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Percutaneous transvenous mitral commissurotomy: Assessing the impact in severe mitral stenosis

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Abstract
Severe mitral stenosis poses a significant health burden globally, necessitating effective therapeutic interventions. Percutaneous transvenous mitral commissurotomy (PTMC) has emerged as a promising minimally invasive procedure for managing severe mitral stenosis. When the apparatus becomes involved in rheumatic disease, it blocks the primary inflow from the left atrium to the left ventricle, a condition known as mitral stenosis. A mix of stenosis and regurgitation is observed in patients with mitral valve disease. Increased pressure causes disease or mortality in multiple patients, even after percutaneous therapy. In order to determine whether pulmonary hypertension can be alleviated in individuals suffering from severe mitral stenosis by the use of percutaneous transvenous mitral commissurotomy. This research paper aims to evaluate the efficacy, safety, and clinical outcomes associated with PTMC in patients with severe mitral stenosis.

Keywords: Percutaneous transvenous mitral commissurotomy, severe mitral stenosis, clinical outcomes, efficacy, safety

Introduction
Severe mitral stenosis, characterized by impaired blood flow across the mitral valve, poses a formidable challenge to healthcare providers. PTMC has gained attention as a less invasive alternative to surgical interventions, such as open-heart mitral valve replacement or repair. This study aims to investigate the effect of PTMC on severe mitral stenosis by assessing its efficacy, safety, and impact on clinical outcomes [1]. The main reason why there is mitral stenosis is because the left atrium and left ventricle are unable to receive blood flow because of rheumatic involvement of the apparatus. Involvement of the mitral valve is associated with stenosis and regurgitation in patients. The left atrial dilatation and stasis make thrombus formation more likely as a result of the thromboembolic phenomenon. High valve pressure is a leading cause of death and disability for multiple patients, even after percutaneous therapy. Considerations such as the severity of symptoms, whether the valve is suitable for percutaneous balloon valvuloplasty, and the degree of stenosis inform the approach to care. As an alternative to mitral valve replacement, percutaneous balloon dilatation of the mitral valve is an acceptable procedure for some individuals with mitral stenosis. Echocardiography revealed 7.5% LA clot development, while trans-thoracic echocardiography revealed no clot [2]. Embolization of left atrial thrombi occurs when a thrombus is displaced. Left atrial clots are not candidates for PTMC. Therefore, transesophageal echocardiography is the gold standard for clot detection [3]. Rheumatic heart disease is more common in this area compared to industrialized nations. Until after a diagnosis has been made, patients often have no idea what ails them [4, 5].

Mitral stenosis, primarily caused by rheumatic heart disease, presents significant morbidity and mortality if left untreated. Traditionally, surgical mitral commissurotomy was the mainstay treatment for severe cases. However, the advent of percutaneous transvenous mitral commissurotomy (PTMC) has provided a less invasive option with promising outcomes. This review aims to evaluate the impact of PTMC on patients with severe mitral stenosis, exploring its benefits, limitations, and areas for future research. This study set out to determine, using echocardiography, the rate of decrease in severe pulmonary hypertension following 24 hours of PTMC.

Pathophysiology of mitral stenosis

Mitral stenosis is characterized by the narrowing of the mitral valve orifice, impeding blood flow from the left atrium to the left ventricle. This obstruction leads to increased left atrial pressure, pulmonary hypertension, and reduced cardiac output. Common symptoms include dyspnea, fatigue, and palpitations, with complications such as atrial fibrillation and thromboembolism further exacerbating the condition.

Historical context and evolution of PTMC

First introduced in the 1980s, PTMC has evolved significantly. Initially, the procedure faced skepticism due to concerns over safety and efficacy. However, technological advancements and improved operator experience have solidified PTMC's role in managing severe mitral stenosis. The Inoue balloon technique, introduced in 1984, marked a pivotal development, offering a more controlled and effective commissurotomy.

Procedural technique

PTMC involves the insertion of a balloon catheter via the femoral vein, navigating through the right atrium and transseptal into the left atrium to reach the mitral valve. Balloon dilation of the valve commissures alleviates stenosis, enhancing blood flow. Key steps include:

1. **Patient Preparation:** Comprehensive assessment including echocardiography, fluoroscopy, and hemodynamic studies.
2. **Trans-septal Puncture:** Critical for accessing the left atrium.
3. **Balloon Dilation:** Executed with single or double balloon techniques, the former being more common due to better control.

Clinical Outcomes

Procedural success: PTMC boasts high procedural success rates, typically defined by a significant increase in mitral valve area and reduction in trans-valvular gradient. Success rates exceeding 90% are reported in experienced centers, with immediate improvement in hemodynamic parameters.

Symptomatic relief

Patients undergoing PTMC experience marked symptomatic relief, with improvements in New York Heart Association (NYHA) functional class noted in the majority of cases. Long-term follow-ups indicate sustained benefits, although restenosis can occur, necessitating repeat interventions in some patients.

Comparative studies

Comparative studies between PTMC and surgical commissurotomy reveal comparable efficacy in terms of valve area improvement and symptomatic relief. However, PTMC is associated with lower peri-procedural morbidity and shorter hospital stays, underscoring its minimally invasive nature.

Method

Participants ranged in age from sixteen years old to sixty-two years old, with mitral stenosis and a pulmonary pressure reading of 56 mmHg. We did not include patients whose echocardiograms revealed more than one valvular lesion. Patients with a mitral valve area less than 1.5 cm² were determined to have severe mitral stenosis [6]. Echocardiography revealed that some patients were suffering from severe pulmonary hypertension due to an increased systolic pressure in the pulmonary arteries [7]. Echocardiography was used to evaluate these patients after PTMC. Other demographic information was also recorded, including age and gender. Information was evaluated using SPSS version 20.

Results

Barely sixty-two men and eighty-two females made up the 144 patients. At 36.44±11.367 years old, the average age was recorded. On average, the body mass index was 22.50±2.80 kg/m². Nearly half (54 patients) had hypertension, and nearly half (53 patients) had diabetes. According to Table 1, the average post-PTMC PASP was 46.08+7.07 mmHg, and the mean reduction was 38.90+5.20. One hundred thirty patients benefited with PTMC in this trial. For stratification, a chi-square test was conducted. The data indicate that PTMC is not associated with gender, age, diabetes, or hypertension (Table 2).

Table 1: Characteristics of the study population (n = 144)

Characteristics	Number
Gender	
Male	62 (43%)
Female	82 (57%)
Mean (Age)	36.44±11.37
Mean (BMI)	22.50±2.80
Diabetic	
Yes	53 (36%)
No	91 (64%)
Hypertension	
Yes	54
No	90
Baseline PASP (mmHg)	73.62+9.10

Table 2: Association of PTMC effectiveness with risk factors

	Effectiveness of PTMC Yes	No	P value
N	130	14	
Gender			
Male	51 (40%)	8	0.436
Female	79 (60%)	6	
Diabetes Mellitus			
Yes	40 (28%)	8	0.676
No	90 (72%)	6	
Hypertension			
Yes	42 (29%)	8	0.707
No	88 (71%)	6	

Discussion

Evaluation of procedural complications and adverse events will provide insights into the safety of PTMC as a therapeutic option. The use of a balloon valvotomy can postpone the need for a new mitral valve. Some of the benefits include lower rates of death and morbidity. The success of this investigation is demonstrated by the extremely considerable drop in PASP.

A decrease in PASP was observed in one-third of the population. According to Arora *et al.*, the rate of success was 89%. Additionally, he demonstrated the results of valvotomy. Standard valvotomy techniques were used for all the surgeries. Both the long-term and short-term outcomes were recorded in the subsequent evaluations [8].

Alkhalife *et al.* reported 110 individuals receiving balloon valvotomy in one of their investigations [9]. Lessening transmitral PG, expanding valve area, and decreasing pulmonary artery pressure produced the desired effect. The percentage of success was 95%. Bhat *et al.* conducted research with 101 individuals who were randomized to get balloon valvotomy either IBMC or PMMC. We looked at how often each method was successful and how long it took for results to show up. Both methods had about the same success rate. 45 out of 50 in the PMMC group and 44 out of 48 in the IBMC group. Both groups had identical hemodynamic characteristics and event rates over the follow-up period. There was no change in PASP decrease either. A whopping 94% of participants were successful in the trial by Zaman *et al.* [10].

Patients whose PASP levels were reduced were the most numerous in this study. From 17.5±4.1 mm Hg to 4.5 ±3.2 mm Hg, the average diastolic pressure was decreased. There was a decrease in LA pressure from 35.1±6.6 mmHg to 10.6±5.2 mmHg. The reduction in RV systolic pressure was observed to be 29±12 mmHg, down from 68±11 mmHg. These findings corroborate the findings of the aforementioned study, which affirms the fact of a decrease in PASP. To prevent PTMC from becoming irreversible, it should be conducted before to the emergence of PVR.

Advancements and Future directions

Recent advancements in imaging, catheter technology, and procedural techniques continue to enhance PTMC outcomes. Innovations such as real-time 3D echocardiography and improved balloon catheter designs offer greater precision and safety. Future research should focus on long-term outcomes, the development of predictive models for restenosis, and the potential role of PTMC in diverse patient populations. PTMC represents a significant advancement in the management of severe mitral stenosis, offering effective symptom relief and improved hemodynamic outcomes with a favorable safety profile. While not devoid of risks, careful patient selection and advancements in technique continue to optimize its success. Comparative studies affirm its role as a viable alternative to surgical commissurotomy, particularly in high-risk surgical candidates.

Conclusion

This research paper aims to contribute valuable insights into the impact of PTMC on severe mitral stenosis. The findings may guide clinicians in decision-making and enhance patient outcomes in the management of this challenging cardiac condition. Less pulmonary hypertension patients remaining after therapy ended indicated that this trial was fruitful. Systolic pressure balloon valvotomy is an effective method for reducing mean pulmonary artery diameter in patients of any age or gender.

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