Diffuse Large B-cell Lymphoma Diagnosed by Intracardiac Echocardiography-guided Cardiac Tumor Biopsy

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Abstract

A 44-year-old man presented with exertional dyspnea. Transthoracic echocardiography (TTE) revealed a large tumor protruding into the right atrium and extending into the left ventricle. Cardiac magnetic resonance imaging and contrast enhanced computed tomography also confirmed the intracardiac tumor detected by TTE. An endomyocardial biopsy was performed under the intracardiac echocardiography (ICE) guidance, and he was diagnosed to have diffuse large B-cell lymphoma following the histological analysis. ICE-guided cardiac tumor biopsy is expected to be a useful diagnostic strategy that can minimize the risk of procedural complications.

Key words: biopsy, intracardiac echocardiography, intracardiac tumor, diffuse large B-cell lymphoma


Introduction

Although endomyocardial biopsy (EMB) under fluoroscopic or echocardiographic guidance is widely performed in many cardiac intervention laboratories, it is not easy to deliver a biopomte to an intracardiac tumor, and there is a possibility of the various complications. Intracardiac echocardiography (ICE) has been increasingly used to facilitate transseptal puncture, ablation of cardiac arrhythmias, mitral commissurotomy, and the closure of interatrial septal abnormalities since approximately 40 years ago. ICE can clearly show intracardiac structures, and can help obtain an EMB for a suspected cardiac tumor.

Case Report

A 44-year-old man presented with new onset exertional dyspnea and chest discomfort. Physical examination showed normal auscultation except for pretibial pitting edema. Chest X-rays showed an enlarged cardiac silhouette and right pleural effusion without lung congestion. Blood laboratory examination showed white blood cell count 6,200/μL, hemoglobin 12.6 g/dL, hematocrit 38.9%, and platelet count 103,000/μL. The laboratory data revealed abnormal values; serum lactate dehydrogenase (LDH) of 254 IU/L, serum C-reactive protein (CRP) of 1.99 mg/dL, and serum soluble interleukin-2 receptor (sIL-2R) of 2,881 U/mL. He was not receiving any immunosuppressive drugs and he had no antibody to human immunodeficiency virus (HIV). The electrocardiogram demonstrated persistent atrial fibrillation with negative T waves in the lateral leads, and low voltage in the limb leads. Transthoracic echocardiography (TTE) and transesophageal echocardiography (TEE) revealed a large tumor protruding into the right atrium (RA), and several hypoechoic lesions extending into the left atrium (LA), the left ventricle (LV) and left pulmonary artery, which involved almost two-thirds of the whole heart, with moderate pericardial effusion and no sign of cardiac tamponade (Fig. 1A, B). Contrast-enhanced computed tomography (CT) also confirmed the intracardiac tumor involvement detected by TTE and TEE (Fig. 2A) and cardiac magnetic resonance (CMR) imaging further delineated the characteristics of this large invasive intracardiac tumor with slightly hyper intensity relative to cardiac muscle by T1- and T2-weighted MR images (Fig. 2B). Based on laboratory as well as imaging features,
cardiac lymphoma was strongly suspected. Furthermore, positron emission tomography scan (PET) imaging revealed extra-cardiac involvement in the iliac and sacral bones with hypermetabolic activity (Fig. 2C). However, the histopathological examination of an iliac bone marrow biopsy was negative. Accordingly, an EMB was obtained under ICE and fluoroscopic guidance to minimize the risk of procedural complications.

The patient was placed under local anesthesia, and a 8 Fr (Swartz and SR2, St. Jude Medical, St. Paul, MN, USA) and a 8.5 Fr long sheath were advanced through the sheaths in the internal jugular vein and the common femoral vein, respectively, into the RA, extending into the left atrium (LA), and the left ventricle (LV). RV: right ventricle, Ao: aorta, PE: pericardial effusion.

**Figure 1.** A transthoracic echocardiography on admission in the parasternal long axis view (A) and a transesophageal echocardiography (B) showed the large intracardiac tumor (white arrows) protruding into the right atrium (RA), extending into the left atrium (LA), and the left ventricle (LV). RV: right ventricle, Ao: aorta, PE: pericardial effusion.

No specific cutoffs have been proposed to quantify extracardiac involvement have been reported as PCL (9). The present case could also be considered as PCL. Primarily, except for myxomas, are very rare with an incidence of 0.001-0.28% (2). The majority of primary cardiac tumors are benign, and about 75% of those are myxomas (3). Sarcoma is the most common primary malignant tumors (4). In contrast, a secondary cardiac tumor, which metastasizes or directly invades the heart, are 20-40 times more common (5). Cardiac metastases usually involve multiple lesions of myocardium. Cancers of lung, esophagus, and breast as well as lymphoma, leukemia, and melanoma are well known as the primary sources of the metastasis (6). The present case could be diagnosed as diffuse large B cell lymphoma based on imaging findings and an endomyocardial biopsy.

PCL is an extremely rare malignant tumor in heart, accounting for only 1.3% of primary cardiac tumors and 0.5% of extranodal lymphomas (2). On the other hand, secondary cardiac lymphoma is more common; it represents 13.6% of PCL (9). The present case could be diagnosed as diffuse large B cell lymphoma based on imaging findings and an endomyocardial biopsy.

**Discussion**

Primary cardiac tumors, except for myxomas, are very rare with an incidence of 0.001-0.28% (2). The majority of primary cardiac tumors are benign, and about 75% of those are myxomas (3). Sarcoma is the most common primary malignant tumors (4). In contrast, a secondary cardiac tumor, which metastasizes or directly invades the heart, are 20-40 times more common (5). Cardiac metastases usually involve multiple lesions of myocardium. Cancers of lung, esophagus, and breast as well as lymphoma, leukemia, and melanoma are well known as the primary sources of the metastasis (6). The present case could be diagnosed as diffuse large B cell lymphoma based on imaging findings and an endomyocardial biopsy.

PCL is an extremely rare malignant tumor in heart, accounting for only 1.3% of primary cardiac tumors and 0.5% of extranodal lymphomas (2). On the other hand, secondary cardiac lymphoma is more common; it represents 13.6% of metastases to the heart (7). PCL was classically defined as an extranodal lymphoma involving only the heart and/or pericardium (2); however, Cairns et al. (8) suggested that PCL could also present as small secondary lesions elsewhere, with the vast bulk of the tumor arising in the heart. Therefore, the current definition of PCL is a lymphoma presenting as cardiac disease, especially when the vast bulk of the tumor is intrapericardial (5). Several cases with extensive extracardiac involvement have been reported as PCL (9). The present case could also be considered as PCL. No specific cutoffs have been proposed to quantify extracardiac disease. Many reports revealed that PCL usually arise...
from the right chamber of the heart, especially the RA (10). In the present case, PCL also diffusely infiltrated the walls of the whole heart including RA. It is generally too difficult to make an accurate diagnosis because PCL has various clinical manifestations without any specific pathognomonic features. Diagnostic delay and difficulty worsen the prognosis. However, recent reports suggest that an earlier diagnosis and appropriate therapy can improve the long-term prognosis (11). In general, a definitive diagnosis as PCL is confirmed by an endomyocardial, surgical excisional biopsy or pericardial fluid cytology.

The guidelines regarding the role of EMB in the management of cardiovascular disease defined by the American Heart Association (AHA), the American College of Cardiology (ACC), and the European Society of Cardiology (ESC) guidelines (12) all define the use of biopsy for suspected cardiac tumors to be a class IIa indication. Previous reports demonstrate that a transvenous EMB procedure under fluoroscopic guidance is safe when performed by experienced technicians, the overall rate of complications is between 1% and 3%, the risk of cardiac perforation with tape-nade is less than 0.05% (12, 13). A transvenous EMB procedure under TEE guidance is a useful, simple and safe method (14-19). However, it causes patient discomfort and sometimes requires general anesthesia in addition to local pharyngeal anesthesia. In addition, the procedure exposes the echocardiographer to radiation during the procedure. In contrast, ICE guidance can overcome these disadvantages of TEE. ICE was originally used to guide noncoronary interventional procedures, such as the electrophysiological procedures, and the closure of interatrial septal abnormalities (20-23). ICE can clearly show intracardiac structures and devices and there have been several reports discussing ICE-guided cardiac tumor biopsy (24-28).

These techniques allow the technician to safely and effectively position the biopome at the exact angle of the tumor under clear imaging of ICE. In addition, ICE generates a 360-degree image perpendicular to the catheter as well as an intravascular ultrasound image. It is necessary to note the biopome movement in the vertical direction relative to the ICE imaging plane. ICE guidance can confirm the accurate location of tumor, direct a biopome to the tumor, and also

Figure 2. Contrast computed tomographic imaging (A) and magnetic resonance imaging (B) showed the intracardiac tumor (white arrows) protruding into the right atrium (RA), and left atrium (LA), extending into the left ventricle (LV) and pulmonary artery (PA). Positron emission tomography scan imaging (C) reveals extra-cardiac involvement in the iliac and sacral bone with hypermetabolic activity (white arrowheads). RV: right ventricle, Ao: aorta, SVC: superior vena cava, PE: pericardial effusion

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it has the potential to reduce major complications. Furthermore, it can avoid general anesthesia, and shorten the time for procedures and the length of radiation exposure (23, 29). These differences clearly indicate the superiority of ICE in comparison to TEE guidance. There are two types of ICE imaging; cross-sectional imaging using a rotating transducer and sector-based imaging using a phased-array transducer. In general, phased-array ICE has advantages over rotational ICE due to a greater depth of field, flexibility, and color Doppler function. However, a rotational ICE was employed in the current case, because it has a better near-field view and much lower catheter cost in comparison to phase-array ICE. ICE guidance may increase the cost of the procedure in comparison to fluoroscopic or echocardiographic guidance. However, it is expected to reduce the overall medical cost by improving the procedural success rate, preventing complications, shortening bed stays, and avoiding the cost of the medical staff, the anesthetic drugs and the equipment required for of TTE. In conclusion, ICE guidance is a useful strategy for the histopathological diagnosis of a cardiac tumor.

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


