# Comparison of Immediate and Mid-Term Results of Mitral Balloon Valvotomy in Children and Adolescents with those in Adults

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*Background and aim of the study:* **The study aim was to evaluate and compare the hemodynamic benefits of mitral balloon valvotomy (MBV) in young (child/adolescent) and older (adult) patients with severe mitral stenosis.**

*Methods:* **The younger group comprised 61 patients (mean age 17 ± 3 years), and the older group 264 patients (mean age 35 ± 10 years). All patients underwent MBV using an Inoue balloon to treat symptomatic and severe mitral stenosis. The long-term follow up of both groups was monitored on a comparative basis.**

*Results:* **The success rate of MBV was similar in both groups (95% in younger patients, 96% in older patients) (p = 0.36). Mitral valve area (MVA) was increased from 0.8 ± 0.2 to 2.0 ± 0.3 cm$^2$ in the younger group, and from 0.8 ± 0.3 to 1.9 ± 0.3 cm$^2$ in the older group. The mean mitral valve gradient was decreased significantly both in the younger group (from 13 ± 5 to 5 ± 2 mmHg) and older group (from 12 ± 5 to 5 ± 3 mmHg) (p <0.001). Both groups had similar MVA and mean gradient at baseline and follow up. At follow up (mean 37 ± 27 months), MVA monitored by Doppler echocardiography remained at 1.7 ± 0.4 and 1.6 ± 0.4 cm$^2$ (p = 0.08). Similarly, the mitral valve mean gradient remained stable (p = 0.92). Severe mitral regurgitation developed in one younger patient, and in seven older patients (p = 0.66). Two cases of tamponade occurred in each group, and one older patient suffered a transient stroke. There was no mortality in either group.**

*Conclusion:* **In patients with rheumatic mitral stenosis, the outcome of MBV in children and adolescents was at least comparable with that in adults. In addition, the benefits were similar in each age group on completion of follow up.**

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The prevalence of rheumatic mitral stenosis in both middle-aged and younger age groups in developed countries differs from that in developing countries (1-3). Age is a significant predictor of success for many cardiac procedures (4,5). Mitral balloon valvotomy (MBV) is the procedure of choice in adult patients with severe mitral stenosis and favorable anatomy (6,7). Although similar benefits have been reported in children and adolescents (8-10), few data are available regarding differences in outcome between the two groups following such intervention. Herein, the outcome and complications of MBV to treat mitral stenosis in children and adolescents were compared to those observed in adults.

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## Materials and methods

Hemodynamics data obtained during catheterization, together with echocardiography data, were obtained from adult patients (aged ≥20 years) with severe mitral stenosis (mitral valve area monitored by echo Doppler <1.2 cm$^2$) who underwent MBV. Similar data were also collected from younger patients (aged <20 years) with mitral stenosis who had undergone similar procedures.

A total of 325 patients was enrolled into the present authors' registry for MBV between December 1989 and December 1998. The mean age of younger patients (n = 61) was 17 ± 3 years, while that of older patients (n = 264) was 35 ± 10 years. MBV was carried out following a clinical evaluation and the performance of routine laboratory investigations which included complete blood count, urea and electrolytes, chest radiography and electrocardiography.

MBV was carried out using an Inoue balloon as described previously, in valves with a mitral echo score

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<10 and mitral regurgitation grade <2 using Seller's criteria (10,11). Cardiac hemodynamics data (with catheterization) and Doppler echocardiography (using the pressure half-time method) were acquired before and immediately after MBV. The procedural success of MBV was defined as an increase in mitral valve area of at least 50% from basal value, and in the absence of severe mitral regurgitation. Complications and mitral valve area were carefully recorded. At follow up, patients were assessed both clinically and echocardiographically.

**Statistical analysis**

A paired *t*-test was used to compare results (expressed as mean ± SD) before and after MBV, and at follow up examination. Differences were considered statistically significant if the p-value was <0.05. The chi-square test or Fisher's exact test was used to compare frequencies in non-continuous data.

## Results

Patient demographic and hemodynamic data are summarized in Table I. All subjects were symptomatic, and in NYHA classes III to IV. Similar incidences of atrial fibrillation were noted in the two groups: 3% (n = 2) in the younger group; 10% (n = 27) in the older group (p = 0.09). Previous surgical commissurotomy had been performed in 14 patients (5%) in the older group, but in no patient of the younger group (p = 0.07).

The success rate of MBV was similar in both groups: 95% (n = 58) in younger patients; 96% (n = 253) in older patients (p = 0.36). The mitral valve could not be crossed in two younger patients and in four older patients due to a hugely dilated left atrium. Both groups had similar mitral valve anatomy as scored by Wilkins score (mean 7.4 ± 1.4 in younger patients; mean 7.7 ± 1.3 in older patients; p = 0.14). The mitral valve area as assessed by echo Doppler was increased from 0.8 ± 0.2 to 2.0 ± 0.3 $cm^2$ in the younger group, and from 0.8 ± 0.3 to 1.9 ± 0.3 $cm^2$ in the older group (p <0.001). However, although there was no difference in mitral valve area between the two groups before MBV (p = 0.92), a significant difference was noted immediately after the procedure (p = 0.02). Similarly, mitral valve area, when assessed by catheter using Gorlin's formula, showed a significant difference between the two study arms following MBV (1.9 versus 1.7 $cm^2$; p = 0.02). However, this difference was not accompanied by any difference in mitral valve mean gradient between the two arms.

The mitral valve mean gradient decreased from 13 ± 5 to 5 ± 2 mmHg in younger patients, and from 12 ± 5 to 5 ±3 mmHg in older patients (p <0.001). The resultant gradient after MBV was similar in the two study arms (p = 0.92). The mitral valve mean gradient obtained after catheterization was consistent with the above data.

The catheter-derived mean left atrial pressure was decreased significantly, from 25 ± 6 to 15 ± 4 mmHg in

*Table I: Results of valvotomy by echocardiography and cardiac catheterization in younger (aged <20 years) and older (aged ≥20 years) patients.*

| Parameter | Pre-MBV | | p-value | Post-MBV | | p-value | Follow up | | p-value |
|---|---|---|---|---|---|---|---|---|---|
| | Younger | Older | | Younger | Older | | Younger | Older | |
| Patients (n) | 61 | 264 | - | - | - | - | - | | |
| Successful (n) | 58 | 253 | 0.36 | - | - | - | 50 | 278 | 0.08 |
| AF (n) | 2 | 27 | 0.09 | - | - | - | - | - | - |
| Catheterization* | | | | | | | | | |
| MVA ($cm^2$) | 0.8 ± 0.3 | 0.8 ± 0.2 | 0.92 | 1.9 ± 0.6 | 1.7 ± 0.5 | 0.02 | - | - | - |
| MMG (mmHg) | 17 ± 5 | 16 ± 5 | 0.16 | 6 ± 3 | 6 ± 2 | 0.92 | - | - | - |
| ASD | - | - | - | 1 | 3 | 0.74 | - | - | - |
| Echocardiography* | | | | | | | | | |
| Mitral score | 7.4 ± 1.4 | 7.7 ± 1.3 | 0.14 | - | - | - | - | - | - |
| MVA ($cm^2$) | 0.8 ± 0.2 | 0.8 ± 0.3 | 0.92 | 2.0 ± 0.3 | 1.9 ± 0.3 | 0.02 | 1.7 ± 0.4 | 1.6 ± 0.4 | 0.08 |
| MMG (mmHg) | 13 ± 5 | 12 ± 5 | 0.15 | 5 ± 2 | 5 ± 3 | 0.92 | 6 ± 2 | 6 ± 3 | 0.92 |
| ASD | - | - | - | 9 | 35 | 0.77 | 1 | 4 | 0.93 |
| MR | - | - | - | 1 | 7 | 0.66 | - | - | - |

*Values are mean ± SD.
AF: Atrial fibrillation; ASD: Atrial septal defect; MBV: Mitral balloon valvotomy; MMG: Mean mitral gradient; MR: Mitral regurgitation; MVA: Mitral valve area.

the younger group, and from 24 ± 6 to 16 ± 5 mmHg in the older group (with similar left atrial pressure in the two arms, before MBV (p = 0.24) and after MBV (p = 0.09)). The trend in the regression of catheter pulmonary artery pressure was similar in the two arms (p = 0.6). The catheter cardiac index measured by thermodilution method was increased from 3.0 ± 0.8 to 3.3 ± 0.8 l/min/$m^2$ in the younger group, and from 2.7 ± 0.6 to 3.0 ± 0.8 l/min/$m^2$ in the older group (p = 0.01).

**Study complications**

No deaths occurred in either patient group. One older patient had an embolic stroke, but recovered uneventfully within two days. This patient was in atrial fibrillation and receiving therapeutic doses of warfarin, but no transesophageal echocardiography was performed prior to MBV. No other embolic events occurred in any patient. Comparable rates of other complications were noted in the two groups. New mitral regurgitation occurred in 19% of the patients (n = 60), but severe mitral regurgitation was noted in eight (3%) (one younger patient and seven older patients; p = 0.66). Cardiac tamponade developed in two patients in each group (p = 0.11), and these were drained in the catheterization laboratory with no sequelae. Atrial septal defect (ASD) was detected (using color Doppler echocardiography) in nine patients of the younger group (15%), and in 35 patients of the older group (13%) (p = 0.77). On oximetry, ASD was observed in one younger patient and three older patients (p = 0.74), indicating the presence of non-significant hemodynamic shunts.

**Follow up**

All patients showed an improvement in symptoms to NYHA class I-II, as reported elsewhere (12). Follow up was conducted in 278 patients (89%), with mean periods of 37 ± 27 months in the younger group and 44 ± 29 months in the older group (p = 0.08). Mitral valve area (assessed by Doppler echocardiography) was 1.7 ± 0.4 $cm^2$ in the younger group and 1.6 ± 0.4 $cm^2$ in the older group (p = 0.08). Mitral valve mean gradient values were 6 ± 2 and 6 ± 3 mmHg respectively in these patients (p = 0.92). ASD was detected in one younger patient and in four older patients (p = 0.93). Restenosis (defined as a follow up Doppler mitral valve area <1.2 $cm^2$ or >50 % loss of the initial gain in mitral valve area) developed in eight patients (13%) in the younger group, and in 25 patients (10%) in the older group (p = 0.28).

## Discussion

Several reports have provided favorable results for the immediate and long-term results of MBV to relieve mitral stenosis in both children and adolescents (8-10), though direct comparison with the outcome in adults has not been documented. The results of the present study showed a significant increase in mitral valve area following completion of the MBV, as well as an improvement in the hemodynamics of younger patients. This was noted both on catheter and echocardiography investigations of mitral valve area. Although the Wilkins score was similar, the younger age group was noted to have less calcification. This has been reported as the most useful predictor of suboptimal MBV intervention (13,14), but this benefit became less apparent as the follow up progressed. A possible explanation for this phenomenon is a more aggressive tissue reaction to injury during MBV, though this must be confirmed experimentally. Taking into consideration the smaller body mass index of children and adolescents (mean 1.5 ± 0.2 kg/$m^2$), the gains in mitral valve area appear higher in this age group. However, the decrease in mitral valve mean gradient between the two groups was not significant.

It is important here to stress the value of penicillin prophylaxis in reducing the recurrence - and future prevention - of rheumatic pathology in young patients, as patients with such valvular damage should have been treated up to their 20th year and for a period of not less than 10 years (15).

Another significant benefit was the gain in cardiac index, and this has been reported previously. The younger age group had a higher index as the cardiac compliance of the left ventricle decreased with age (16).

Overall, the complication rate was low and comparable in both groups. Severe mitral regurgitation was noted in 3% of patients, and systemic embolic complications occurred in one patient in the older group. ASD was observed on color Doppler to be similar in both groups, with ~14% immediately and 2% at subsequent follow up examination. Clinical data were available in 288 patients for up to 84 months, and symptomatic improvement in NYHA class ranged from I to II in the two groups. The restenosis rate in the two groups was also similar.

*In conclusion*, MBV - when performed in a younger age group - was favorable when compared with adults. The complication rate was similar, and the results of a mid-term follow up were equally satisfactory, in both groups.

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**References**

1. Stollerman GH. Rheumatic fever in the 21st century. Clin Infect Dis 2001;33:806-814
2. Rullan E, Sigal LH. Rheumatic fever. Curr Rheumatol Rep 2001;3:445-452
3. Carroll JD, Feldman T. Percutaneous mitral balloon valvotomy and the new demographics of mitral stenosis. JAMA 1993;270:1731-1736
4. Owada CY, Teitel DF, Moore P. Evaluation of Gianturco coils for closure of large (> or = 3.5 mm) patent ductus arteriosus. J Am Coll Cardiol 1997;30:1856-1862
5. Grassman E, Johnson S, Krone R. Predictors of success and major complications for primary percutaneous transluminal coronary angioplasty in acute myocardial infarction. An analysis of the 1990 to 1994 Society for Cardiac Angiography and Interventions Registries. J Am Coll Cardiol 1997;30:201-208
6. Gaasch WH. Eisenhauer AC. The management of mitral valve disease. Curr Opin Cardiol 1996;11:114-119
7. Palacios IF. Percutaneous mitral balloon valvotomy for patients with mitral stenosis. Curr Opin Cardiol 1994;9:164-175
8. Zaki A, Salama M, El Masry M, Elhendy A. Five-year follow-up after percutaneous balloon mitral valvuloplasty in children and adolescents. Am J Cardiol 19991;83:735-739
9. Joseph PK, Bhat A, Francis B, et al. Percutaneous transvenous mitral commissurotomy using an Inoue balloon in children with rheumatic mitral stenosis. Int J Cardiol 1997;62:19-22
10. Kinsara A, Fawzy M, Sivanandam V. Immediate and midterm outcome of mitral balloon valvotomy in children and adolescents. Can J Cardiol 2002;18:967-971
11. Sellers RD, Levy M J, Amplatz K, Lillehei CW. Retrograde angiography in acquired cardiac diseases: Technique, indications and interpretation in 700 cases. Am J Cardiol 1964;14:437-447
12. McKay C, Kawanishi D, Kotlewski A, et al. Improvement in exercise capacity and exercise hemodynamics 3 months after double balloon catheter valvuloplasty treatment of patients with symptomatic mitral stenosis. Circulation 1988;77:1013- 1021
13. Cannan CR, Nishimura RA, Reeder GS, Ilstrup DR, Larson DR, Holmes DR, Tajik AJ. Echocardiographic assessment of commissural calcium: A simple predictor of outcome after percutaneous mitral balloon valvotomy. J Am Coll Cardiol 1997;29:175-180
14. Block PC, Tuzcu EM, Palacios IF. Percutaneous mitral balloon valvotomy. Cardiol Clin 1991;9:271-287
15. Castagna PC, Frattini C, Vignati G, Austoni P. The follow-up in adulthood of subjects with progressive rheumatic disease in childhood. Considerations of secondary prevention. Minerva Pediatr 1990;42:543-546
16. Fawzy ME, Choi WB, Mimish L, et al. Immediate and long-term effect of mitral balloon valvotomy on left ventricular volume and systolic function in severe mitral stenosis. Am Heart J 1996;132:356-360