Late evolution of mitral commissurotomy in patients with low echocardiographic score

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Abstract

Objective: The purpose of this study was to analyze the late results with open mitral commissurotomy in patients with low echocardiographic scores and to identify variables influencing these late results.

Methods: We studied 50 patients who underwent open mitral commissurotomy due to rheumatic mitral stenosis at the Heart Institute University of São Paulo Medical School. Enrolled patients had a Wilkins echocardiographic score \( \leq 9 \) and a mean mitral valve area (MVA) of \( 0.94 \pm 0.19 \text{ cm}^2 \). Patients underwent clinical, electrocardiographic, and echocardiographic evaluations preoperatively, immediate postoperatively, at 6 months, at 12 months, and then annually for 11 years.

Results: There was no hospital mortality. During 383.58 patient/years of follow-up, there were two late deaths, one related to valve disease. Actuarial survival was \( 94.3 \pm 4.0\% \) at 11 years. The linearized reoperation rate was 1.3% patient/year, and the linearized thromboembolism rate was 0.8% patient/year. No patients developed endocarditis. The mean MVA was 2.50 \( \pm 0.44 \text{ cm}^2 \) during the immediate postoperative period, decreasing to 1.74 \( \pm 0.4 \text{ cm}^2 \) over 60 months \((P < 0.01)\). Although it was 1.40 \( \pm 0.24 \text{ cm}^2 \) at 132 months, variations observed after 60 months were not significant. In regard to MVA, patients with higher echocardiographic scores had worse late results than patients with low scores \((P = 0.002)\). Neither the grade of subvalvular apparatus involvement nor MVAs during the preoperative and immediate postoperative periods significantly influenced the late evolution of MVAs.

Conclusions: Open mitral commissurotomy produces satisfactory results in patients with low echocardiographic scores.

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1. Introduction

In 1925, Souttar [1] performed the first successful closed mitral commissurotomy (CMC), which was the gold standard for many years. In Brazil, between 1951 and 1953, Zerbini et al. [2] operated on 66 patients with a hospital mortality rate of 4.5% and good results on pure stenosis. CMC is still used in some countries because of its low cost [3]. However, the introduction of cardiopulmonary bypass allowed open mitral commissurotomy (OMC), permitting direct vision of the lesions in a clear surgical field.

In 1964, Kay et al. [4] described better hemodynamic results and similar mortality using OMC in comparison to closed operative approach to treating mitral stenosis. Although the introduction of cardiopulmonary bypass also allowed valve replacement, this decision depended on the surgeon’s evaluation in the operating room. The absence of previous criteria to define the best surgical indication was not a problem, because both techniques required thoracotomy and cardiopulmonary bypass.

In 1984, Inoue et al. [5] introduced percutaneous balloon valvuloplasty (PBV) for the treatment of mitral stenosis. In contrast to OMC, this procedure required rigid criteria specifying its indications. In 1988, Wilkins et al. [6] introduced an echocardiographic score that is calculated by the evaluation of four components (thickness, calcification and mobility of leaflets, and involvement of subvalvular...
Values (from 1 to 4) are settled to each component and a higher sum of values is related to a more diseased valve. PBV has been used in patients with echocardiographic score \( \leq 8 \). In most PBV series, the mitral valve area (MVA) has increased from about 1.0 to around 2.0 cm\(^2\) [7].

In 1994, Antunes et al. [8] reported results of a series of 100 patients selected for OMC by echocardiographic score. The early results were better than those achieved by others using PBV. Similarly, Cardoso et al. [9] showed that patients who underwent OMC had a better outcome (a greater immediate increase in MVA) in a 1998 comparative study of OMC versus PBV in patients with low echocardiographic scores. Thus, the purpose of this study was to analyze late results with OMC in patients with a low echocardiographic score and to identify variables influencing these late results.

2. Materials and methods

From January 1990 until August 1994, 50 consecutive patients underwent OMC for rheumatic mitral stenosis at the Heart Institute, University of São Paulo Medical School. Patients younger than 60 years of age, in functional class (FC) II, III or IV (NYHA, New York Heart Association) [10], and with an echocardiographic score \( \leq 9 \) were included. Patients with other cardiovascular disease requiring surgical treatment, previous embolic events, or echocardiographic evidence of a thrombus or moderate-to-severe mitral regurgitation were excluded. Informed consent was obtained from all patients, and our institutional human research ethics committee approved the study protocol.

Patient age ranged from 20 to 54 years (mean 32.68 ± 8.29 years) and 41 patients (82%) were female. The NYHA functional class was II in three patients (6%), III in 46 (92%) patients, and IV in one (2%) patient. Forty-six patients (92%) were in sinus rhythm and 4 (8%) were in atrial fibrillation. The MVA ranged from 0.50 to 1.40 cm\(^2\) (mean 0.94 ± 0.19 cm\(^2\)), and the transvalvar gradient ranged from 3.00 to 28.00 mmHg (mean 12.30 ± 5.57 mmHg). Forty-two patients (84%) had no regurgitation and 8 (16%) had mild regurgitation. The echocardiographic score was 4 in 3 patients (6%), 5 in 1 (2%), 6 in 10 (20%), 7 in 12 (24%), 8 in 18 (36%), and 9 in 6 (12%). Patients who underwent a hemodynamic study based on age criteria did not show any evidence of coronary disease.

The operations were done conventionally using cardiopulmonary bypass with moderate hypothermia (28 °C) and intermittent cold (4 °C) crystalloid cardioplegic solution. Patients underwent clinical and laboratory evaluations during the preoperative period, immediately postoperatively, at 6 months, at 12 months, and then annually for a maximum of 11 years.

Statistical analysis was performed using Kaplan–Meier actuarial survival curves and event linearized rates [11,12].

Repeated-measures analysis of variance [13] was used to study mean values of quantitative echocardiographic variables determined during follow-up and to compare MVA evolution between groups. Temporary missing data were incorporated into the analysis using all at random method [14]. When statistically significant differences were observed over time, multiple comparisons were done using the F-test on the basis of Wald statistics [15]. We also used a regression model to evaluate trends in the behavior of these variables over time [16]. A significance level of 5% (\( \alpha = 0.05 \)) was adopted.

3. Results

There was no hospital mortality. One patient underwent reoperation due to bleeding and six patients had acute atrial fibrillation reverted during their hospital stay. On the day before discharge, 48 patients (96%) were in FC I and 2 (4%) were in FC II. In regard to rhythm, 45 patients (90%) were in sinus rhythm, 4 (8%) were in atrial fibrillation, and 1 (2%) had an ectopic atrial rhythm. The MVA ranged from 1.70 to 3.60 cm\(^2\) (mean 2.50 ± 0.44 cm\(^2\)), and the increase in this area from baseline was statistically significant (\( P < 0.0001 \)). The transvalvar gradient ranged from 2.00 to 15.00 mmHg (mean 5.82 ± 2.55 mmHg), and the reduction in this gradient was also significant (\( P < 0.0001 \)). Mitral regurgitation was absent in 32 patients (64%), mild in 16 (32%), and moderate in 2 (4%).
Follow-up, consisting of 383.58 patient/years, was completed in 45 patients (90%). Two deaths occurred during follow-up, one at 30 months, not related to valve disease [11]. At 11 years postoperatively, actuarial survival was 94.3 ± 4.0% and valve-related actuarial survival was 96.4 ± 3.5% (Figs. 1 and 2, respectively).

In regard to reoperations, four patients underwent valve replacement and one underwent recommissurotomy during the late follow-up period. Two of these reoperations were performed after 72 months and one each after 74, 93 and 123 months of follow-up. Two procedures were indicated for restenosis, two for double lesions, and one for regurgitation. The reoperation linearized rate was 1.3% patient/year.

Two patients also underwent PBV during follow-up, one after 62 months and another after 95 months. The reintervention linearized rate (reoperation + PBV) was 1.8% patient/year, and the thromboembolism linearized rate was 0.8% patient/year. There were no cases of endocarditis in this series. In regard to cardiac function, 22 patients (50% of the patients who completed late follow-up) were in FC I, 14 (31.8%) were in FC II, and 8 (18.2%) were in FC III during the late follow-up period. In addition, 33 patients (75%) were in sinus rhythm, 10 (22.7%) were in atrial fibrillation, and 1 (2.3%) was using a pacemaker due to atrioventricular blockade.

The MVA varied over the study; Fig. 3 shows a significant continuous decrease in the mean MVA from the immediate postoperative period until the 36th postoperative month and then another significant decrease from the 48th to the 60th postoperative month. The MVA ranged from 1.2 to 2.5 cm² (mean 1.74 ± 0.4 cm²) at 60 months. Although the MVA ranged from 1.10 to 1.70 cm² (mean 1.40 ± 0.24 cm²) at 132 months, variations observed after the 60th month did not reach statistical significance (Fig. 3). There was a tendency for the MVA to stabilize during the late follow-up, as shown in the regression model (Fig. 4). The transvalvar gradient did not change during late follow-up relative to immediate results. In regard to valve function, 17 patients (38.6%) had no mitral regurgitation, 15 (34.1%) had mild regurgitation, 9 (20.5%) moderate, and 3 (6.8%) severe.

Comparative analysis revealed that the group with lower echocardiographic scores (4, 5 or 6) had better MVA results than the group with higher echocardiographic scores (7, 8 or 9) (P = 0.002) (Fig. 5). The groups did not significantly differ in regard to the baseline characteristics of age (P = 0.0912), gender (P = 0.4138), FC (P = 0.4187), or cardiac rhythm (P = 0.5664). Patients with lower (1 or 2) and higher (3 or 4) subvalvular components of their echocardiographic scores demonstrated similar MVA evolution (Fig. 6). These groups also did not significantly differ in regard to the baseline characteristics of age (P = 0.8801), gender (P = 0.6675), FC (P = 0.6703), and cardiac rhythm (P = 1.000).

Late MVA results also did not differ between patients with a preoperative MVA < 1 versus ≥ 1 cm² (Fig. 7). These groups also showed no significant baseline differences in gender (P = 1.000), age (P = 0.9534), FC (P = 0.2543), or cardiac rhythm (P = 0.6298). Similarly, patients with an immediate postoperative MVA ≥ 2.42 versus < 2.42 cm² had comparable late results. However, the group with a superior increase in MVA during the immediate postoperative period (i.e. MVA ≥ 2.42 cm² group) experienced a faster decrease in this variable during follow-up (Fig. 8). As with the previous comparisons, these
groups did not significantly differ in regard to baseline age ($P = 0.4387$), gender ($P = 0.1383$), FC ($P = 0.6092$), or cardiac rhythm ($P = 0.6092$).

4. Discussion

The good results and safety of OMC have been well known for decades [4]. The introduction of PBV offered new content to reactivate the discussion about the optimal treatment of mitral stenosis. Results of PBV in patients with echocardiographic scores $\leq 8$ have been considered comparable to those with OMC; however, the OMC studies reviewed by these investigators did not use this score in their patient selection [7,17].

Antunes et al. [8,18] were the first to test the hypothesis that OMC could provide better results in patients who were selected by echocardiographic score. They achieved good results, as expected, in their study of 100 patients with a preoperative echocardiographic score $\leq 10$. The mean MVA increased from a baseline value of $1.04 \pm 0.23$ to $2.88 \pm 0.49 \text{cm}^2$ during the immediate postoperative period. There was no hospital mortality [8]. Over 9 years of follow-up, the group demonstrated an actuarial survival rate of 96%, a freedom from reoperation rate of 98%, and a freedom from valve-related events rate of 92%. The mean MVA was $2.37 \pm 0.42 \text{cm}^2$ after a mean follow-up interval of $8.5 \pm 11$ years [18].

Although our results are not quite as good, we think our finding that the MVA evolution tends to stabilize late during follow-up is significant. Using a linear regression model, Essop et al. [19] described a continuously decreasing MVA during follow-up after OMC. In the present study, we used a different method proposed by Blackstone et al. [16].

A few randomized studies comparing OMC and PBV have been published. In one prospective randomized study, Ben Farhat et al. [20] compared three groups of 30 patients with rheumatic mitral stenosis and echocardiographic scores $\leq 8$ who underwent PVB, OMC, or CMC. Immediately after the surgery, the mean MVA increased from $0.9 \pm 0.2$ to $2.1 \pm 0.5 \text{cm}^2$ in the PVB group, from $0.9 \pm 0.2$ to $2.2 \pm 0.4 \text{cm}^2$ in the OMC group, and from $0.9 \pm 0.2$ to $1.6 \pm 0.3 \text{cm}^2$ in the CMC group. After 7 years of follow-up, the MVA had decreased to $1.8 \pm 0.4 \text{cm}^2$ in the PVB group, $1.8 \pm 0.3 \text{cm}^2$ in the OMC group, and $1.3 \pm 0.3 \text{cm}^2$ in the CMC group. The results from these surgical groups were not as good as expected, and the authors attributed this finding to demographic factors.
In a prospective randomized study conducted at our institution, Cardoso et al. [9] compared results from OMC and PBV in 88 patients with echocardiographic scores ≤ 9. During the immediate postoperative period, the mean MVA increased from 1.05 ± 0.25 to 2.18 ± 0.4 cm² in the PBV group and from 0.98 ± 0.21 to 2.52 ± 0.46 cm² in the OMC group. After 12 months of follow-up, the MVA had decreased to 2.02 ± 0.42 cm² in the PBV group and to 2.13 ± 0.32 cm² in the OMC group. Postprocedural mitral regurgitation was more frequent in the PBV group.

In another prospective randomized study, Reyes et al. [21] compared results from OMC and PBV in 60 patients with severe mitral stenosis and echocardiographic scores ≤ 11. The mean MVA immediately increased from 0.9 ± 0.3 to 2.0 ± 0.6 cm² in the OMC group and from 0.9 ± 0.3 to 2.1 ± 0.6 cm² in the PBV group. By 3 years postoperatively, the MVA had decreased to 1.8 ± 0.4 cm² in the OMC group but increased to 2.4 ± 0.6 cm² in the PBV group. We believe the latter finding was associated with postprocedural regurgitation; although the authors do not clearly establish a correlation between these events, they do describe a higher incidence of this complication (postprocedural regurgitation) in the PBV group. In regard to their OMC results, other studies [8,9,22], including our own series, have demonstrated superior outcomes.

In our study, comparative analysis revealed that the echocardiographic score was predictive of late outcomes, as expected. This correlation could support use of more rational surgical indication criteria for OMC. The subvalvular component of the echocardiographic score was analyzed because, in some previous studies, results of CMC and PBV were worst in patients with severe subvalvular involvement [23–25]. In fact, both procedures do not allow interventions on subvalvular lesions. Potential advantages of using OMC in this situation should be discussed, because our patients with more or less subvalvular involvement experienced similar MVA evolutions. Ideally, it would be desirable to analyze other components of the echocardiographic score. In our study, only the subvalvular component was high (3 or 4) in a sufficient number of patients to allow comparative analysis. Choudhary et al. [22] used the severity of subvalvular involvement, the presence of mitral valve calcification, left atrial thrombus/clot, mild regurgitation, and/or other valve disease, and failure or restenosis after CMC or PBV as indication criteria for OMC. In their 276 patients, the mean MVA increased from a baseline value of 0.52 ± 0.12 to 2.60 ± 0.60 cm² during the immediate postoperative period.

Comparison of our patients’ preoperative MVA values revealed better evolution in the group with higher values during this period; however, this finding is probably not significant because of the number of patients in the study. The findings upon comparing MVA values from the immediate postoperative period (i.e. that patients with a greater immediate increase in MVA experienced a faster decrease in MVA during follow-up) was unexpected.

In applying findings to clinical practice, we cannot consider a good immediate result (with MVA) as predictive of a better late evolution. Reyes et al. [21] described similar findings with PBV. Thus, we believe that echocardiographic score can be useful and serve as a better predictor of results with OMC.

5. Conclusion

In conclusion, OMC appears to provide satisfactory results in patients with low echocardiographic scores. Our findings also suggest that the MVA stabilizes during the late postoperative period and that the echocardiographic score influences late evolution of the MVA.

References