



The Value of Echocardiography in the Diagnosis of Non-compaction of the Ventricular Myocardium

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Abstract: To analyze the echocardiographic features of non-compaction of the ventricular myocardium (NVM) and evaluate the diagnostic value of echocardiography in NVM. 34 patients with clinically diagnosed cardiac insufficiency and cardiac arrhythmia were examined by multi-slice scan with GE vivid 7 and Philips IE33 color Doppler sonography. The echocardiographic findings were NVM. Echocardiographic features of NVM were summarized and the distribution characteristics of the lesion area were analyzed. It was found that echocardiography in all 34 patients had obvious characteristics. The myocardium at the lesion site was divided into 2 distinct layers. The outer layer was thin and dense, and the inner layer was thicker, consisting of rich trabeculae and deep recesses with different sizes, which tended to occur in the apical and lateral walls. Color Doppler ultrasound can detect blood flow in the recess and interconnect with the heart cavity. 34 patients were involved in varying degrees of valvular regurgitation of mitral, tricuspid and aortic valves. 29 patients had left ventricular dysfunction, 17 patients with complete left bundle branch block, 12 patients with premature ventricular contractions, and 7 patients with atrial fibrillation. To be concluded, NVM has typical echocardiographic features. Echocardiography can be diagnosed without noticeable symptoms, and it is the most convenient method for diagnosis of NVM.

Keywords: Non-compaction, Ventricular Myocardium, Echocardiography, Trabecular Bone, Diagnosis

1. Introduction

Non-compaction of ventricular myocardium (NVM) is also known as spongy myocardium or myocardial sinusoids continuous state. Its main characteristic is the coarse reticular trabecular meshwork and deep trabecular recess in the left ventricular cavity, which is the result of the stagnation of myocardial densification in the process of embryonic development (week 5 to week 8) [1]. This article aims at analyzing the echocardiographic features of non-compaction of the ventricular myocardium and evaluate the diagnostic value of echocardiography in NVM. The clinical manifestations of NVM were varied from asymptomatic to progressive cardiac dysfunction, congestive heart failure, arrhythmia, embolism and even sudden death [2]. Echocardiography is the core technology for diagnosing NVM. In this study, the author analyzed the echocardiographic findings of 34 patients with NVM, and discussed the application value of echocardiography in the diagnosis of cardiac densification with a view to increase awareness of this

disease. It was proved that echocardiographic findings of 34 patients are consistent with the characteristics of NVM.

2. Data and Methods

2.1. Clinical Data

From April 2011 to October 2017 in our hospital, 34 cases of diagnosed NVM patients, aging from 27 to 69 years old, and the average (49 + 11) years old. There were 25 males and 9 females, most of whom went to the hospital because of chest tightness, shortness of breath, palpitation, and dyspnea. Clinical preliminary diagnosis of coronary atherosclerotic heart disease (coronary heart disease) in 11 cases, 9 cases of dilated cardiomyopathy, myocarditis in 4 cases, chest tightness to be checked in 10 cases. Electrocardiogram (ECG) was conducted in 17 cases with complete left bundle branch block, 12 with ventricular premature beat and 7 with atrial fibrillation. All patients were examined by clinical, chest X - ray, 12 - lead electrocardiogram and echocardiography, of

which 5 cases were performed by MRI.

2.2. Methods

GE vivid7, Philips IE33 color Doppler ultrasound diagnostic apparatus, the probe frequency (2~4) MHz. Make patients lie in the left lateral position, take the parasternal, apical, xiphoid and other parts to acquire left ventricular long axis, short axis series section, apical two chambers, four chamber section and other multi-section for the survey of cardiac structure, the size of each chamber, heart function, observe the valvular regurgitation, focus on the ventricular wall thickness and echo, use local amplification to observe the distribution, thickness and wall motion of non-dense myocardium, and the thickness of non-dense myocardium and dense myocardium were measured respectively to calculate the ratio. This study uses Paterick [3] methods, namely making $N/C \text{ ratio} \geq 2$ in ventricular diastolic end and parasternal short axis view the quantitative diagnostic criteria for diagnosis of NVM. The use of end-diastolic phase as the measurement phase was in line with the recommendation by the American Society of Echocardiography (ASE) to measure wall thickness at end-diastole [4]. In the meantime, Paterick et al. [3] found

that in the short axis of the parasternal compartment, the end diastolic $N / C \text{ ratio} \geq 2$ was used as a diagnostic criterion, which was correlated with the diagnosis of cardiac magnetic resonance.

3. Results

Echocardiography of a group of 34 patients showed that in 27 cases of Non-compaction of the ventricular myocardium in the left ventricle, 7 cases of Non-compaction of the ventricular myocardium. In patients with left ventricular NVM, the intracardiac diameter increased significantly at the end of diastole and EF decreased at the same time. Myocardial involvement of the left ventricular apex in 11 cases, left ventricular papillary muscle of the posterior wall in 7 cases, left ventricular papillary muscle in 6 cases, 10 cases of the free part of the right ventricle. The amplitude and systolic thickening rate of the affected myocardium decreased significantly compared with the normal myocardium, the left chamber increased in 9 cases, the right cavity increased in 10 cases, cardiac enlargement in 11 cases, and the normal in 4 cases. See Table 1.

Table 1. 34 cases of echocardiographic performance in NVM patients.

Myocardial involvement site	n	Age	Cardiac volume	EF /%	FS /%	Myocardial thickness /mm
Left ventricular apex	11	27~69	The left cavity was enlarged in 3 cases, the right cavity was enlarged in 4 cases, and 4 cases were normal.	27~46	12~26	2~4
left ventricular papillary muscle of posterior wall	7	31~51	the cardiac enlargement	29~54	18~28	3~5
left ventricular papillary muscle	6	32~58	Left cavity enlargement	19~38	13~33	2~6
the free part of the right ventricle	10	35~49	The right cavity was enlarged in 6 cases and 4 cases of cardiac enlargement	40~67	20~35	3~6



Figure 1. Two-dimensional sonogram of NVM.

Echocardiography also found that the affected endocardial surface can be seen in multiple abnormal thick, honeycomb trabecular meshwork and staggered deep recess (Figure 1). Because of staggered mesh structure and endocardial discontinuity, lesions near the apical wall were the most obvious and the lesion compact myocardium was significantly thinner. There are fewer movements, non-dense loosening and thickening of the myocardium, and rich trabecular tissue. The ratio of non-dense myocardium to dense myocardial thickness

is greater than 2. Color Doppler ultrasound showed that the low-velocity blood flow in the recess was interlinked with the heart cavity (Figure 2). 34 patients with NVM were accompanied by valve reflux of different degrees of the mitral valve, three tip and aortic valve. The left atrial diameter increased (37~54 mm, the mean was (43 + 6) mm, and the left ventricle was 58~77 mm, with an average of (60 + 6) mm], of which 19 patients had significantly reduced left ventricular systolic function and cardiac ejection fraction (EF) <30%.



Figure 2. Color Doppler flow map of NVM.

4. Discussion

NVM is a kind of heart disease which is not common in the clinic. It is owned by a class of congenital diseases characterized by prominent trabecular and denuded crypts in the myocardium. NVM has many clinical manifestations in the clinic, and it can cause many heart complications, so in the clinical diagnosis, it is easily confused with other heart diseases, leading to misdiagnosis [5-6].

NVM is divided into 3 types: left ventricular NVM, right ventricular NVM and biventricular NVM. Among these 3 types, left ventricular NVM is the most common in clinic, and the affected myocardium can be distributed in any location, including left ventricular apex, left ventricular myocardial and right ventricular free ventricular. If the disease leads to myocardial involvement in a chamber, volume enlargement of the chamber usually occurs, and at the same time, the diastolic function of the chamber is weakened.

The clinical manifestations of NVM are various, which appear separate from time and severity. Its earlier reports were more frequent about children, but recent reports of adult morbidity have increased. Symptoms vary greatly in the starting age. Most patients have no symptoms in the early time, but in middle age and even old age, they begin to suffer from it. The main clinical manifestations are: (1) heart failure. Mainly for left heart failure, right heart failure can also serve as combined. (2) More rapid ventricular arrhythmia, left bundle branch block is also more common; (3) Endocardial thrombosis with systemic embolism, mainly for systemic embolism, which is related to atrial arrhythmia or heart disease and intraluminal thrombus shedding; (4) Pulmonary hypertension.

Although NVM is a kind of specific diseases, its clinical manifestations are not specific, so it is not possible to make a definitive diagnosis of this condition through clinical manifestations. If ECG and X-ray diagnosis are utilized, the diagnosis may also be positive, and the resulting increase in the volume of the heart chamber. Heart failure and additional symptoms can easily be confused with other cardiomyopathies. If you cannot make a clear diagnosis of NVM, then it will delay the best treatment time if NVM degenerates into the late, then the prognosis will become very poor, seriously affecting the quality of life of patients. The current clinical on the densification of NVM is mainly confirmed by echocardiography [8-9]. Some scholars [10] have summarized the echocardiographic characteristics of NVM in detail and differentiated the echocardiographic features with other types of cardiomyopathy, which has improved the accuracy of clinical diagnosis of this disease. The NVM is clearly separated into two layers under ultrasound. The thickness of the inner layer is more than 2

times of that of the superficial layer. Meanwhile, under the color Doppler ultrasound, it can be noted that there is blood circulation between the trabecular meshwork and the velocity of flow is slower. The results of this study also demonstrate that echocardiographic findings of 34 patients are consistent with the characteristics of NVM.

5. Conclusion

To sum up, echocardiography has a significant diagnostic effect for NVM. It can accurately display the location of cardiac lesions and has great practical value in the diagnosis of NVM. It is worth of clinical application.

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