TISSUE DOPPLER IMAGING IN ASSESSMENT OF THE LEFT VENTRICULAR FUNCTION IN ISCHEMIC HEART DISEASE

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Abstract

Background : Ischemic heart disease (IHD) may cause local movement disorders and the assessment of EF systolic function measured by M-mode ultrasound may be wrong. The study aims to provide the value of using tissue Doppler imaging (TDI) to assess the systolic function through the movement of the mitral ring. **Subjects and Method**: 94 patients with heart failure due to coronary artery disease and 34 healthy people as control group included in this study. We made echocardiography and Doppler tissue of mitral ring at the 2 and 4 chamber views. **Results**: The S wave of annular mitral valve at 2 and 4 chamber views in patients group were lower than controls: 4.93 ± 1.51cm/s vs 7.50 ± 0.86 cm/s; 4.71 ± 1.66 cm/s vs 7.41 ± 0.84 cm/s, 4.46 ± 0.92 cm/s vs 97.24 ± 0.68 cm/s; 4.66 ± 1.13 cm/s vs 7.70 ± 0.74 cm/s . On the other hand, no difference in the speed of movement according to the artery lesions. **Conclusions**: The S wave velocity of 4 annular mitral sites decreased in patients with heart failure due to ischemic heart disease. There was no difference in S wave velocity at the 4 sites of mitral annulus according to LAD or RCA lesions. The S wave velocity on the pulse TDI may be used alternatively to assess the systolic left ventricular function.

Key words: *TDI, heart failure, ischemic heart disease.*

1. INTRODUCTION

Ischemic heart disease according to current statistics is the leading cause of heart failure in developed countries (50.3%). Myocardial tissue Doppler method is enable to assessment of myocardial motion thereby helping to survey the function of the left ventricle. Assessing ventricular systolic function by EF has the drawback because the M-mode ultrasound is incorrect in case of IHD while the 2D ultrasound process EF measurements more accurate but complex. The aim of study is to show the power of TDI in assessment of LV function.

2. SUBJECTS AND METHODS

2.1. Patients Group

Included 94 patients ages 46-84, mean age 68.86 ± 10.02, hospitalized in the Department of Intervention Cardiology and Internal Cardiology - Hue Central Hospital.

2.2. Selection of patients

Evidence of heart failure due to coronary disease:

+ Heart failure: Framingham criteria . Echocardiography: EF ≤ 50%.

+ Evidence of myocardial infarction (ESC 2012)

+ Coronary stenosis ≥ 50%.

Excluded criteria:

+ Heart failure due to non coronary diseases.

+ Non significative coronary diseases.

+ Valvular heart diseases.

2.3. Controls group

We selected 34 healthy people of the same age as patients group.

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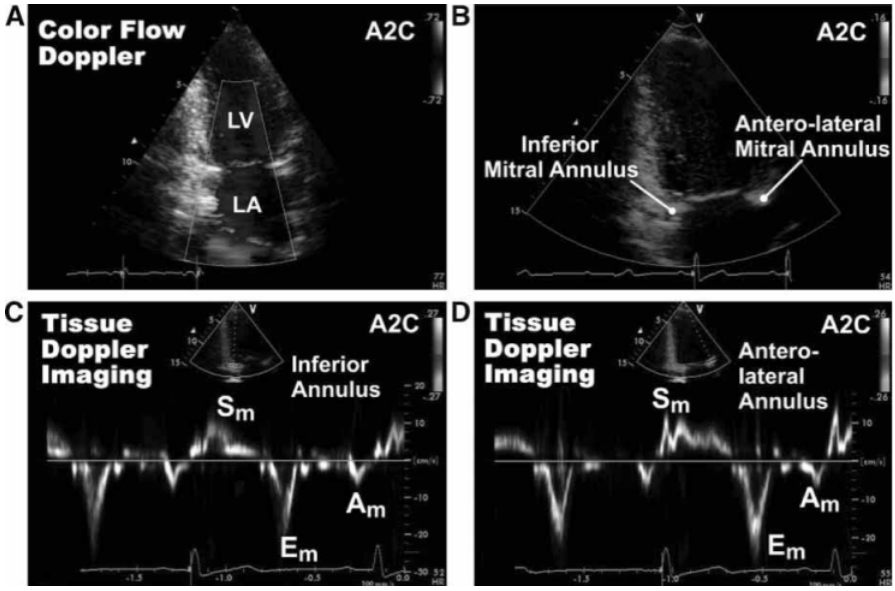

Figure 1. Movement of mitral annulus with tissue Doppler at the 4 sites of the apical 2 and 4 chambers views

Echocardiography study:

- The parameters of left ventricular M-mode ultrasound taken in the left parasternal long axis view as recommended by the 2015 ASE guidelines. The EF was measured in M-mode and 2D echocardiography (Teicholz and Simpson method).

- The S wave of mitral pulse Doppler tissue at the apical 2 and 4 chambers views (anterior, posterior, septal, lateral). The S wave velocity was taken at the top of the S wave.

Ultrasound system used: Hewlett Packard HD.

Coronarography: Seldinger technique. Philips system.

Three cardiologists visually assessed the percent diameter stenoses and determined their severity. Detected stenoses were viewed in two orthograde projections. The cardiologists determined which view and film sequence demonstrated the highest degree of stenosis and then determined where the measurement should be taken. In an end-diastolic frame, the stenosis was described as the percent diameter stenosis.

3. RESULTS

Table 1. Parameters of left ventricle on M-mode Echocardiography

Parameters	Patients groupX ± SD			p
	Male	Female	Both	
BSA	1.59± 0.12	1.43 ± 0.13	1.53 ± 0.14	< 0.01
LVM	220.20 ± 64.01	207.65 ± 55.53	215.12 ± 60.13	< 0.01
LVMI	143.44 ± 42.89	137.74 ± 32.88	141.14 ± 39.06	< 0.01
LVD/BSA	3.61 ± 0.46	3.81 ± 0.47	3.69 ± 0.47	< 0.05
LVDs/BSA	2.83 ± 0.47	3.04 ± 0.52	2.92 ± 0.49	< 0.05
LVDd	5.71 ± 0.64	5.43 ± 0.61	5.60 ± 0.64	< 0.05
LVDs	4.49 ± 0.68	4.34 ± 0.66	4.44 ± 0.68	> 0.05
EF (M-mode)	42.66 ± 7.13	40.02 ± 9.55	41.59 ± 8.25	>0.05
EF4 (Simpson)	34.12 ± 8.62	36.29 ± 8.89	35.00 ± 8.75	>0.05
EF2 (Simpson)	34.06 ± 8.79	34.33 ± 8.58	34.17 ± 8.67	>0.05

Table 2. TDI of mitral annulus at the 4 chambers view

S wave (cm/s)	Patients (n=94)	Controls (n=34)	p
Lateral S	4.93±1.51	7.50 ± 0.86	<0.01
Septal S	4.71±1.66	7.41 ± 0.84	<0.01

The S wave of patients decreased in comparison with controls group at the 4 chambers view (p<0.01).

Table 3. TDI of mitral annulus at the 2 chambers view

S wave (cm/s)	Patients (n=94)	Controls (n=34)	p
Anterior S	4.46 ± 0.92	7.24 ± 0.68	<0.01
Posterior S	4.66 ± 1.13	7.70 ± 0.74	<0.01

The S wave of patients decreased in comparison with controls group at the 2 chambers view.

Table 4. S wave velocity according to local coronary disease

S wave(cm/s)	Anterior IHD (n=18)	Posterior IHD (n=10)	p
Lateral S	4.65 ± 1.39	4.51 ± 1.03	> 0.05
Septal S	4.63 ± 0.95	4.36 ± 1.21	> 0.05
Anterior S	4.30 ± 0.73	4.88 ± 1.25	> 0.05
Posterior S	4.83 ± 1.37	4.47 ± 0.91	> 0.05

There was no difference in TDI velocity at the 4 sites of mitral annulus. (p > 0.05)

Table 5. S wave velocity in 4 sites with LAD disease

S wave (cm/s)	Velocity (cm/s) (n=72)	p
Lateral S	4.38 ± 1.12	>0.05
Septal S	4.47 ± 0.98	
Anterior S	4.43 ± 10.94	
Posterior S	4.64 ± 1.14	

We did'nt find the difference in S velocity at 4 sites of mitral ring when the LAD artery have been obstructed (p > 0.05).

Table 6. S wave velocity at 4 sites with RCA disease

S wave (cm/s)	Velocity(cm/s) (n=69)	p
Lateral S	4.68 ± 1.27	>0.05
Septal S	4.53 ± 1.06	
Anterior S	4.51 ± 0.96	
Posterior S	4.58 ± 1.21	

There was no difference in S velocity at 4 sites of mitral ring with the lesion of RCA artery (p>0.05).

4. DISCUSSION

The normal heart muscle movement is complex in three separate components: radial, longitudinal axis, and rotation. No ultrasound technique can assess the ventricular ejection through these three axis simultaneously. The debate has been taken place about the relative importance of each component. However, many people accept that shrinking the longitudinal axis is an indispensable part of the whole function contractions and equally important role as a radial thickening of the heart muscle in the ejection function [4]. The longitudinal axis function is not only influenced by physiological aging but also sensitive to the myocardial injury. The disorder can make the function of two kind of myocardial fibers weaken. However, it was found in pathological conditions (myocardial infarction, hypertrophy etc), the longitudinal axis function is impaired before, so the study of the longitudinal axis function can help detect early the cardiac functional disorder. There is evidence that the longitudinal axis function is an indicator of myocardial contraction and more sensitive than the conventional ultrasound [6].

4.1. The parameters in M-mode echocardiography

The result in the table 1 showed that the patients had the hypertrophy and dysfunction of the left ventricle. There was also a dilatation of the left ventricle. The 2D EF was dropped below the threshold 40% in which the term cardiomyopathy may be used. That means the severity in myocardial injury due to coronary disease in patients group.

The statistical results showed the difference about EF in M-mode and 2D echocardiography. The EF measurement in 2D echocardiography is more accurate than the M-mode echocardiography in ischemic heart disease, so the 2D EF must be taken [1].

4.2. Movement of mitral annulus in controls vs patients groups

Table 2 and 3 present the differences between 2 groups in S wave velocity according to 2 and 4 chamber views. The S wave velocity in patients decreased significatively.

In a systematic study and meta-analysis conducted in the United Kingdom consists of 8 study with 568 patients, TDI measurement (pulse or color Doppler Tissue) assessing the maximum systolic velocity in the patient with coronary disease. The results showed a decrease in myocardial velocity in patients with coronary artery disease [2].

In a study over 100 patients including 50 heart failure patients with chronic heart failure and 50 patients in cardiac shock, K Adnan Hameed found that the systolic function is normal when the S velocity >7.5cm/s with sensitivity 79%, specificity 88%. The author also came to the conclusion that the patients with cardiogenic shock has the S velocity lower than the patients in chronic heart failure with the same EF [5].

Piercarlo Ballo also seek correlations between the two methods used to measure the motion of mitral annulus: M-mode and pulse Doppler techniques. The author found a very good correlation between the two methods [7]. Many studies demonstrate that the mitral ring motion measured by TDI is a simple method to tell the left ventricular systolic function [6].

4.3. The myocardial velocity and the local movement disorders

We conducted a comparison in velocity at 4 sites of mitral ring for 2 groups of patients acquired the lesion of LAD and RCA, the anterior versus posterior diseases. However we did not see any difference between the velocity at the sampling sites in each cardiac wall ($p > 0.05$). This result may explained by the most of patients who had a severe left ventricular dysfunction. In this case, the motion of all cardiac wall may be decreased instead of local hypokinesia.

5. CONCLUSIONS

The S wave velocity of 4 annular mitral sites decreased in patients with heart failure due to ischemic heart disease. There was no difference in S wave velocity at the 4 sites of mitral annulus according to LAD or RCA lesions. The S wave velocity on the pulse TDI may be used alternatively to assess the systolic left ventricular function.

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