Severity of Subvalvular Impairment in the Results of Mitral Valvuloplasty with Inoue Catheter

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Abstract

Background: Balloon mitral valvuloplasty was introduced in 1984 by Inoue et al and is currently considered the method of choice in the treatment of mitral stenosis.

Objective: To compare results of mitral valvuloplasty in patients with mitral stenosis with subvalvular impairment ≥3 and <3.

Methods: Retrospective study with 104 patients undergoing mitral valvuloplasty with Inoue balloon. Patients were stratified into two groups: subvalvular impairment (SVI) ≥3 and SVI <3. The immediate results were compared at 12 months and 24 months or more between the groups with data obtained by echocardiography and hemodynamic study.

Results: The immediate results revealed success in both groups, with statistical significance pre / post-procedure regarding the echocardiographic and hemodynamic parameters and no significant differences between groups. Echocardiographic results at 12 months showed that the mean gradient and the valve area were similar and not statistically significant between the groups, the same occurring in the comparison of echocardiographic results at 24 or more months.

Conclusion: The results obtained with mitral valvuloplasty with Inoue balloon did not differ both in patients with subvalvular impairment ≥3 and <3.

Keywords: Mitral valve stenosis; Balloon valvuloplasty; Mitral valve

Introduction

Mitral balloon valvuloplasty was introduced in 1984 by Inoue et al.1 In 1986, McKay et al.2 put it into practice in the United States. In Brazil, it was first reported in 1987.3 It is currently considered the method of choice in the treatment of mitral stenosis.4,5

The selection of candidates for mitral valvuloplasty requires accurate assessment of the mitral valve morphology.6 The echocardiographic score proposed by Wilkins et al.7 is currently the most widely used instrument for the assessment of morphological characteristics of the mitral valve and, along with other mitral valve structures, it can provide data on the evolution. Young patients, valve anatomy with Wilkins echocardiographic scores ≤8 points, sinus rhythm, no history of mitral regurgitation prior to the procedure or history of surgical commissurotomy are cases with better outcomes.

It is worth noting that the echocardiographic score, being a predictor of late outcome, is not a contraindication to percutaneous valvotomy, even when it is high (>8 points), especially in the subgroup of patients at high surgical risk and in pregnant women with mitral stenosis in functional class III or IV of the New York Heart Association (NYHA), on optimized medication.8,9
The purpose of this study was to compare mitral valvuloplasty results with Inoue catheter in patients with mitral stenosis with subvalvular commitment ≥3 and <3, according to echocardiographic criteria.

Methods

This is a retrospective study with 104 patients undergoing percutaneous mitral valvuloplasty with Inoue balloon: 83 (79.8%) females and 21 (20.2%) males, average age 33.7±10.4 years.

The recommendation of all procedures considered the echocardiographic score, the mitral valve area, clinical examination and the patients’ symptoms.

The procedure was prescribed to patients with mobile thrombus or risk position (septum or mitral annulus and left atrium), associated mitral regurgitation >2/4+ by the Sellers et al. classification or another valve disease, coronary artery disease or congenital disease associated with surgical indication.

Patients were stratified into two groups using the echocardiographic score of Wilkins et al. with SVI ≥3 (n=47; 45.19%) and SVI <3 (n=57; 54.81%). Mitral regurgitation <2+ was present in 20 (19.20%) patients pre-procedure and 14 (13.46%) patients had undergone previous surgical commissurotomy; of these, 7 (50%) patients had SVI ≥3. Patients with echocardiographic score up to 9 were included.

The immediate results were compared after dilation in both groups using echocardiographic data (mean gradient and valve area) and hemodynamic data (mean gradient and systolic blood pressure in the pulmonary artery). The results obtained by echocardiography as to the mean gradient and mitral valve area were analyzed to draw a comparison between groups at 12 months and 24 or more months post-procedure.

The finding of mitral valve area after the procedure was considered a success, as calculated by echocardiography ≥1.5 cm² or 50% gain compared to the area measured before the procedure.

Failure was defined as discontinuation of the procedure caused by technical problems or due to the development of severe mitral regurgitation (3+ or 4+) after balloon inflation or death. Severe mitral regurgitation was determined by the method of Sellers et al. by regurgitating contrast area within the left atrium in left ventricular systole, using 3+ and 4+ for severe degree. Using the method of echocardiography (Echo), severe mitral regurgitation was defined by the extension of regurgitant jet into the left atrium by Doppler.

Restenosis was considered when it occurred during the mitral valve area follow-up calculated by echocardiography of <1.5cm² or loss of at least 50% of the initial gain on the first post-procedure echocardiography.

Student’s t-test was used for statistical analysis, considering significance when p<0.05.

Results

Immediate results

The procedure was successful in 103 patients (99.03%). Failure occurred in 1 (0.96%) patient in the SVI group ≥3 due to technical problems (inflation impossibility at distal portion of the balloon). Mitral regurgitation post-procedure occurred in 23 (22.12%) patients. 12 (52.17%) in the SVI ≥3 group and 11 (47.83%) in the SVI <3 group, being mild in 19 (18.4%) patients and moderate in 4 (3.8%) patients.

As shown in Table 1, in the SVI ≥3 group, the mean gradient on Echo decreased from 16.3±5.2 mmHg to 5.4±2.9 mmHg; the valve area on Echo increased from 1.16±0.24 cm² to 2.5±0.4 cm²; hemodynamic mean gradient decreased from 19.7±6.7 mmHg to 4.7±3.7 mmHg; and the systolic pulmonary artery pressure decreased from 75.8±26 mmHg to 58±23 mmHg. Therefore, comparing the immediate results, there was success in both groups, with statistical significance pre-/post-procedure regarding the echocardiographic and hemodynamic parameters and no significant differences between the two groups (Table 1).
### Table 1
Echocardiographic and hemodynamic results of the groups studied

<table>
<thead>
<tr>
<th>Groups</th>
<th>Mean gradient Echo (mmHg)&lt;br&gt;pre/post</th>
<th>Valve area Echo (cm²)&lt;br&gt;pre/post</th>
<th>Mean gradient Hemodynamic (mmHg)&lt;br&gt;pre/post</th>
<th>Pulmonary artery systolic pressure Hemodynamic (mmHg)&lt;br&gt;pre/post</th>
</tr>
</thead>
<tbody>
<tr>
<td>SVI ≥ 3</td>
<td>16.3±5.2 / 5.4±2.9&lt;br&gt;(p &lt;0.001)</td>
<td>1.16±0.24 / 2.5±0.4&lt;br&gt;(p &lt;0.005)</td>
<td>20.0±7.2 / 4.7±3.7&lt;br&gt;(p &lt;0.0001)</td>
<td>75.8±26.0 / 58.0±23.0&lt;br&gt;(p &lt;0.005)</td>
</tr>
<tr>
<td>SVI &lt; 3</td>
<td>15.7±5.4 / 5.5±2.3&lt;br&gt;(p &lt;0.005)</td>
<td>1.19±0.23 / 2.5±0.4&lt;br&gt;(p &lt;0.001)</td>
<td>19.7±6.7 / 4.7±3.3&lt;br&gt;(p &lt;0.0001)</td>
<td>64.2±17.0 / 49.7±13.0&lt;br&gt;(p &lt;0.001)</td>
</tr>
</tbody>
</table>

SVI = subvalvular impairment; Echo – echocardiography

### Results at 12 months

Eighty (n=80) patients reached 12 months of follow-up, with 71 (88.7%) patients under clinical and echocardiographic follow-up: 39 (54.93%) from the SVI ≥3 group and 32 (45.07%) from the SVI <3 group.

Comparing the echocardiographic results at 12 months, the mean gradient in the SVI ≥3 group was 5.9±2.8 mmHg and 5.2±2.1 mmHg in the SVI <3 group with no statistical significance between them. The valve area was 2.2±0.4 cm² in the SVI ≥3 group and 2.2±0.3 cm² in the SVI <3 group, also without statistical significance between the groups (Table 2).

### Results at 24 months or more

Fifty-seven (n=57) patients achieved 24 or more months of follow-up, with 46 (80.0%) patients under clinical and echocardiographic follow-up: 27 (58.70%) from the SVI ≥3 group and 19 (41.30%) from the SVI <3 group.

Restenosis occurred in 2 (4.34%) patients. Both belonged to the group with subvalvular impairment ≥3 and had prior valvular commissurotomy.

There was progression of mitral insufficiency in 6 (13.04%) patients: 4 (66.67%) from the SVI ≥3 group and 2 (33.33%) patients from the SVI <3 group, regression in 4 (8.70%) patients (two patients in each group) and mitral insufficiency in 3 (6.52%) patients, being 2 (66.67%) patients in the SVI ≥3 group.

Echocardiographic results at 24 months or more revealed: mean gradient of 5.9±3.1 mmHg in the SVI ≥3 group and 5.3±1.6 mmHg in the SVI <3 group with no statistical significance between the groups. Valve area of 2.2±0.5 cm² in the SVI ≥3 group and 2.2±0.2 cm² in the SVI <3 group with non-significant p (Table 3).
Table 3
Echocardiographic results at 24 months to 40 months of the groups studied

<table>
<thead>
<tr>
<th></th>
<th>SVI ≥ 3 group</th>
<th>SVI &lt; 3 group</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean gradient Echo (mmHg)</td>
<td>5.9±3.1</td>
<td>5.3±1.6</td>
<td>NS</td>
</tr>
<tr>
<td>Valve area Echo (cm²)</td>
<td>2.2±0.5</td>
<td>2.2±0.2</td>
<td>NS</td>
</tr>
</tbody>
</table>

SVI = subvalvular impairment; Echo = echocardiography; NS = non-significant

Discussion

Percutaneous mitral valvuloplasty using the Inoue technique is currently the most commonly used form of treatment of mitral stenosis in Brazil. It has proven to be a safe and effective procedure with good long-term and immediate results. In this study, it is observed that the patients characteristics are similar to those published by other national groups: prevalence of women (79.8%) and mean age of 33.7 years, being different from those of developed countries, where patients are older and there are more men. This difference can be attributed to the rheumatic etiology of mitral stenosis in the Brazilian population and the prevalent degenerative etiology in the second group.

In the study sample, the success rate was similar to that reported by other authors: Nascimento et al. = 94.2%; Chen et al. = 96.0%; Cardoso et al. = 100%) with no difference in SVI ≥3 groups and SVI <3.

The appearance of mild mitral regurgitation after mitral valvuloplasty using balloon catheter can occur in 33% to 50% of patients. However, the presence of higher degrees of mitral regurgitation can be observed in the range of 4.0 to 9.0%. In the immediate results, mild mitral regurgitation is found in 18.4% of patients and moderate in 3.8% of patients, occurring similarly in both groups. In the follow-up of 24 months or more there has been a greater tendency to progression and onset of mitral regurgitation in the SVI ≥3 group.

Chen et al. observed 5.2% restenosis rate, Cardoso et al. presented a rate of 2.3%, which is consistent with the rate found in this study (4.3%), the two cases in the SVI ≥3 group. In cases of restenosis, percutaneous mitral valvotomy can be performed as a first choice. There are reports of patients undergoing up to four procedures with good results. The two patients in this study underwent new percutaneous mitral valvuloplasty with success criteria.

The echocardiographic score proposed by Wilkins et al. is a strong determinant in the indication of percutaneous mitral valvuloplasty and is well established that patients with scores ≤8 have better immediate and long-term results and lower complication rates. However, there are few studies that specifically evaluate the subvalvular structure in determining the results after mitral valvuloplasty.

Lemos et al. had not found differences in the success rates considering the echocardiographic score or even when more specific characteristics are considered (e.g., abnormalities in the subvalvular structure). Abascal et al. revealed that of the four components of the echocardiographic score, valvular thickening had the highest correlation with the abnormality in the valve area, followed by subvalvular disease while mobility and calcification had the lowest correlation.

In this study, no differences were found in the immediate and medium-term results comparing the two groups of patients: with SVI ≥3 and SVI <3.

Conclusion

Percutaneous mitral valvuloplasty with Inoue balloon catheter in patients with subvalvular impairment ≥3 allows good immediate and medium-term results. It is
not different from the results obtained in patients with subvalvular impairment <3.

Potential Conflicts of Interest
This study has no relevant conflicts of interest.

References


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This study had no external funding sources.

Academic Association
This study is not associated with any graduate programs.

