

A Poor Consequence Led by Left Ventricular Non-compaction: A Case Report and Review of Literature

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Abstract: Left ventricular non-compaction cardiomyopathy (LVNC) has anatomic characters of prominent left ventricular trabeculation and deep recesses and relatively thinner compacted layer which can lead to structurally and functionally abnormal of heart muscle. Its pathogenesis predominantly be primary cardiomyopathy and also can be results of drug toxicity or response to acquired triggers. Our case is a 27 years old man who had appeared symptoms including dyspnea and palpitation caused by exertion about ten years and been found with atrial septal defect but had not performed intervention. Then he was admitted because of aggravation of symptoms and been diagnosed left ventricular non compaction after finished echocardiography. Afterwards because of symptomatic bradycardia he had pacemaker implantation, but three months later he died of decompensated acute heart failure. LVNC has variable clinical manifestations including heart failure, thromboembolic events, ventricular arrhythmias and heart failure and the diagnosis of LVNC depends on echocardiography and Cardiac magnetic resonance mainly. Its mortality and morbidity are high and its classification as a specific cardiomyopathy be more appropriate. Therapy of end stage myocardial failure dependes on heart transplantation. Implanted cardioverter defibrillator (ICD) or cardiac resynchronization therapy defibrillator (CRTD) is the key method to prevent from sudden death. Risk stratification includes heart failure therapy, oral anticoagulation, heart transplantation and implantation of an automated defibrillator/cardioverter.

Keywords: Left Ventricular Non-compaction, Arrhythmia, Myocardial Trabeculation

1. Introduction

The character of left ventricular non compaction (LVNC) is ventricular wall anatomy abnormality manifested as the presence of prominent left ventricular (LV) trabeculae, a thin epicardial compacted myocardial layer, and deep intertrabecular recesses which is caused by abnormalities during embryogenesis of the endocardium and myocardium. It is congenital disorder and categorized as unclassified cardiomyopathy at first [1].

It can also be present in the right ventricle (RV), either in a biventricular or isolated unilateral RV pattern [2] and often associated with other congenital cardiac defects. Our case is accord with this property. Clinical manifestations of LVNC are highly variable, ranging from no symptoms to decompensate congestive heart failure. Other symptoms include arrhythmias and systemic thromboembolism and so on. Echocardiography

has been the main noninvasive diagnostic methods and magnetic resonance imaging have increased the identification of hyper-trabeculation and LVNC [3], but overall rates of LVNC cardiomyopathy remains very low.

2. Case Presentation

A 27-years old man came to Cardiovascular Clinic because his symptoms aggravated and then was hospitalized. He appeared symptoms ten years ago, at that time he had been found with atrial septal defect but had not perform intervention. He had dyspnea and discomfort in the chest repeatedly at exertion activity and had no symptoms at rest during the ten years. Although he still could act, his exercise tolerance had obviously decreased. At the same time he had frequent and sustained palpitation accompanied shortness of breath when action. At the beginning of this year he had been to cardiovascular clinic of third class hospital to see doctor, the

echocardiography showed that his left ventricular systolic function was poor and he was diagnosed left ventricular non-compacted myocardium, the left ejection fraction was 38%, the main location of non-compacted myocardial segments is shown in Figure 1.

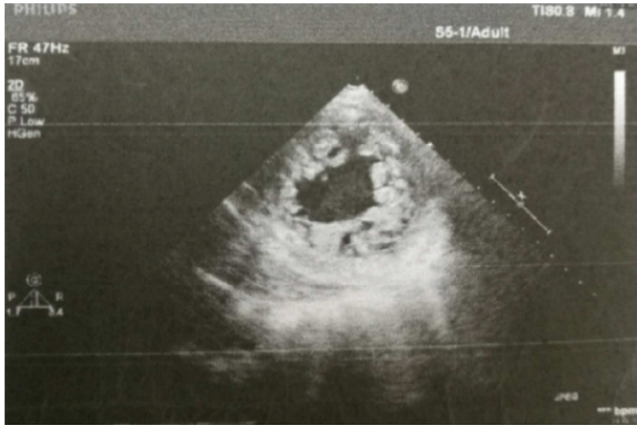


Figure 1. The patient transection view of left ventricular apical, there are both numerous trabeculae and deep recesses.

His holter ECG showed completely left bundle branch block and 12415 solo times atrial premature on the basement of sinus heart rhythm. Half a day before hospitalized, he appeared dizziness and chest tightness and dyspnea accompanied amaurosis repeatedly once more, every time these symptoms lasted several seconds and then mitigated. He had no history of hypertension, diabetes and coronary heart disease. Because his first degree relatives had not been screened, so if he had family history of cardiomyopathy or not was not very clear. His physical examination revealed no signs

of decompensated HF.

His cardiac ultrasound appeared Left ventricle apparently dilated (LVEDD67mm, LVESD56mm) and showed prominent myocardial trabeculations and deep recesses. At the same time it showed pulmonary arterial hypertension about 65mmHg and ASD (atrioventricular septal defect). It was globally dysfunctional with an ejection fraction 34% and global hypokinesia and dyskinesia of the apex. Diastolic function showed mild dysfunction ($E/A < 1$). Right ventricle showed normal morphology and function. Left atrium was dilated (42mm) and coexisted with moderate mitral regurgitation.

In the emergency department his Laboratory examination appeared blood gas analysis PH was low to 7.29 which means acidosis. NT-pro BNP was 2775pg/ml, MYO was 239ng/ml, glucose was 16.44mmol/l. GGT was 98u/L, AST was 202u/L. Blood routine examination showed WBC was $15.82 \times 10^9/L$, neutrophil granulocyte was 81.2%. Chest X ray showed mild pulmonary edema.

When he was admitted to CCU for the first day he suffered many times of heart arrest and we performed cardio-pulmonary resuscitation for him. At that time his ECG showed III degree AV block and ventricular escaped beat about 26bpm (shown in Figure 2-a) even after using the medicine and then we put in a temporary pacemaker for him. After observed several days he was still pacemaker dependent, so we implanted permanent pacemaker for him, the ECG is shown in Figure 2-b. He recovered better and better until he discharged. But three months later when we phoned him for follow-up examination we were told he had died of recurrent acute heart failure, what a pity.



Figure 2. (upper-a) Electrocardiography showed III degree AV block and ventricular beats; (under-b) Electrocardiography after implanted pacemaker.

3. Discussion

3.1. Epidemiology

Males has higher noncompaction incidence than females. LVNC cardiomyopathy remains a remarkably rare entity with a prevalence less than 0.02% [4, 5], but rates of hypertrabeculation and LVNC without overt cardiomyopathy discovered on cardiac imaging have been reported as high as 40% [6]. It is perhaps familial or sporadic. Because of low prevalence of LVNC cardiomyopathy, data from randomized controlled trials to guide the management is limited. The main management is to aim at its complications. Hypertrabeculation displayed a balanced gender distribution with a prevalence of 1.4% in males and 1.1% in females [7]. Because of the presence of severely depressed left ventricular function and heart failure at younger or relatively early stage, avoiding pregnancy was stressed to female. Patients first degree relatives should be screened with echocardiography.

3.2. Clinical Features

Clinical manifestations are highly variable just as we above mentioned, it has triad including various degrees of congestive heart failure, all kinds of arrhythmias and systemic thrombosis. There is also sudden cardiac death related to it.

63% of patients has depressed ventricular systolic function [8]. The age at diagnosis or onset of heart failure varied widely too [9]. Sub-endocardium layer hypo-perfusion and microcirculatory dysfunction maybe playing important roles in ventricular dysfunction and arrhythmias. Sub-endocardium ischemia may result from isometric contraction of the endocardium and myocardium within the deep inter-trabeculae recesses and left ventricular dilation. Arrhythmias are common in patients with ventricular non-compaction. Atrial fibrillation has been reported in over 25%, ventricular tachyarrhythmia has been reported as many as 47%, sudden cardiac death accounted for half of the deaths of patients with LVNC [10, 11]. Paroxysmal supraventricular tachycardia may be just independent events and complete heart block has also been reported in patients with LVNC [12]. Conduction abnormalities seen on electrocardiography (EKG) are identified in over 80% of patients with LVNC, including left and right bundle branch block, AV block, intra-ventricular block, repolarization abnormalities [13]. An association between neuromuscular disorders and non-compaction has also been reported [14], about 82% of patients having some form of neuromuscular disorder. neurological and musculoskeletal evaluations and screening echocardiography are recommended to first degree relatives of patients. Embolic events were frequent complication, bilateral posterior cerebral artery stroke was reported by Marwa [15]. Diastolic dysfunction in LVNC may be related to both abnormal relaxation and restrictive filling caused by the numerous prominent trabeculae [16].

3.3. Histology

Excessive trabeculae and deep recess form network

structure and near the apex 1/3 of the left ventricular wall segment is the most obvious. It can spread to the middle of the wall, generally not involving the basal segment of the wall. Mostly for the left ventricular involvement, a small number involving the right ventricle and biventricular [17, 18]. This abnormal structure Increased involvement of the heart cavity and reduced systolic function also, moreover there was also report that persistent intra-myocardium sinusoids and related congenital obstructive lesions of the left or right ventricular outflow tract. This abnormality is often associated with other congenital cardiac defects.

LVNC cardiomyopathy has been categorized as unclassified by the World Health Organization [19] on definition and classification of cardiomyopathies at early years.

3.4. Diagnosis

Because of nonspecific clinical manifestations it is hard to make correct diagnose for LVNC at an early age, but combine with imaging can make it easy relatively. Ichida et al reported [20] that the diagnosis of LVNC was missed in 89% of children. Ritter et al observed a mean time from onset of symptoms to correct diagnosis of more than 3 years in one adult population with LVNC [19]. As to the abnormal structure there are report [8, 21] that the abnormally thickened myocardium as a 2-layered, with a normally compacted epicardial layer and a thickened endocardia layer. They proposed a quantitative evaluation for the diagnosis of LVNC by determining the ratio of maximal thickness of the non-compacted to compacted layers (measured at end systole in a parasternal short axis view), with a ratio >2 diagnostic of LVNC. This technique allowed differentiation of the trabeculation of LVNC from that observed with dilated cardiomyopathy or hypertensive cardiomyopathy.

According to the 2006 AHA scientific statement, LVNC cardiomyopathy can be diagnosed with echocardiography (ECHO), magnetic resonance imaging (MRI), or LV angiography with ventriculography [3]. By means of ECHO prominent ventricular trabeculations with deep inter-trabecular recesses can be seen. Multi-detector computed tomography (MDCT) with angiography is a helpful noninvasive modality when cardiac MRI is unavailable or a patient has a contraindication [22, 23]. MRI, MDCT and so forth provides good correlation for localization and extent of noncompaction of ventricular myocardium and is useful in cases with poor echocardiographic image quality. So these methods make the diagnose of LVNC more easy and accurate and reliable.

3.5. Genetics

Different gene mutations in non-compaction including familial and sporadic forms have been described. Ichida et al [24] reported mutations in the G4.5 gene and the alpha-dystrobrevin gene, which is associated with non-compaction and congenital heart disease. The Double Mutation DSG2-p. S363X and TBX20-p. D278X are also

Associated with Left Ventricular Non-Compaction Cardiomyopathy [25]. A new study found that those ventricular non-compaction patients with HCN4 and RYR2 mutation presented with a higher LV ejection fraction and more frequent biventricular non-compaction, but only patients with HCN4 mutation presented with a lower heart rate [26]. So our case and his family members should had gene test earlier.

3.6. Management

Treatments focuses on symptoms come from complications of LVNC cardiomyopathy, incorporate congestive heart failure, stroke and sudden cardiac death which come from malignant ventricular arrhythmias such as ventricular tachycardia and fibrillation primary or secondary to bradycardia [2, 27-29]. To evaluate atrial and ventricular arrhythmias by ECG monitoring and ambulatory ECG should be performed every year for every patient had been diagnosed. If the patient has indication for implantable cardioverter defibrillator (ICD), it should be considered [30]. The main indications for primary prevention of sudden cardiac death may apply to patients with LVNC are those with cardiomyopathy and ejection fraction $\leq 35\%$ and high-risk hypertrophic cardiomyopathy with LVNC who might develop to malignant ventricular tachyarrhythmia. If patients had both heart failure with reduced ejection fraction and prolonged intraventricular conduction, biventricular pacemakers should be considered which may reduce the death rate.

Prevention of systemic embolic complications is also an important management strategy. Current evidence supports the use of Long-term prophylactic anticoagulation for the primary prevention of thromboembolic events in patients with LVNC is recommended whether or not thrombus has been found, reduced ejection fraction $< 40\%$, and/or atrial fibrillation, and patients with intra-cardiac thrombi identified on ECHO or other cardiac imaging [31]. Standard medical therapy for ejection fraction reduced heart failure (HFrEF) and diastolic ventricular heart failure are necessary. As to those patients with refractory congestive heart failure can accept cardiac transplantation because the risk of frequently ventricular tachycardia and sudden cardiac death is very high.

4. Prognosis

The prognosis for patients with LVNC varies and be poor mostly, nearly 60% of patients had either died or undergone cardiac transplantation within 6 years of diagnosis. Zi-Qi Zhou et al [22] reported that Arrhythmia combined with presence of LGE (late gadolinium enhancement) or LVEF $< 30\%$ is associated with poor prognosis in LVNC patients. Gene mutation in LVNC need early genetic test in order to provide future opportunities to tailor management to each formulation of LV hyper-trabeculation and LVNC [31]. Ongoing studies include genomic and proteomic analyses, studies to identify genetic variation, and novel biomarkers to improve the diagnosis and prognosis of LVNC [32]. clinical risk stratification and development of novel genetically

tailored treatment strategies are needed urgently [33, 34]. We needed more study to enhance our ability of early diagnose and targeted therapy for hypertrabeculation and LVNC cardiomyopathy patients.

5. Conclusions

Hypertrabeculation and noncompaction are cardiac image and echocardiography descriptions of LV morphology, but these findings are also observed in some congenital heart disease and other acquired cardiomyopathies. The symptoms of our case were classic including congestive heart failure and bradycardia arrhythmias, in the mean time he had congenital heart disease of atrial septal defect, all of these uniting typical manifestation of cardiac ultrasound could fully compliance with standard diagnosis of LVNC cardiomyopathy.

Our case appeared severe congestive heart failure symptoms and we had given him standardizing anti-heart failure therapy and implanted pacemaker for him for bradycardia, he lacked indications for more aggressive therapy at that time. We told him to come to clinic on time so we can evaluate his exercise tolerance, detection his ventricular size and function after the pacemaker implantation, but he died of acute left heart failure three month later which beyond our expectation. This bad consequence proved still further the poor prognosis of LVNC. Meanwhile we should laid stress on the patient to have appropriate physical exercise, have a good rest, avoid emotional excitement and frequent follow-up.

Citations

Statement of Ethics

The authors have no ethical conflicts to disclose.

Disclosure Statement

The authors have no conflicts of interest to declare.

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