

ASSESSMENT OF LEFT VENTRICULAR MECHANICAL DYSSYNCHRONY IN PATIENTS WITH SEVERE MITRAL REGURGITATION OF RHEUMATIC ETIOLOGY

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قالوا

سببناك لا علم لنا
إلا ما علمتنا إنك أنت
العليم العظيم

صدق الله العظيم

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Abstract

Introduction:

The degree of left ventricular mechanical dyssynchrony in patients with severe mitral regurgitation of rheumatic etiology is not well known. Echocardiographic methods have been used to assess LV mechanical dyssynchrony, are still lagging.

Methods:

The study included 31 patients with severe mitral regurgitation had rheumatic etiology (RHD group), In addition 22 age and gender matched healthy subjects were studied and served as a (control group). All patients underwent history taking, clinical examination and ECG and also Transthoracic Echocardiography (TTE) was done . Tissue Doppler Imaging (TDI) was performed to determine the left ventricular systolic dyssynchrony by measuring Ts-SD % and Ts-Dif %. The Real-Time 3D Echocardiography (RT3DE) was performed to assess the global left ventricular ejection fraction and the systolic dyssynchrony by measuring systolic dyssynchrony index (SDI).

Results:

There was statistically significant difference between the two groups regarding Ts-SD, Ts-Dif, corrected Ts-SD and corrected Ts-Dif ($p = 0.000$). There was statistically significant differences between the two groups regarding Tmsv16-SD% and Tmsv12-SD% ($p = .026$ $p = 0.027$) respectively, and also there was statistically significant difference between the two groups regarding Tmsv6- SD% ($p = 0.017$).and Tmsv6 -Dif% ($p = 0.016$) . In our study the prevalence of LV dyssynchrony was [(22.5%)(7 RHD patients from 31 RHD patients)] by using SDI cut-off 8.3% , and the prevalence of LV dyssynchrony was [(19.4%) (6 RHD patients from 31 RHD patients)] by using the Yu index cut-off >32.6 ms.

Pearson's correlation coefficient in RHD patients showed Dyssynchrony parameters:

Tmsv16-SD% and Tmsv12-SD% were statistically significant negatively correlated with 2DEF ($r = -0.535$ $P = 0.002$) ($r = -5.489$ $P = 0.042$) and with 3DEF ($r = -5.518$ $p = 0.020$) ($r = -0.255$ $P = 0.04$) respectively., but Tmsv16-SD% was Positive statistically significant correlated with LVESD ($r = 0.471$ $P = 0.007$) with LVESV ($r = 0.990$ $p = 0.000$) with EDV3D ($r = 0.527$ $P = 0.002$) and with ESV3D ($r = 0.551$ $p = 0.002$). Tmsv12 –SD% was positive statistically significant correlated with EDV3D ($r = 0.502$ $P = 0.004$) and with ESV3D ($r = 0.478$ $P = 0.002$) with PASP ($r = 0.356$ $P = 0.030$) with regurgitant volume ($r = 0.420$ $P = 0.013$) . 2DEF was Positive statistically significant correlated with 3DEF ($r = 0.409$ $P = 0.022$).

Conclusion:

this is the first study to demonstrate that in patients with severe MR due to rheumatic etiology there is left ventricular dyssynchrony. RT3DE and TDI were able to objectively and accurately evaluate LV function and LV dyssynchrony.

Key word

Dyssynchrony – Mitral Regurgitation - Rheumatic

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List of Abbreviations

A-wave	A
Atrial Fibrillation	AF
American Heart Association	AHA
Arterial hypertension	HTN
Aortic regurgitation	AR
Aortic stenosis	AS
American society of echocardiography	ASE
Body mass index	BMI
Body surface area	BSA
Basal inferoseptal	BIS
Basal inferior	BL
Basal lateral	BI
Basal anterior	BA
Basal posterior	BP
Basal anteioseptal	BAS
Control group	C
Corrected heart rate	cHR
Congestive heart failure	CHF
Cardiac magnetic resonance	CMR
Cardiac resynchronization therapy	CRT
Continues wave Doppler	CWD
E-wave	E
Electrocardiogram	ECG
End diastolic volume by three Dimensional echocardiography	EDV 3D
Ejection fraction	EF
Effective regurgitant orifice surface area	EROSA
End systolic volume by three Dimensional echocardiography	ESV 3D
Female	F
Fraction shortening	FS

Height	H
Hypertrophic cardiomyopathy	HCM
Heart failure	HF
Infective endocarditis	IE
Interventricular septum dimension	IVSD
Left atrium	LA
Left atrial area	LAA
Left bundle branch block	LBBB
Left ventricle	LV
Left ventricular end diastolic volume index	LVDVI
Left ventricular end diastolic dimension	LVEDD
Left ventricular ejection function	LVEF
Left ventricular end systolic dimension	LVESD
Left ventricular end diastolic volume	LVEDV
Left ventricular end systolic volume	LVESV
Left ventricular hypertrophy	LVH
Left ventricular mass	LVM
Left ventricular mechanical dyssynchrony	LVMD
Left ventricular mass index	LVMI
Left ventricular end systolic volume index	LVESVI
Maximal difference	DIF
Mid inferoseptal	MIS
Mid lateral	ML
Mid inferior	MI
Mid anterior	MA
Mid posterior	MP
Mid anteroseptal	MAS
Mitral regurgitation	MR
Mitral stenosis	MS
Mitral valve area	MVA
Myocardial oxygen consumption	MVO2

Mitral valve prolapsed	MVP
New York heart Association	NYHA
Pulmonary artery systolic pressure	PASP
Posterior wall dimension	PWD
Posterior wall thickness	PWT
Rheumatic fever	RF
Regurgitant fraction	RF
Rheumatic heart disease	RHD
Real time three – dimensional echocardiography	RT3DE
Right ventricle	RV
Regurgitant volume	RV
Relative wall thickness	RWT
S-wave	S
Septal wall thickness	SWT
Standard deviation	SD
Systolic dyssynchrony index	SDI
Shortness of breathing	SOB
Transesophageal echocardiography	TEE
Type 2 diabetes mellitus	T2DM
Time from QRS onset to minimal systolic volume	Tmsv
Tricuspid regurgitation	TR
Time from QRS onset to peak systolic tissue velocity	Ts
Transthoracic echocardiography	TTE
Time-velocity integral	TVI
Vena contracta	VC
Velocity of circumferential fiber shortening	VCF
Volume – time curves	VTC
Weight	W

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INTRODUCTION

Rationale and background:

Left ventricular dyssynchrony refers to uncoordinated ventricular movement which may occur during ventricular contraction (systolic dyssynchrony) or during relaxation (diastolic dyssynchrony). Systolic dyssynchrony can be defined as uncoordinated timing of contraction in different segments of the myocardium. Systolic dyssynchrony in patients with heart failure and depressed ejection fraction (EF) has been investigated extensively in recent years after development of cardiac resynchronization therapy (CRT).

The presence of mechanical dyssynchrony in patients with normal EF has not been directly examined, but there have been two published studies that are relevant to this topic. In the first report, the presence of dyssynchrony in patients with congestive heart failure (CHF) and EF >40 was investigated. That study showed that systolic dyssynchrony is not uncommon ⁽¹⁾. In the second study, the presence of a prolonged QRS duration was associated with worse outcome in patients with CHF and normal EF ⁽²⁾. In addition, there are few studies that have examined the degree of systolic and diastolic dyssynchrony in patients with diastolic dysfunction and normal EF together with the effect of medical and non-medical treatment. Those studies evaluated patients with coronary artery disease ⁽³⁾, aortic stenosis ⁽⁴⁾, hypertrophic cardiomyopathy ^(5, 6) and hypertension ⁽⁷⁾.



A more recent study concluded that left ventricular function is affected not only by a depressed contractile status of the myocardium, abnormal loading conditions or both, but also by disturbed synchrony of myocardial walls ⁽⁸⁾ and that persistent mechanical dyssynchrony contributes to progressive ventricular remodeling and impaired systolic left ventricular function ⁽⁹⁾.

Although the diagnosis of left ventricular dyssynchrony is made mainly in patients with heart failure and prolonged QRS duration (>120 ms), there is still increasing number of reports that have identified dyssynchrony in absence of heart failure; thus the prevalence of left ventricular dyssynchrony may be still underestimated ⁽⁸⁾.

To our knowledge, only one study investigated the effect of primary mitral regurgitation on left ventricular synchrony ⁽¹⁰⁾. The study showed that patients with moderate to severe mitral regurgitation, dilated left ventricle and normal EF, did not show left ventricular dyssynchrony as assessed by two-dimensional, maximum shortening strain using magnetic resonance imaging (MRI). However, the authors could not rule out the possibility that patients with more extensive left ventricular remodeling and systolic dysfunction would result in left ventricular dyssynchrony. They also stated that this is true when left ventricular EF decreases to low normal (i.e. 50%) which would be indicative of left ventricular dysfunction in primary mitral regurgitation.



Hypothesis:

It is known that chronic mitral regurgitation is a form of volume overload that affects both the left ventricle and the left atrium. The lesion is well tolerated and left ventricular contractile function remains within the normal range for many years despite the presence of severe mitral regurgitation ⁽¹¹⁾. Left ventricular eccentric hypertrophy develops as new myocardial sarcomers are added and total left ventricular volume increases progressively. Late in the course of the disease, interstitial fibrosis of the left ventricle which accompanies long standing pathological hypertrophy results in decline in left ventricular function. Therefore, left ventricular EF of approximately 50% actually denotes left ventricular dysfunction.

In patients with rheumatic heart disease, it was described that the final stage of rheumatic inflammation of the myocardium is characterized by healing of the exudative and proliferative reaction which eventually converted into a characteristic spindle-shaped, flame-shaped or triangular scar that lies mainly between the muscle bundles and surrounding blood vessels ⁽¹²⁾.

We hypothesized that patients with primary mitral regurgitation of rheumatic etiology, dilated left ventricle and depressed EF may have systolic dyssynchrony, possibly related to the nature of rheumatic pathology (scarring, progressive fibrosis, contracture and calcification) that affects the mitral valve leaflets, chordae tendinae and left ventricle, and also due to the presence of variable degrees of eccentric left ventricular hypertrophy.



AIM OF THE WORK

We designed this prospective study to assess left ventricular mechanical dyssynchrony in rheumatic heart disease (RHD) patients with severe mitral regurgitation and dilated left ventricle.

The objectives of this study are to :

- 1-Evaluate the presence of left ventricular mechanical dyssynchrony, its degree and its relationship to the left ventricular ejection fraction in patients with severe mitral regurgitation of rheumatic etiology
- 2- Compare the different echocardiographic methods used to assess mechanical dyssynchrony and their application in patients with rheumatic heart disease and severe mitral regurgitation.