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Evaluation of the Patients with Severe LV Systolic Dysfunction and Mitral Valve Stenosis after Percutaneous Transvenous Mitral Commissurotomy

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Abstract

Introduction: A valid alternative to surgical therapy in selected patients with mitral stenosis is percutaneous transvenous mitral commissurotomy (PTMC).There is an increase in preload and severe heart failure in patients with severe LV dysfunction and severe mitral stenosis (MS) after PTMC. In the present study, we evaluate the patients with MS who underwent PTMC aimed at dyspnea and pulmonary hypertension.

Method: In this cross-sectional study, 20 patients with severe LV systolic dysfunction (LVEF less than 35%) and severe MS (MVA<1.5 cm^2) who underwent PTMC between March-2009 and March-2015 were enrolled. TTE was performed a day before, one day, and six months after PTMC. Mitral valve area (MVA) and systolic pulmonary atrial pressure (SPAP) before and after the procedure were compared.

Result: Eleven (55%) patients were female (mean age: 46.0 ± 13.09). All patients underwent successful PTMC without any complications. The systolic PAP decreases significantly from 61.25 ± 9.15 mmHg at baseline to 36.75 ± 3.72 mmHg one day after procedure (p<0.0001), also it reached to 34.5 ± 3.2 mmHg 6 month after PTMC. The Mitral valve area (MVA) increased from 0.76 ± 0.14 cm^2 at baseline to 1.26 ± 0.17 cm^2 one day later. Also, NYHA Functional class in the majority of patients significantly improved.

Conclusion: Mitral valve area and pulmonary artery pressures appeared to influence the outcome of PTMC. Despite the increased preload in patients with severe systolic LV dysfunction, dyspnea recovered, and FC and SPAP were significantly reduced after six months of performing PTMC.

Keywords: Mitral stenosis; Systolic left ventricle dysfunction; Percutaneous transvenous mitral Commissurotomy

Introduction

Rheumatic Fever (RF) is an important clinical entity in developing countries where Rheumatic Heart Disease (RHD) represents a significant cause of cardiac morbidity. Recent reports have documented the incidence of RF as high as 206/100.000 and RHD prevalence as high as

18.6/1000, though, there are variations in the different geographical areas [1-6]. The mitral valve (MV) is the most commonly affected. It is exclusively affected by 25% and is affected by other valves in 40% of patients [7]. Inoue K and colleagues were the first to perform Percutaneous Trans-Mitral Commissurotomy (PTMC) in 1982. Since then, PTMC became standard to help patients with MS who have favorable mitral anatomy for it. Also, there is a technical improvement in the procedure that influences the outcome [8].

PTMC is one of the nonsurgical commissurotomies in patients with hemodynamically significant mitral stenosis [9].

The success of PTMC is higher in patients with thin, pliable valve leaflets, and little subvalvular disease, subsequently the assessment of the mitral valve morphology is essential [10,11]. Although PTMC procedure increases the Mitral Valve Area (MVA), in some patients, this procedure is unable to obtain an optimal MVA, indicating the need for clinical evaluation before selecting the patient for the procedure [12-14]. Furthermore, other PTMC related complications such as cardiac perforation, embolic stroke, and mitral regurgitation limit the procedure. Occasionally, mitral regurgitation and mitral restenosis lead to emergency mitral valve replacement or a redo of PTMC subsequently [15,16]. PTMC tends to delay the need for MV replacement for about ten years or more, and some of these patients may be amenable for redo valvuloplasty [17,18].

Balloon commissurotomy has two major types, the double and the single balloon Inoue technique. The later has become the most popular worldwide [19]. The present study is aimed to assess the immediate, short, and long term outcomes of PTMC in patients with severe mitral stenosis and severe heart failure in Rajaei Cardiovascular Medical and Research Center that is a tertiary cardiac care center, Tehran, Iran.

Materials and Method

Patients and methods

In this observational cross-sectional study, the entire patient with heart failure and severe mitral valve stenosis who underwent PTMC between March-2009 and March-2015 in this tertiary cardiac care center were enrolled. The patients with severe left ventricular systolic dysfunction (LVEF less than 35%) and severe mitral stenosis who are a candidate for PTMC were all included. The patients with severe aortic insufficiency or stenosis or significant Coronary Artery Disease (CAD) were excluded. The change in dyspnea according to NYHA Functional Class (FC), valvular surface area, SPAP, and MR in a day before the procedure and after it (one day and 6 months later), are evaluated. For all the patients, the self-positioning single balloon (Inoue balloon technique) was used for the commissurotomy. Successful PTMC determined as an increased of the mitral valve surface more than 1.5 cm^2, or at least about 50% increased size in echocardiography.

Statistical analysis

SPSS 18.0 (Chicago, USA) was used for all statistical analyses. Continuous and categorical variables are presented as mean ± standard deviation or median and were assessed with appropriate tests. The student t-test was used to compare the quantitative variables, and the Chi-square test was used to compare the categorical variables. The two groups were compared using Pearson's chi-square or Fisher Exact test for a categorical variable. From the nonparametric test, Wilcoxon was used to measuring the relationship between ordinal and categorical variables. $p<0.05$ was considered as the level of significance.

Results

In the current study, 20 patients [mean age: 46.0 ± 13.09 years old, 11 (55%) female] were enrolled. Of them, 16 (80%) patients had atrial fibrillation rhythm. The systolic PAP was decreased from 61.25 ± 9.15 mmHg to 36.75 ± 3.72 mmHg and 34.5 ± 3.2 mmHg one day and six months after PTMC, respectively ($p<0.001$). The MVA was increased from 0.76 ± 0.14 mm^2 before the procedure to 1.26 ± 0.17 mm^2 one day after procedure ($p<0.001$); however, the MVA has not been changed considerably after six months of follow up. Also, the NYHA function class of patients significantly was better during follow up (Table 1). The mean of EF was 28.5 %, which no changes were observed after the procedure. Although there were some patients with mild mitral regurgitation, nobody experiences mitral regurgitation more than mild following the PTMC procedure.

	Before the procedure	24 hour after the procedure	Six months after the procedure	P-value
Clinical findings				
Dyspnea NYHA FC				
I	0		10(50%)	<0.0001
II	8(40%)		10(50%)	
III	8 (40%)		0	
IV	4 (20%)		0	
Echocardiography findings				
SPAP (mmHg)	61.25 ± 9.15	36.75 ± 3.72	34.50 ± 3.20	<0.001
MVA (cm^2)	0.76 ± 0.14	1.26 ± 0.17	1.26 ± 0.17	<0.001
MR severity				
No	7(35%)	3(15%)	3(15%)	0.01
Mild	13(65%)	17(85%)	17(85%)	
MR: mitral regurgitation; MVA: mitral Valve area; sPAP: systolic pulmonary arterial pressure				

Table 1: Clinical and echocardiography findings before and after PTMC procedure in patients with severe systolic heart failure.

Discussion

One of the most frequent long term complications of rheumatic fever is MS. PTMC has become a prevalent technique over time to relieve symptom for selected patients with moderate to severe MS, with Inoue technique that introduced by Inoue et al. in 1984 [20]. The immediate outcomes of PTMC are similar to those with closed and open surgical mitral commissurotomy [21]. Nevertheless, PTMC is recommended as a Class I indication for symptomatic patients in the absence of contraindication [22]. This study was done in a tertiary center with a high volume PTMC procedure [23]. In our study, we evaluated the high-risk patients with systolic heart failure and server MS. The females were predominantly more than males which the results are similar to another study performed in Iran [24,25]. The MVA usually doubles, with a 50% to 60% reduction in transmitral gradient. In this study, similarly, the MVA was significantly increased after the procedure. Overall, 80% to 95% of the patients may have a successful procedure, which is defined as MVA>1.5 cm^2 in the absence of complications [26]. In our study, the MVA was significantly increased after PTMC, and after six months of follow-up, there wasn't a significant change in the mitral valve area. Some other studies showed mitral anatomy is one of the best predictors of mitral opening

after the procedure; however, a good result could also be obtained in some cases with a high score if procedure performed in a high volume center with excellent operator experience [27]. Rheumatic process and/or abnormal turbulences by the already deformed valve are the pathophysiology of mitral stenosis in rheumatic heart disease. Both mechanisms might contribute to further commissural fusion, thickening, and calcification of valvular or subvalvular structures both in natural and previously commissurotomized valves. Interstitial myocardial infiltrates and Aschoff nodules have been observed in the ventricular myocardium of patients with rheumatic carditis, but significant myocyte necrosis is usually absent, even in patients with congestive heart failure [28].

Previous studies demonstrated the rapid progression of valve disease in those subjects with a greater mitral valve echocardiographic scores and higher peak and mean transmitral gradients [29]. In a study by Gul et al. 141 cases with isolated mitral stenosis who underwent PTMC were enrolled, which of them 24 cases had LVEF less than 50%. Twenty-four hours echocardiography after the procedure showed that 10 (7.1%), 6 (4.2%), and 4 (3%) had respectively mild, moderate, and severe MR. Also, EF improvement was found in this study in comparison to ours, which showed no significant EF change ($p>0.05$). In other studies, reduced SPAP was mostly seen [30].

In another study, Shikano and collaborators evaluated thirty-three cases with isolated MS and showed 21% of the cases with reduced constriction of the left ventricle. In addition, they explained, the incidence of the AF inpatient with lower EF was more than the group with normal EF (85% vs. 31%); the results were similar to our study in which we showed 80% of the cases had AF [31]. Another study showed that 52 cases that underwent PTMC were followed for the six months, with no significant change in valvular surface area after the procedure, similar to our study. This study also showed thirty-three cases experience clinical improvement during the follow up [32], and in our study in spite of severe left ventricular systolic dysfunction, NYHA Functional class in majority cases had been prominently improved.

The increased mitral valve regurgitation has been considered as PTMC complications, and in our study, only four of the cases had increased mitral valve regurgitation to a mild degree after the procedure. In this study, patients had a severe left ventricular failure, and after the procedure, although left ventricular preload was increased, there was not only clinical deterioration but also improvement according to patients FC, on the other hand, reduced SPAP was seen in those patients that cause improving in NYHA FC.

Bilen et al. showed that there was no significant difference between LVEF in patients with MS and control group ($p>0.05$), but patients with MS had significantly lower LV longitudinal strain and strain rate measurements than the control group although there were no significant differences in MS subgroups for LV strain and strain rate measurements [33]. Lee and collaborators evaluated patients with isolated MS (without considering left ventricular function) and showed that there was a significant change in the larger range in the pathology of the protoplasm of a myocardial cell, but no relationship with severity of the stenosis was found [34]. In a study by Gash, it was shown that although there was no relationship between LVEF in patients with or without MS, 30% of the cases had LVEF less than 50% [35]. In the present study, the mean of EF was 28.5% which was not changed even after the procedure.

Conclusion

Despite the increase of the preload and severe LV dysfunction, after PTMC procedure, the patient's dyspnea was improved and also, SPAP was decreased. According to our results, there is a desirable outcome after PTMC, even in severely ill patients with severe MS and heart failure, when procedure performed in an experienced center by professional operators.

Study Limitation and Suggestion

The major limitation was our small sample size, and not a randomized trial, we would suggest the studies with greater sample size, and randomized control trials to predict the better outcome. Another limitation was the presence of the patients who refused to follow the study; therefore, we remove them from our project.

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