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Cardiac Metastasis from Small Lung Cell Carcinoma: Using Multimodality Imaging in Diagnosis and Clinical Follow up

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Abstract

Cardiac masses are rarely seen in clinical practice, and due to ambiguity of their symptoms, they are difficult to diagnose and mostly being diagnosed incidentally. Mostly metastases (secondary tumors) are seen in the heart and they are 20 times more common than primary tumors. Although lymphatic and blood metastases are seen also direct local invasion to the heart may be observed. Imaging techniques are touchstone in detection of cardiac masses, differential diagnosis and treatment plans. Transthoracic echocardiography, trans-esophageal echocardiography, cardiac MRI, cardiac CT provides essential information. In the differential diagnosis location of mass and character of tissue are quite important 63 year-old male patient has admitted to emergency service with complaint of increasing shortness of breath. Imaging methods and lung biopsy revealed small cell lung carcinoma in the patient and he was included in the chemotherapy and radiotherapy program. After treatment PET-CT and transthoracic echocardiography were performed on the patient to evaluate the response to treatment. In this article, we will try to explain the place, advantages and disadvantages of multimodality imaging methods in diagnosis and follow-up.

Keywords: Cardiac masses • Metastasis • Small cell carcinoma • Multimodality imaging • Echocardiography

Introduction

Cardiac masses are rarely seen in clinical practice, and due to ambiguity of their symptoms, they are difficult to diagnose and mostly being diagnosed incidentally. Mostly metastases (secondary tumors) are seen in the heart and they are 20 times more common than primary tumors. Although lymphatic and blood metastases are seen also direct local invasion to the heart may be observed [1]. Multimodality imaging techniques play a crucial role in the diagnosis, distinguishing between benign and malignant character and treatment of the cardiac masses. In these case we will present how we made the differential diagnosis step by step by using imaging techniques in a patient with primary focus of a small cell lung carcinoma that spread to the heart *via* direct invasion in a complementary manner and we will discuss how imaging methods should be used and their advantages -disadvantages in response to treatment and follow-up.

Learning objective

Cardiac masses are very rare pathologies in clinical practice. We tried to explain how to use step by step multimodality imaging technics and which imaging technic should be select first, when we suspect malign tumors in cardiac involvement and when is additional imaging required.

Case Presentation

63 year-old male patient has admitted to emergency service with complaint of increasing shortness of breath over the last 3 months and involuntary 5 kg weight loss in the past 5 months. Patient has smoking history of 10 pack-year (ex-smoker over 20 years), diabetes mellitus type 2 (linagliptin + dapagliflozin) and rheumatoid arthritis (sertrolizumab). Patient describes his symptoms related to exertion and have been increasing gradually and recently present at rest. After anamnesis physical examination was performed and vital parameters checked; blood pressure was 112/82 mmHg, saturation 93%, pulse 72/minute, fever 36.7C. During thorax examination, rhonchi were heard in the right middle zone on auscultation. As a result after patient's first visit and examination in the emergency service we evaluated routine hemogram, biochemistry, BNP, and troponin levels and ECG, chest X ray, was performed initially. There were no abnormality in blood count, creatinin, AST/ALT, troponin, and BNP levels, ECG was normal sinus rhythm. Chest radiography revealed pleural effusion and enlargement of the heart shadow on the right side (Figure 1).

Based on the findings on the chest X-ray, the patient underwent Transtorasic Echocardiography (TTE). In the TTE ejection fraction was 65%. Atrioventricular valves were normal but a giant mass with multilobulated appearance, amorphous structure and irregular borders is observed in both left and right atria. The mass, measuring 8.5 × 5 cm, extended from interatrial septum towards the bases of both left and right atria. No mass is observed in the inferior vena cava. Minimal pericardial effusion surrounding the heart was detected (Figures 2-4), (Video 1a,1b,1c).

As a result of TTE malignant tumor is suspected due to masses multilobulated nature, presence in multiple heart chambers and accompanying pericardial effusion. Transesophageal Echocardiography (TEE) and contrast-enhanced chest Computed Tomography (CT) was performed for the differential diagnosis. In the contrast-enhanced CT performed a mass was observed in the right paracardiac area where it measured approximately 98 × 90 × 111 at its widest point. The mass had distinct extensions into both left and right atria with unclear borders to the heart. In the arterial phase hypodense areas, which did not enhance contrast, were seen within the mass. The mass surrounded the right main pulmonary artery and the artery leading to the right upper lobe of the lung, and also surrounded the artery leading to the right lower lobe of the lung and making it difficult to delineate. It appeared as a soft tissue density occupying lesion with clearly lobulated and irregular borders (Figures 5 and 6), (Video 2a,2b).

In the TEE performed a mass with multilobulated appearance, amorphous structure, and irregular borders, measuring 6.0 × 6.3 cm is visualized extended from superior vena cava to right atrium and from right pulmonary veins into the left atrium as well as from interatrial septum towards combined base of both atria. No mass is seen in the inferior vena cava. Minimal pericardial effusion is seen and mass has no connection the atria-ventricular valves (Figure 4), (Video 3a,3b). The patient underwent a contrast-enhanced cardiac MRI, and a mass with late contrast enhancement and a connection with the lungs was observed spreading from both atria to the heart (Figures 7 and 8), (Video 4).

Due to its malignant nature PET-CT and lung biopsy were planned for

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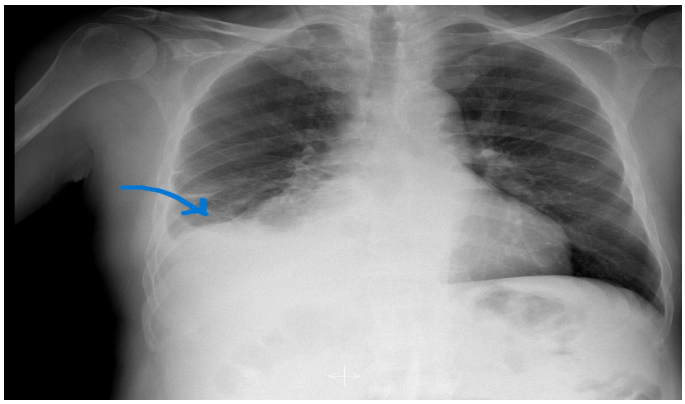

Figure 1. There is a pleural effusion and an enlargement in the heart shadow in the marked area on the chest x-ray.

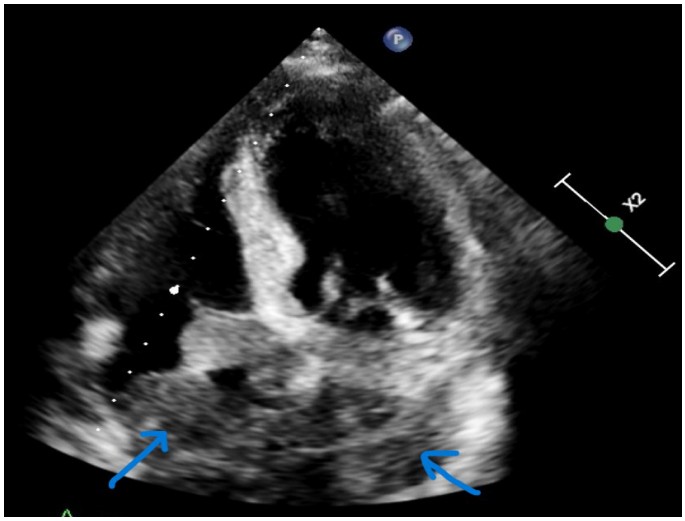

Figure 2. Apical four-chamber view on transthoracic echocardiography. In the marked areas, a mass spreading from the interatrial septum to both the right and left atrium is observed.

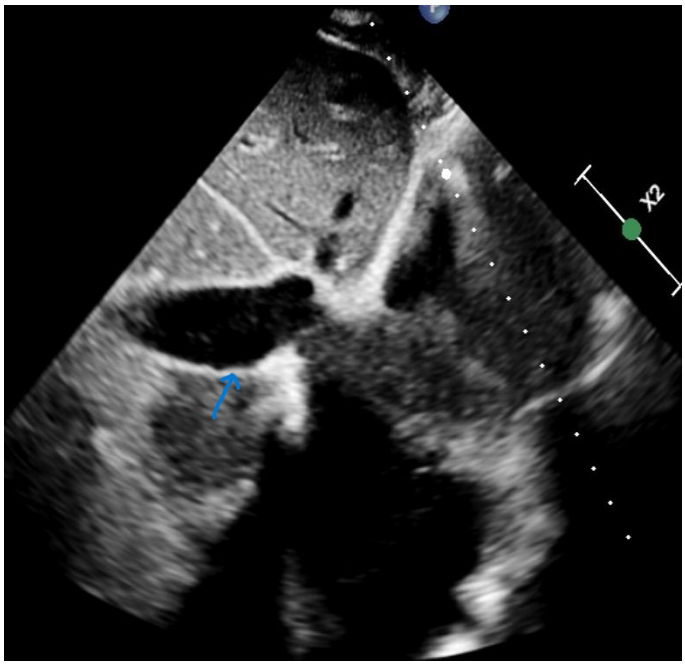

Figure 3. No mass was observed in the inferior vena cava in the subcostal image of transtoracic echocardiography.

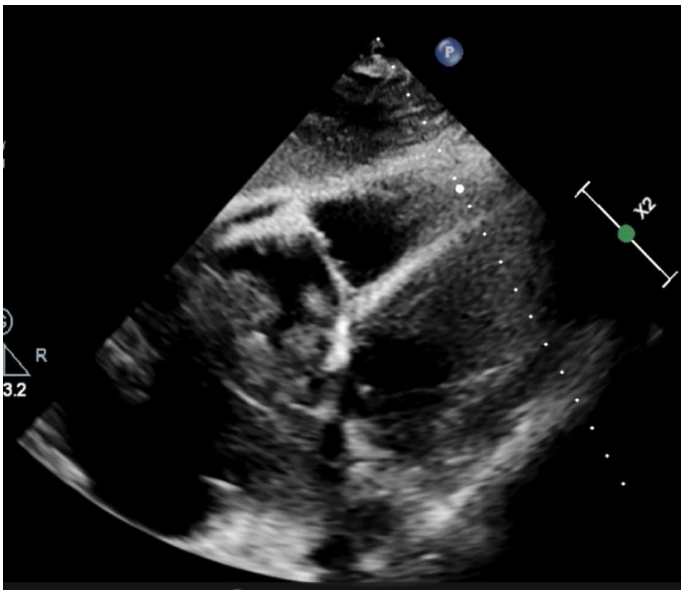

Figure 4. Cardiac mass with biatrial involvement on subcostal image of transtoracic echocardiography.

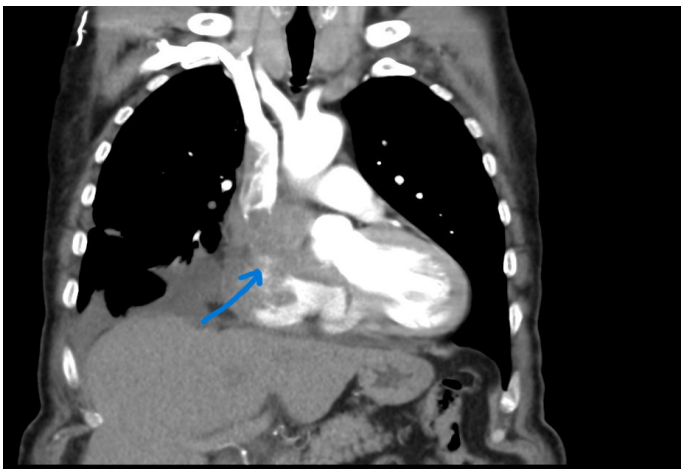

Figure 5. On computed tomography, a giant mass with high contrast and connection to both the lung and heart was observed in the coronal section.

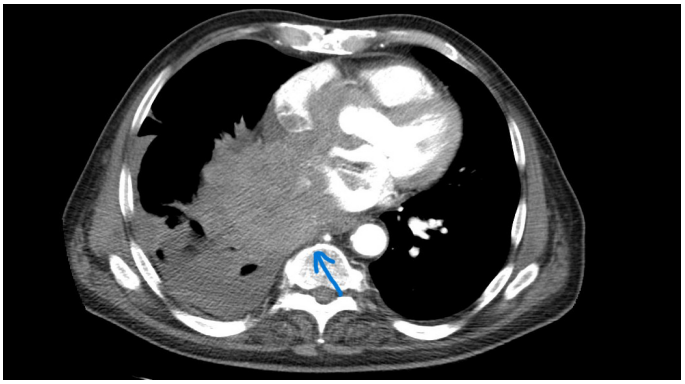

Figure 6. On computed tomography, a giant mass with high contrast and connection to both the lung and heart was observed in the axial section.

detection of metastases, differential diagnosis and treatment management. In the PET-CT performed a hypermetabolic mass lesion with heterogenous character, highly suspicious for malignancy, was detected in the mediobasal segment of the lower lobe of the right lung and in both atrial chambers of the heart. The primary origin of the mass could not be assessed clearly. After that lung biopsy was performed to detect the primary lesion, clarify the histopathological diagnosis and plan the treatment of the patient.

In the immunohistochemical and histopathological study, synaptophysin (+), pancytokeratin (+), chromogranin (+), TTF-1 (-). Ki-67 score was found to be 80-90%. The biopsy revealed small-cell lung carcinoma, and it was considered that primary focus was in the lung with direct invasion to the heart. As a result patient was diagnosed stage 4 lung carcinoma and consulted to oncology and referred to relevant department. The patient was started on combined radiotherapy and etoposide, cisplatin as a chemotherapy regimen. After 3 months of chemotherapy treatment, the patient underwent control PET-CT and transthoracic echocardiography in response to the treatment. The examinations showed that the tumor size decreased and the patient responded to the treatment. It was observed that the tumor size decreased. Transthoracic echocardiography showed that the size of the mass decreased to 31mm × 29mm. It was observed that FDG uptake decreased in control PET-CT (Figures 9-12).

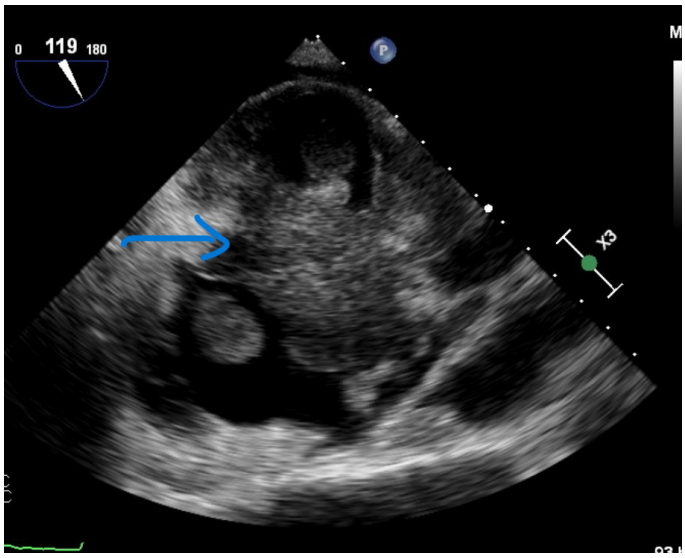

Figure 7. On transeusophageal echocardiography a giant mass observed . Invaded the both atria and superior vena cava.

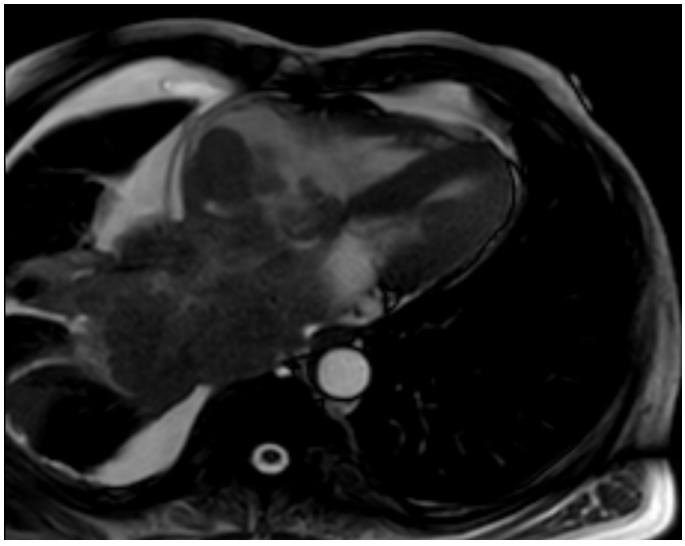

Figure 8. On cardiac MRI a giant mass with late contrast enhancement and a connection with the lungs was observed spreading from both atria to the heart.

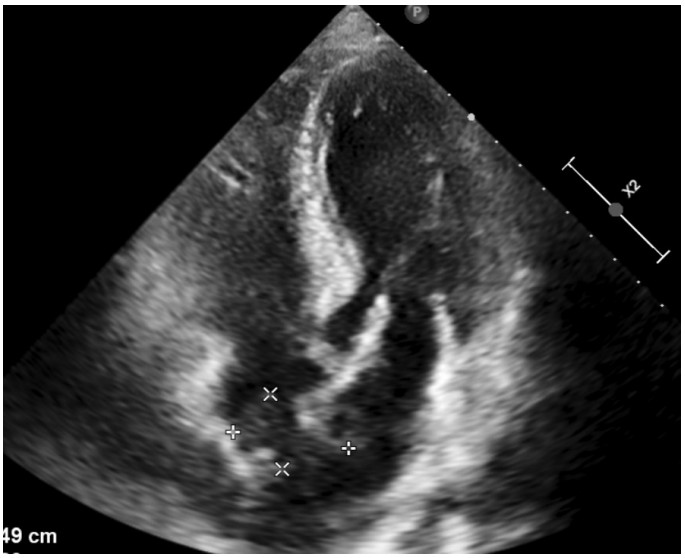

Figure 9. Transthoracic echocardiography showed that the size of the mass decreased to 31mm × 29mm.

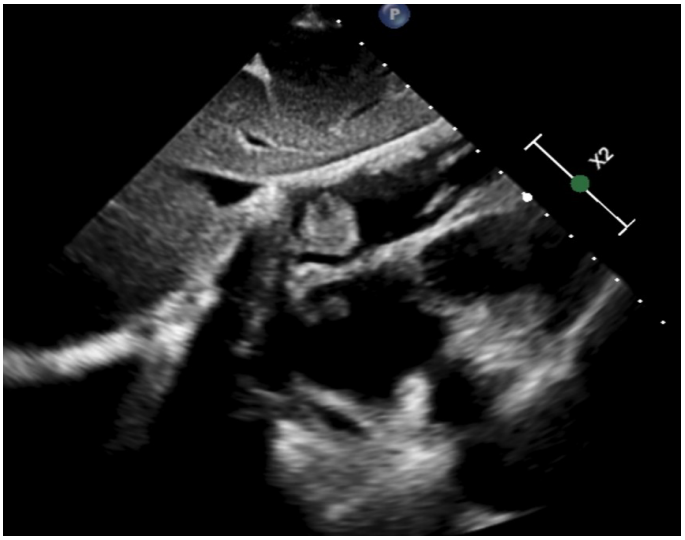

Figure 10. Transthoracic echocardiography showed that the size of the mass decreased to 31mm × 29mm in subcostal image.

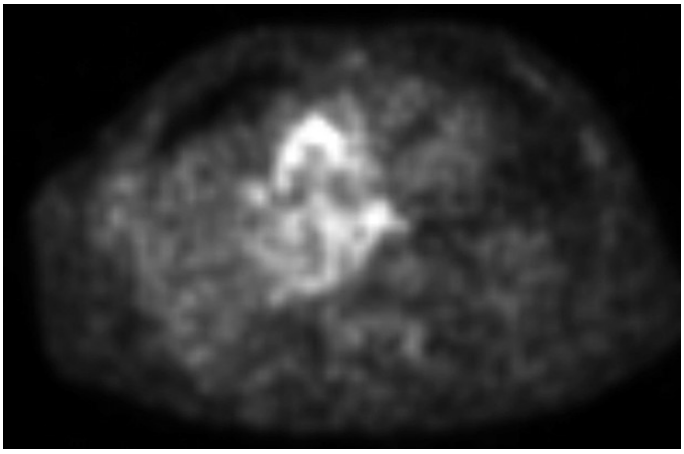

Figure 11. In PET-CT hypermetabolic mass lesion with heterogenous character, highly suspicious for malignancy, was detected in the mediobasal segment of the lower lobe of the right lung and in both atrial chambers to the heart.

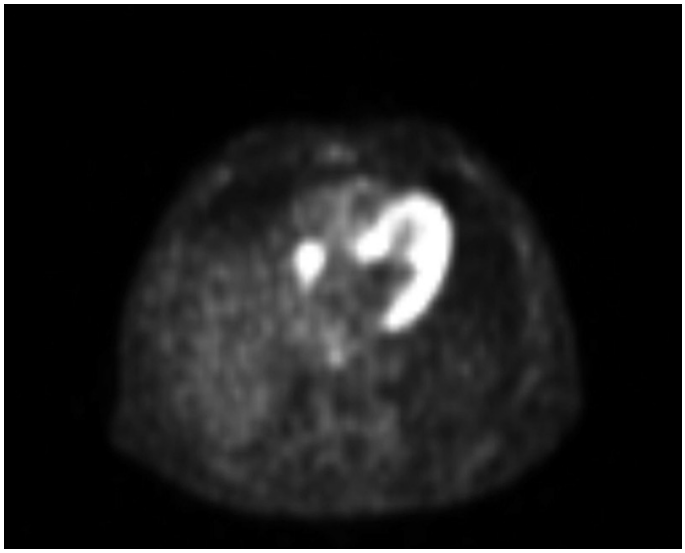

Figure 12. FDG uptake decreased in control PET-CT.

Discussion

Cardiac masses are rarely seen in clinical practice, and due to ambiguity of their symptoms, they are difficult to diagnose and mostly being diagnosed incidentally. Cardiac masses are uncommon findings and can be categorized as either neoplastic or non-neoplastic (such as trombi, vegetation). Neoplastic cardiac masses are comprised of primary benign tumors, primary malignant tumors, or metastatic tumors. Primary cardiac tumors are exceedingly rare with a reported prevalence of 0.001 to 0.03 % in an autopsy series. Primary tumors of the heart are benign in 90% of the cases and commonly includes myxomas and papillary fibroelastomas [1,2]. Among the primary tumors sarcomas and lymphomas are frequently detected [1-3]. While metastatic tumors to the heart are reported to be 20 to 40 times more common Secondary tumors of the heart commonly invades the pericardium and presents them as pericardial effusion. Less commonly endocardia and myocardial invasions also can be detected. Among the tumors that most frequently metastasize to the heart, lung and breast cancer are the most common [1,3]. Lymphatic and blood metastases are seen also direct local invasion to the heart may be observed.

Symptoms of the cardiac masses are mostly ambiguous and may present in 3 different ways; Symptoms related to the site of invasion (neurological findings in brain metastases, effusion and dyspnea, A, V block, arrhythmia in cardiac metastases etc). Thromboembolic complications (mostly in myxomas and papillary fibroelastomas), Non-specific symptoms such as fever, night sweats and loss of weight due to the mass [1]. Also cardiac metastasis should be suspected, especially if cardiac symptoms develop (dyspnea, AV block...) or if pericardial effusion is detected in imaging methods, especially in patients followed up with malignancy. Due to the lack of specific signs and symptoms for cardiac masses, their diagnosis is difficult, they are rarely included in differential diagnoses, and they are often discovered incidentally.

There is no standard consensus on the approach to cardiac masses and they are very rare conditions. Therefore decisions regarding follow-up, surgery, chemotherapy and radiotherapy are quite challenging. Predicting whether recurrence will occur afterward is also difficult. Since there is no standard consensus in treatment planning assessments are made on case-by-case basis. It is evident that there are gaps in this area. Detection of primary source are not easy due to ambiguity of signs and symptoms. In our case a mass in heart detected firstly and based on the data obtained from imaging methods, it is determined that the primary tumor actually originated from the lungs.

Imaging techniques are touchstone in detection of cardiac masses, differential diagnosis and treatment plans. Transthoracic echocardiography, transesophageal echocardiography, cardiac MRI, cardiac CT provides essential information. In the differential diagnosis location of mass in heart and character of tissue are quite important (While mostly myxomas are in the left atrium which is always bening, malignant sarcomas are often found in the right atrium) [1]. But considering the cost efficiency it is not proper to request every single test. It seems like a logical approach to use imaging methods in a stepwise manner, from simplex to complex and from less invasive to more invasive, to reach final diagnosis. The presence of a cardiac mass in more than one heart chamber, combined effusion, high contrast enhancement, central necrosis, and specific tissue characterization is a sign of malignancy and it is reasonable to investigate the diagnosis using additional imaging.

The first-line imaging method for cardiac metastasis screening or diagnosis of cardiac masses should be always transthoracic echocardiography, as it is inexpensive and does not contain radiation. It can indicate whether pericardial effusion is accompanied by involvement of the A-V valves, whether pericardial effusion is accompanied or not, in which chamber the tumor is located and its connection with cardiac structures. Transesophageal echocardiography can show these more closely and in detail. The disadvantages of transthoracic echocardiography are that its specificity and sensitivity decrease in patients with poor acoustic window. At this point, contrast-enhanced cardiac MRI can be used both to differentiate benign from malignant and to determine tissue characterization. And MRI is superior to transthoracic echocardiography in patients with poor acoustic window and determining the tissue characterization. However, MRI is a weak method in showing small and mobile masses. Especially in small masses attached to the AV valves, such as vegetation's or papillary fibroelastoma, trombi [2,3-5].

Studies have shown that PET-CT is a powerful test in differentiating benign or malignancy in cardiac tumors and predicting prognosis. However, it is not a routine imaging method used in the diagnosis of cardiac masses and it is an expensive examination which involves radiation and sometimes the high metabolic activity of the myocardium can be confused with the tumor. It should be a final examination before diagnosis or should be used to evaluate the response to treatment [4,5]. Contrast-enhanced computed tomography is a useful and rapid examination for detecting metastases and determining the primary focus. It can be used to save time for the patient, but the use of contrast material is a disadvantage in patients with impaired renal function tests. High contrast enhancement on tomography is a finding in favor of high vascularity and malignancy in the tumor [3].

In this case echocardiography was performed as the first diagnostic tool, and the location of the mass and its relationship with the heart chamber and valves were clarified. Then, more detailed examination was performed with transesophageal echocardiography. Contrast-enhanced computed tomography revealed that the mass was connected to the lung and had high contrast, which showed us that it was compatible with malignancy. With cardiac MRI, the spread in myocardial tissue and its connection with extracardiac structures were detected. Tissue characterization was examined and a differential diagnosis was made from sarcomas, which are primary tumors of the heart and based on CT and MRI images it was concluded that the mass was metastasized from lung. Then, PET CT was taken and invasive biopsy was performed to confirm the diagnosis. After chemotherapy regimen and radiotherapy treatment PET-CT and transthoracic echocardiography were performed again on the patient to evaluate the response to treatment. A regression in mass size was observed in both imaging methods.

Video 1a: Apical four-chamber view on transthoracic echocardiography. In the marked areas, a mass spreading from the interatrial septum to both the right and left atrium is observed.

Video 1b: No mass was observed in the inferior vena cava in the subcostal image of transtoracic echocardiography.

Video 1c: Cardiac mass with biatrial involvement on subcostal image of transtoracic echocardiography.

Video 2a: On computed tomography, a giant mass with high contrast and connection to both the lung and heart was observed in the coronal section.

Video 2b: On computed tomography, a giant mass with high contrast and connection to both the lung and heart was observed in the axial section.

Video 3a: 2D transesophageal view of the tumor.

Video 3b: 3D transesophageal view of the tumor.

Video 4: The patient underwent a contrast-enhanced cardiac MRI, and a mass

with late contrast enhancement and a connection with the lungs was observed spreading from both atria to the heart.

Conclusion

Therefore, in selected patients, transthoracic echocardiography, which is a cheap, radiation-free and practical method, can be used not only in diagnosis but also in response to treatment and clinical follow up with serial imaging. Of course, PET-CT is superior to transthoracic echocardiography in evaluating response to treatment, but especially in cases requiring serial follow-up, transthoracic echocardiography can be preferred because it does not contain radiation and is inexpensive. Finally most of the time lesions can be diagnosed using non-invasive imaging methods. However, when a diagnostic deadlock is reached in the differential diagnosis steps, it should be remembered that biopsy, as an invasive method, still plays an important role as the final test both for differentiation and for determining the specific treatment regimen.

Acknowledgement

None.

Conflict of Interest

We declared no potential conflict of interest with respect to the research, authorship,and /or publication of this article.

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