Clinical and Echocardiographic Outcomes of Tricuspid Regurgitation After Percutaneous Transmitral Commissurotomy: Prospective Cohort

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Abstract

PURPOSE: The gap in evidence in the management of multivalvular lesions can be addressed by providing more data on clinical and echocardiographic outcomes after percutaneous transmitral commissurotomy (PTMC) in patients with concomitant significant tricuspid regurgitation (TR) at baseline.

METHODS: This is a single-center cohort study of adult Filipinos 19 years or older, admitted between January 2019 and October 2020 due to severe mitral stenosis with moderate to severe TR subjected to PTMC. The outcome post-PTMC was divided into 2 groups: significant TR, which included the progression of moderate to severe TR or persistence of severe TR, and insignificant TR group, which included those with mild TR, regression of moderate to mild TR, severe to moderate, or persistence of moderate TR. The clinical and echocardiographic parameters of these groups were compared at baseline, at 24 hours, 1 month, and 6 months postprocedure. The numerical data between significant and nonsignificant TR were compared using nonparametric Mann–Whitney U test and categorical data using the χ^2 test.

RESULTS: Thirty-eight patients with significant mitral stenosis and TR post-PTMC were analyzed. At 24 hours post-PTMC, the significant TR group had significantly higher right atrial volume index (42.3 vs 26.1, $P = 0.004$), right ventricular dimension (RVD) mid (3.81 vs 2.92, $P = 0.001$), systolic pulmonary arterial pressure (60.5 vs 38.5, $P = 0.003$), and right ventricular outflow tract (2.8 vs 2.2, $P = 0.001$) and lower mitral valve (MV) planimetry (1.25 vs 1.58, $P = 0.009$). At 1 month, RVD mid (3.4 vs 2.8, $P = 0.02$) and tricuspid valve (TV) annulus (3.35 vs 2.76, $P = 0.10$) were significantly higher in the significant TR group. At 6 months, right atrial volume index (59 vs 24.7, $P = 0.001$), RVD mid (4 vs 2.73, $P = 0.006$), and TV annulus (4.5 vs 2.67, $P = 0.001$) were significantly higher in the significant TR group. The insignificant TR group on the sixth month had significantly improved functional class New York Heart Association I (32 vs 5 $P = 0.019$).

CONCLUSION: Percutaneous transmitral commissurotomy improved functional class and echocardiographic parameters of systolic pulmonary arterial pressure, MV planimetry, and MV gradient on short-term follow-up on both groups of TR. The majority of outcomes after the procedure had insignificant TR. However, those with significant TR had higher RVD mid and TV annulus from 24 hours to 6 months when compared with the insignificant TR group.

KEYWORDS: rheumatic heart disease, mitral stenosis, percutaneous transmitral commissurotomy, tricuspid regurgitation

INTRODUCTION

Many Filipinos suffer from rheumatic heart diseases (RHDs), one of which is mitral stenosis (MS). In rheumatic MS, approximately 6% have organic or functional tricuspid valve (TV) involvement.[1] Based on our valve registry recorded last 2005 to 2007, 28% of our admissions have severe MS.[2] Among the large medical facilities in the country, the Philippine Heart Center serves as an ideal venue for investigation of disease burden and course, as it caters to patients with multivalvular lesions. Being a premiere referral center for cardiovascular care, in particular, a wide spectrum of patients with MS are seen at the Philippine Heart Center, many of whom have concomitant valve lesions that require mechanical intervention on top of medical support. If we strictly follow the international guidelines for MS, many of our patients will need to undergo surgery instead of percutaneous transmitral commissurotomy (PTMC) because of unfavorable clinical and anatomic characteristics.[3] However, our resources are limited mainly due to cost and expertise. Many are left to endure limited functional capacity, increased risk for stroke, and poor quality of life while waiting to be operated on. One of the said contraindications for PTMC is concomitant severe tricuspid regurgitation (TR). Although mentioned that it may be considered in selected patients with sinus rhythm, moderate atrial enlargement, and functional TR secondary to pulmonary hypertension, most do not fit these criteria.[3] Our institution tallied a total of 1586 PTMC procedures from 1989 to 2012.[4] Since then, few retrospective unpublished studies regarding outcomes of TR after PTMC were done. Both studies showed regression of moderate and severe TR, improvement of functional classification, and other echocardiographic parameters, such as TV annulus, right atrial and ventricular diameter, and pulmonary artery (PA) pressure on short- and long-term follow-up.[5,6] Similarly, international studies from developing countries where MS secondary to RHD is endemic support that PTMC in severe MS with significant TR does regress and is directly related to factors, such as the severity of MS, PA pressure, and right ventricular diameter.[7–9] The gap in evidence concerning combined and multivalve disease in MS can be addressed by providing more data on the natural history and impact of the intervention on the clinical and echocardiographic outcomes that will better define the indications for PTMC. This study aimed to compare the clinical and echocardiographic parameters among significant and nonsignificant TR after percutaneous transmitral commissurotomy.

METHODS

The design is a prospective cohort study, which included all patients 19 years or older with rheumatic MS admitted at the Philippine Heart Center between January 2019 to October 2020 for PTMC due to symptomatic severe MS with concomitant moderate to severe TR. The TR may be functional or organic with or without other associated valve lesions. Baseline clinical characteristics, anthropometric data, and functional capacity were determined and two-dimensional transthoracic echocardiogram with Doppler (2DED) was performed before the PTMC within admission, after 24 hours, on outpatient at 1 and 6 months. An echo machine was used, using the latest Siemens model, and certified echo sonographers performed imaging in the study. A sole designated echocardiographer level III served as the reader of the 2DED studies. The participants were asked to follow up using a phone call to arrange the meeting, with a window period of 1 week from the time of the original schedule for checkup and outpatient 2DED in our institution. The outcome of PTMC was divided into two groups: the significant TR, which included the progression of moderate TR to severe TR or the persistence of severe TR, and the insignificant TR group, which included those with mild TR, regression of moderate TR to mild TR, severe TR to moderate TR, or persistence of moderate TR after PTMC. To evaluate the short-term outcome, the groups were compared from baseline, 24 hours, 1 month, and 6 months using the same echocardiographic parameters. For participants who were not able to have face-to-face follow-up and outpatient 2DED due to travel restrictions imposed by COVID, the 2DED evaluation was forfeited, and patients were asked to follow up with their local internal medicine specialist or cardiologist for assessment of functional capacity and anthropometric data. The clinical data were then recorded from telephone interview. The approach and grading of valve lesions were based on established international guidelines.[10,11]

(1) Significant TR—any progression of TR, moderate to severe, or persistence of severe TR after PTMC
(2) Insignificant TR—any regression of TR, moderate to mild or severe to moderate, or persistence of moderate or mild TR after PTMC
(3) Body mass index—calculated as weight in kilograms divided by the square of height in meters, categorized as underweight (<18.5 kg/m^2), normal (18.5–22.9k g/m^2), overweight (23–29.9 kg/m^2), or obese (≥30 kg/m^2)
(4) New York Heart Association (NYHA) functional class—assessment of functional capacity done by a cardiologist or internist, categorized as I (no limitation of physical activity), II (slight limitation of physical activity), III (marked limitation of physical activity), or IV (heart failure at rest)

The clinical and echocardiographic data obtained at baseline were checked for completeness and categorized into four types per time, 24 hours, 1 month, and 6 months using Microsoft Excel (version 16.30; Microsoft Inc, Redmond, Washington): (1) echocardiographic parameters of patients with significant TR, (2) echocardiographic parameters of patients with insignificant TR, (3) clinical characteristics of patients with significant TR, and (4) clinical characteristics of patients with insignificant TR. The checking of data was done twice by two different investigators to ensure correctness and validity.

Statistical Analysis

All analyses were done using the Statistical Package for the Social Sciences version 23 (SPSS Inc, Chicago, Illinois). Numerical data were summarized as means and with their SD and interquartile ranges, whereas categorical data were presented as percentages. Comparison of numerical data between significant and nonsignificant TR categories was done using nonparametric Mann–Whitney *U* test. Categorical data were compared using χ^2 test. All $P < 0.05$ was considered statistically significant.

RESULTS

From January 2019 to October 2020, the institution documented a total of 38 cases of severe MS with moderate to severe TR for PTMC. Their clinical profile is summarized in Table 1. Among those with significant TR, the mean age was 42 years, with female predominance (84.2%), and patients were mostly classified as NYHA II (92.1%). Atrial fibrillation was noted in 68.4%, whereas sinus rhythm was noted in 31.6%. Of this sample, 73.7% had normal body mass index. Two patients (5.3%) had a previous PTMC. The average duration of time of diagnosis to the procedure was 26.8 months. Ten cases had a stroke (26.3%) before the intervention. The average total Wilkin score was 8.7. The mean scores for leaflet mobility, valve thickness, valvular subcalcification, and subvalvular thickening are displayed in Table 1.

FIGURE 1. Study flowchart

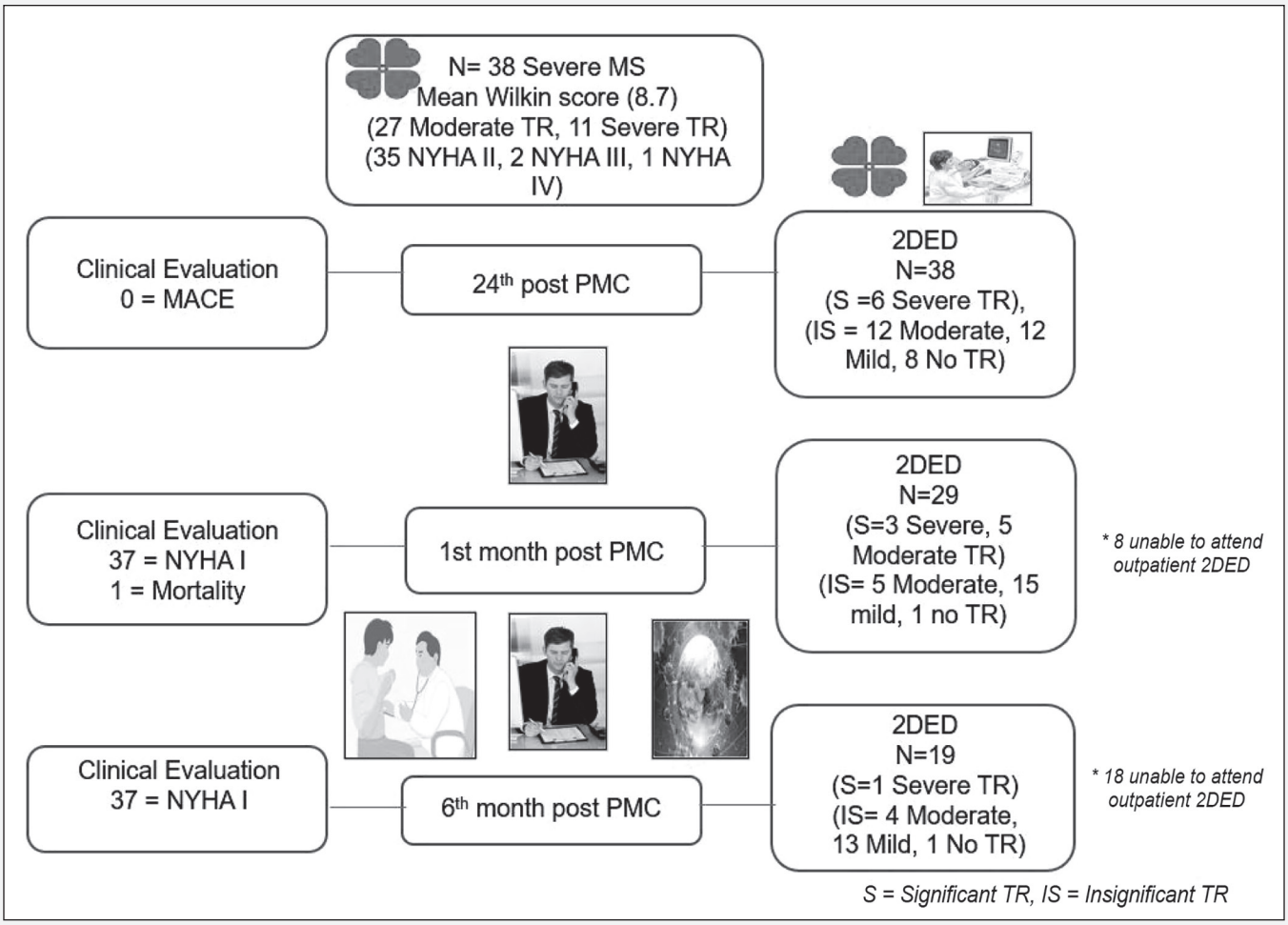

TABLE 1. Baseline Characteristics of Severe Symptomatic Mitral Stenosis With Significant TR

Characteristics	Frequency (%); Mean ± SD; Median (IQR)
Age, y	42 ± 11.3 (44.5)
Sex	
Male	6 (15.8)
Female	32 (84.2)
NYHA functional class	
I	0
II	35 (92.1)
III	2 (5.3)
IV	1 (2.6)
Rhythm	
Sinus rhythm	12 (31.6)
Atrial fibrillation	26 (68.4)
Height, m	1.57 ± .058 (1.57)
Weight, kg	55.3 ± 8.8 (54.5)
Body mass index, kg/m^2	
Underweight	5 (13.2)
Normal	28 (73.7)
Overweight	5 (13.1)
Obese	0
Previous PTMC	2 (5.3)
Diagnosis to PTMC time, mo	26.8 ± 25.1 (12)
History of stroke/transient ischemia attack	10 (26.3)
Wilkins score (total)	8.7 ± 0.8 (8)
Leaflet mobility (mean)	2.1 ± 0.2
Valve thickness (mean)	2.2 ± 0.4
Valvular calcification (mean)	2.1 ± 0.3
Subvalvular thickening (mean)	2.2 ± 0.4

Percentage values in parentheses reflect vertical sum. IQRs are enclosed in parentheses after the mean.
IQR=interquartile range; NYHA=New York Heart Association; PTMC=percutaneous transmitral commissurotomy; TR=tricuspid regurgitation.

The baseline echocardiographic parameters measured prior to PTMC showed normal mean values of left ventricular end-diastolic diameter, left ventricular end-systolic diameter, left ventricular mass index, right atrial volume index (RAVI), right ventricular fractional area change, right ventricular dimension (RVD) mid, PV annulus left ventricular outflow tract, and right ventricular outflow tract (RVOT). The mean values of left ventricular relative wall thickness, left atrial volume index (LAVI), PA pressure, mitral valve (MV) gradient, and TV annulus were elevated, whereas MV planimetry was small as displayed in Table 2.

TABLE 2. Baseline Echocardiographic Data of Patients With Severe Mitral Stenosis With Moderate to Severe Tricuspid Regurgitation (N = 38)

	Mean	SD
No. of patients	38	—
Left ventricular end diastolic dimension, cm	4.1	0.49
Left ventricular end systolic dimension, cm	2.8	0.44
Left ventricular mass index	81.4	18.7
Left ventricular relative thickness	0.44	0.10
Ejection fraction by Simpson, %	59.2	7.7
Left atrial volume index, mL/m^2	65.2	19.7
Right atrial volume index, mL/m^2	29.6	7.3
Right ventricular fractional area change, %	44.9	7.9
Right ventricular dimension mid, cm	3.1	0.74
Systolic pulmonary arterial pressure, mm Hg	68	27.8
Mitral valve planimetry, cm^2	0.71	0.19
Mitral valve gradient, mm Hg	15.7	5.3
Tricuspid valve annulus, cm	3.0	0.51
Pulmonic valve annulus, cm	2.27	0.39
Left ventricular outflow tract, cm	1.8	0.19
Right ventricular outflow tract, cm	2.4	0.50

The echocardiographic parameters measured 24 hours post-PTMC showed significantly higher RAVI among those with significant TR (mean, 42.3 vs 26.1; *P* = 0.004), higher RVD mid (mean, 3.81 vs 2.92; ***P*** = 0.001), higher PA pressure (mean, 60.5 vs 38.5; *P* = 0.003), and larger for TV annulus (mean, 3.46 vs 2.8; *P* = 0.002) and RVOT (mean, 2.8 vs 2.2; *P* = 0.001). Mitral valve planimetry was smaller in those with significant TR (mean, 1.25 vs 1.58; *P* = 0.009) (Table 3).

TABLE 3. Comparison in Echocardiographic Data of Significant and Insignificant TR 24 Hours After PTMC

	Significant TR	Insignificant TR	*P**
	Mean (SD)		
No. of patients	6	32	
Left ventricular end diastolic dimension, cm	4.3 (0.61)	4.4 (0.37)	0.52
Left ventricular end systolic dimension, cm	2.86 (0.54)	2.81 (0.41)	0.77
Left ventricular mass index	88.67 (49.3)	80.5 (19.8)	0.48
Left ventricular relative thickness	0.41 (0.16)	0.40 (0.11)	0.87
Ejection fraction by Simpson, %	62 (3.8)	64.5 (6.3)	0.35
Left atrial volume index, mL/m^2	59.7 (39)	55.7 (18.2)	0.69
Right atrial volume index, mL/m^2	42.3 (10.3)	26.1 (12.1)	0.004
Right ventricular fractional area change, %	43.2 (9.6)	48.5 (7.5)	0.14
Right ventricular dimension mid, cm	3.81 (0.53)	2.92 (0.51)	0.001
Systolic pulmonary arterial pressure, mm Hg	60.5 (18.4)	38.5 (15.2)	0.003
Mitral valve planimetry, cm^2	1.25 (0.13)	1.58 (0.28)	0.009
Mitral valve gradient, mm Hg	5.16 (1.6)	5.43 (1.7)	0.73
Tricuspid valve annulus, cm	3.46 (0.29)	2.8 (0.45)	0.002
Pulmonic valve annulus, cm	2.4 (0.22)	2.2 (0.41)	0.26
Left ventricular outflow tract, cm	1.8 (0.21)	1.85 (0.22)	0.58
Right ventricular outflow tract, cm	2.8 (0.35)	2.2 (0.31)	0.001

**Significant P values if P < 0.05 (in bold font), Mann–Whitney U test.*
PTMC=percutaneous transmitral commissurotomy; TR=tricuspid regurgitation.

The echocardiographic parameters measured 1 month post-PTMC showed that those with significant TR had higher RVD mid values (mean, 3.4 vs 2.8; $P = 0.02$) and larger TV annulus values (mean, 3.35 vs 2.76; $P = 0.010$). The rest of the echocardiographic parameters were not significantly different between the two groups compared (Table 4).

TABLE 4. Comparison of Echocardiographic Data of Significant and Insignificant TR From 24 Hours to 1 Month After PTMC

	Significant TR	Insignificant TR	P*
	Mean (SD)		
No. of patients	8	21	
Left ventricular end diastolic dimension, cm	4.4 (0.51)	4.3 (0.44)	0.55
Left ventricular end systolic dimension, cm	3.01 (0.56)	2.89 (0.38)	0.51
Left ventricular mass index	94.1 (38.1)	86.2 (26.1)	0.52
Left ventricular relative thickness	0.39 (.039)	0.40 (0.09)	0.88
Ejection fraction by Simpson, %	61.7 (4.5)	63.2 (4.7)	0.45
Left atrial volume index, mL/m^2	70.3 (32.3)	55.9 (23.0)	0.18
Right atrial volume index, mL/m^2	36.1 (18.3)	25 (12.9)	0.07
Right ventricular fractional area change, %	46.3 (7.5)	47.3 (5.7)	0.71
Right ventricular dimension mid, cm	3.4 (0.85)	2.8 (0.44)	0.02
Systolic pulmonary arterial pressure, mm Hg	51.8 (22.9)	41.0 (24.3)	0.28
Mitral valve planimetry, cm^2	1.43 (0.19)	1.39 (0.25)	0.71
Mitral valve gradient, mm Hg	5.7 (2.5)	6.1 (1.7)	0.65
Tricuspid valve annulus, cm	3.35 (0.80)	2.76 (0.34)	0.010
Pulmonic valve annulus, cm	2.21 (0.31)	2.17 (0.35)	0.77
Left ventricular outflow tract, cm	1.86 (0.23)	1.85 (0.19)	0.91
Right ventricular outflow tract, cm	2.43 (0.36)	2.33 (0.37)	0.52

**Significant P values if P < 0.05 (in bold font), Mann–Whitney U test.*
PTMC=percutaneous transmitral commissurotomy; TR=tricuspid regurgitation·

The echocardiographic parameters measured 6 months post-PTMC showed that those with significant TR had significantly higher values for RAVI (mean, 59 vs 24.7; *P* = 0.001), RVD mid (mean, 4.0 vs 2.73; *P* = 0.006), and TV annulus (mean, 4.5 vs 2.67; *P* = 0.001). The other echocardiographic parameters did not significantly vary between the two groups (all *P* > 0.05) (Table 5).

TABLE 5. Comparison in Echocardiographic Data of Significant and Insignificant TR From 1 to 6 Months After PTMC

	Significant TR	Insignificant TR	*P**
	Mean (SD)		
No. of patients	1	18	
Left ventricular end diastolic dimension, cm	4.0	4.6 (0.43)	0.18
Left ventricular end systolic dimension, cm	2.7	2.9 (0.48)	0.61
Left ventricular mass index	79	86.1 (25.9)	0.79
Left ventricular relative thickness	0.55	0.37 (0.08)	0.059
Ejection fraction by Simpson, %	54	62.1 (5.1)	0.13
Left atrial volume index, mL/m^2	100	52.9 (27.1)	0.11
Right atrial volume index, mL/m^2	59	24.7 (7.6)	0.001
Right ventricular fractional area change, %	54	47.3 (7.3)	0.38
Right ventricular dimension mid, cm	4.0	2.73 (0.39)	0.006
Systolic pulmonary arterial pressure, mm Hg	45	39.2 (9.1)	0.55
Mitral valve planimetry, cm^2	1.46	1.41 (0.23)	0.85
Mitral valve gradient, mm Hg	4.2	6.5 (3.3)	0.49
Tricuspid valve annulus, cm	4.5	2.67 (0.36)	0.001
Pulmonic valve annulus, cm	2.4	2.1 (0.29)	0.37
Left ventricular outflow tract, cm	2.2	1.90 (0.17)	0.11
Right ventricular outflow tract, cm	2.8	2.2 (0.31)	0.12

**Significant P values if P < 0.05 (in bold font), Mann–Whitney U test.*
PTMC=percutaneous transmitral commissurotomy; TR=tricuspid regurgitation.

A comparative profile of cases of the baseline characteristics and classification of significant and insignificant TR on 2DED at 24 hours post-PTMC to the clinical characteristics at 6 months was made (Table 6). A higher proportion of those who had nonsignificant TR were classified as NYHA class I (86.5% vs 13.5%, $P = 0.019$); they were also heavier (mean, 58.5 vs 47.7 kg; $P = 0.042$). The mean total Wilkin score was statistically higher among those with significant TR (mean, 9.6 vs 8.5; $P = 0.003$). Higher mean scores were given to valve thickness (mean, 2.6 vs 2.1; $P = 0.006$) and valvular calcification (mean, 2.5 vs 2.1; $P = 0.030$). No differences were noted in terms of the age, sex distribution, rhythm, height, body mass index, the proportion of cases with previous PTMC, duration of time from diagnosis to PTMC, and the history of stroke ($P > 0.05$).

TABLE 6. Comparison in Characteristics of Significant and Insignificant TR From 24 Hours to 6 Months After PTMC

Characteristics	Significant TR	Insignificant TR	P
Age, y	39.6 (18.3)	43.1 (9.8)	0.50
Sex			
Male	1 (16.7)	5 (83.3)	0.94
Female	5 (15.6)	27 (84.4)	
Functional class NYHA			
I	5 (13.5)	32 (86.5)	0.019*
II	0	0	
III	0	0	
IV	1	0	
Rhythm			
Sinus rhythm	2 (16.7)	10 (83.3)	0.06
Atrial fibrillation	3 (12)	22 (88)	
Height, m	1.6 (.07)	1.57 (.05)	0.24
Weight, kg	47.7 (24.3)	58.5 (7.5)	0.042†
Body mass index, kg/m^2			
Underweight	0	1 (100)	0.29
Normal	5 (19.2)	21 (80.8)	
Overweight	0	10(100)	
Obese	0	0	
Previous PTMC	0	2 (100)	0.52
Diagnosis to PTMC time, mo	26.6 (28.1)	26.9 (24.9)	0.98
History of stroke/TIA	1 (11.1)	8 (88.9)	0.80
Wilkins score (total)	9.6 (1.0)	8.5 (0.76)	0.003†
Leaflet mobility (mean)	2.1 (0.4)	2.0 (0.24)	0.39
Valve thickness (mean)	2.6 (0.51)	2.1 (0.36)	0.006†
Valvular calcification (mean)	2.5 (0.54)	2.1 (0.33)	0.030†
Subvalvular thickening (mean)	2.3 (0.51)	2.1 (0.39)	0.43

Significant P values if P < 0.05 (in bold font).
**χ^2 Test.*
†Mann–Whitney U test.
IQR=interquartile range; NYHA=New York Heart Association; PTMC=percutaneous transmitral commissurotomy; TIA=transient ischemic attack; TR=tricuspid regurgitation.

FIGURE 1. Echocardiographic parameters from baseline to 6 months of follow-up

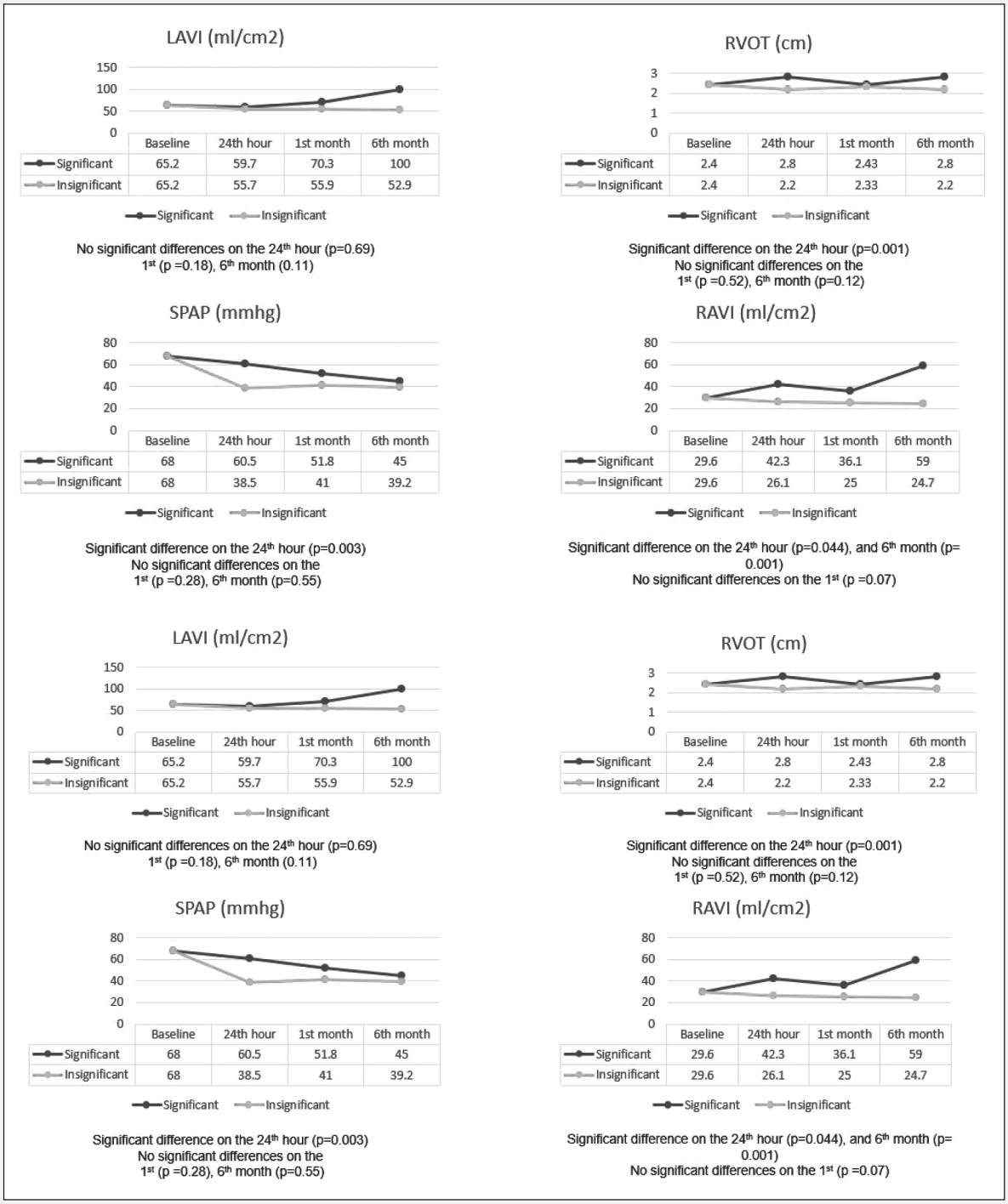

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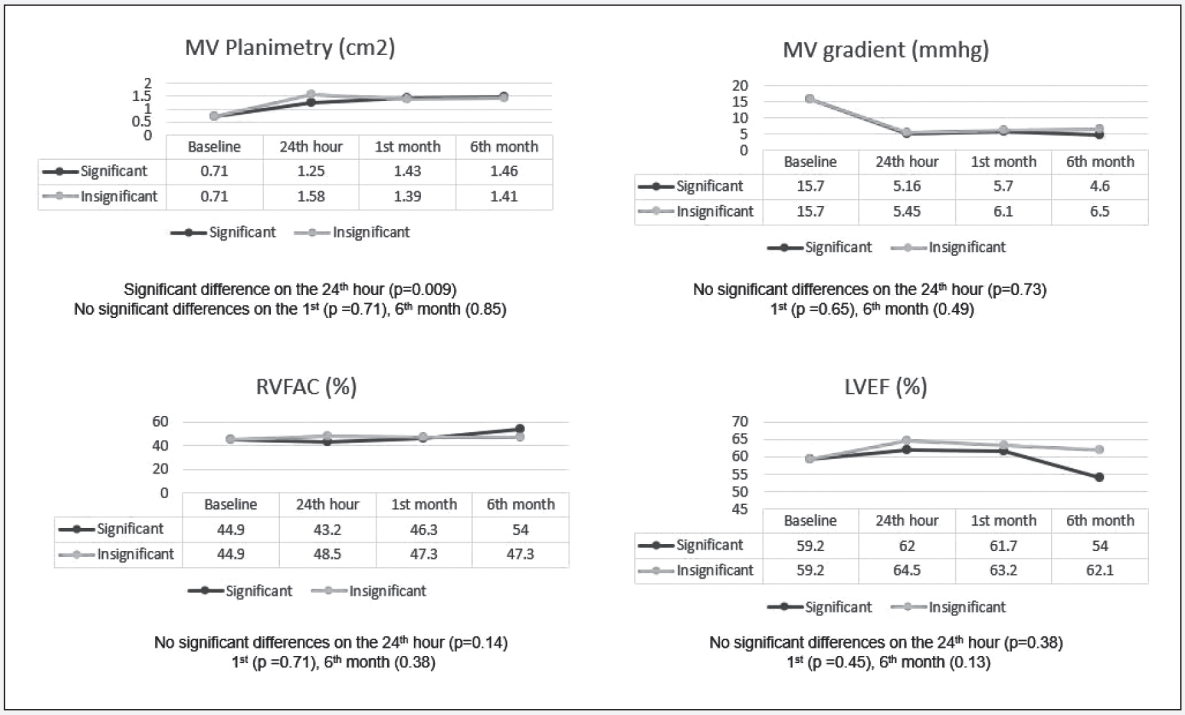
FIGURE 1. Echocardiographic parameters from baseline to 6 months of follow-up



DISCUSSION

The hemodynamic consequences of MS and TR are increased systolic pulmonary arterial pressure (SPAP), RAVI, RVD mid, RVOT, TV annulus, and LAVI, which can be temporary or permanent. Percutaneous transmitral commissurotomy improved baseline parameters of MV planimetry, MV gradient, SPAP, and functional class on both groups of TR. Most outcomes post-PTMC had insignificant TR. However, those with significant TR had higher RVD mid and TV annulus from the 24 hours to 6 months of follow-up. The present analysis suggests that even in the presence of moderate to severe TR, PTMC yields beneficial outcomes in patients with baseline functional class NYHA II–III (Appendix).

Most participants belonged to the middle-aged group together with the long interval between the diagnosis of RHD with MS and the intervention of almost 2 years. The factors of cost, geographic location, reluctance, and availability of the procedure may have contributed. The participants were dominated by females; the cause of this association is unknown.[13] It is when patients experienced dyspnea, fatigue, and decreased exercise intolerance at work or during labor that they were first diagnosed. Some were referred for evaluation and treatment before noncardiac surgery or recently discovered valvular atrial fibrillation that suffered an embolic stroke. Atrial fibrillation is the most common complication, and the prevalence is related to the severity of obstruction and the patient's age.[14] The participants with baseline NYHA III had orthopnea and were previously admitted for pulmonary congestion. One patient on NYHA IV had high-risk pneumonia and on mechanical ventilatory and vasopressor support.

The baseline echocardiographic parameters demonstrated average values of normal LV volume, function, left ventricular mass index, and somewhat increased left ventricular relative wall thickness. A typical normal or small LV is expected because the obstruction had left the receiving chamber underfilled. However, specific patterns of LV remodeling may be related to compensation of a low cardiac output or coexisting valvular or myocardial abnormalities.[15] Severe MS reflected a very small MV planimetry, high MV gradient, and dilated LAVI. The combination of obstruction and moderate to severe TR in this group led to hemodynamic consequences of a dilated TV annulus and increased SPAP. The other right-sided parameters that may also have secondary effects due to pressure and volume overload had normal average values at baseline.

The relief of obstruction brought about by PTMC through commissural separation and fracture of nodular calcium had physiologically caused a reduction of pressure to the left atrial, pulmonary vascular, and the right-sided structures. At the 24th hour after the procedure, echocardiographic data revealed that 6 of 38 participants had significant TR. When compared with the insignificant TR group, those in the significant TR group had significantly larger RAVI, RVD mid, RVOT, and TV annulus; higher PA pressure; and lower MV planimetry. On further follow-up, during the first and sixth months after PTMC, the echocardiographic data revealed 8 of 29 and 1 of 19 participants had significant TR. After 1 month, a larger RVD mid and TV annulus and, after the sixth month, a larger RAVI, RVD mid, and TV annulus persisted among the significant TR group.

The baseline change of SPAP, MV planimetry, and MV gradient

after PTMC in both groups is responsible for the improvement of the functional class seen in the participants we followed up with. Almost all were in NYHA class I at 1 and 6 months post-PTMC; aside from this, they did not suffer any complications such as stroke or infective endocarditis. The improvement of the functional class was in those with baseline NYHA II–III; the majority were able to work and tolerated a successful noncardiac surgery. One case with NYHA IV had emergent PTMC and died because of sepsis. There were few studies regarding the role of emergent PTMC in NYHA class IV; both advocated that PTMC may be done in critically ill patients, and if surgery carries a high prohibitive risk, however, the prognosis was still dismal.[15,16]

The most studied association of the improvement after PTMC is the reduction of PA systolic pressure.[8,9] In our study, a continuous drop of SPAP was seen from baseline to 6 months in the significant group, whereas in the insignificant group, an initial drop that then plateaued on the 1- and 6-month periods was seen. Hence, PTMC can reduce SPAP in both groups; however, reversion to normal pulmonary pressure may not be possible because of the chronicity and the adaptive changes of pulmonary arteriolar constriction and organic obliteration of pulmonary vasculature. A lack of significant improvement and difference in LAVI between the two groups was evident. It may be associated with the long-standing and permanent damage to the left atrium as reflected by a high percentage of atrial fibrillation.[16] A continuous improvement of RAVI, RVD mid, and TV annulus was seen from baseline to 6 months but only in the insignificant group, as also seen in other retrospective studies.[6,7] The RAVI, RVD mid, and TV annulus measurements should be monitored in the significant TR group as these parameters may be used for detection, risk stratification, and initiation of therapy in right-sided heart failure.[17–19]

The classification of 6 significant and 32 insignificant TR at 24 hours post-PTMC showed that the significant TR group has a significantly higher Wilkin score at 9.6, and the components of valvular thickness and calcifications were significantly higher. These parameters may correlate with the MS severity and the higher volume and pressure from the obstruction; hence, differences between the two groups were evident. The Wilkin score is the most validated parameter that predicts immediate and long-term morbidity and mortality[20]; incorporation of associated valve lesion such as TR may better elucidate the course of the disease as a whole. Lower body weight was seen in the significant TR group on follow-up. The value of this parameter is yet to be explored, but it may herald a possible cardiac cachexia[21] due to worsening valve lesion in patients with persistent significant TR.

LIMITATIONS AND RECOMMENDATIONS

The unfortunate effects of the COVID pandemic had brought the cases down of elective PTMC procedure; hence, an adequate sample size to represent both groups was not attained. The dropout rates for the acquisition of 2DED data were 22% at 1 month and 49% at 6 months. The lockdown instituted to different parts of our country precluded the participants from the scheduled date of 2DED at our institution. The percentage that belonged to significant TR group was 16% at 24 hours, 27% at 1 month, and 5% at 6 months. The high dropout rates may have altered the true incidence of each group. We recommend a larger sample size and low dropout rates to predict the factors of outcome for each group. Also, the determination of factors associated with or predictive of functional class or major cardiovascular events would have a greater impact on management.

CONCLUSION

Percutaneous transmitral commissurotomy improved baseline parameters of SPAP, MV planimetry, MV gradient, and functional class on short-term follow-up on both groups of TR. Most outcomes after the procedure had insignificant TR. However, those with significant TR had higher RVD mid and TV annulus from 24 hours to 6 months when compared with insignificant TR group and may need further monitoring and correlation with clinical status.

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APPENDIX

Definitions[12]

(1) Left ventricular internal dimension—normal diastolic dimension (left ventricular end-diastolic diameter) in centimeters: 4.2–5.84 in males, 3.78–5.22 in females; normal systolic dimension (left ventricular end-systolic diameter) in centimeters: 2.5–3.98 in males, 2.16–3.48 in females
(2) Left ventricular remodeling- based on the measurement of ""left ventricular mass index (LVMI) normal is ≤115 in males, ≤96 in females; left ventricular relative wall thickness (LVRT) normal is ≤0.42. Concentric remodeling (normal LVMI and increased LVRT), eccentric hypertrophy (increased LVMI, normal LVRT), and concentric hypertrophy (increased LVMI and LVRT)
(3) Ejection fraction—normal range: 52–72 in males, 54–74 in females
(4) Left atrial volume index—measured in mL/m^2: normal (16–34), mild
(5) dilatation (35–41), moderate dilatation (42–48), and severe dilatation >48
(6) Right atrial volume index—measured in mL/m^2: normal range: 15–27 in females and 18–32 males
(7) Right ventricular fractional area change—normal is >35%
(8) Right ventricular dimension mid—measured in centimeters at the two-
(9) dimensional echo and midlevel, normal is 1.9–3.5
(10) Systolic pulmonary arterial pressure—measured in mm Hg, normal (18–34), mild (35–59), moderate (60–79), and severe (>80)
(11) Mitral valve (MV) planimetry—measured in centimeters squared: mild (>1.5), moderate (1–1.5), and severe (<1.0)
(12) MV mean gradient—measured in mm Hg: mild (<5), moderate (5–10), and severe (>10)
(13) Tricuspid valve annulus—measured in centimeters: normal is 1.3–2.8
(14) Pulmonic valve annulus—measured in centimeters: normal is 1.7–2.3
(15) Left ventricular outflow tract—measured in centimeters: normal is 1.8–2.4
(16) Right ventricular outflow tract—measured in centimeters: normal is 2.1–3.5 in females and 1.7–2.7 in males