A Case of Reversible Cardiomyopathy Due to Pre-Excitation

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Financial support:
This study was funded by the Key Projects in the National Science and Technology Pillar Program of the 13th Five-Year Plan Period, grant/award number: 2017YFC1308300; CAMS Innovation Fund for Medical Science, grant/award number: 2020-I2M-1-002; and Key Projects in the National Science and Technology Pillar Program of the 12th Five-Year Plan Period, grant/award number: 2011BAI11B08

Conflict of interest:
None declared

Patient: Female, 25-year-old
Final Diagnosis: Pre-excitation cardiomyopathy
Symptoms: Decreased exercise tolerance • recurrent chest tightness
Clinical Procedure: —
Specialty: Cardiology
Objective: Rare disease

Background: Pre-excitation cardiomyopathy is a specific type of cardiac disease related to asymptomatic pre-excitation. It is rarely reported and is prone to misdiagnosis; therefore, the actual incidence of pre-excitation cardiomyopathy may be underestimated. The purpose of this case report is to present a case of pre-excitation cardiomyopathy caused by an accessory pathway.

Case Report: A 25-year-old woman was admitted to the hospital with concerns of recurrent chest tightness and decreased exercise tolerance for 3 months. Pre-excitation was found by electrocardiogram. Contraction of the left ventricular wall reduced diffusely, and the overall left ventricle moved asynchronously. The regional septum basal segment swung to the right ventricle like an aneurysm in systolic period. No significant myocardial fibrosis was found. Pathological examination of endomyocardial biopsy demonstrated nonspecific changes of mild interstitial edema. Pre-excitation cardiomyopathy was eventually diagnosed. A right anteroseptal para-hisian manifest accessory pathway was located in an electrophysiological study, and radiofrequency catheter ablation was subsequently performed to block the advanced conduction. During the follow-up at 6 months after ablation, left ventricular dyssynchrony and systolic dysfunction were improved and symptoms were significantly relieved.

Conclusions: Pre-excitation cardiomyopathy is characterized by asynchronous left ventricular motion, impaired cardiac function, and manifestations of heart failure. Asynchronous electromechanical contraction coupling plays an essential role in the pathogenesis. Blocking the accessory pathway could help to correct the dyssynchrony, reverse remodeling, improve left ventricular function, and alleviate symptoms. Patients can have a good prognosis through accurate diagnosis and appropriate treatment.

Keywords: Pre-Excitation Cardiomyopathy • Electromechanical Dyssynchrony • Reversible Cardiac Remodeling

Full-text PDF: https://www.amjcaserep.com/abstract/index/idArt/941780

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Background

Pre-excitation is generated by abnormal electrical signal conduction via an accessory pathway. It is commonly derived from incomplete separation of atrioventricular connection during early embryogenesis [1]. Pre-excitation is characterized by a short PR interval, prolonged QRS duration, and initial slurring upstroke (delta wave) on a 12-lead electrocardiogram. Vector of delta and QRS wave with the combination of R wave changes in chest lead pinpoints an accessory pathway. QRS duration has been considered to be related with myocardial precontraction and abnormal diastolic function.

The overall heart function of pre-excitation could be almost normal, with patients merely having asynchronous ventricular wall motion but no obvious clinical symptoms. However, with the development of the disease, clinical manifestation of heart failure can be apparent despite the patient never having palpitations. Differential diagnosis should be made with other situations, such as tachycardia-induced cardiomyopathy and idiopathic dilated cardiomyopathy, with coexisting asymptomatic pre-excitation. In the past, it was widely believed that patients could develop heart failure with the condition of persistent or recurrent tachycardia [2]. Tachycardia-induced cardiomyopathy has been widely recognized. Currently, however, abnormal cardiac structure and function induced by asymptomatic pre-excitation is of great concern. Patients have features of asynchronous left ventricular systole, left ventricular enlargement, interventricular septum thinning, and clinical heart failure. Pre-excitation cardiomyopathy is finally diagnosed in these patients. The treatment strategy and prognosis of pre-excitation cardiomyopathy is different from that of dilated cardiomyopathy. Therefore, it should not be regarded as a special type of dilated cardiomyopathy. The purpose of this case report is to present a case of pre-excitation cardiomyopathy caused by accessory pathway.

Case Report

A 25-year-old woman was admitted to the hospital with the concern of recurrent chest tightness and decreased exercise tolerance for 3 months. She felt uncomfortable after daily activities and never felt palpitations. The patient denied an abnormal family history. There was no abnormality in markers of myocardial injury on laboratory examination. A short PR interval (114 ms) and prolonged QRS duration (166 ms) combined with a delta wave were observed on 12-lead electrocardiogram (Figure 1A). Transthoracic echocardiogram and transesophageal echocardiogram both showed severe dilation of the left ventricle (65 mm) and thinning of basal segment in interventricular septum (3-4 mm) with enhanced echo. The contraction of the left ventricular wall was reduced diffusely (left ventricle ejection fraction [LVEF], 40%, left ventricle global longitudinal strain [LVGLS], 14.7%) and the overall left ventricle moved uncoordinatedly (Figure 2A). Cardiac magnetic resonance also revealed
Figure 2. Comparison of echocardiogram. (A) Preoperative echocardiogram showed left ventricle dilation, basal segment of ventricular septum thinning, and regional wall swung toward the right ventricle in the systolic period (marked by arrow). Left ventricular longitudinal strain images displayed dyssynchronous left ventricle motion (left ventricle global longitudinal strain [LVGLS], 14.7%). Septal segments of the left ventricle had most abnormal strain values. (B) There was a recovery trend of paradoxical movement in ventricular septum after catheter ablation (marked by arrow). Left ventricular systolic function improved slightly (LVGLS, 15.8%). (C) The structure and synchrony of ventricular septum improved significantly 6 months after catheter ablation (marked by arrow; LVGLS, 19.7%).
obvious thinning of the interventricular septum and paradoxical movement of the left ventricle. Furthermore, the regional interventricular septum basal segment swung to the right ventricle like an aneurysm in systolic period. No significant myocardial fibrosis was observed (Figure 3). Resting myocardial perfusion imaging and myocardial metabolic imaging revealed decreased perfusion and metabolism of the left ventricular myocardium. Coronary computed tomography angiography showed no clear artery stenosis. Dilated cardiomyopathy combined with asymptomatic pre-excitation was temporarily diagnosed.

The patient was then prescribed with standard anti-heart failure medications during hospitalization (sacubitril/valsartan 50 mg twice a day, bisoprolol 5 mg once a day, furosemide 20 mg once a day, and spirolactone 20 mg once a day). The symptoms did not improve significantly, so she underwent further examination. Pulmonary artery pressure and pulmonary artery wedge pressure was normal, as measured by a Swan-Ganz catheter. Endomyocardial biopsy of the right ventricular septum was then conducted. Pathological examination showed the nonspecific change of mild interstitial edema. Nonspecific ultrapathological change of myocardial cells was found by electron microscope. Myocardial hypertrophy or degeneration, inflammatory cell infiltration, fibrous hyperplasia, and fat tissue replacement were not observed. Differential diagnosis of arrhythmic cardiomyopathy was excluded, and pre-excitation cardiomyopathy was finally diagnosed. An electrophysiological study showed a right anterosetal Para-Hisian macroscopic accessory pathway. An ablation catheter was sent to the right atrial tricuspid annulus, and radiofrequency ablation was subsequently performed. The QRS complex was shortened, and the delta wave disappeared after successful ablation. Moreover, systolic synchrony of left ventricle motion improved and cardiac function increased (LVGLS, 15.8%; Figure 2B).

During the 1-month follow-up, no discomfort after discharge was reported. The characteristic of pre-excitation remained absent on electrocardiogram (Figure 1B). The dilated left ventricle was diminished, and regional thinning basal segment of interventricular septum (5 mm) still bulged mildly to the right ventricle, with an estimated length of 35 mm. The contraction of the left ventricle improved (left ventricle, 69 to 61 mm; LVEF, 40% to 46%). Three months after catheter ablation, further reduction of the left ventricle and continuous improvement of systolic function was observed. Six months later, cardiac structure and function continued to normalize (left ventricle, 69 to 55 mm; LVEF, 40% to 59%). The synchrony of the left ventricle and cardiac function improved persistently (LVGLS, 19.7%). The regional thinning and asynchronous motion in the basal segment of interventricular septum still existed, but there was a trend of remission (Figure 2C). The patient was satisfied with the therapeutic effect and could finally go back to work.

Discussion

There is no definite epidemiological data of pre-excitation cardiomyopathy at present. Only about a hundred cases have been reported worldwide in the past 20 years. The actual incidence of pre-excitation cardiomyopathy may be underestimated because some cases are diagnosed with idiopathic dilated cardiomyopathy with coexisting asymptomatic pre-excitation. The specific clinical characteristic of pre-excitation cardiomyopathy is absent. Patients can have only pre-excitation on electrocardiogram but have no clinical signs or symptoms until developing into late progression with heart failure. Overall, patients with typical pre-excitation cardiomyopathy have the following features: (1) manifestation of heart failure, (2) no persistent or recurrent tachycardia attack history, (3) asymptomatic pre-excitation via accessory pathway, (4) left ventricle dilation, systolic function reduction, and dysynchrony, and (5) exclusion of tachycardia-induced cardiomyopathy.

The pathogenesis of pre-excitation cardiomyopathy has not been verified yet. It is commonly believed that electromechanical dyssynchrony plays an essential role in the disease generation. Regional pre-excitation of the ventricle stimulated by abnormal electrical signal from an accessory pathway can lead to the abnormal sequence of depolarization and repolarization of the left ventricle, which is similar to right ventricular apical pacing or complete left bundle branch block [3]. The extent of the pre-excited ventricular myocardium depends on the relative timing of normal and eccentric ventricular activation. Because of the electromechanical coupling mechanism, the following left ventricular motion is consequently asynchronous. Prolonged contradictory movements can activate myocardial remodeling, promote ventricle dilation, and eventually damage cardiac function [4-6].
Among patients with an accessory pathway, up to half with ventricular pre-excitation are free of any symptoms. It is speculated that several factors are involved in the development of pre-excitation cardiomyopathy, especially age and the feature of accessory pathway. In the present case, asynchronous and decreased septal movement was observed in a patient with a right anteroseptal accessory pathway, which is partially consistent with previous reports. Experimental and clinical data have demonstrated that left ventricular dyssynchrony is different according to the location of the accessory pathway. Previous observations have reported occasionally that abnormal interventricular septal motion can occur in patients because of right septal or posteroseptal accessory pathways. In addition, a left-sided accessory pathway can result in abnormal left ventricular posterior wall motion. Different patterns of conduction due to the sites of accessory pathways lead to the difference of asynchronous left ventricular movement [7].

Some other probable mechanisms can be involved in the progress. Effective ventricular filling time may decrease because of regionally advanced systole. Meanwhile, a short PR interval leads to impairment of the assisted pumping effect of the atrium, which all may account for the weakened myocardial contractility and workload. It is confirmed by animal experiments that myocardial atrophy and segmental wall thinning due to long-term decreased local preload could induce an abnormality of regional wall motion, left ventricular dyssynchrony, and mitral regurgitation [8]. Moreover, deficient cardiac ejection is related to inadequate perfusion of the coronary artery, which can also aggravate ventricular remodeling [9]. Hemodynamic change caused by partially premature and relatively delayed ventricular motion can also contribute to the progressive dilatation of the left ventricle.

Significantly low attenuation, which indicates myocardial fat depositing, is observed in the abnormal region of pre-excitation on cardiac computed tomography [10]. Injured metabolism of free fatty acids in myocytes probably suggests irreversible myocardial damage. Whether long-term pre-excitation could induce irreversible injury such as myocardial fibrosis remains unknown. There is an urgent need for large sample analysis of cardiac magnetic resonance to evaluate the changes of the myocardium.

Pre-excitation cardiomyopathy is reversible with early diagnosis and treatment. The best strategy to correct the dyssynchrony of the left ventricle is by blocking the atrioventricular accessory pathway. In this case, positive change of the left ventricular structure and function was observed in the 6-month follow-up. Studies have demonstrated that the improvement of LVEF after catheter ablation is related with the change of systolic dyssynchrony index by speckle-tracking of the echocardiogram [11,12]. A previous study reported that more than 1 year after a successful procedure of catheter ablation, left ventricular contraction and mitral regurgitation can improve significantly. Moreover, catheter ablation can prevent the patient from receiving cardiac resynchronization defibrillation or heart transplantation due to progressive decline in cardiac function. In some studies, however, there is no effective improvement of left ventricular function after catheter ablation, indicating that long-term untreated pre-excitation can develop into irreversible damage.

Antiarrhythmic drugs are not generally recommended for pre-excitation cardiomyopathy, except for patients with a high risk of catheter ablation. For patients with severe cases who have remaining left ventricle systolic dysfunction after ablation, standard anti-heart failure medicine is recommended for further treatment. Meanwhile, the prescription should be alterable and flexible, based on the intensive monitoring of heart function.

**Conclusions**

Pre-excitation cardiomyopathy is a specific type of cardiac abnormality related to asymptomatic pre-excitation. It is rarely reported and is easily misdiagnosed as idiopathic dilated cardiomyopathy. Pre-excitation cardiomyopathy is characterized by asynchronous left ventricular motion, enlarged left ventricle, impaired cardiac function, and manifestations of heart failure. Asynchronous electromechanical contraction coupling plays an essential role in the pathogenesis of the disease. Patients can have a good prognosis through accurate diagnosis and reasonable treatment. The key strategy is blocking the atrioventricular accessory pathway, which is the expressway of the advanced signal, to correct the dyssynchrony. Precise management could help to restore left ventricular systolic synchronization, reverse remodeling, improve left ventricular function, and alleviate symptoms.

**Acknowledgements**

The authors thank the patient for her participation and agreement to the publication of the report.

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