Immunohistochemical analysis of the resected tumor showed TTF-1 positive, CK7 positive and CK20 negative, suggesting metastasis of adenocarcinoma from lung cancer. Recently, medical examination with FDG-PET/CT was performed to check neoplasms including metastatic lesions from lung cancer. FDG-PET/CT demonstrated an increased uptake in the heart, left hilar and mediastinal lymph nodes (Fig. 1A, B). Intense focal activity in the right atrium strongly suggested a malignant tumor, where contrast-enhanced CT scan showed an enhanced mass lesion at the septal side of the right atrium and MRI detected it as a 38 mm tumor. Myocardial aspiration biopsy by
right heart catheterization confirmed a cardiac metastasis of adenocarcinoma (Fig. 1C). The aspirated cell population was so small that it was not possible to examine the cells immunohistochemically to verify them as lung cancer cells. Because systemic evaluation included FDG-PET/CT and upper gastrointestinal endoscopy showed no evidence of the other primary cancers, and because the metastatic tumor of the brain originated from lung cancer, we diagnosed it as a metastatic cardiac tumor from non-small cell lung cancer.

There were no symptoms or signs including embolic episodes. Electrocardiograph (ECG) demonstrated first-degree atrioventricular (AV) block that was not detected two years previously, and then it progressed to Mobitz type II second-degree AV block (Fig. 2A, B). The serum level of CA19-9 was increased to 279.3 U/mL. Epidermal growth factor receptor (EGFR) mutations were not detected by analysis of EGFR status of the resected brain metastasis.

The present patient was treated with a combined chemotherapy of carboplatin (area under the curve=5, iv) and pemetrexed (500 mg/m², iv). After 4 cycles of the chemotherapy, the width of the cardiac tumor imaged by MRI was reduced from 38 mm to 28 mm (Fig. 1D, E), AV block was improved (Fig. 2C, D), and the serum level of CA19-9 was decreased to 84.4 U/mL. Maintenance therapy with pemetrexed (500 mg/m²) was continued. She has stable disease (SD) lasting more than 17 months, and the maintenance therapy is continuing. Serum level of CA19-9 is still decreasing.

**Discussion**

In the present case, eleven years after the surgery for non-small cell lung cancer, cardiac metastasis from the lung cancer at the right atrium was found by FDG-PET/CT and cytologically confirmed by aspiration biopsy of the tumor. Because metastatic cardiac tumors do not usually cause symptoms, the detection is mainly owned to imaging evaluation. Echocardiography, CT scan and MRI are widely used, and recently the usefulness of FDG-PET has been reported (3). In the present case, FDG-PET showed the cardiac tumor at the septum of the right atrium where normal uptake in the myocardium 

Cardiac uptake of FDG is variable. It ranges from background activity to intense accumulation depending on substrate availability and need. In the fasting state, myocardium preferentially utilizes free fatty acids as its energy source, whereas myocardium uptakes as much as 3- to 5-fold glucose following oral glucose loading. Therefore, for oncologic imaging of the thorax, it is preferable to minimize cardiac activity by fasting for 4 to 6 hours prior to FDG application (4), as done in the present case.

Lung cancer has been known to spread to the heart through a lymphatic channel and hematogenous pathway (5). And the major metastatic pathway from the lung to
the heart is considered to be lymphatic (5). Metastasis to the pericardium was the most frequently involved, affected in 65.8% of 193 cases, followed by the myocardium (29.0%), epicardium (24.9%) and endocardium (3.1%) (2). Thus, metastasis to the septal side of the right atrium, which is endocardial metastasis, is rare. In the present case, although hilar and mediastinal lymphatic metastasis were observed, it was not confirmed which pathway was involved. Because brain metastasis via a hematogenous pathway was found two years previously, it is reasonable to speculate that the metastasis to the septal side of the right atrium was hematogenous.

The clinical manifestation of metastatic cardiac tumors is generally asymptomatic. Irritability, shortness of breath, anorexia, fatigue and/or palpitations are rare complaints. Cardiac tamponade is one of the early and frequent signs (6). Fatal arrhythmias and myocardial infarction have been reported. ECG shows several patterns including T wave and ST segment modification, bundle-branch block and low-voltage QRS (7). Supraventricular arrhythmias are rhythm disturbances generally found in cardiac metastasis. Ventricular tachycardia is rare (5). In the present case, first-degree AV block followed by Mobitz type II second-degree AV block were observed. Because the cardiac metastasis was located at the septal side of right atrium close to AV node, and the AV block improved along with the reduction of the tumor size after the chemotherapy, we speculate the AV block was induced by the tumor metastasis.

Although metastatic cardiac tumors have a potential to cause fatal complication, their treatment is not yet established because they depend on the characteristic of primary lesions. Systemic chemotherapy is thought to be the most effective option, and in some cases radiotherapy could be an alternative (1). We selected chemotherapy with carboplatin and pemetrexed. The metastatic cardiac tumor shrank, and the AV block was improved. Furthermore, the serum level of CA19-9 after treatment was decreased.

Because management of metastatic cardiac tumors is possible, careful monitoring of the heart by echocardiography, CT scan, MRI and/or FDG-PET facilitates diagnosis of metastatic cardiac tumors and their treatment in order to avoid fatal complications.

**Conclusion**

We presented a case of cardiac metastasis from non-small cell lung cancer which was found by FDG-PET/CT and was controlled for more than 17 months. In patients with cancer, careful attention to the heart using imaging evaluation including FDG-PET/CT is valuable to detect early stages of cardiac metastasis.

**The authors state that they have no Conflict of Interest (COI).**

**References**

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