International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2016): 79.57 | Impact Factor (2017): 7.296

Clinical Profile and Comparative Assessment of Mitral Regurgitation with Two and Three Dimensional Trans Thoracic Echocardiography

Rajat Mohan[1], Kavita Tyagi[2], JPS Sawhney[3], Sangeeta Sachdeva[4], Payal Nindra[5]

[1]Noninvasive dept., Department of Cardiology. Dharma Vira Heart Centre. Sir Ganga Ram Hospital New Delhi -110060

[2]Department of Cardiology, Max Superspeciality Hospital Saket, Delhi 110017

[3] Department of Cardiology.Dharma Vira Heart Centre .Sir Ganga Ram Hospital New Delhi-110060

[4]Noninvasive Department, Department of Cardiology. Dharma Vira Heart Centre. Sir Gangaram Hospital, New Delhi – 110060

[5]Noninvasive Department, Department of Cardiology. Dharma Vira Heart Centre. Sir Gangaram Hospital, New Delhi – 110060

Abstract: ***We studied 80 subjects : 53 (66.3%) females , mean age 54.68±14.02 years.33(41.25%) hypertensive and diabetics .Atrial fibrillation , in 35 (43.75%) patients . 53(66.25%) presented with shortness of breath.Vena contracta width 5.80 ± 1.59 mm by 2 d echo and by 3 d echo 7.66 ± 4.77 , p value 0.001. The Effective Regurgitant Orifice Area with 2 d echo , 33.17 ± 19 mm and with 3 d echo 47.97 ± 21.94 , p<0.001. A 1 , normal in 51 (63.8%) patients with 2d echo : normal only in 29(36.3%) of patients with 3 d echo, p<0.001. A2, normal in 24 (30%) with 3 d echo and normal in 51 (63.8%) with 2 d echo , p<0.001. A3 , normal in 33 (41.3%) by 3 d which was normal in 52(62.0%) by 2 d echo. P1 normal with 2 d echo in 63(78.8%) while with 3 d echo in 38(47.5%) of patients , p<0.001. The P2 normal in 69 (86.7%) with 2 d echo while normal in 44(55.0%) of the patients with 3 d. The P3 normal in 70(87.5%) with 2 d echo, in 51(63.8%) of the patients with 3 d echo.***

Keywords: Mitral regurgitation, Clinical profile, Comparative assessment, Transthoracic echocardiography

1. Introduction

The mitral valve is a complex structure[1].Mitral regurgitation is often referred to as *organic*, if there is an intrinsic valve disease, or functional, if the valve is structurally normal but leaks as a result of an extravalvular abnormality, such as an alteration in left ventricle chamber geometry and/or dilatation of the mitral annulus that adversely affects normal coaptation of the mitral valve leaflets during systole . In contrast to conventional 2 dimensional echocardiography, which only displays the mitral valve leaflets en face from the left ventricle perspective, 3D echocardiography enables en face visualization from both left ventricle and left atrial perspectives. The latter view is also known as the ‘‘surgical view,’’ because it resembles the intraoperative image of the mitral valve after the surgeon, standing on the patient’s right side, opens the left atrium 2. Despite proven superiority of three dimensional echocardiography over two-dimensional echocardiography no Indian studies are available comparing the two modalities. So we decided to take up this study.

2. Review of Literature

Manuel Martínez-Sellés et al studied 272 patients to investigate the prevalence of the different causes of severe mitral regurgitation and the influence of gender on that prevalence, in their study , 143 were women (52.6%)3 . Their mean age was 70.2+13.8 years (interval 24- 94 years) .

Hariram Tiwari and Kriengkrai Hengrussamee 4 ,did a retrospective study in which they analyzed 180 patients with chronic isolated severe MR determined by two-dimensional and Doppler echocardiography from January to December 2007 , the mean age was 53 years and 100 patients were men (56%).

Pizzarello etal 5 in their original study of clinical and echocardiographic features of isolated severe pure mitral regurgitation , found coronary artery disease as cause of mitral regurgitation in 34% of cases , mitral valve prolapse was found in 48% cases , infective endocarditis was in 12% of cases and rheumatic heart disease was seen in 6% of the cases. This reflects the high prevalence of coronary artery disease since many decades irrespective of geographic differences . In the study by Hariram Tiwari and KriengkraiHengrussamee4 , ischemic heart disease was seen in 28 (16%) of the patients .

R.A. R.A. Pizzarello etal have quoted the several studies that have shown that rheumatic heart disease is a much less common cause of MR than was previously reported 5 (Burgess et al., 1973; Mintz et al., 1979; Selzer and Katayama, 1972;Waller er al., 1982). Waller et al. (1982), reported that in a series of 97 patients with isolated severe chronic, pure MR, rheumatic heart disease was the etiology in only 3% of the cases. They found that mitral valve prolapse (62 %) and coronary artery disease (30%) were the most common etiologies.
Ling et al 6 found in their patients that heart failure occurred in 63%, atrial fibrillation in 30% of patients with mitral regurgitation. In the study of prevalence and clinical profile of valvular heart disease in a teaching hospital by D. Radha Krishnan and V Srinivas7 the mean systolic pressure in

isolated mitral regurgitation was 125.78 and mean diastolic pressure was 76.24 mmHg .

PaaladineshThavendiranathan did a study to test the accuracy of an automated 3-dimensional (3D) proximal isovelocity surface area (PISA) (in vitro and patients) and stroke volume technique (patients) to assess MR severity using real-time volume color flow Doppler transthoracic echocardiography[8] and concluded that Automated real-time 3D volume color flow Doppler based 3D PISA is more accurate than the 2D PISA method to quantify MR.

Ahmad Zaghlol et al subjected Fifty patients to both 2D and 3D transthoracic color Doppler flow mapping techniques to assess mitral regurgitation by VC [9]. Their studied group of patients consisted of 50 patients, 28 males and 22 females. Their age ranged from 45 to 65 years with a mean of 55.1±7.4 years. Thirty patients with ischemic or dilated cardiomyopathy, 11 patients with rheumatic heart diseases, and 9 patients with mitral valve prolapse. In patients with central jet mitral regurgitation, the VC width obtained by 2D and 3D were nearly equal (0.68+0.22vs 0.65+0.17cm, p= 0.063) and significantly correlated with effective Regurgitant orifice area EROA (r= 0.548, p= 0.005 and r= 0.747, p= 0.001, respectively). In patients with eccentric jet of mitral regurgitation, the VC width measured by 2D overestimated the VC area measured by 3D echocardiography (0.67+0.168cm vs 0.53+0.174cm, p= 0.040) and this 2D VC width was poorly correlated with EROA (r= 0.125, P= 0.088). In contrast, the VC area measured by 3D echocardiography in patients with eccentric jet of mitral regurgitation correlated well with EROA (r= 0.812, p= 0.002). Conclusions drawn are that Real-time three dimensional echocardiography provides more accurate and highly reproducible assessment of VC cross-sectional area in patients with both central and eccentric mitral regurgitation than two-dimensional echocardiography.

3. Methods

This study was conducted in the Department of Cardiology of 'Sir Ganga Ram Hospital', New Delhi from June , 2013 to April, 2015. Sample size of 80 was calculated using the formula $(Z^2 \times p \times q)/d^2$) ,p=70% , precision error of estimation (d) = 0.10 and alpha = 0.05.

All patients underwent a detailed general physical and clinical cardiological examination. The diagnoses was on the basis of clinical and two Dimensional Transthoracic Echocardiographic findings. The mitral valve Leaflets , annulus , quantification of mitral regurgitation , were studied by both modalities. Statistical testing was conducted with the statistical package for the social science system version SPSS 17.0. Continuous variables were presented as mean ± SD or median if the data is unevenly distributed. Categorical variables will be expressed as frequencies and percentages. For all statistical tests, a p value less than 0.05 was taken to indicate a significant difference.

4. Results

Out of studied 80 subjects, 27 (33.8%) were males and 53 (66.3%) were females and the mean age was 54.68±14.02 years. Table 1, showing age distribution of patients. Mean weight of the studied patients was 62.24±9.48 kg and the mean height was 161.35±7.19 cms. Table 2, showing etiological distribution of patients.

Table 1: Showing age distribution of patients

Age Groups	Frequency	%
<=30 yrs	3	1.90%
31 - 50 yrs	25	15.60%
51 - 60 yrs	25	15.60%
61 - 70 yrs	21	13.10%
71 - 80 yrs	6	3.80%
Total	80	100%
Mean ± SD	54.68 ± 14.02	
Min – Max	19 – 82	

Table 2: Showing etiological distribution of patients

Etiology	Males	Percentage	Females	Percentage	Total (%)
Ischemic Heart Disease	13	48.14%	12	22.64%	25(31.25%)
Rheumatic Heart Disease	1	3.70%	19	35.84%	20(25%)
Dcmp	2	7.40%	5	9.43%	7(8.75)
Infective Endocarditis	1	3.70%	2	3.77%	3(3.75%)
Connective Tissue Disorder	1	3.70%	1	1.88%	2(2.5%)
Mitral Valve Prolapse	1	3.70%	2	1.88%	3(3.75)
History Not Available	8	29.62%	12	22.64%	20(25%)
Total	27	100%	53	100%	80(100%)

The mean systolic pressure of studied subjects was 166.63±22.23 , and mean diastolic pressure was 79.97±801 mmHg. Out of the studied subjects, 6 (7.5%) were hypertensive , 33(41.25%) were hypertensive and diabetics and 2(2.5%) were only diabetics. Table 3 : showing various types of presentation in the patients .

Table 3: Showing various types of presentation in the patients

	Males	Percentage	Females	Percentage	Total (%)
Asymptomatic	4	14.81%	8	15.09%	12(15%)
Atrial Fibrillation	11	40.74%	24	45.28%	25(31.25%)
Shortness Of Breath	19	70.37%	34	64.15%	53(66.25%)
Fever (Infective Endocarditis)	1	3.70%	2	3.77%	3(3.75%)
Chest Pain	3	11.11%	7	13.20%	10(12.5%)

Annulus transverse diameter was found to be 37.29± 6.68 mm by 2 d echo and 42.75 ± 6.10 mm by 3 d echo p<0.001 . Vena contracta width was 5.80 ± 1.59 mm by 2 d echo and by 3 d echo it was 7.66 ± 4.77 , p value being 0.001. The Effective Regurgitant Orifice Area was calculated by PISA method with 2 d echo which was found to be 33.17 ± 19 mm

. It was compared with Anatomic Regurgitant Orifice Area measurements by 3 d echo which was 47.97 ± 21.94, p<0.001. Table 4 and 5 showing percentage of excess mobility, normal mobility, prolapsing, restricted mobility of A1,A2,A3 and P1,P2,P3 segment of anterior mitral leaflet and posterior mitral leaflet respectively.

Table 4: Showing percentage of excess mobility, normal mobility, prolapsing, restricted mobility of A1,A2,A3 segment of anterior mitral leaflet

A1	2D Group		3D Group		P Value	A2	2D Group		3D Group		P Value	A3	2D Group		3D Group		**P Value**
	Frequency	%	Frequency	%			Frequency	%	Frequency	%			Frequency	%	Frequency	%	
EM	10	12.60%	8	10%	<0.001	EM	8	10%	6	7.50%	<0.001	EM	8	10%	6	7.50%	**<0.001**
N	51	63.80%	29	36.30%		N	51	63.80%	24	30%		N	52	62.00%	33	41.30%	
P	4	5.00%	35	43.80%		P	7	8.80%	40	50%		P	7	8.80%	33	41.30%	
RM	15	18.80%	8	10%		RM	14	17.50%	10	13%		RM	13	16.30%	8	10%	
Total	10	12.60%	80	100%		Total	80	100%	80	100%		Total	80	100%	80	100%	

Table 5: Showing percentage of excess mobility, normal mobility, prolapsing, restricted mobility of P1, P2, P3 segment of posterior mitral leaflet

P1	2D Group		3D Group		P Value	P2	2D Group		3D Group		P Value	P3	2D Group		3D Group		P Value
	Frequency	%	Frequency	%			Frequency	%	Frequency	%			Frequency	%	Frequency	%	
EM	4	5%	0	0.0%	<0.001	EM	3	3.8%	0	0.0%	<0.001	EM	3	3.8%	0	0.0%	<0.001
N	63	78.8%	38	47.5%		N	69	86.3%	44	55.0%		N	70	87.5%	51	63.8%	
P	1	1.3%	30	37.5%		P	0	0.0%	29	36.3%		P	0	0.0%	23	28.8%	
RM	12	15.0%	12	15%		RM	8	10.0%	7	8.8%		RM	7	8.8%	6	7.5%	
Total	80	100%	80	100%		Total	80	100%	80	100%		Total	80	100%	80	100%	

5. Discussion

In the present study the maximum number of patients were in age group 31 – 50 yrs and 51 – 60 yrs , 25 (31.20 %) in each group. Rheumatic heart disease was present in 25% of the patients of which 1(3.70%) were males and 19(35.84%) were females . This is showing the high prevalence of rheumatic disease in our Indian scenario and variations in different ethnic groups .In a report of a WHO Expert Consultation on RHEUMATIC FEVER AND RHEUMATIC HEART DISEASE the prevalence of physiological valvular regurgitation in normal people varied by valve: mitral regurgitation was present in 2.4–45% of normal individuals 10, 11. In the present study rheumatic heart disease was present in 25% of patients.

In the present study Dilated cardiomyopathy was found in 7 (8.75%) patients : 2 (7.40%) male patients and 5 (9.43%) females patients and Infective endocarditis was present in 1(3.70%) of males and 2(3.77%) of females , total 3.75% of patients . Connective tissue disorder was present in 1 each male and females patient (2.5%) .In the study by Hariram Tiwari and KriengkraiHengrussamee4 , the causes of MR were floppy mitral valve 131 (73%), endocarditis 16(9%), rheumatic disease 12(7%), ischemic heart disease 12(7%), dilated cardiomyopathy 6 (3%), and an unknown etiology 3 (1%). In the present study Mitral valve prolapse was the etiology seen in 1 male patient (3.70%) and 2 female patients (3.77%) , total of 3.75% study subjects. Suman Bhandari etal 12 in their Valvular Heart Disease : Diagnosis and Management have quoted that the prevalence of this entity is 1% to 2.5% of the population.

In the present study history related to cardiac pathology was not available in 8(29.62%) of male patients and 12(22.64) of female patients , total 20 (25%) patients , reflecting the large burden of disease undiagnosed and potentiality of patients who will present to emergency department with complications 1st time. In study by Manuel Martínez-Sellés et the etiology being unclear in 32 patients (11.8%) . It may be a reflection of a large segment of society not much careful about their health and disease status . This also reiterates the fact that Regurgitant lesions are tolerated well.

Shortness of breath seems to be the commonest presentation among symptomatic patients. In the present study the mean systolic pressure was 166.63+22.23 , with a range from 110-160 and mean diastolic pressure was 79.97+801 mmHg. This shows the simultaneous high prevalence of hypertension. Total 10 (12.5%) of patients presented with chest pain in our present study. However in present study 12 (15%) of patients were asymptomatic from cardiac symptoms point of view. They had presented with other ailments and were diagnosed as mitral regurgitation while cardiac evaluation.

In the present study Mitral Valve was reconstructed en face from the left atrium (LA). AROA was measured by planimetry from 3D pictures and compared to the EROA by proximal Isovelocity surface area and proximal MR jet width from 2D echo.

AltiokE evaluated Direct measurement of anatomic regurgitant orifice area (AROA) by 3-dimensional transesophageal echocardiography [13]. In 72 patients (age 70.6 ± 13.3 years, 37 men) with mild to severe MR, 3-dimensional transesophageal echocardiography and transthoracic color Doppler echocardiography were performed to determine AROA by direct planimetry, EROA by proximal convergence method, and vena contracta area (VCA) by 2-dimensional color Doppler echocardiography. AROA determined by direct planimetry was 0.30 ± 0.20 cm^2, EROA determined by proximal convergence method was 0.30 ± 0.20 cm^2.

The prolapse of A1 segment was seen only in 4(5.0%) of patients with 2 d echo but with 3 d echocardiography it was seen in 35(43.8%) of patients.

Prolapse of A2 was seen in 40 (50 %) of patients with 3 d echo which was however seen only 7(8.8%) of the patients by 2 d echo. Excess mobility and restricted mobility were

found in less number of patients with 3 d echo 6(7.5%) and 10 (13%) respectively in contrast to the findings of Excess mobility and restricted mobility by 2 d echo 8(10%) and 14 (17.5%) respectively.

A3 Prolapsing segment was seen in 33 (41.3%) of patients by 3 d echo and 7(8.8%) of patients by 2 d echo. In conclusion , 3 d echo appears to be better at picking up the prolapse segment than 2 d echo and overall prevalence of prolapsed valve could be higher .

P1 was found to be normal with 2 d echo in 63(78.8%) patients while with 3 d echo it was normal in 38(47.5%) of patients , which was statistically significant $p<0.001$. The P2 segment , in the present study was found to be normal in 69(86.7%) of the patients with 2 d echo while it was normal in 44(55.0%) of the patients with 3 d echo , which is statistically significant. The prolapse segment was not seen in any of the patient with 2 d echo while it was seen in 29 (36.3%) of the patients with 3 d echo. The P3 ,Prolapse segment was not seen in any of the patients with 2 d echo while it was seen in 23(28.8%) of the patients with 3 d echo.

6. Conclusions

Statistical difference in vena contracta width , annulus and effective regurgitant orifice are measurements may enable us to quantify many more moderate regurgitations as severe ones leading to need of more number of early interventions . However more long term studies are required to establish the standard values on 3D echo. To confirm our findings of different scallops, large studies are required specially confirmation of results during surgery. Further large studies are required for studying various shapes of annulus and its dynamics . Studies are required to differentiate the different dimensions of different shapes of vena contracta and their implications on the assessment of severity and treatment outcomes. Effective regurgitant orifice are by PISA method should be done by both 2d echo and 3 d echo for comparison. Despite extensive search we could not find detail morphological and mobility study references , which could have helped us for comparative evaluation.

References

[1] Fuster V, RourkeR.O , Wilson P.P , Walsh R. A. et al . Mitral Valve Regurgitation Including the Mitral Valve Prolapse Syndrome. Walsh A. R. , Simon D.I**. ,**Robert A. Editors. Hurst's The Heart . 12th Edition ,New York, The mcgraw-Hill Companies publishers ,2008 : 1721
[2] Roberto M. Lang, Luigi P. Badano, Wendy Tsang, David H Adams, Eustachio Agricola , Thomas Buck etal GUIDELINES AND STANDARDS . EAE/ASE Recommendations for Image Acquisition and Display Using Three-Dimensional Echocardiography. J Am Soc Echocardiography 2012;25:3-46.
[3] Manuel Martínez-Sellés,, Miguel A. García-Fernández, Mar Moreno, etal . Influence of Gender on the Etiology of Mitral Regurgitation . Rev Esp Cardiol. 2006;59:1335-8
[4] HariramTiwari ,KriengkraiHengrussamee .Etiological Profile of Chronic Isolated Severe Mitral Regurgitation Determined by Two-dimensional and Doppler Echocardiography . Thai Heart J 2011; 24 : 55-63
[5] R.A.Pizzarellom, J.Turnerm, D.Goldmanm etal. Clinical and Echocardiographic Features of Isolated Severe Pure Mitral Regurgitation. Clin. Cardiol. 1984; 7: 565-571
[6] Ling LH, Enriquez-Sarano M, Seward JB, et al. Clinical outcome of mitral regurgitation due to flail leaflet. N Engl J Med 1996; 335:1417-23.
[7] D Radha Krishnan, V Srinivas. The study of prevalence and clinical profile of valvular heart disease in a teaching hospital Andhra Pradesh. Journal of Evidence Based Medicine and Healthcare. 2015;2 : 2488-99.
[8] PaaladineshThavendiranathan, Shizhen Liu, SaurabhDatta etal. Quantification of Chronic Functional Mitral Regurgitation by Automated 3-Dimensional Peak and Integrated Proximal Isovelocity Surface Area and Stroke Volume Techniques Using Real-Time 3-Dimensional Volume Color Doppler Echocardiography In Vitro and Clinical Validation. *Circ Cardiovasc Imaging*. 2013;6:125-133.
[9] Ahmad Zaghlol, InasDeraz, HananKasem. Role of Real-Time 3-Dimensional Echocardiography in Mitral Regurgitation Heart Mirror Journal 2012; 6 : 1687-6652 .
[10] Yoshida K .Colour Doppler evaluation of valvular regurgitation in normal subjects. Circulation, 1988, 78:840–847.
[11] Lembo NJ et al. Mitral valve prolapse in patients with prior rheumatic fever. Circulation, 1988, 77:830–836.
[12] Suman Bhandari, K Subramanyam, N Trehan. Valvular Heart Disease : Diagnosis and Management . JAPI 2007; 55 :575-584.
[13] Altiok E, Hamada S, van Hall S, et al., Comparison of direct planimetry of mitral valve regurgitation orifice area by three-dimensional transesophageal echocardiography to effective regurgitant orifice area obtained by proximal flow convergence method and vena contracta area determined by color Doppler echocardiography, *Am J Cardiol*, 2011;107:452–8.