Comparison of Immediate and Long-Term Outcome of Percutaneous Transvenous Mitral Commissurotomy in Patients Who Have and Have not Undergone Previous Surgical Commissurotomy

Takahide Ito, MD; Michihiro Suwa, MD; Yuzo Hirota, MD; Yoshio Kita, MD;
Yoshiaki Otake, MD; Ayaka Moriguchi, MD; Haruhiko Onaka, MD;
Keishiro Kawamura, MD

This study compared the immediate and long-term outcome of percutaneous transvenous mitral commissurotomy (PTMC) in patients who had (restenosis group, $n=9$) or had not (de novo group, $n=27$) previously undergone surgical mitral commissurotomy. The baseline echocardiographic score, which is an index of deformity of the mitral valve apparatus, was significantly higher in the restenosis group than in the de novo group (11 ± 3 vs 7 ± 2 , $p<0.01$), although age, left atrial diameter, and the prevalence of atrial fibrillation were similar. PTMC was performed by the Inoue technique, and was abandoned in 1 patient from the restenosis group because of failed trans-septal puncture. Including this patient, 3 patients (33%) in the restenosis group had a thickened atrial septum compared with only 1 (4%) in the de novo group. One patient in the de novo group developed cardiac tamponade during this procedure. In both groups, the mitral valve area increased significantly, but the success rate of PTMC was lower in the restenosis group (4/9 patients, 44%) than in the de novo group (22/27 patients, 81%) ($p<0.05$). Twenty-six patients who had successful PTMC were followed up over 51 ± 14 months. After 4 years of follow-up, 3 out of 4 patients (75%) in the restenosis group and 3 out of 22 patients (14%) in the de novo group demonstrated echocardiographic restenosis ($p<0.01$). Stepwise multivariate analysis revealed that the echocardiographic score was the only significant predictor of both the immediate and long-term outcome. In conclusion, the immediate and long-term outcome of PTMC were worse in patients who had undergone previous surgical mitral commissurotomy than in those who had not. This was mainly attributable to the difference in the severity of the valvular lesions. In addition, our data suggested that a thickened atrial septum, possibly related to surgery as well as chronic rheumatic disease, may affect the performance of PTMC.

(Jpn Circ J 1997; 61: 218–222)

Key Words: Mitral stenosis; Percutaneous transvenous mitral commissurotomy; Immediate and long-term outcome; Surgical mitral commissurotomy

Percutaneous transvenous mitral commissurotomy (PTMC) has been used as an alternative to surgical mitral commissurotomy in patients with symptomatic mitral stenosis^{1–3}. Subsequently, this procedure was proved to be effective even in patients with mitral restenosis after surgical commissurotomy^{4–6}. Previous reports have shown that the immediate and

short-term outcome of PTMC are similar in patients with and without previous mitral valve surgery^{5,6}. However, compared with patients without a history of mitral valve surgery, patients who develop restenosis after surgery have more serious valvular lesions because of the longer duration of disease or because of the operation itself^{7,8}. The severity of valvular lesions

(Received May 27, 1996; revised manuscript received July 5, 1996; accepted July 29, 1996)

Third Division, Department of Internal Medicine, Osaka Medical College, Takatsuki, Osaka, Japan

Mailing address: Michihiro Suwa, MD, Third Division, Department of Internal Medicine, Osaka Medical College, 2-7, Daigaku-cho, Takatsuki City, Osaka, 569, Japan

Table 1 Baseline Characteristics of the 2 Groups

	<i>De novo</i> group (n=27)	<i>Restenosis</i> group (n=9)	<i>p</i> Value
Age (years)	55±12	56±8	ns
Male/female	9/18	4/5	ns
No. of patients with AF	18(67%)	8(89%)	ns
NYHA Class			
II	9	2	
III	11	5	
IV	7	2	ns
Echo-score	7±2	11±3	<0.01
Left atrial diameter (mm)	50±6	53±7	ns
No. of patients with IAST	1(4%)	3(33%)	<0.05

Values are expressed as means±SD. AF, atrial fibrillation; Echo-score, echocardiographic score; NYHA, New York Heart Association; IAST, thickening of the interatrial septum.

before PTMC, which is expressed as echocardiographic score, is reported to be a significant predictor of the outcome after this procedure.^{5,9,10} Thus, the post-PTMC outcome might be expected to be worse in patients who have previously undergone surgical commissurotomy. In the present study, we compared the immediate and long-term outcome of PTMC in patients with and without previous surgical mitral commissurotomy.

Methods

Between July 1988 and March 1994, we attempted PTMC in 36 patients with symptomatic mitral stenosis. Among them, 9 (restenosis group) had undergone open mitral commissurotomy 12.5±2.7 (mean±SD) years before. The remaining 27 patients (de novo group) had not undergone mitral valve surgery previously. Both groups were selected using the following criteria: no evidence of atrial thrombus on transesophageal echocardiography, no recent systemic embolism, and no more than grade II mitral regurgitation. All patients underwent clinical and noninvasive studies before and after PTMC. Diagnostic cardiac catheterization was performed immediately before PTMC.

After right and left heart catheterization, PTMC was performed by the Inoue balloon technique.¹ Cardiac output was measured using the thermodilution method and intracardiac pressures were recorded on a strip chart. These hemodynamic measurements were also performed after PTMC. Left ventriculography was performed before and after PTMC to confirm the degree of mitral regurgitation. Successful PTMC was defined as a mitral valve area ≥1.5 cm² and an increase in mitral valve area of at least 25%.⁸ The mitral valve area before and immediately after PTMC was assessed by the pressure half-time method

using transthoracic Doppler. In 26 patients who had successful PTMC, follow-up study was performed after 51±14 (mean±SD) months (range 11–74 months). At follow-up, the mitral valve area was also estimated by the pressure half-time method. Mitral valve restenosis was defined as >50% loss of the mitral valve area and/or a valve area <1.5 cm².⁸

Deformity of the mitral valve was quantified using an echocardiographic score according to the criteria of Wilkins et al.¹¹ A maximum of 4 points was assigned for each of 4 characteristics according to the severity: valvular calcification, impaired mobility, valve thickening, and subvalvular changes (0 indicates normal and 4 the most severe abnormality). Then the 4 separate scores were totaled to give the overall echocardiographic score. Scoring was done by careful review of the videotapes of transthoracic echocardiograms by 2 or 3 echocardiographers who were not informed of the outcome of PTMC. The thickness of the atrial septum was measured in the transverse view on transesophageal echocardiograms. If the minimum thickness was >2 mm, the septum was considered to be thickened.

Statistical Analysis

Data are expressed as means±SD. Differences between the 2 groups were analyzed with the unpaired *t* test. The paired *t* test was used for comparing the changes after PTMC. Differences in categorical variables were estimated using the chi-square test. Univariate analysis and stepwise multivariate analysis were performed to identify factors predicting immediate and long-term outcome of PTMC. A *p* value <0.05 was considered significant.

Results

The baseline characteristics of the 2 groups are

Fig 1. Appearance of the normal (left) and thickened (right) interatrial septum by transesophageal echocardiography. Arrows depict the interatrial septum (IAS). AoV, aortic valve; LA, left atrium; RA, right atrium.

Table 2 Hemodynamic Changes With PTMC

	<i>De novo group (n=26)</i>		<i>Restenosis group (n=8)</i>	
	<i>Pre-PTMC</i>	<i>Post-PTMC</i>	<i>Pre-PTMC</i>	<i>Post-PTMC</i>
PCWP (mmHg)	14±6	9±3*	15±3	11±2*
Transmitral pressure gradient (mmHg)	9±4	4±2*	8±2	5±2†
Cardiac output (L/min)	3.7±1.0	3.7±1.0	3.9±0.3	4.1±0.5
Mitral valve area (cm ²)	1.13±0.33	2.03±0.53*	1.22±0.24	1.81±0.60†

Values are expressed as means±SD. * $p<0.01$ and † $p<0.05$ compared with pre-PTMC. PCWP, pulmonary capillary wedge pressure; PTMC, percutaneous transvenous mitral commissurotomy.

shown in Table 1. Age, gender, prevalence of atrial fibrillation, New York Heart Association functional class, and left atrial diameter were similar in both groups. However, the echocardiographic score was significantly higher in the restenosis group than in the de novo group, and thickening of the atrial septum was more common in the restenosis group.

Immediate Outcome

One patient in the de novo group suffered from myocardial rupture with subsequent cardiac tamponade during PTMC, and died from low output syndrome several days later. No other complications were noted, such as the development of greater than grade II mitral regurgitation, cardiac tamponade, or thromboembolism. PTMC could not be performed in 1 patient from the restenosis group because transseptal puncture failed. Including this patient, 3 patients in the restenosis group had a thickened interatrial septum compared with only 1 in the de novo group (Fig 1). Changes in the hemodynamic variables induced by PTMC are shown in Table 2. In both groups, cardiac output was unchanged, but the mean pulmonary capillary wedge pressure and mean transmitral pressure gradient were reduced with a resultant

increase in mitral valve area. However, the success rate of PTMC was lower in the restenosis group (4/9 patients, 44%) than in the de novo group (22/27 patients, 81%) ($p<0.05$).

Long-Term Outcome

Twenty-two patients from the de novo group and 4 from the restenosis group were enrolled in the follow-up study. During the follow-up period, no deaths occurred. At 4 years after the start of follow-up, 3 patients from the de novo group (14%) and 3 from the restenosis group (75%) demonstrated echocardiographic evidence of restenosis ($p<0.01$).

Factors Predictive of Outcome

To determine predictive factors of both the immediate and long-term outcome, univariate and stepwise multivariate analyses were performed using the following variables: age, atrial fibrillation, left atrial dimension, echocardiographic score, and previous surgical commissurotomy. The results of the univariate analysis are listed in Table 3. The univariate analysis revealed that age and echocardiographic score were significant factors predicting the immediate outcome, and both echocardiographic score and previous

Table 3 Factors Predictive of the Immediate and Long-Term Outcome of PTMC by Univariate Analysis

Variables	Immediate outcome p Value	Long-term outcome p Value
Age	0.0483	0.8886
Rhythm	0.6368	0.4138
Left atrial diameter	0.0809	0.6408
Previous OMC	0.0774	0.0058
Echo-score	0.0032	0.0006

OMC, open mitral commissurotomy. Other abbreviations as in Table 1.

mitral valve surgery was directly related to the long-term outcome. With stepwise multivariate analysis, on the other hand, only echocardiographic score emerged as a significant factor predicting both the immediate and long-term outcome of PTMC.

Discussion

Immediate Outcome

PTMC has been shown to be a safe procedure even in patients who have previously undergone surgical mitral commissurotomy⁴⁻⁶. In our patients who had previously undergone surgical commissurotomy, no serious adverse event occurred during the perioperative period. There was a significant increase in the mitral valve area after PTMC in the restenosis group as well as in the de novo group. These results are similar to the findings of most previous series, in which the mitral valve area has been reported to increase from about 1.0 cm² to at least 2.0 cm².^{1,3} In the present study, however, the success rate was lower in patients who had had previous surgery than in those who had not. This finding contradicts previously published data that showed no difference.^{5,6}

The discrepancy between our results and those of others is most likely due to different baseline patient characteristics and population. The severity of the valvular lesions, the age and number of patients studied, and the incidence of atrial fibrillation as well as physician-related factors vary among studies. Of the factors being considered, the severity of the valvular lesions may contribute to a greater extent to this discrepancy, because the increase in valve area achieved by PTMC is inversely related to echocardiographic score.^{1,13} In our patients the echocardiographic score was significantly higher in those who had previously undergone surgery. Although the stepwise multivariate analysis revealed that previous surgical commissurotomy was not a factor predictive of the immediate outcome, our data suggest that more careful attention

should be paid to the management of symptomatic mitral stenosis in patients who have previously undergone surgical commissurotomy.

Thickening of the Atrial Septum

The present study suggests that a thickened atrial septum could prevent passage of the balloon catheter. Thickening of the atrial septum has not been considered previously as having a possible influence on the outcome of PTMC. There are several explanations for the high prevalence of a thickened atrial septum in patients with previous mitral valve surgery. First, the longer duration of disease may allow further progression of the rheumatic inflammatory response throughout the atrial septum? Given that neither PTMC nor surgical commissurotomy is carried out until patients with mitral stenosis become symptomatic, the duration of valvular disease would be at least 10 years longer in patients who have previously had surgery than in those who have not. Secondly, the operation itself may be responsible for thickening of the interatrial septum. For instance, right atrial manipulation at the time of cardiopulmonary bypass or any foreign trauma to the atrial septum, or both, might induce thickening of the atrial septum. Other causes of atrial septal thickening include the aging process and normal anatomic variation.

Our small sample size does not allow us to conclude that the thickened atrial septum definitely influenced PTMC. However, evaluation of the interatrial septum before PTMC may be useful for determination of an appropriate puncture site, allowing a reduction in patient and operator X-ray exposure.

Long-Term Outcome

Few data are available concerning the long-term results of PTMC.¹² Previous studies have demonstrated that, in patients who have previously undergone surgical commissurotomy, the short-term results of PTMC are discouraging even although the immediate results may be satisfactory.^{5,6} Like the immediate outcome, restenosis is reported to be directly related to a high echocardiographic score in patients undergoing PTMC.^{12,13} In the present study, 3 of 4 patients had echocardiographic restenosis after 4 years of follow-up. This result was consistent with the findings of a previous study, which showed that patients who had previously undergone surgical commissurotomy more frequently required mitral valve replacement after 4 years.¹² Considering that the immediate result was also discouraging in our patients with mitral restenosis, mitral valve replacement may be a better therapeutic choice for these patients.

Limitations

Some factors influencing the results of PTMC were not assessed in this study. These include balloon size, pre-PTMC functional class, and pre-PTMC grade of mitral regurgitation^{14,15}. The small sample size, which was the main limitation of this study, prevented inclusion of these variables in the statistical analysis. However, the main purpose of this study was to compare the outcome of PTMC in patients who had and had not previously undergone surgical commissurotomy, rather than to determine which factors predict the outcome of PTMC.

Conclusions

This study demonstrated that the immediate and long-term outcome of PTMC were less favorable in patients who had undergone previous surgical mitral commissurotomy than in those who had not. This difference was mainly attributable to the severity of the valvular lesions. Thickening of the interatrial septum may influence the performance of PTMC, although a larger study is required to confirm this.

References

1. Inoue K, Owaki T, Nakamura T, Kitamura F, Miyamoto M: Clinical application of transvenous mitral commissurotomy by a new balloon catheter. *J Thorac Cardiovasc Surg* 1984; **87**: 394–402
2. Al Zaibag M, Al Kasab S, Ribeiro PA, Al Fagih M: Percutaneous double-balloon commissurotomy for patients with mitral valve stenosis. *Lancet* 1986; **1**: 757–761
3. Nobuyoshi M, Hamasaki M, Kimura T, Nosaka H, Yokoi H, Yasumoto H, et al: Indications, complications, and short-term clinical outcome of percutaneous transvenous mitral commissurotomy. *Circulation* 1989; **80**: 782–792
4. Rediker DE, Block PC, Abascal VM, Palacios IF: Mitral balloon valvuloplasty for mitral restenosis after surgical commissurotomy. *J Am Coll Cardiol* 1988; **11**: 252–256
5. Medina A, De Lezo JS, Hernandez E, Pan M, Romero M, Merian F, et al: Balloon valvuloplasty for mitral restenosis after previous surgery: a comparative study. *Am Heart J* 1990; **120**: 568–571
6. Davidson CJ, Bashore TM, Mickel M, Davis K: Balloon mitral commissurotomy after previous surgical commissurotomy. *Circulation* 1992; **86**: 91–99
7. Brawnwald E: Valvular heart disease. In: Brawnwald E, editor. *Heart disease: a textbook of cardiovascular medicine*, 4th edn. Philadelphia: WB Saunders, 1992; 1007–1077
8. Arora R, Kalra GS, Murty RGS, Trehan V, Jolly M, Mohan JC, et al: Percutaneous transatrial mitral commissurotomy: immediate and intermediate results. *J Am Coll Cardiol* 1994; **23**: 1327–1332
9. Tuzcu EM, Block PC, Griffin B, Dinsmore R, Newell JB, Palacios IF: Percutaneous mitral balloon commissurotomy in patients with calcific mitral stenosis: immediate and long-term outcome. *J Am Coll Cardiol* 1994; **23**: 1604–1609
10. Ruiz CE, Zhang HP, Gamra H, Allen JW, K Lau FY: Late clinical and echocardiographic follow up after percutaneous balloon dilatation of the mitral valve. *Br Heart J* 1994; **71**: 454–458
11. Wilkins GT, Weyman AE, Abascal VM, Block PC, Palacios IF: 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
12. Hang I-K, Block PC, Newell JB, Tuzcu EM, Palacios IF: Percutaneous mitral balloon commissurotomy for recurrent mitral stenosis after surgical commissurotomy. *Am J Cardiol* 1995; **75**: 601–605
13. Abascal VM, Wilkins GT, O'Shea JP, Choong CY, Palacios IF, Thomas JD, et al: Prediction of successful outcome in 130 patients undergoing percutaneous balloon mitral commissurotomy. *Circulation* 1990; **82**: 448–456
14. Herrman HC, Wilkins GT, Abascal VM, Weyman AE, Block PC, Palacios IF: Percutaneous balloon mitral commissurotomy for patients with mitral stenosis: analysis of factors influencing early results. *J Thorac Cardiovasc Surg* 1988; **96**: 33–38
15. Post JR, Feldman T, Isner J, Herrmann HC: Inoue balloon mitral commissurotomy in patients with severe valvular and subvalvular deformity. *J Am Coll Cardiol* 1995; **25**: 1129–1136