Study Of Ventricular Function In Patients With Rheumatic Valvular Heart Disaese

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Abstract: Objective: In India, the commonest cardiovascular ailment encountered in hospitals is rheumatic heart disease, mitral valve being most commonly affected. Rheumatic mitral valve disease affects left-ventricular performance as a result of myocardial and functional factors. This study is aims to review the use of Tissue Doppler Echocardiography over conventional echocardiography in assessment of ventricular functions in patients having rheumatic heart disease. Material and Methods: This is a cross sectional study carried out at Shree Sayajirao General Hospital and Medical College Baroda. Total of 35 patients with an established diagnosis of rheumatic MS, and 30 age-matched healthy individuals were included in this study. Echocardiography equipped with TDE function was performed on each participant. The mitral valve area, gradient across mitral valve, Left atrial size, ejection fraction, isovolumic contraction time of ventricles, myocardial velocity of ventricular walls were measured. Discussion: The average age of study population was 33 years with 57% females patients and 43% males patients. There was maximum correlation between Systolic myocardial velocity and ejection fraction calculated by Simpson's Four Chamber method . Regional distribution of systolic dysfunction occur in rheumatic mitral valve disease with maximum maximum affection of posterior and lateral wall and minimal affection of interventricular septum. LV systolic and diastolic dysfunction can occur in pure mitral stenosis independent of severity of mitral stenosis & Tissue Doppler echocardiography appears to be feasible in the prediction of subclinical LV dysfunction. [Mekha M et al NJIRM 2013; 4(1) : 22-28]

Key Words: TDE- Tissue Doppler Echocardiography,MS-Mitral stenosis

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Introduction: Rheumatic mitral valve disease affects left-ventricular performance as a result of myocardial and functional factors. We planned this study to evaluate the effect of rheumatic mitral valve disease on right- and left-ventricular functions using Tissue Doppler echocardiography and compare it with 2D Echocardiography.

In India, the commonest cardiovascular ailment encountered in hospitals is rheumatic heart disease. It has been found that chronic mitral valvular diseases due to rheumatic fever has been the prime cause of severe cardiac disability in young adults who constitute the most productive group of people in general population. In pure mitral stenosis (MS), the pathophysiologic role of mechanical and myocardial factors for impairment of left-ventricular performance is still not clear.[1] The hemodynamic factors contributing to the clinical disability in patients with MS have been under investigation and discussion for many years.[2]As there is changes in anatomy of mitral valves, apparatus, atria and ventricles interpretation in ventricular functions becomes difficult with conventional echocardiography.

In approximately one-fourth of patients with pure MS the systolic performance is under a normal level. This is probably caused by the chronic decrease in preload, and from the increase of afterload, resulting from the reduced left-ventricular thickness. [3] In addition, decreased compliance of the left ventricle, together with the variable diastolic suction, might have an impact on ventricular function.[1 2 4] Thus, both myocardial and mechanical factors play important roles in left-ventricular systolic and diastolic functions. [1] Tissue Doppler echocardiography (TDE) by which regional ventricular wall-motion velocity can be measured, and quantitative evaluation of the wall motion velocities in various heart diseases has become possible. [5 9] This study is aims to review the use of Tissue Doppler echocardiography over conventional echocardiography in assessment of ventricular functions in patients having rheumatic heart disease.

Aims Of Study: To evaluate the different parameters obtained through the Tissue Doppler echocardiography with conventional echocardiography and Doppler ultrasound echocardiography with conventional examination

of the patients with rheumatic mitral stenosis for diagnosis and assessment.

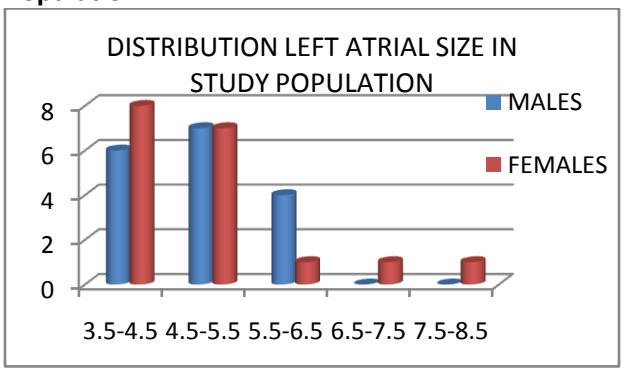
Material and Methods: The study has been carried out at Shree Sayajirao General Hospital and Medical College Baroda during period of March 2009 to July 2010. This is a cross sectional study of ventricular function using tissue color Doppler imaging (TDI) in patients with rheumatic mitral valve disease. Written and informed permission of every patient was taken, IRB permission was not taken.

Patients with age less than 12 years, mitral valve disease of other than rheumatic aetiology, Pregnant females were excluded from study.

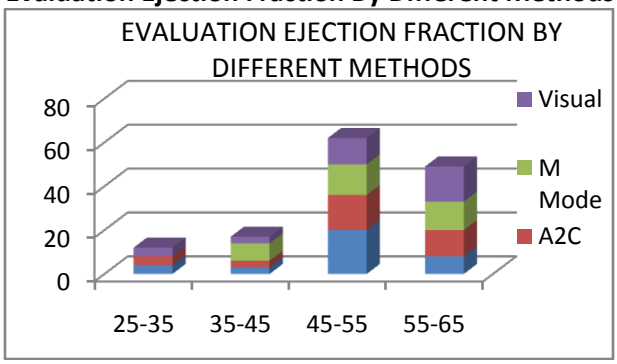
A total of 35 patients with an established diagnosis of rheumatic MS, and 30 age-matched healthy individuals were included in this study. 30 age-matched healthy participants were selected as control participants, with no cardiovascular symptoms or evidence of significant organic cardiovascular disease as assessed by chest radiograph, electrocardiography, and echocardiography. Echocardiography equipped with TDE function was performed on each participant. The mitral valve area, mitral valve gradient, Left atrial size, ejection fraction, isovolumic contraction time of ventricles were measured. Myocardial velocities were recorded at 4 different sites (septum, lateral, anterior, and inferior) of the left ventricle, and the right-ventricular free wall annulus by TDE. The positive systolic velocity when the mitral and tricuspid ring moved toward the cardiac apex, and negative diastolic velocities when the mitral annulus moved toward the base away from the apex were measured.

The early diastolic velocity/late diastolic velocity ratio was calculated for each wall and its correlation with mitral valve area evaluated. Patients with mitral valve disease were compared with healthy participants, and the relationship of DTI variables with mitral valve area was evaluated.

Results: Distribution Left Atrial Size In Study Population



Evaluation Ejection Fraction By Different Methods



Evaluation Mitral Valve Gradient :

	STUDY	CONTROL	P VALUE
PEAK MV GRADIENT	21.3	5.8	P = 0.032
MEAN MV GRADIENT	13.6	3.1	P < 0.0001

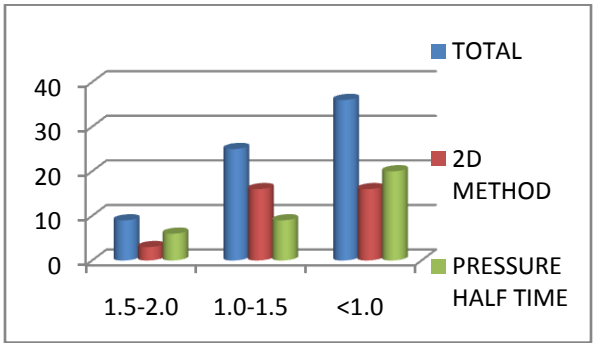
Severity Of Valvular Lesion In Study Population

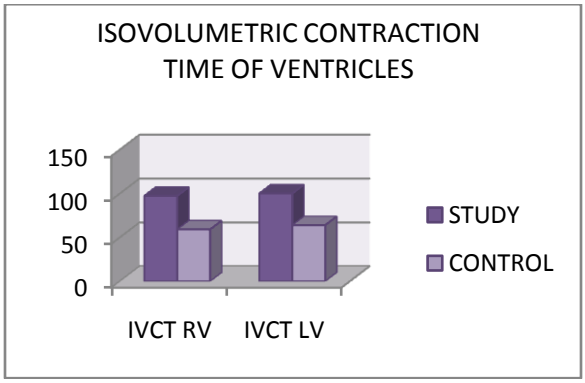
SEVERITY OF LESION (cm^2)	MVA	NO.OF PATIENTS	PERCENT
MILD	1.5-2.0	3	9
MODERATE	1.0-1.5	15	43
SEVERE	<1.0	17	48

Evaluation Of Isovolumetric Contraction Time Of Ventricles

	STUDY	CONTROL	P VALUE
IVCT RV	97.32	59.10	P < 0.001
IVCT LV	100.10	63.94	P< 0.0001

Evaluation Mitral Valve Area By Different Methods





EVALUTION OF MYOCARDIAL VELOCITY:
VP_s – Peak systolic myocardial velocity,
VPE_m – Early diastolic myocardial velocity,
VPA_m – Late diastolic myocardial velocity

Interventricular Septum

MYOCARDIAL VELOCITY	STUDY	CONTROL	P VALUE
VP_S	0.062	0.099	P < 0.001
VPE_m	0.055	0.114	P < 0.0001
VPA_m	0.040	0.103	P < 0.0001
VPE_m/ VPA_m	1.92	1.11	P = 0.0018

Lateral Wall

MYOCARDIAL VELOCITY	STUDY	CONTROL	P VALUE
VP_S	0.063	0.132	P < 0.0001
VPE_m	0.067	0.113	P < 0.0001
VPA_m	0.035	0.092	P < 0.001
VPE_m/ VPA_m	2.28	1.22	P = 0.002

Anterior Wall

MYOCARDIAL VELOCITY	STUDY	CONTROL	P VALUE
VP_S	0.070	0.130	P = 0.0328
VPE_m	0.074	0.119	P < 0.0001
VPA_m	0.065	0.099	P = 0.014
VPE_m/ VPA_m	1.22	1.201	P < 0.001

Inferior Wall

MYOCARDIAL VELOCITY	STUDY	CONTROL	P VALUE
VP_S	0.067	0.110	P < 0.0001
VPE_m	0.078	0.125	P < 0.0001
VPA_m	0.050	0.103	P < 0.0001
VPE_m/ VPA_m	1.66	1.22	P = 0.022

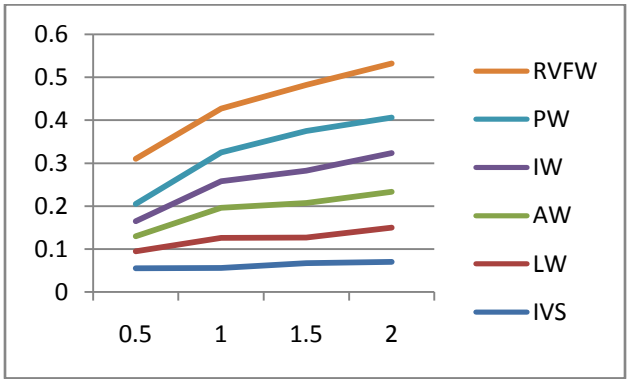
Posterior Wall

MYOCARDIAL VELOCITY	STUDY	CONTROL	P VALUE
VP_S	0.077	0.104	P = 0.0002
VPE_m	0.084	0.136	P < 0.0001
VPA_m	0.063	0.106	P < 0.0001
VPE_m/ VPA_m	1.74	1.31	P < 0.001

Right Ventricular Free Wall

MYOCARDIAL VELOCITY	STUDY	CONTROL	P VALUE
VP_S	0.107	0.142	P < 0.0001
VPE_m	0.106	0.156	P < 0.001
VPA_m	0.082	0.133	P < 0.0001
VPE_m/ VPA_m	1.54	1.19	P < 0.001

Correlation Between Peak Systolic Velocity (Vp_s) And Mitral Valve Area



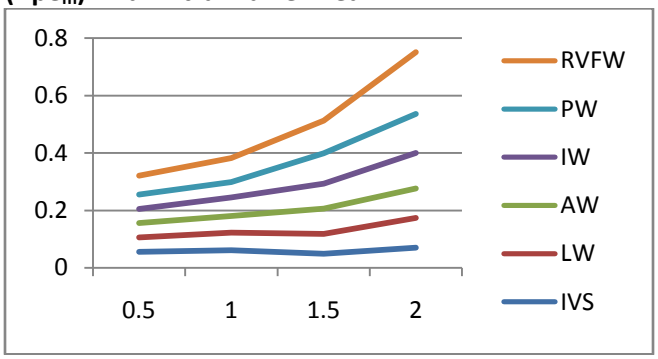
Correlation Between Systolic Function Assessed By 2d Echo And Tisssue Doppler Imaging

2D ECHO: Global left ventricular systolic function by 2D echo is assessed by the estimation of ejection fraction.

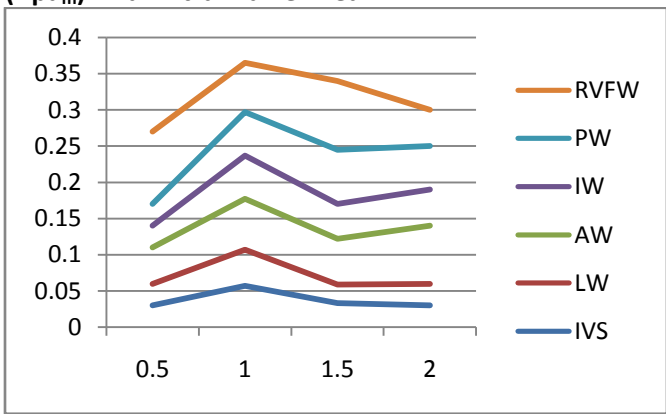
TDI : Left ventricular function was assessed by peak systolic myocardial velocities for septum, lateral, inferior, anterior, posterior and right ventricular free wall.

In our study out of 35 patients all had peak systolic velocity (VP_S) lower in all septum, lateral, inferior, anterior, posterior and right ventricular free wall as compared with controls.

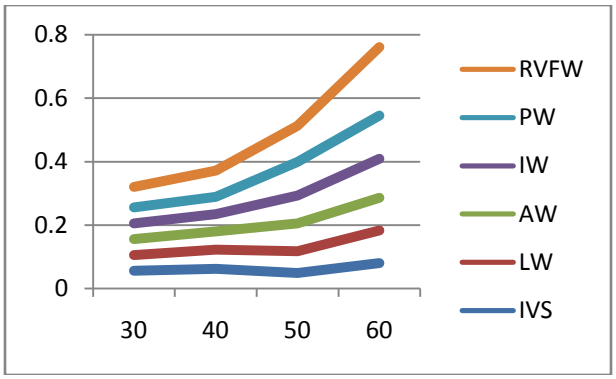
Correlation Between Early Diastolic Velocity (Vpe_m) And Mitral Valve Area



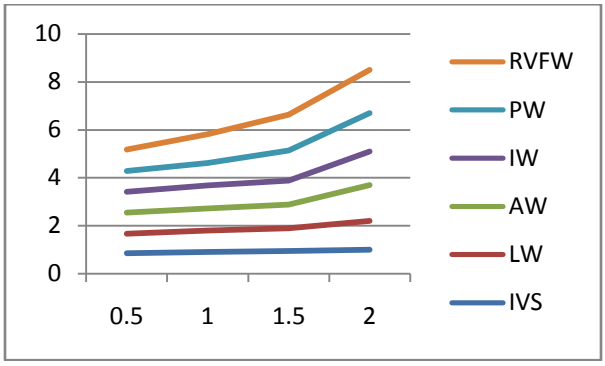
Correlation Between Late Diastolic Velocity (Vpa_m) And Mitral Valve Area



Correlation Between Myocardial Velocities And Ejection Fraction



Correlation Between Early Diastolic Velocity (Vpe_m) /Late Diastolic Velocity (Vpa_m) And Mitral Valve Area



Out of 12 patients having Ejection Fraction > 50% , 7(58%) patients were having lower peak systolic velocity (VP_S) as compared with control group.

Systolic velocity values were significantly lower in mitral stenosis patients,more markedly so in those with atrial fibrillation than in the control group (P <0.001).

Systolic velocity (VP_S) was also correlated with ejection fraction obtained by different methods. There was maximum correlation between Systolic myocardial velocity and ejection fraction calculated by Simpson's Four Chamber Method.

Thus it was found Simpson's Four Chamber Method is the most reliable method amongst all methods for assessment of ejection fraction. Thus it was found that patients who did not show systolic dysfunction on 2D ECHO were having systolic dysfunction by TDI.

Discussion: This is a cross sectional study of ventricular function using tissue color Doppler imaging (TDI) in patients with rheumatic mitral valve disease.

30 age and sex matched healthy controls were assessed clinically and by electrocardiogram & various echocadiographic parameters with calculation of ventricular function by Tissue Doppler Imaging.

Ventricular function by Tissue Doppler Imaging in study group and control group were compared. The average age of study population was 33 years.57% of patients were females and 43% of patients were males.

Left Atrial Size : Study population had increased LA size with lowest value of 35mm and highest value of 79 mm with average of 47 mm.

Out of total patients studied 40% of patients had LA size of 3.5-4.5 and 4.5-5.5, 14% of patients had LA size of 5.5-6.5 and 3% of patients had LA size of 6.5-7.5 and 7.5-8.5.Out of 35 patients 7 patients were having LA size > 5.5 mm all of them had severe MS.

Thus there is positive correlation between severity of mitral stenosis and LA size.

SEVERITY OF LESION (cm^2)	MVA	LA SIZE (3.5-4.5)	LA SIZE(4.5-5.5)	LA SIZE >5.5
MILD	1.5-2.0	9	5	-
MODERATE	1.0-1.5	4	10	-
SEVERE	<1.0	-	-	7

Ejection Fraction : Out of 35 patients 9%, 11%, 45% and 35% of patients had average EJECTION FRACTION in range between 25-35,35-45,45-55,55-65 respectively as measured by different methods.

Correlation Of Ejection Fraction With Different Parameters: Out of 23 patients having Ejection Fraction < 50% , 15(64%) patients were having atrial fibrillation, 13 (56%) of patients were having severe pulmonary hypertension. Also 11(47%) patients were having higher end systolic volume and end diastolic volume.

Out of 12 patients having Ejection Fraction > 50% 3(25%) patients were having atrial fibrillation, 2 (16%) of patients were having severe pulmonary hypertension. Also 3(33%) of patients were having higher end systolic and end diastolic volume.

Thus patients having Ejection Fraction < 50% had higher incidence of atrial fibrillation, pulmonary hypertension and had higher end-diastolic and end-systolic volumes as compared to those with Ejection Fraction > 50%.

So, LV Systolic dysfunction independent of severity of mitral valve lesion is associated with higher incidence of atrial fibrillation and pulmonary hypertension.

	EF < 50	EF > 50	P value
AF	64%	25%	P < 0.001
PAH	56%	16%	P < 0.0001
LV EDV	47%	33%	P = 0.0022
LV ESV	47%	33%	P = 0.0022

Isovolumetric Contraction Time Of Ventricles : Average of IVCT RV was higher 97.32 in study group as compared to 59.10 control group with p value p < 0.001.Average of IVCT LV was higher 100.10 in study group as compared to 63.94 control group with p value p < 0.001.

Also it was found that IVCT LV was markedly raised in patients having low ejection fraction as compared with those having normal ejection fraction.IVCT RV was markedly raised in patients having severe mitral stenosis as compared to patients having mild and moderate mitral stenosis. p<0.001

Systolic Function Assessed By Tisssue Doppler Imaging : Peak systolic velocity (VP_S)::IV SEPTUM: VP_S was lower in study group 0.062 than in control group 0.092. Difference was statistically significant with p value < 0.0001. LAT. WALL : VP_S was lower in study group 0.063 than in control group 0.132 with p value < 0.0001. ANT. WALL: VP_S was lower

in study group 0.070 than in control group 0.130 with p value P = 0.0328. INF. WALL : VP_S was lower in study group 0.067 than in control group 0.110 with p value < 0.0001. POST.WALL : VP_S was lower in study group 0.077 than in control group 0.104 with p value = 0.0002. RV FREE WALL : VP_S was lower in study group 0.107 than in control group 0.142 with p value < 0.0001.

The decrease in myocardial velocities varied for each wall. The VP_S Had similar low values at anterior, lateral, and inferior walls, whereas the decrease of septal velocity is less than those of the other wall velocities. However maximum drop in VP_S was found in posterior and lateral wall.

Thus it was found that regional distribution of systolic dysfunction occur in rheumatic mitral valve disease with maximum affection of posterior and lateral wall and minimal affection of interventricular septum.p<0.001.

Diastolic Function Assessed By Tisssue Doppler Imaging: Peak early Diastolic velocity (VPE_m)

IV SEPTUM: VPE_m was lower in study group 0.055 than in control group 0.114 with p value < 0.001 LAT. WALL: VPE_m was lower in study group 0.067 than in control group 0.113 with p value < 0.001. ANT. WALL : VPE_m was lower in study group 0.074 than in control group 0.119 with p value < 0.0001. INF. WALL : VPE_m was lower in study group 0.078 than in control group 0.125 with p value < 0.001. POST. WALL: VPE_m was lower in study group 0.084 than in control group 0.136 with p value < 0.0001RIGHT VENTRICULAR FREE WALL : VPE_m was lower in study group 0.106 than in control group 0.156 with p value < 0.001

Peak Late Diastolic velocity (VPA_m)::IV SEPTUM: VPA_m was lower in study group 0.040 than in control group 0.103 with p value < 0.0001. LAT. WALL : VPA_m was lower in study group 0.035 than in control group 0.092 with p value < 0.0001. ANT. WALL: VPA_m was lower in study group 0.065 than in control group 0.099 with p value = 0.014. INF. WALL : VPA_m was lower in study group 0.055 than in control group 0.103 with p value = 0.022. POST. WALL : VPA_m was lower in study group 0.063 than in control group 0.103 with p value < 0.0001. RV FREE WALL : VPA_m was lower in study group 0.082 than in control group 0.133 with p value < 0.0001
Ratio of Peak Early Diastolic velocity (VPE_m) / Peak Late Diastolic velocity (VPA_m):: IV SEPTUM: Ratio was lower in study group 0.092 than in control group 1.2. Difference was statistically significant with p value < 0.0001. LAT. WALL : Ratio was lower in study group 0.091 than in control group 1.1 with p value < 0.0001. ANT. WALL : Ratio was lower in study group 0.087 than in control group 1.4 with p value < 0.001. INF. WALL : Ratio was lower in study group 0.092 than in control group 1.2 with p value < 0.001. POST. WALL : Ratio was lower in study group 0.097 than in control group 1 with p value < 0.001. RV FREE WALL : Ratio was lower in study group 1.1 than in control group 1.13. Difference was statistically not significant with p value > 0.05
The different degree reduction in diastolic myocardial velocities suggests that myocardial pathology might also be effective in addition to functional changes.

Correlation Between Systolic Function Assessed By 2d Echo And Tisssue Doppler Imaging

2D ECHO Global left ventricular systolic function by 2D echo is assessed by the estimation of ejection fraction.
TDI Left ventricular function was assessed by peak systolic myocardial velocities for septum, lateral, inferior, anterior, posterior and right ventricular free wall.

Out of 12 patients having Ejection Fraction > 50% by 2D ECHO , 7(58%) patients were having lower peak systolic velocity (VP_S) by TDI as compared with control group. And all 35 patients had peak systolic velocity (VP_S) lower in all septum, lateral, inferior, anterior, posterior and right ventricular free wall as compared with controls

Thus it was found that patients who did not show systolic dysfunction on 2D ECHO were having systolic dysfunction by TDI.

Systolic velocity (VP_S) was also correlated with ejection fraction obtained by different methods. There was maximum correlation between Systolic myocardial velocity and ejection fraction calculated by Simpson's Four Chamber Method. Thus it was found Simpson's Four Chamber Method is the most reliable method amongst all methods for assessment of ejection fraction.LV systolic and diastolic dysfunction can occur in pure mitral stenosis independent of severity of mitral stenosis and can be better evaluated with TDE.

Conclusion: In a nutshell therefore, Tissue Doppler echocardiography appears to be feasible in the prediction of subclinical LV dysfunction in mitral stenosis patients whether they have atrial fibrillation or sinus rhythm.

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