

FACTORS RESPONSIBLE FOR INSIGNIFICANT DECREASE IN PULMONARY ARTERY PRESSURE IMMEDIATELY AFTER PER CUTANEOUS TRANS-MITRAL COMMISSUROTOMY IN PATIENTS OF RHEUMATIC MITRAL STENOSIS

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ABSTRACT

OBJECTIVE: To determine the factors responsible for insignificant decrease in pulmonary artery pressure immediately after percutaneous trans-mitral commissurotomy (PTMC) in patients of rheumatic mitral stenosis.

METHODS: This cross-sectional study was conducted on patients undergoing PTMC at Cardiology Unit, Lady Reading Hospital, Peshawar, Pakistan from 11th February, 2016 to 28th February, 2018. Pulmonary artery pressure (PAP) was noted before and after PTMC through echocardiography. Data was analyzed with SPSS Version 20.0, categorical and continuous variables were described as frequencies/percentages and mean±SD respectively. Odds ratio was determined for factors negatively affecting the fall in PAP.

RESULTS: Out of 159 patients, 108 (67.9%) were females. Mean age was 25.38±10.67 years. PAP was insignificantly decreased in patients >30 years (p>0.05), symptoms for >5 years (p>0.05), left atrium diameter >4.5cm (p>0.05), atrial fibrillation (p>0.05), right ventricle diameter >2.5cm (p>0.05) and NYHA IV dyspnea (p>0.05). Odds Ratio for failure of significant decrease in PAP immediately post-PTMC was 1.68 for age more than 30 years, 1.10 for symptoms more than 5 years, 3.73 for LA diameter more than 4.5 cm, 2.31 for RV diameter more than 2.5 cm, 2.32 for history of atrial fibrillation and 6.71 for NYHA IV dyspnea.

CONCLUSION: Factors which negatively affect the immediate fall in PAP post-PTMC are age >30years, duration of symptoms >5years, LA diameter >4.5cm, history of atrial fibrillation, RV diameter >2.5cm and NYHA IV dyspnea and hence are the poor predictors of successful PTMC while NYHA IV dyspnea has highest odds for insignificant decrease.

KEY WORDS: Pulmonary Hypertension (MeSH); Mitral Stenosis (MeSH); Percutaneous Transvenous Mitral Commissurotomy (Non-MeSH); Pulmonary Artery Pressure (Non-MeSH).

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INTRODUCTION

Rheumatic Heart Disease is an undeniable public health related issue worldwide, especially in the underdeveloped nations where its

death toll reaching to a million annually.¹ Mitral Stenosis (MS) is its catastrophic complication.²⁻⁴ In Pakistan, MS is a major issue as the incidence of Rheumatic fever (RF) is very high.⁵ Due to the high pressures in the pulmonary

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vasculature, MS leads to a cascade of vasculopathic changes resulting in pulmonary hypertension. It badly affects the patient's quality of life.⁶

Long-term event-free lifespan depends greatly on Pulmonary artery hypertension (PAH).⁷⁻⁹ PTMC has emerged a first-line interventional treatment for MS.¹⁰ Immediately post-PTMC, a decrease in pulmonary artery pressure (PAP) is observed with further gradual decline taking place over long-term.¹¹⁻¹⁴ Since the success of PTMC in the long run depends invariably on the decrease in PAP, patients with insufficient immediate decrease in PAP post-PTMC have a poor long-term prognosis.^{15,16} Noor A, et al.¹⁷ observed that age, right ventricular (RV) size and left atrial (LA) pressure were independently associated with a fall in pulmonary artery systolic pressure (PASP) immediately post-PTMC. The factors which dictate the decrease in PAH haven't been comprehensively studied.

Since the success of PTMC depends greatly on the fall in PAP after PTMC, the objective of this study was to identify the factors responsible for an insignificant decrease in PAP immediately post-PTMC, so that patients should be triaged before enrolment in such invasive procedure and success could be predicted beforehand.

METHODS

This cross-sectional study was conducted in Cardiology Unit, Lady Reading Hospital, Peshawar, Pakistan after approval from institutional review board (IRB). A total of 163 patients with rheumatic mitral stenosis needing PTMC from 11th February, 2016 to 28th February, 2018 were enrolled after following inclusion and exclusion criteria. One patient refused to undergo

TABLE I: BASELINE CHARACTERISTICS

Variables		Descriptive Statistics
Age group (years)	<20 years	23.3% (n=37)
	20-30 years	50.9% (n=81)
	>30 years	25.8% (n=41)
Dyspnea	NYHA class II	21.4% (n=34)
	NYHA class III	44.6% (n=71)
	NYHA class IV	34% (n=54)
Duration of symptoms	> 5 years	71.1% (n=113)
	≤ 5 years	28.9% (n=46)
Findings of Echocardiography	Mean LA diameter (cm)	4.6±0.8
	↑LA diameter	50.9% (n=81)
	Mean RV diameter (cm)	2.6±0.9
	↑RV diameter	43% (68)
	Mean LVEF	57.18±9.3
	EF < 50%	32.7% (n=52)
	Mean MVA (cm ²)	0.96±0.12
MVA < 0.8 cm ²	52.8% (n=84)	
Findings of Catheterization Laboratory	Mean MVG (mmHg)	22.0±6.24
	Mean PAP (mmHg)	60.5±14.5
	Mean LA Pressure (mmHg)	41.36±7.09

NYHA= New York Heart Association, LA= Left Atrium, RV= Right Ventricle, LVEF= Left ventricular ejection fraction, EF= Ejection fraction, MVA= Mitral valve area, Cath:= Cardiac catheterization, MVG= mitral valve gradient, PAP= pulmonary artery pressure, ↑= increased, ↑LA diameter= LA diameter >4.5cm, ↑RV diameter= RV diameter >2.5cm

TABLE II: DECREASE IN PULMONARY ARTERY PRESSURE AMONG DIFFERENT

Variables		Pre PTMC (PAP)	Post PTMC (PAP)	P-Value
Age	<20 years	58.21±9.8	45.32±10.9	0.001
	20-30 years	57.1±10.7	36.71±9.8	0.001
	>30 years	58.34±11.3	51.9±10.8	0.41
Gender	Male	57.2±11.3	39.9±9.6	0.001
	Female	61.6±8.9	47.6±10.7	0.001
Atrial fibrillation	NO	59.9±13.1	48.07±11.2	0.001
	YES	61.9±11.3	54.07±11.7	0.912
Dyspnea	NYHA class III	59.7±10.1	43.7±11.8	0.001
	NYHA class IV	61.9±8.8	53.7±8.4	0.51
Duration of Symptoms	<5 years	59.8±7.8	47.6±10.7	0.001
	>5 years	61.9±8.9	53.7±12.1	0.325
Findings of Echocardiography	↑LA diameter	64.1±9.4	59.7±10.3	0.712
	Normal LA diameter	55.9±11.4	35.6±12.4	0.001
	↑RV diameter	63.1±7.8	53.6±13.8	0.539
	Normal RV diameter	60.12±13.9	33.4±11.9	0.001
	MVA < 0.8 cm ²	61.6±9.1	46.4±11.8	0.001
	MVA>0.8cm ²	57.7±11.4	37.9±10.1	0.001

NYHA= New York Heart Association, LA= Left Atrium, RV= Right Ventricle, LVEF= Left ventricular ejection fraction, EF= Ejection fraction, MVA= Mitral valve area, Cath:= Cardiac catheterization, MVG= mitral valve gradient, PAP= pulmonary artery pressure, ↑= increased, ↑LA diameter= LA diameter >4.5cm, ↑RV diameter= RV diameter >2.5cm

PTMC and 3 lost to follow up due to some personal reasons. So a total of 159 patients were evaluated in final study. A detailed history, physical exam, transthoracic echocardiography (TTE) and trans-esophageal echocardiography (TEE) were performed for the patients.

Pre PTMC, Pulmonary Artery Pressure (PAP) was recorded on TTE. Patients with rheumatic mitral stenosis having a mitral valve area (MVA) ≤1.0cm² were included while patients were excluded if they had left atrial and left atrial appendage(LA/LAA) thrombus, aortic

stenosis (AS) or aortic regurgitation (AR), mitral regurgitation (MR) >I+ and previous history of Mitral valve procedures. Consent was taken from each patient. PTMC was performed by the standard procedure using the single Inoue balloon technique.¹⁸ All patients underwent TTE 48 hours after PTMC to record immediate post procedure PAP. A decrease in PAP of ≥20% post PTMC was considered as successful drop in PAP.

A predesigned proforma was used to record relevant data. Data analysis was done in SPSS Version 20.0. Continuous & Categorical variables were recorded as mean±SD & frequencies/percentage respectively. Paired sample t-test was used to compare the means with P-value ≤0.05 as significant. Logistic regression was applied on the basis of ≥20% decrease in PAP after PTMC to determine Odds of insignificant fall in PAP. P-value of ≤0.05 was taken as significant, PAP was taken as dependent variable with <20% decrease as insignificant.

RESULTS

Out of 159 patients, 108 (67.9%) were females and 51 (32.1%) were males. Mean age of patients was 25.38±10.67 years and about 50.9% (n=81) of patients were from 20-30 years age group (Table I). About 28.9% (n=46) patients presented with palpitations and 30.8% (n=49) had atrial fibrillation (AF). Mean duration of symptoms was 11.6±8.1 years and majority (n=113; 71.1%) had symptoms for more than 5 years duration. Seventy-one patients (44.6%) had NYHA class III dyspnea. About half of patients (n=81) had increased LA diameter¹⁹ i.e. >4.5cm. Findings of Echocardiography and Catheterization Laboratory are given in Table I.

One hundred and eleven (70%) patients had a successful decrease in PAP after PTMC compared to 48 (30%) patients who had <20% fall in PAP after PTMC. PAP decreased in patients was significant in all categories except age>30 years, symptoms for >5years, increased LA diameter, increased RV diameter, history of AF and NYHA IV dyspnea details shown in table II.

Odds Ratio for failure of significant decrease in PAP ($\geq 20\%$) after PTMC was also calculated (table III) showing highest odd for NYHA IV dyspnea (6.71) followed by increased LA diameter (3.73).

DISCUSSION

In our study, we found that younger patients with MS had a better fall in PAP as compared to patients with advancing age having a OR for failure of decrease in PAP as 1.68 ($p < 0.001$) in patients above 30 years of age. Another important factor which determined the fall in PAP was duration of symptoms where we found that patients who were symptomatic for > 5 years had an insignificant decrease in PAP from 61.9 ± 8.9 mmHg to 53.7 ± 12.1 ($p = 0.325$) with an OR of 1.10 ($p < 0.001$). Increased LA diameter was another factor for failure of statistically significant fall in PAP where the drop in PAP was from 64.1 ± 9.4 mmHg to 59.7 ± 10.3 mmHg ($p = 0.712$) with an OR of 3.73 ($p < 0.001$). History of AF also determined the fall in PAP post-PTMC with insignificant fall in PAP from 61.9 ± 11.3 mmHg to 54.07 ± 11.7 ($p = 0.912$) and an OR for failure of 2.32 ($p < 0.001$). Increased RV diameter pre-PTMC was also correlated with insignificant fall in PAP from 63.1 ± 7.8 mmHg to 53.6 ± 13.8 ($p = 0.539$) compared to patients with a normal sized RV with OR of 2.31 ($p < 0.001$). Lastly, patients in NYHA IV pre-PTMC had a poor fall in PAP from 61.9 ± 8.8 mmHg to 53.7 ± 8.4 mmHg ($p = 0.51$) with an OR of 6.71 ($p < 0.001$). So, NYHA IV dyspnea alone increases the odds of insignificant drop in PAP by 6.71 times.

Ahmad Noor, et al.¹⁷ reported three factors which could predict a drop in PAP immediately post-PTMC independent of other variables and these were mean LA pressure, RV enlargement and a younger age at baseline. Not only our results comparable to his findings where we have shown that patients with larger RV size and older age (> 30 years) were associated with poor decrease in PAP, but we have also taken into consideration other baseline factors which could predict the outcome. Shiro Miura, et al.¹⁵ reported that PAP and AF were independent predictors of outcomes post-PTMC with Hazard Ratio of 2.57 and 2.73 respectively which are comparable to our study's results. We also found that history of AF determined the fall in PAP post-PTMC with insignificant fall in PAP from 61.9 ± 11.3 mmHg to 54.07 ± 11.7 ($p = 0.912$) and a OR for failure of statistically

significant decrease in PAP of 1.32 ($p < 0.001$). Kim KH, et al.²⁰ reported a poor prognosis in patients with higher pre-PTMC LA volume. We also found LA size to be a factor which adversely affects the fall in PAP after PTMC with a OR for insignificant fall in PAP post PTMC of 3.73 ($p < 0.001$).

This study had its limitations due to the fact that it was a single center study and we did not follow the patients for further decrease in PAP after PTMC as observed by Chen CR, et al.¹⁴ that PAP gradually decreased over a period of time after PTMC. Further prospective studies need to be done to find the association between PAP and different factors which affect the outcome of PTMC as far as PAP is concerned.

CONCLUSION

Advanced age (> 30 years), symptom duration (> 5 years), RV & LV enlargement, NYHA IV dyspnea and history of AF are factors responsible for insignificant decrease in PAP immediately post-PTMC. Also these factors increase the odds of insignificant decrease from 1.10 to 6.71 times. So, planned interventions are needed in patients with MS before they develop pulmonary hypertension to increase the efficacy of this procedure.

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TABLE III: ODDS RATIO FOR FAILURE OF SUCCESSFUL DECREASE IN PULMONARY ARTERY PRESSURE AFTER PTMC

Variables	Odds Ratio	P-Value
Age > 30 years	1.68	0.001
Symptoms > 5 years	1.10	0.001
↑LA diameter	3.73	0.001
↑RV diameter	2.31	0.001
Atrial Fibrillation	2.32	0.001
New York Heart Association class IV	6.71	0.001

PTMC: Per Cutaneous Trans Mitral Commissurotomy LA= Left Atrium, RV= Right Ventricle, ↑= increased, ↑LA diameter= LA diameter > 4.5 cm, ↑RV diameter= RV diameter > 2.5 cm.

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AUTHORS' CONTRIBUTIONS

Following authors have made substantial contributions to the manuscript as under:

MSJ: Conception and design, acquisition of data, drafting the manuscript, final approval of the version to be published

SAH: Acquisition, analysis and interpretation of data, drafting the manuscript, final approval of the version to be published

SBK & AMG: Acquisition of data, critical revision, final approval of the version to be published

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

CONFLICT OF INTEREST

Authors declared no conflict of interest

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