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ASSOCIATION OF RV FUNCTION AS ASSESSED BY TAPSE, RV TEI INDEX AND NYHA FUNCTIONAL CLASS AFTER SUCCESSFUL PTMC OF MS PATIENTS.

Cardiology

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KEYWORDS

INTRODUCTION

Rheumatic heart disease causes significant morbidity and mortality. Mitral stenosis (MS) is the commonest presentation in rheumatic heart disease. Rheumatic MS is a frequent cause of valve disease in developing countries. Despite decrease in the prevalence of rheumatic fever still accounts for 25% of native valvular heart disease.[1] The treatment option and its timing should be decided on the basis of clinical, morphological, and functional characteristics. Since its introduction in 1984 by Inoue et al. Percutaneous Transvenous Mitral Commissurotomy (PTMC) has become established as a safe and effective treatment for rheumatic MS and remains the treatment of choice in patients with a favorable anatomy.[2]The Right Ventricular (RV) function is an important determinant of clinical symptoms, exercise capacity, pre-operative survival and postoperative outcome in patients with MS. In patients with MS, the RV function may be altered due to an increase in the left atrial pressure and changes in the pulmonary arteriolar vasculature or may be affected by the rheumatic process directly.[3]

In patients with MS, previous studies have shown discordant results as regards to improvement of Right Ventricular (RV) function after PTMC.Hence, the purpose of this study is to evaluate the immediate and short term follow up impact of successful PTMC on RV function using two-dimensional and tissue Doppler echocardiographic indices and with functional status(NYHA class).

Aim and Objectives

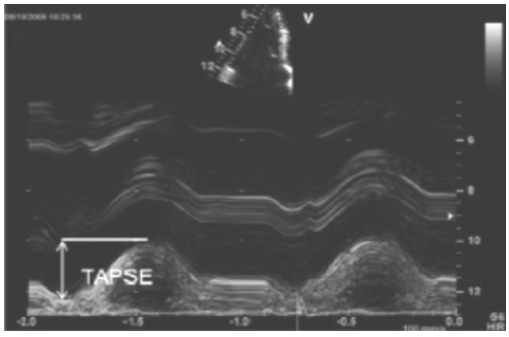
- To determine the difference in RV Function as assessed by TAPSE, RV Tei index Post Successful BMV(Balloon mitral valvotomy) from baseline among MS patients undergoing BMV at 24 hours and at 1 month.
- To determine the Clinical improvement as assessed by NYHA Functional class of Successful BMV from baseline among MS patients at 24 hours and at 1 month.
- Corelating both of the above.

Methodology

Fifty patients who are undergoing balloon mitral valvuloplasty for rheumatic mitral stenosis at Cardiology Dept. SMS Medical College included in this study. All patients who are included in the study have formal written consent.All patients after clinical assessment are examined in the left lateral decubitus position by M-mode, two-dimensional, Doppler and DTI(Doppler tissue imaging) echocardiography with the use of Philips echocardiography machine device with a 2.5 MHz transducer.Mitral Valve Area (MVA) is determined by planimetry in every patient. The end and mean mitral valve transmitral pressure gradients are measured using the Bernoulli principle from continuous wave Doppler recordings through the center of mitral inflow. Systolic Pulmonary Artery Pressure (SPAP) is derived from the tricuspid regurgitant jet peak velocity using the modified Bernoulli equation.

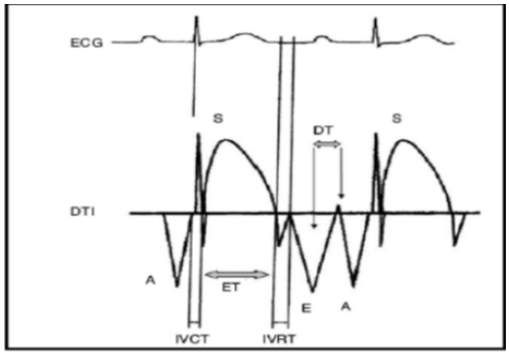
The Wilkins score is used to assess the suitability of the mitral valve's morphology for balloon mitral valvuloplasty and Ruling out other Contraindications of the procedure.M mode- The tricuspid annular plane systolic excursion (TAPSE) was measured by the level of systolic excursion of the lateral tricuspid valve annulus towards the apex in the apical four chamber view.

Fig-1



RV Tei Index- The Tei index of RV myocardial performance was calculated as the time between tricuspid valve closure and tricuspid valve opening, divided by the RV ejection time and obtained from the lateral tricuspid annulus as the sum of IVCT and IVRT divided by ET.DTI cursor is placed at the lateral tricuspid annulus of the RV free wall.IVCT(Isovolumic contraction time) -From the peak of R wave of ECG to the beginning of S.IVRT(Isovolumic relaxation time) -The time interval occurring between the end of S and the onset of E wave .ET(Ejection time) -From the beginning to the end of S-wave.

Fig-2



- NYHA(New york heart association) functional class- table 1

Class I	No limitation of physical activity. Ordinary physical activity does not cause undue breathlessness, fatigue, or palpitations.
Class II	Slight limitation of physical activity. Comfortable at rest, but ordinary physical activity results in undue breathlessness, fatigue, or palpitations.
Class III	Marked limitation of physical activity. Comfortable at rest, but less than ordinary physical activity results in undue breathlessness, fatigue, or palpitations.
Class IV	Unable to carry on any physical activity without discomfort. Symptoms at rest can be present. If any physical activity is undertaken, discomfort is increased.

Inclusion criteria-

- Sinus rhythm
- Isolated Severe/VerySev. MS
- Suitable valve morphology by echocardiographic criteria
- Absence of concomitant cardiovascular disease requiring surgical correction
- Patients in New York Heart class 2 to Mobile 4

Exclusion criteria-

- Atrial fibrillation
- Significant Aortic Valve Disease
- Significant Pulmonary valve disease
- Organic TV(tricuspid valve) Disease
- NYHA 4 Not mobile
- Pregnancy
- Echocardiographic criteria for contraindications of balloon valvuloplasty

Successful balloon mitral valvuloplasty criteria-

- The PTMC is performed via an antegrade transvenous approach using a balloon and stepwise dilatation strategy . The nominal balloon diameter was decided according to the height of the patient (i.e. height (cm)/10+10 = balloon diameter).
- 50% reduction in mean diastolic transmitral gradient.
- MVA greater than 1.5 cm2 or 50 % Increment.
- In the absence of complications like MR not more than moderate grade.
- A decrease in mean left atrial pressure to less than 18 mmHg(During PTMC procedure).

Statistical analysis-

Continuous data are summarized in the form of Mean and SD difference and means of 2 different groups are analysed using Student t Test, 3 different groups ANOVA is used.Pearson correlation coefficient is used to detect correlation between baseline Values and Post Successful BMV values at 24 hrs and at 1 month.

RESULTS

The study included 51 patients {23 males (41.67%) and 28 females (48.33%)}.Patients' age ranged from 15 to 48 (mean 27.10± 9.286 years).Patients' weight ranged from 42 to 68 kg (51.53 ±3.821).Patients' height ranged from 148.00 to 172.000 cm (158.400± 3.821).Majority of patients were in NYHA class II (30 patients; 68.33%) and (21 patients; 31.66%) in NYHA class III.

Table 2.

	F			M			Total			P Value
Gender	N	Mean	SD	N	Mean	SD	N	Mean	SD	
AGE	28	25.79	8.69	23	30.74	8.07	51	28.02	8.70	.042
Ht	28	157.75	3.18	23	164.91	6.58	51	160.98	6.12	.000
MVA(Baseline)	28	0.86	0.21	23	0.89	0.17	49	0.86	0.20	.329
TAPSE Baseline	28	16.64	0.83	23	16.87	1.10	51	16.75	0.96	.405
24 hrs	28	18.57	1.23	23	19.13	1.01	51	18.82	1.16	.067
1 month	28	19.93	0.72	23	19.43	0.90	51	19.71	0.83	.09

(Abbreviations, Ht- Height)

Ejection fraction was normal in all the patients.No other significant valvular disease was present.The mean Wilkin's score was 7.36± 0.31. The mean MVA by planimetry was 0.853 ± 0.297 cm2 and by PHT was 0.888± 0.221 cm2.The mean transmitral pressure gradient was 15.967± 5.38 and the mean EDG(End diastolic gradient) was 5.1 ± 1.71.

The mean value of pulmonary arterial systolic pressure (PASP) was 60.833± 19.855 mmHg. Mean TAPSE was 16.32± 4.0 mm.The mean RVTei index was (0.512± 0.093).No atrial or atrial appendage thrombus was detected in all patients before the procedure by using TEE. Reassessment of mitral valve score and evaluation of MR was also done by TEE. The nominal balloon diameter was decided according to the height of the patient (i.e. height (cm)/10+10 = balloon diameter in cm).

Table-3

RV TEI Index Baseline	28	0.52	0.03	23	0.51	0.02	51	0.51	0.03	.196
24 hrs	28	0.42	0.02	23	0.43	0.02	51	0.43	0.02	.705
1 month	28	0.41	0.02	23	0.41	0.02	51	0.41	0.02	.593
NYHA Baseline	28	2.75	0.44	23	2.57	0.51	51	2.67	0.48	.170
24 hrs	28	1.57	0.50	23	1.52	0.51	51	1.55	0.50	.729
1 month	28	1.2	0.00	23	1.24	0.21	51	1.22	0.14	.274
LAP(Baseline)	28	32.96	3.58	23	32.78	2.94	51	32.43	3.33	.211
PASP(Baseline)	28	60.93	12.99	23	59.39	11.24	51	60.63	13.03	.08
MDG(Baseline)	28	13.39	1.47	23	14.35	0.83	51	14.37	1.22	.897
W/S	28	7.29	0.81	23	7.70	0.56	51	7.47	0.73	.08
MVA(24 Hrs)	28	1.36	.44	23	1.32	.34	51	1.34	.40	.10
LAP(24 Hrs)	28	15.96	3.58	23	14.78	2.94	51	15.43	3.33	.211
PASP(24 Hrs)	28	36.93	12.99	23	39.39	11.24	51	39.63	13.03	.08
MDG(24 Hrs)	28	6.39	1.47	23	5.35	0.83	51	5.90	1.22	.897
MVA(1 Month)	28	1.38	.40	23	1.34	.31	51	1.36	.39	.19
PASP(1 Month)	28	35.90	12.99	23	35.29	11.24	51	35.45	13.03	.08
MDG(1 Month)	28	5.30	1.47	23	5.35	0.83	51	5.76	1.22	.897

Table -4

Abbreviations, LAP- Left atrial pressure during procedure, Cath measurement. W/S- Wilkins score Successful BMV was done for all selected patients without any evidence of complications and no more than moderate MR mitral regurgitation that was detected by echo Doppler(Successful criteria for BMV defined earlier)

There was significant increase in MVA between before and after 24 h of PTMC, but no difference in MVA at 24 h and 1 month.

There was significant drop in mean PG before and 24 h post BMV, but no difference in mean diastolic gradient at 24 h and 1 month.

Table-5

Paired Samples Test								
	Paired Differences					t	df	Sig. (2-tailed)
	Mean	SD	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
24 hrs - TAPSE Baseline	2.08	0.82	0.11	1.85	2.31	18.08	50	<0.001S

1 month - TAPSE Baseline	2.96	0.94	0.13	2.70	3.22	22.56	50	<0.001S
24 hrs - RV TEI Index Baseline	-0.09	0.02	0.00	-0.09	-0.08	-37.63	50	<0.001S
1 month - RV TEI Index Baseline	-0.11	0.02	0.00	-0.11	-0.10	-37.40	50	<0.001S
24 hrs - NYHA Baseline	-1.12	0.59	0.08	-1.28	-0.95	-13.57	50	<0.001S
1 month - NYHA Baseline	-1.65	0.48	0.07	-1.78	-1.51	-24.37	50	<0.001S
1 month- 24 hrs TAPSE	1.12	0.62	.12	1.01	1.21	10.4	50	0.12NS
1 month- 24 hrs RV Tei Index	-0.02	0.01	.02	-0.02	-0.01	-14.4	50	0.22NS
1 month- 24 hrs NYHA	-0.9	0.62	.08	-1.01	-0.08	-10.4	50	0.34NS

Table-6

Abbreviations, S- Significant, NS- Non significant There was significant drop in PASP before and after 24 h, but no significant difference in PASP at 24 h and 1 month.

There was significant increase in TAPSE before and 24 h, but no significant difference in TAPSE at 24 h and 1 month.

There was significant improvement in RV Tei index before and 24 hrs after PTMC, but no significant difference at 24 hrs and 1 month.

There was significant improvement in NYHA class of the patients before and 24 hrs after PTMC, but no significant difference at 24 hrs and 1 month.

DISCUSSION

In the current study, the TAPSE, RV Tei index were compared before BMV, 24 hrs post BMV and 1 m after the procedure to assess the impact of successful BMV on right ventricular functions and relate these with patient functional status(NYHA Class).Correlation between improvement in TAPSE and RV Tei Index with NYHA functional class is very well seen after successful PTMC in our cohort with very significant P values.

As after successful BMV MVA increases afterload to RV decreases which makes PASP to decrease significantly and TAPSE and RV Tei Index to improve significantly.This improvement is translated into improved function status of the patient(NYHA class).

In the current study, PASP showed a significant decrease between (before and after 24 h; before and after 1 m); but no significance between (after 24 h and after 1 m) occurred due to a sudden increase in the mitral valve area which caused a sudden decrease in the pressure gradient across the mitral valve leading to a decrease in left atrial pressure, pulmonary venous congestion and pulmonary artery pressure. This causes acute decrease in RV afterload which has a positive effect on the contractile function of RV. Also in the current study PASP showed significant negative correlation with MVA ($r = 0.542$, $P = 0.002$) after BMV.

There was a positive correlation between RV Tie index and systolic pulmonary artery pressure. This was concordant with the study by Drighil et al.[4] which included 21 patients who demonstrated a significant decrease in PASP and RV Tei Index post BMV and a positive correlation between RV Tie index and pulmonary artery systolic pressure before BMV.

Arat et al.[5] study on 56 patients who underwent PMBV for isolated rheumatic MS with assessment of RV function before PMBV, 48 h and 3 months after PMBV noted that PASP was still relatively higher in the intermediate follow up period in patients with baseline PAH(Pulmonary arterial hypertension) compared to patients without baseline PAH. Whatever improvement seen in PASP that usually happens immediately after successful BMV. If PASP still high after successful procedure this PAH is likely to persist and leads to significant impact on patient poor functional status(NYHA class).

TAPSE is one of the parameters which reflect systolic function of RV. In the current study TAPSE showed significant increase between before and after 24 h; before and after 1 month;but no significance increase occurred between 24 h and 1 month.

Study by Mahfouz et al.[6] which included 147 patients in rheumatic MS. This study revealed a significant increase in TAPSE post BMV denoting that the RV function is usually impaired (even subclinical) in those patients in spite of mild pulmonary hypertension.

In accordance with previous studies, Arat et al.[5] suggested that patients with MS have depressed global and regional RV function compared with normal subjects; findings go hand in hand with previous radionuclide and haemodynamicstudies.

Adavane et al.[7] by a study on 33 patients with MS before BMV, 24–48 h after BMV and 1 month after BMV assessed echocardiographic parameters of RV function which showed a significant increase of TAPSE (immediately after BMV; and at 1 month) and a significant correlation with the decrease in PVR(Pulmonary vascular resistance) and PASP, with increase in MVA. In patients with MVA> 1.5 cm2 after successful BMV results in a significant improvement of RV systolic function assessed by TAPSE and RV Tei Index.Mehta et al.[8] noticed a minimal increase in RV free wall annular velocities in 25 patients studied following PBMV(**Percutaneous Balloon Mitral Valvuloplasty)** and concluded that RV dysfunction might persists in the period immediately following BMV despite significant changes in (PASP) pulmonary artery pressures, and this could explain the persistence of right sided congestion in some of these patients and poor functional NYHA class.

Contrary in our cohort improvement in MVA after successful PTMC translated well into decrease in PASP which translated well into improvement in RV function parameters like TAPSE and RV Tei Index which also translated into improvement in functional status (NYHA class) of the patient.

In the current study, RV Tie index showed a significant drop (before and 24 h post BMV; before and 1 m(month) after successful BMV) but no significant drop occurred (24 h and 1 m) after successful BMV. Also, RV Tie index showed significant negative correlation with changes in MVA. As well, there was a positive correlation between RV Tie index and systolic pulmonary artery pressure. This result was concordant with Drighil et al[5].On the other hand, Arat et al.[5] showed that, the baseline RV Tie index was higher in patients with PAH(PASP>40) and no significant difference in the RV Tie index during 3-month follow-up. Evaluation at 3 months showed that the RV Tie index of patients with baseline PAH decreased to values similar to those of patients without baseline PAH.Contrary in our cohort patients with severe PAH(PASP>60) and patients without severe PAH(PASP<60) showed improvement in RV function parameters TAPSE and RV Tei Index equally after successful PTMC. Maximum improvement occurred immediately following procedure at 24 hrs and this is also seen translating into patient functional status(NYHA class) improvement. This suggests that RV dysfunction is contributed by both degree of MS as well as degree of PAH. Interestingly PAH also depends on degree as well as duration of MS.

Difference is that to start with PAH patients had worse level of mitral stenosis compared with Non-PAH patients, so they had poor RV function parameters at baseline TAPSE and RV Tei Index and worse functional status(NYHA class).

Mohan et al[3] studied 25 consecutive patients with isolated rheumatic mitral stenosis before, immediately after (40± 12 h) and at a mean follow up of 11.5 months after PTMC. The RV Tie index was not affected immediately after successful PTMC, however, at follow-up of about one year, the RV Tie index showed a significant decrease.The likely explanation for this is that most of the time like in our study improvement of successful PTMC in all terms is immediate but for some instances like for PASP improvement lags behind successful PTMC and PAH improves over time. This is the reason for delayed improvement in RV function parameters like TAPSE and RV Tei Index and patient remains symptomatic poor (NYHA class) functional status due to this RV dysfunction of high PAH. Secondly even if PASP

improves after successful PTMC RV function parameters like TAPSE and RV Tei Index lags behind improvement in PASP. And this time poor RV functional parameters are responsible for poor functional status(NYHA class) of the patient.

The drop in RV Tie index and systolic pulmonary artery pressure together immediately post-BMV suggest that RV systolic function improved as a result of an acute decrease in RV afterload. This is concordant with the study by Borges et al.[10] who demonstrated an improvement in RV Tie index after vasodilator therapy in patients with chronic pulmonary hypertension like Drighil et al.[4,9]The tissue Doppler index of combined(S systolic and D diastolic)right ventricular function Tei Index was significantly correlated with the mean pulmonary artery pressure and systolic pulmonary artery pressure before PTMC and also immediately after the procedure; however, at follow up, the index had no correlation with the Doppler estimated pulmonary artery systolic pressure. Likely due to poor assessment parameters for RV functions.(Reproducibility)

So in a nutshell improvement of the functional status (NYHA class) of the patient after successful PTMC is multifactorial.First PTMC is successful means significant improvement in MVA after the procedure without complications.Second PASP should fall after the successful procedure significantly, this depends on both degree of MS as well as duration of disease.Thirdly RV function parameters TAPSE and RV Tei Index should improve significantly after successful procedure in concordance with improvement in PASP.All these parameters are complexly inter-related as well.

CONCLUSION

The current study showed a significant improvement in both systolic and diastolic function of RV as observed by different echocardiographic parameters post successful BMV patients as well as in NYHA functional class. The improvement in TAPSE, RV Tei Index and NYHA functional class seen was even better in patients without baseline PAH even after equal post procedure MVA.(severe PAH and without severe PAH).Further work using larger numbers of patients is needed to confirm our findings and to assess their utility in patient's follow-up and management.Attention should be given to PAH patients who remain symptomatic even in long run after everything is done right to give a trial of may be PAH therapies.

Limitations-

Observational study so with bias
Small cohort
Follow up is only 1 month
At 24 hours NYHA functional status is difficult to assess

LAP is measured at different time in cath lab during procedure with different heart rate but rest of the parameters are measured by echocardiography at different time with different heart rate, this might cause error in defining successful PTMC, though both times patient were in controlled heart rates.

RV function assessment has poor echocardiographic parameters. (Reproducibility)

Future directions-

- Larger cohort to power all types of spectrum of disease.
- Longer follow up to assess impact of PASP and RV function on functional status (NYHA class) of the patient.
- To assess contribution of degree of MS, PASP and RV dysfunction on functional status(NYHA class) of the patient with different cohort design.
- To try anti Pulmonary hypertensive medications in symptomatic poor functional status patients after successful BMV at follow up with PAH.
- To see effects of RV dysfunction on long term clinical outcomes on follow up for these patients.

REFERENCES-

1. Carroll JD, Feldman T (1993) Percutaneous mitral balloon valvotomy and the new demographics of mitral stenosis. JAMA 270: 1731-1736.
2. Inoue K, Owaki T, Nakamura T, Kitamura F, Miyamoto N (1984) Clinical application of transvenous mitral commissurotomy by a new balloon catheter. J Thorac Cardiovasc Surg 87: 394-402.
3. Mohan JC, Sengupta PP, Arora R (1999) Immediate and delayed effects of successful percutaneous transvenous mitral commissurotomy on global right ventricular function in patients with isolated mitral stenosis. Int J Cardiol 68:217-223.
4. Rodriguez L, Gillinov A. Mitral valve disease. In: Topol E, editor. Cardiovascular medicine. Philadelphia: Lippincott Williams & Wilkins; 2016. p. 347–66, 3:(22).
5. Hirata N, Sakakibara T, Shimazaki Y, Watanabe S, Nomura F, et al. (1992) Preoperative and postoperative right ventricular function during exercise in patients with mitral stenosis. J Thorac Cardiovasc Surg 104: 1029-1034.
6. Otto C. Surgical and percutaneous intervention for mitral stenosis. In: Otto CM, editor. Valvular Heart Disease. second ed. Philadelphia: Saunders; 2013. p. 272–6.
7. Wilkins G, Weyman A, Abascal V, et al. Percutaneous balloon dilatation of the mitral valve: an analysis of echocardiographic variables related to outcome and the mechanism of dilatation. Br Heart J 1988;60:299–308.
8. Mehta V, Mukhopadhyay S, Yusuf J, et al. Acute effects of percutaneous transvenous mitral commissurotomy on right ventricular function in rheumatic mitral stenosis: A tissue Doppler echocardiographic study. Indian Heart J 2003;55(5). Article No. 83.
9. Dalen J, Fenster P. Mitral stenosis. In: Alpert JS, Dalen JE, Rahimtoola SH, editors. Valvular heart disease. Philadelphia: Lippincott Williams & Wilkins; 2000. p. 347–66, 3:(22).
10. Borer JS, Hochreiter C, Rosen S (1991) Right ventricular function in severe non-ischaemic mitral insufficiency. Eur Heart J 12 Suppl B: 22-25.