Results of Mitral Valve Replacement, with Special Reference to the Functional Tricuspid Insufficiency

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Summary

(1) Surgical results of mitral valve replacement were studied especially in reference to the functional tricuspid insufficiency observed in 31 patients with advanced mitral diseases.

(2) Eighteen patients were complicated with right heart failure manifested by hepatomegaly, oliguria and ascites at the time of admission, and 13 patients did not reveal this manifestation. Cardiothoracic ratios were 70% in the former and 66% in the latter, the pulmonary artery pressures 73.5 mm Hg and 66.5 mm Hg, and the right atrial pressures 16.2 mm Hg and 7.5 mm Hg, respectively.

(3) Mitral valves were replaced with Starr-Edwards' prostheses in all cases. Isolated mitral valve replacement was performed in 17 patients, mitral valve replacement combined with tricuspid annuloplasty in 7 patients and simultaneous mitral and tricuspid valve replacement in 7 patients. There were 3 early deaths and 2 late deaths.

(4) Hemodynamic studies on the follow-up state revealed that the pulmonary artery pressures were reduced in most cases, but on the contrary, the right atrial pressures were variable. In patients with right heart failure undergoing isolated mitral valve replacement, there was a higher incidence of the unsatisfactory results in the follow-up period.

(5) From the results of this series, the authors propose that the functional tricuspid insufficiency should not be left alone but treated surgically according to its severity, that is, moderate tricuspid insufficiency in patients without right heart failure should be intervened by tricuspid annuloplasty and severe tricuspid insufficiency in patients with right heart failure needs tricuspid valve replacement.

Additional Indexing Words:
Advanced mitral valve diseases Functional tricuspid insufficiency
Isolated mitral valve replacement Tricuspid annuloplasty Tricuspid valve replacement

It has been stated that the functional tricuspid insufficiency (TI) in patients with mitral stenosis would be expected to regress after correction of the primary lesion. However, in patients with advanced mitral lesions under-
going mitral valve replacement (MVR) it remains controversial. The purpose of this paper is to study on this problem from the authors’ experience.

CASE MATERIALS

TI was confirmed during surgery in 31 of 66 patients with MVR in this institute. Because tricuspid valves were pliable and appeared to be normal on palpation and inspection in all cases, the nature of TI was decided as functional. Nine patients were male and 22 patients female. Ages ranged from 17 to 55 years and the averaged age was 34.3 years (Table I). Atrial fibrillation was disclosed in all but 2 patients and systemic artery or cerebral embolism had occurred in 3 patients before admission. Ten patients suffered from pure or predominant mitral stenosis and 21 patients from pure or predominant mitral insufficiency. Cardiotoracic ratios ranged from 89 to 54 per cent and the average was 68.7 per cent (Table II). At the time of admission, right heart failure manifested by jugular pulsation, hepatomegaly, oliguria and ascites was demonstrated in 18 patients, and they had been all medicated by diuretics as well as digitalis glycosides for long term. Two patients revealed simultaneously severe left heart failure and were in orthopnea.

Right heart catheterization was preoperatively carried out in 22 patients. In 8

<table>
<thead>
<tr>
<th>Age (Yrs.)</th>
<th>Group A</th>
<th>Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td>17-20</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>21-30</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>31-40</td>
<td>3</td>
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<td>41-50</td>
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<td>51-55</td>
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</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>13</td>
</tr>
</tbody>
</table>

Table I. Ages of Patients and Their Conditions at the Time of Admission

<table>
<thead>
<tr>
<th>CTR %</th>
<th>Group A</th>
<th>Group B</th>
</tr>
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<tbody>
<tr>
<td>54-60</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>61-70</td>
<td>5</td>
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</tr>
<tr>
<td>71-80</td>
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<td>Unknown</td>
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<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>13</td>
</tr>
<tr>
<td>Aver. CTR</td>
<td>70%</td>
<td>66%</td>
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</table>

Table II. Preoperative Values of Cardiotoracic Ratios
Fig. 1. Right atrial pressures at preoperative catheterization.

Fig. 2. Pulmonary artery pressures at preoperative catheterization.
of 18 patients with right heart failure at the time of admission (Group A) the right atrial pressures were from 2.5 to 24 mm Hg and the average value was 16.2 mm Hg, and more than 15 mm Hg in all but 1 patient. In 10 of 13 patients without right heart failure (Group B) the right atrial pressures were from -2.5 to 14 mm Hg and the average value was 7.5 mm Hg (Fig. 1). Pulmonary artery pressures were more or less elevated in most patients. The averaged systolic pressure of the pulmonary artery was 73.5 mm Hg in Group A and 66.8 mm Hg in Group B, respectively (Fig. 2).

Operative Methods

Mitral valve replacement was performed through the median sternotomy under the standard cardiopulmonary bypass and intermittent anoxic arrest. Mitral cusps, chordae tendineae and papillary muscles were resected en-bloc, and Starr-Edwards' ball-valve prostheses were fixed by multiple figure-of-eight sutures. According to preoperative hemodynamics and intraoperative findings, tricuspid annuloplasty was concomitantly performed in 7 patients. Annuloplasty was achieved by buttressed mattress-sutures placing at the lateral and/or inner commissures. In 7 other patients, tricuspid valves were replaced with Starr-Edwards' prostheses simultaneously. Aortic regurgitation was observed in 2 patients but was not operated upon because of its mildness. Preoperatively, complete A-V block was disclosed in a patient and a demand-type pacemaker was also implanted.

Surgical Results

Group A: Isolated MVR was performed in 8 patients, MVR combined with annuloplasty in 4 patients and double valve replacement in 6 patients, respectively. Of these 18 patients, 2 cases with isolated MVR and 1 case with double valve replacement died in the early postoperative period. The first case was a 29-year-old female of mitral insufficiency associated with mild aortic regurgitation and severe pulmonary hypertension (Pp/Ps: 1.0), and died from low output failure immediately after isolated MVR without surgical intervention on her severe TI expecting its spontaneous regression. The second case was a 55-year-old female of mitral stenosis. Her postoperative course was deteriorated by pulmonary insufficiency and dehiscence of the sternum-wound, and expired 5 days after isolated MVR. The third case was a 46-year-old female of mitral insufficiency associated with severe accumulation of ascites and oliguria. She died 38 days after double valve replacement due to uremia which occurred 34 days postoperatively and was not improved by peritoneal dialysis. In the follow-up period, 1 case died probably from cerebral embolism 20 months after surgery, but not from cardiac dysfunction.

When the preoperative symptoms of right heart failure persisted or recurred in the follow-up period, the condition was decided as poor. Six
patients were in the poor condition. Five of them with isolated MVR needed medication of both digitalis and diuretics in spite of restriction of salt-diet. Another patient of MVR combined with annuloplasty became rather worse postoperatively and after 7 months, underwent secondarily tricuspid valve replacement (TVR) with good result (Fig. 3, 4, 5). Four of 6 patients with MVR+TVR were in the good condition, although their immediate postoperative courses were rather eventful and prolonged because of their advancity and higher age (averaged 40.7 years). In one of them the postoperative term was too short to evaluate the final condition.

Group B: Isolated MVR was performed in 9 patients, MVR combined with annuloplasty in 3 patients and double valve replacement in 1 patient.

Fig. 3. Chest X-ray findings of a 23-year-old female, who underwent initially the isolated MVR and secondarily TVR. A: Preoperative, B: After MVR, C and D: After TVR.
Fig. 4. Pre- and postoperative findings of cardiac catheterization of the case of Fig. 3. Marked ventricularization and elevation of the right atrial pressure are demonstrated after isolated MVR.

Table III. Surgical Results

<table>
<thead>
<tr>
<th>Group</th>
<th>Procedure</th>
<th>No. of Pats.</th>
<th>Hospital Deaths</th>
<th>Convalescence</th>
<th>Follow-up</th>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Good</td>
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<tr>
<td>A</td>
<td>Isolated MVR</td>
<td>8</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>MVR+Annuloplasty</td>
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<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>MVR+TVR</td>
<td>6</td>
<td>1</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>B</td>
<td>Isolated MVR</td>
<td>9</td>
<td>0</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>MVR+Annuloplasty</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>MVR+TVR</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>31</td>
<td>3</td>
<td>1</td>
<td>16</td>
</tr>
</tbody>
</table>

There were no early death but one late death which was from traffic accident. In the follow-up period, 3 patients were in the poor condition, but the other 10 patients showed satisfactory results (Table III).
On the other hand, the hospital mortality of 35 patients without TI was 2.9 per cent (1 death) and no late death occurred.

**DISCUSSION**

The so-called functional tricuspid insufficiency is the result of right ventricular hypertension and dilatation of the tricuspid annulus. The optimal treatment of patients with TI is less well defined since there has been little information available concerning the follow-up study after MVR. This study was prompted by the experience that a patient of Group A with severe pulmonary hypertension died due to low output failure immediately after isolated MVR. Since then, the authors have carefully evaluated TI for all patients, and have actively treated this lesion according to its severity with a satisfactory result. The authors, then, were rather interested in the late results of patients associated with TI.

Braunwald and associates\(^2\) described from their experience of 28 cases
that many of these lesions would regress spontaneously after MVR, and the mechanism for the relief of TI should be related to the postoperative regression of pulmonary hypertension. Study on hemodynamics in the follow-up period of this series revealed that the pulmonary artery pressures were reduced even in patients followed by the poor condition as well as in patients with satisfaction (Fig. 6), and, nevertheless, in some of them right atrial pressures were rather elevated in the follow-up period (Fig. 7). From the authors' own experience it appears that TI should be surgically intervened according to its severity.

However, there has been no definite information to evaluate the severity as to choice of treatment, and the descriptions, heretofore, seem to be too subjective or obscure like as minimal, moderate or severe. The authors studied on the guide to anticipate the indication of surgical treatment of TI preoperatively. Values of the pulmonary artery pressure or Pp/Ps ratio were not available (Fig. 2). On the other hand, the right atrial pressure was in-
formative because it was distinctly more than 15 mm.Hg in Group A and less than 15 mm.Hg in Group B (Fig. 1), and interestingly there was a marked difference in incidence of the poor condition after isolated MVR between both groups (Table III). Therefore, the authors proposed that tricuspid insufficiency with atrial pressure higher than 15 mm.Hg should be concomitantly treated by certain surgical interventions.

The next problem is the selection of surgical methods, that is, tricuspid annuloplasty versus TVR. Starr and associates\(^3\),\(^3\) advocated an aggressive approach, concomitant TVR, when there would be still significant TI at the end of MVR, from their studies on postoperative hemodynamics and microscopic examination of resected specimens. Pluth and Ellis\(^4\) described that surgical correction was not necessary if TI was minimal, and if it was moderately severe to severe, TVR was the operation for choice. In this series, all but 1 patient treated by annuloplasty were satisfactory in the follow-up period, and this method appears yet to be valuable for patients, especially, of Group B, with moderate regurgitation through the tricuspid valve. However, the experience of another patient who was not improved by annuloplasty is to indicate the limitation of this method, and the authors also agree that TVR might be more reliable than annuloplasty about the long-term effectiveness
in patients of Group A with severe tricuspid regurgitation (Table III).

REFERENCES