Case Report

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Solitary neurofibroma of the heart

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Abstract

Solitary neurofibroma of the heart is extremely unusual. Few reports of neurofibroma in the left ventricle have been published. In this case report, we present the results of transthoracic echocardiography, myocardial contrast echocardiography, cardiac magnetic resonance imaging, and histopathologic examination of a patient with a neurofibroma of the heart. The patient had no evidence of any other metastasis or primary tumor in other organs, which is clinically rare.

Keywords

Neurofibromatosis, primary heart tumor, solitary, myocardial contrast echocardiography, transthoracic echocardiography, cardiac magnetic resonance imaging, case report

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Introduction

Primary tumors of the heart and pericardium are rare, with an incidence of only 0.0017% to 0.28% among autopsy cases.[1] The most common type of primary heart tumor in children is rhabdomyoma, while myxoma is more common in adults (80%).[2] Neurofibromatosis is a rare neurogenetic disease that can be caused by autosomal dominant inheritance or genetic mutation. The disease originates from neuroepithelial tissue and is commonly observed in the larger nerve stems and branches of the limbs, trunk, head, and neck. Neurofibromatosis is a neurocutaneous syndrome that is often accompanied by other multi-tissue lesions. Solitary neurofibroma of the heart with a benign primary cardiac tumor is exceptionally rare. In this case report, we describe the findings of

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transthoracic echocardiography (TTE), myocardial contrast echocardiography (MCE), and cardiac magnetic resonance imaging (CMRI) in a patient with neurofibromatosis in only the left ventricle without other multi-tissue lesions.

Case report

A 39-year-old woman presented with a 2-month history of recurrent episodes of chest pain and syncope. Cardiovascular examination showed a normal heart rhythm, and a continuous murmur could be heard at the second intercostal space of the left sternal margin. An electrocardiogram showed nonspecific ST-T abnormalities. A computed tomography scan showed a widened pulmonary artery and pericardial effusion. TTE revealed an echo-dense mass ($5.86 \times 5.68 \times 4.53$ cm) in the anterior and inferolateral walls of the left ventricle (Figure 1(a)) on the apical four-chamber view. Color Doppler flow imaging did not detect blood perfusion into the tumor (Figure 1(b)). However, the mass was enhanced on MCE (Figure 1(c)). The left ventricle was mildly dilated with normal systolic function (ejection fraction of 58%). A patent ductus arteriosus was also found (diameter of 0.6 cm). The estimated systolic pulmonary artery pressure was 77 mmHg (Figure 1(d)).

CMRI revealed a mass located in the left ventricular anterior and lateral walls (Figure 2(a)). The mass appeared hypointense on equally enhanced T1-weighted images (Figure 2(b)) and hyperintense on T2-weighted images, showing unclear boundaries with the normal myocardium (Figure 2(c)).

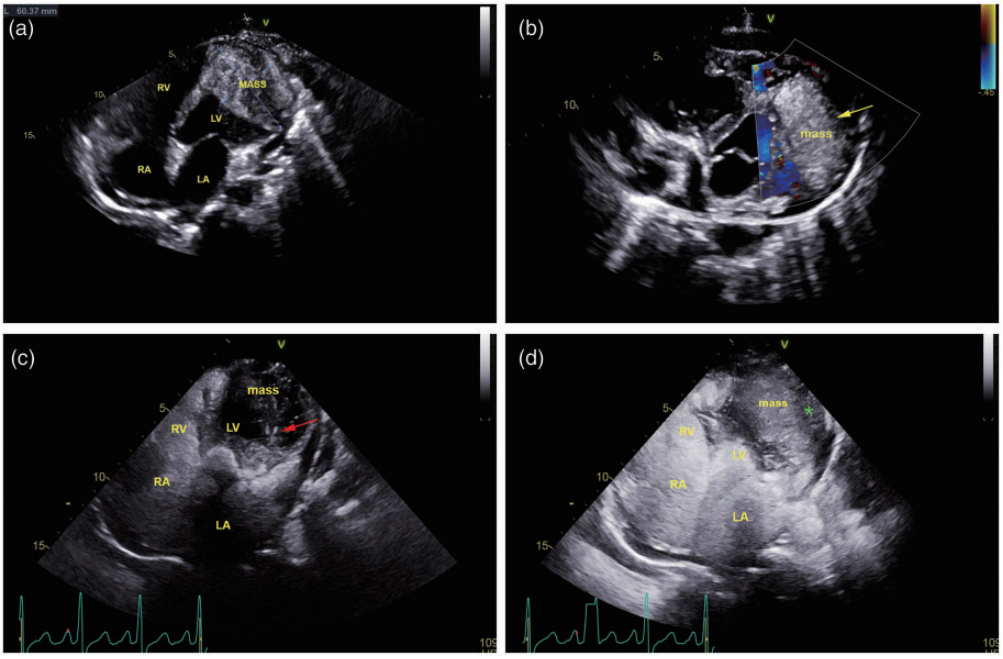

Figure 1. (a) Transthoracic echocardiographic four-chamber view showing a mass in the inferolateral wall of the left ventricle. (b) Echocardiographic four-chamber view with color Doppler flow imaging showing no flow signals within the mass (yellow arrow). (c) Myocardial contrast echocardiography showing that the contrast agent entered the tumor (red arrow). (d) The contrast enhancement of the mass is higher than that of the normal myocardium (green asterisk).

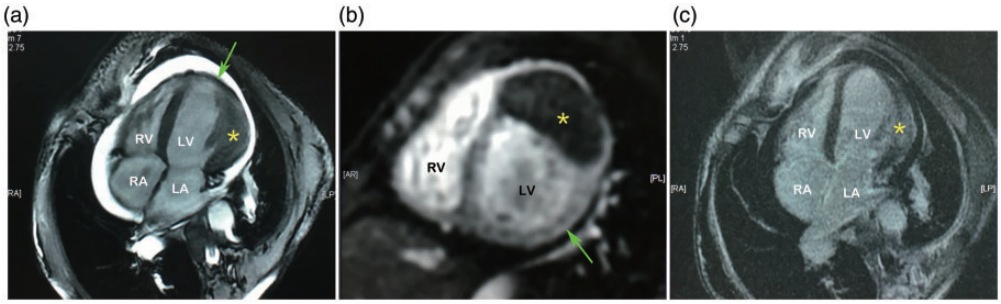

Figure 2. Cardiac magnetic resonance imaging (CMRI) with plain balanced steady-state free precession sequence (four cavities). (a) The surrounding white area indicates pericardial effusion. The tumor signal (yellow asterisk) is lower than normal in the left ventricular wall myocardium (green arrow). (b) CMRI enhanced initial hyperperfusion short-axis scan. Pericardial effusion shows low signal intensity with no enhancement. The myocardial enhancement signal is slightly higher than the tumor enhancement signal. (c) CMRI enhanced delayed scanning (four cavities, basically consistent with (a)). The delayed tumor (yellow asterisk) has a stronger signal than the normal left ventricular wall myocardium (green arrow).

Because the tumor was located in the left ventricle, the tumor was relatively large, and its benign or malignant nature could not be determined on preoperative examination. No surgical contraindications were identified. Arterial catheter ligation and total tumor resection were performed under extracorporeal circulation and general anesthesia. The patient recovered well after surgery and was discharged from the hospital 1 week later. During the operation, the surgeon found a large soft mass ($8.0 \times 5.0 \times 5.0$ cm) in the middle and lower segments of the anterior and lateral walls of the left ventricle. The histopathological diagnosis of the biopsy specimen was a neurogenic tumor with short spindle cells in degenerative nodules (Figure 3(a)). Spindle cell immunohistochemical analysis revealed the following results: cytokeratin (weak +), epithelial membrane antigen (weak +), CD34 (+), STAT6 (−), desmin (−), smooth muscle actin (+), S-100 (+), Ki-67 (1%–2% +) (Figure 3(b)), B-catenin (−), vimentin (+), CR (−), and WT-1 (−).

This study was approved by the Medical Ethics Committee of the Second Affiliated Hospital, Third Military Medical University. The study did not interfere with routine treatment procedures, and the patient provided verbal informed consent.

Discussion

The woman in our case presented with repeated angina and syncope, which may be life-threatening and are indications for surgery. The patient's symptoms of angina and syncope were unrelated to the tumor and might have been attributable to the high systolic pulmonary artery pressure caused by the patent ductus arteriosus. No multi-tissue lesions other than those identified in the heart were found. To our knowledge, only one report of an apparently primary cardiac neurofibroma has been published.[3] In that case, a solid mass was found in the anterior and inferolateral walls of the left ventricle near the apex. Similar to our case, no other malignant lesions apart from those in the heart were found. Several other cases of neurofibroma in the left ventricle or right chambers of the heart have been reported in patients with von Recklinghausen disease (neurofibromatosis 1).[4–6] The anatomical distribution of the

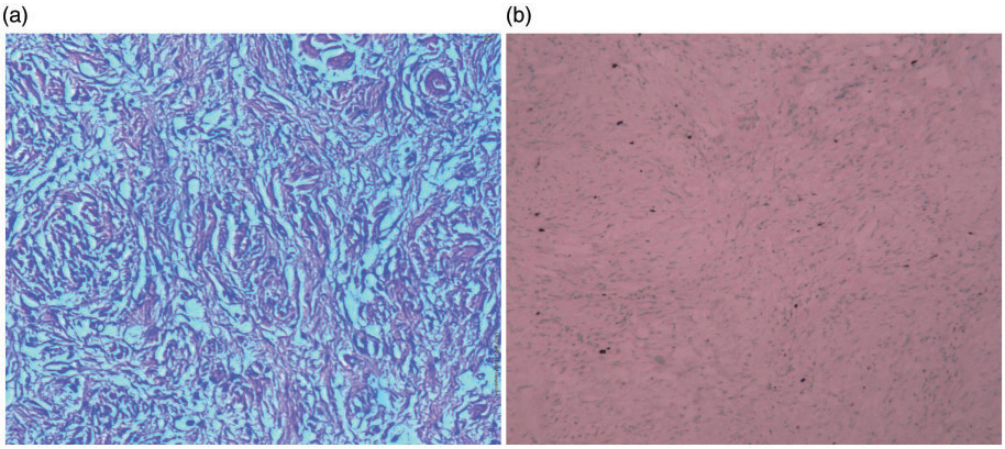

Figure 3. (a) Microscopic examination of the tissue biopsies reveals hyalinized degenerative neurogenic tumors with plexiform and scattered spindle cells (×100; hematoxylin and eosin stain), confirming the diagnosis of a neurofibroma. (b) Cells showing positive immunohistochemical staining are 1% to 2% positive for Ki-67 (×100), indicating that spindle cell proliferation is not active.

vagus plexus provides the nerve tissue that may produce these tumors. The vagus plexus branches through the heart muscle in the areas between the lobules and interlobules. The left heart also has an extensive parasympathetic plexus, which surrounds the heart in the mitral valve region, passing through the epicardium and myocardium and extending to the subendocardial surface.

New imaging modalities as well as conventional TTE are being used to identify disease sites. Detailed anatomical characterization of the heart with TTE has facilitated the study of primary tumor diseases. TTE has an essential role in accurately estimating hemodynamic compromise. CMRI has the highest sensitivity and specificity for the detection of benign and malignant tumors through contrast enhancement. CMRI is the best method for assessing the resolution of soft tissues. It has a high detection rate for neurofibromas at different body locations. The parapharyngeal space, the area around the carotid sheath, and the distribution of the brachial plexus, median nerve, intercostal nerves, and subcutaneous tissue can be clearly observed. Masses of nodules display mainly T1 and T2 signals. After enhancement, they are obviously ring-shaped, and most of the tumors show necrotic liquefaction. In the present case, the appearance of the mass on two-dimensional ultrasound via TTE was different from that of common tumors such as rhabdomyosarcoma and myxoma. In this case, color Doppler flow imaging did not detect blood flow inside the mass, but MCE clearly showed significant contrast enhancement greater than that of the surrounding myocardial tissue. These features are not consistent with the myocardial contrast features of typical benign cardiac tumors. MCE has the advantage of displaying the myocardial blood supply, and in the present case, it indicated that the mass was rich in blood. In fact, some benign tumors, such as cardiac hemangioma, lipoma, and others, can be highly enhanced on MCE.[7] Other common benign heart tumors include myxoma, fibroma, and papillary fibroelastoma. Myxoma is the most common benign cardiac tumor. This tumor type frequently

develops in the left atrium, followed by the right atrium,[8] and it usually has high activity. TTE allows for easier diagnosis of myxoma. Lipoma, second only to myxoma in incidence, is typically located in the cardiac cavity, with regular morphology and a complete capsule. MRI is important for assessing lipoma because this technique is highly specific to adipose tissue. Rhabdomyoma is the most common benign cardiac tumor in fetuses and children. Some studies have suggested that this tumor type is closely related to tuberous sclerosis,[9] and some scholars believe that rhabdomyoma is the result of cardiac changes due to tuberous sclerosis and that it gradually shrinks after birth.[10] Papillary fibroelastoma commonly arises in the heart valves and most often involves the aortic and mitral valves. Venous leiomyomatosis is a rare disease. All patients with this tumor type have a history of uterine fibroids or uterine resection, which are benign lesions. However, the growth pattern of venous leiomyomatosis is similar to that of malignant tumors, which can grow along veins. Ultrasound may only show local thickening of the myocardium, and if this tumor type develops in the ventricular septum, then it may be misdiagnosed as hypertrophic cardiomyopathy. Notably, the MRI manifestations of typical fibromas are low signals on both T1- and T2-weighted imaging, and most tumors are unenhanced, consistent with the characteristics of tumors lacking blood vessels.[11] The most common CMRI features of cardiac malignancies are tissue heterogeneity, tumor size of >5 cm, involvement of more than one heart chamber and surrounding tissues, and contrast enhancement. The degree of enhancement can represent the blood supply of the tumor and the extent of necrosis.[12]

The present case is helpful to our understanding of isolated cardiac neurofibromas. Given the small number of cases, the imaging characteristics of solitary neurofibromas of the heart remain unclear. In the present study, color Doppler flow imaging did not show a strong blood flow signal in the TTE examination of the cardiac neurofibroma. However, unlike most benign tumors, an abundant blood supply was evident on CMRI and MCE. The systolic period was significantly enhanced during MCE reperfusion, and it was longer than that of the surrounding myocardial tissue during the same period. Although such manifestations are not consistent with the myocardial angiographic characteristics of conventional benign cardiac tumors,[13] they are consistent with the ultrasonic manifestations produced by the rich blood supplies of some peripheral neurofibromas. MRI showed low signal intensity on T1-weighted imaging and high signal intensity on T2-weighted imaging, which differs from typical peripheral neuromas but is consistent with the MCE findings. Therefore, the combined use of multiple complementary imaging modalities is considered optimal for the diagnosis of cardiac neurofibroma.

Several cardiac centers around the world have analyzed and discussed the clinical characteristics and prognosis of cardiac tumors and treatment strategies, concluding that surgical treatment is essential for both benign and malignant cardiac tumors.[14] Tumor resection under extracorporeal circulation is currently considered the first-choice treatment for primary cardiac tumors, and the cure rate has been satisfactory.[15] Patients with cardiac tumors may have no obvious symptoms, but as the tumor volume increases, hemodynamic disorders may emerge, thus resulting in related clinical symptoms. Symptoms may vary depending on the size and location of the tumor, and the symptoms may not be strongly correlated with the nature of the tumor.[16] For malignant primary cardiac tumors, especially in patients with

hemodynamic disorders, surgery can not only remove mechanical obstructions and prevent further deterioration of cardiac function but also facilitate clarification of the nature of the tumor and formulation of the subsequent chemoradiotherapy plan.[17]

In conclusion, the presence of a neurofibroma in the heart without evidence of any other metastasis or primary tumor in other organs is clinically unique. A combination of multiple diagnostic imaging methods provides more reliable information for the clinical diagnosis.

Declaration of conflicting interest

The authors declare that there are no conflicts of interest in relation to this work. We have de-identified the information so that the patient's identity cannot be ascertained in any way.

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