Long-Term (29 Years) Results of Reconstructive Surgery in Rheumatic Mitral Valve Insufficiency

Sylvain Chauvaud, MD; Jean-François Fuzellier, MD; Alain Berrebi, MD; Alain Deloche, MD; Jean-Noël Fabiani, MD; Alain Carpentier, MD, PhD

**Background**—Results of conservative surgery are well established in degenerative mitral valve (MV) insufficiency. However, there are controversies in rheumatic disease. This study is the evaluation of one center for rheumatic MV insufficiency based on a functional approach.

**Methods and Results**—From 1970 to 1994, 951 patients with rheumatic MV insufficiency were operated on with the reconstructive techniques elaborated by Alain Carpentier. Aortic valve diseases were excluded. Mean age was 25.8 years (4 to 75), and sinus rhythm was present in 63%. The functional classification used was type I, normal leaflet motion, 71 patients (7%); type II, prolapsed leaflet, 311 patients (33%); and type III, restricted leaflet motion, 345 patients (36%). The combined lesion of prolapse of the anterior leaflet and restriction of the posterior was present in 224 patients (24%). Surgical techniques used were implantation of a prosthetic ring in 95%, shortening of the chords and leaflet enlargement with autologous pericardium, and commissurotomy. Hospital mortality rate was 2%. The mean follow-up was 12 years (maximum, 29 years): 8618 patients per year. Actuarial survival was 89±19% at 10 years and 82±18% at 20 years. The rate of thromboembolic events was 0.4% patients per year (33 events), with 3 deaths. Freedom from reoperation was 82±19% at 10 years and 55±25% at 20 years. The main cause (83%) of reoperation was progressive fibrosis of the MV. The actuarial rate of reoperation was 2% patients per year and was correlated to the degree of preoperative fibrosis.

**Conclusions**—Conservative surgery of rheumatic MV insufficiency has a low hospital mortality rate and an acceptable rate of reoperation. The results are excellent regarding the minimal risk of thromboembolic events. (Circulation. 2001; 104[ suppl I]:I-12-I-15.)

**Key Words:** mitral valve ■ rheumatic heart disease ■ surgery ■ follow-up studies

Reconstructive procedures for rheumatic mitral valve insufficiency remain controversial. The risk of reoperation is higher than in degenerative diseases. However, long-term evaluation is scarce. We reviewed our series from a single-center experience to determine the factors of outcome.

**Methods**

From 1970 to 1994, 951 patients were operated on for reconstructive surgery of isolated mitral valve (MV) insufficiency from rheumatic origin. Associated valve lesions, organic tricuspid valve lesions, and coronary artery disease were excluded. The mean age was 25.8±18 years (4 to 75); 291 patients (31%) were male.

Before surgery, 353 patients (37%) were in functional class (New York Heart Association) II, 503 patients (57%) in class III, and 96 patients (10%) in class IV; 598 patients (62%) were in sinus rhythm. Acute rheumatic fever was present in 36 patients (4%) with corticosteroid therapy. The functional classification based on leaflet motion was used, assessed by cineangiocardiology or by echocardiography since 1982 and confirmed during surgery. Type I (71 patients) was characterized by pure annulus dilatation, type II (311 patients) by leaflet prolapse, and type III by restricted leaflet motion. In this group, a slight degree of MV stenosis was present, but insufficiency was predominant. Type IIa/IIp is a combination of prolapse of the anterior leaflet with retraction of the posterior leaflet and was found in 224 patients.

The clinical pattern was different according to the functional type (Table 1). In type III, patients were older than in type II and type IIa/IIp (P<0.05) and more likely to have atrial fibrillation (52%). The incidence of tricuspid valve insufficiency was more important in type III than in type II and IIa/IIp.

Reconstructive surgery used the techniques described by Carpentier. A rigid Carpentier ring was used in most of the cases (95%) (Table 2). Prolapse of the anterior leaflet caused by chordal or papillary muscle elongation was treated by chordae shortening. Chordal transfer from the posterior to the anterior leaflet was used to treat anterior leaflet prolapse caused by ruptured chordae. Commissurotomy (anterior, posterior, or both) was used in 39%, associated with splitting of the papillary muscle and resection of secondary chordae (27%). Localized calcification was present in 5% (43 patients), usually located on commissures. Triangular resection of the calcified area was performed with edge-to-edge suture. Leaflet enlargement with autologous pericardium (glutaraldehyde treated) was used since 1985 to increase the leaflet surface area and consequently to increase the size of the prosthetic ring.

Tricuspid annuloplasty was performed in 217 patients (22%) with a Carpentier ring (189 patients) or commissure plication (28 patients).
No any left appendage exclusion was performed when atrial fibrillation was present.

Postoperative anticoagulation treatment was recommended for 2 months and stopped when sinus rhythm was restored.

Follow-Up
Follow-up was achieved by telephone interview and mailed questionnaires to the referring physicians and to the patients. Data were obtained during the year 1999 and were 93% complete; 65 patients (7%) were lost from the follow-up. The cumulative follow-up was 8618 patients per year. The mean follow-up was 12.3 years and maximum was 29 years.

Late survival and valve-related outcomes were recorded and analyzed according to the specifications of the Joint Society of Thoracic Surgeons, American Association for Standardizing Definitions of Prosthetic Heart Valve Morbidity.

Statistical Analysis
Univariate analysis of categorical data were carried out with $\chi^2$ or Fisher exact tests. Univariate analysis of continuous variables was carried out with the Student’s $t$ test. Late survival and time-dependent morbidity were evaluated with the Kaplan-Meier method and log rank test.

Results
The overall hospital mortality rate (30 days) was 2% (22 patients), with no difference regarding the functional types. The main cause of hospital death was myocardial failure (18), air embolism (4), mediastinitis (1), and aortic dissection (1). A pacemaker implantation was required in the early postoperative period in 7 patients (0.7%).

Actuarial survival at 10 and 20 years of follow-up was 89 ± 11% and 82 ± 18% (Figure 1). The log rank test did not detect any difference between the functional types. The causes of late death were heart failure without reoperation in 58 patients (6.2%), reoperations in 12 patients (1.2%), thromboemboli in 3 patients (0.3%), and cancer in 4 patients (0.4%). When the cause of the death was not known, the patients were included in cardiac death cause.

The extracardiac causes of death were minimal. Subsequently, the survival rate was similar to freedom from cardiac death.

NYHA functional class was I in 64%, II in 32%, III in 2%, and IV in 1%; 53% of the patients were in sinus rhythm. Among the patients with atrial fibrillation (47%), the compliance to the anticoagulation therapy could not be estimated.

The overall freedom from reoperation was 82 ± 18% at 10 years and 55 ± 25% at 20 years (Figure 2). The reoperation rate was 2% per patient per year; 192 patients were reoperated. The mean delay was 9.3 years (0.1 to 22 years). Mitral valve fibrosis with association of stenosis and recurrent insufficiency was present in 83% (157 patients), and technical failures occurred in 30 patients (17%) (Table 3). Bacterial endocarditis was present in 3 patients and hemolysis in 2 patients. A mitral valve replacement was performed in 169 patients and a second valve repair in 18 patients.

Freedom from reoperation was different regarding the functional type. At 20 years, freedom was 65%, 63%, and 46% for types IIa/IIIp, II, and III, respectively (Figure 3). The reoperation rate was 1.9% per patient per year when a prolapse of the anterior leaflet was present and 2.7% per patient per year when motion of both leaflets was reduced ($P<0.05$); 70% of the patients with a pericardial patch were free of reoperation at 10 years. There is no difference with the others groups. Operative findings were fibrosis of the patch without calcification. A group of patients younger than 19 years was individualized. Freedom from reoperation at 5, 10, 15, and 20 years was 95%, 90%, 88%, and 86%, respectively (Figure 2).

During reoperation, an aortic valve replacement was necessary in 19 patients, tricuspid valve replacement in 3 patients, and tricuspid valve annuloplasty in 20 patients. Hospital death from reoperation rate was 6.5% (11 patients)

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**TABLE 1. Preoperative Data According to Functional Classification**

<table>
<thead>
<tr>
<th>Type</th>
<th>n</th>
<th>Age, y</th>
<th>FC, %</th>
<th>CTR</th>
<th>SR, %</th>
<th>TVI, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>71</td>
<td>26±12</td>
<td>0</td>
<td>22</td>
<td>33</td>
<td>16</td>
</tr>
<tr>
<td>II</td>
<td>311</td>
<td>21±12</td>
<td>0</td>
<td>42</td>
<td>50</td>
<td>8</td>
</tr>
<tr>
<td>IIa/IIIp</td>
<td>224</td>
<td>23±11</td>
<td>0</td>
<td>39</td>
<td>53</td>
<td>7</td>
</tr>
<tr>
<td>III</td>
<td>345</td>
<td>32±13</td>
<td>0</td>
<td>32</td>
<td>56</td>
<td>12</td>
</tr>
</tbody>
</table>

FC indicates functional class (NYHA); CTR, cardiothoracic ratio; SR, sinus rhythm; and TVI, functional tricuspid valve insufficiency.

Age and CTR are expressed as mean±SD.

**TABLE 2. Surgical Techniques**

<table>
<thead>
<tr>
<th></th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carpenter ring</td>
<td>899 (95)</td>
</tr>
<tr>
<td>Chordae shortening</td>
<td>717 (75)</td>
</tr>
<tr>
<td>Chordal transfer</td>
<td>99 (10)</td>
</tr>
<tr>
<td>Commissurotomy</td>
<td>373 (39)</td>
</tr>
<tr>
<td>Pericardial extension</td>
<td>65 (7)</td>
</tr>
</tbody>
</table>

![Figure 1. Actuarial survival of total cohort.](image-url)
when a replacement was necessary and 5.5% when a second repair was possible.

Thirty-five thromboembolic events occurred in 33 patients after valve repair: 0.4% per patient per year. Three events occurred in the first 3 months of postoperative course (2 hemiplegia and 1 gastrointestinal hemorrhage). After 3 months, most of the events were cerebrovascular accidents (29 patients). Systemic limb emboli occurred in 4 patients, and 4 patients had gastrointestinal hemorrhage. All the thromboembolic events were associated with atrial fibrillation; 15 patients recovered without sequelae, and 3 deaths occurred.

The freedom from valve-related events including hospital death, reoperation, late death, and thromboembolic events was (Figure 4) 93%, 82%, 72%, and 52% at 5, 10, 15, and 20 years of follow-up, respectively.

In the group of patients younger than 19 years of age, freedom from reoperation was 81% at 10 years and 54% at 20 years (Figure 5).

Patients operated at the acute phase of rheumatic fever had an operative mortality rate of 6% and a survival rate at 20 years of 60% (Figure 6). Freedom from reoperation was 53% at 20 years (Figure 7).

**Discussion**

This series is characterized by the young age of the population and the very long-term follow-up. The survival rate of this series is superior to valve replacement procedures. The young age of the patients (25 years) explains the nearly absence of extracardiac causes of death. The actuarial survival is stable with time, with no dramatic change at 20 years of follow-up.

**TABLE 3. Causes of Reoperation**

<table>
<thead>
<tr>
<th>Cause</th>
<th>Number (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean delay, y (range)</td>
<td>9.3 (0.1–22)</td>
</tr>
<tr>
<td>Mitral valve fibrosis, n (%)</td>
<td>157 (83)</td>
</tr>
<tr>
<td>Technical failures, n (%)</td>
<td>30 (17)</td>
</tr>
<tr>
<td>Residual prolapse</td>
<td>7</td>
</tr>
<tr>
<td>Ring dehiscence</td>
<td>6</td>
</tr>
<tr>
<td>Leaflet restriction</td>
<td>6</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>11</td>
</tr>
<tr>
<td>Endocarditis, n</td>
<td>3</td>
</tr>
<tr>
<td>Hemolysis, n</td>
<td>2</td>
</tr>
</tbody>
</table>

n=192 patients.

Rheumatic disease is currently known to carry a high risk of reoperation compared with degenerative disease. However, the global rate of reoperation is 2% patients per year. Surgery of anterior prolapse (associated or not with restrictive posterior leaflet) has a freedom of reoperation of 75% at 10 years and 66% at 20 years. Prolapse of the anterior leaflet has a high incidence in rheumatism. Shortening of chordae is a safe procedure confirmed by others. The factors of reoperation are related to the patient and to the functional type and not to the surgical procedure. Several authors found that young age is a predisposing factor of reoperation. From our data, we do not support this predisposing factor of reoperation. In our series, young age is correlated with prolapsed leaflet (type II) and lower incidence of reoperation compared with restricted leaflet motion (type III). The presence of some degree of commissural fibrosis is a deleterious factor. However, MV insufficiency at the acute phase of the inflammatory process is characterized by higher reoperation rate.

The choice of the surgical technique for patients with type III functional type is still under discussion. The reoperation rate is 2.7% patients per year, which is higher than with a mechanical prosthetic device. However, survival is 82% at 20 years and is not influenced by death from reoperation. Thromboembolism rate is very low (0.4% patients per year) despite atrial fibrillation, incidence which remains high. The noncompliance of this population to anticoagulation therapy must be considered in the choice of the treatment. This fact has been emphasized by Duran et al and underlines the importance of a nonthrombogenic surgical procedure.

Localization of rheumatic fever on the aortic valve necessitating a valve replacement was present in 19 patients (2% of the total cohort) at reoperation. A mild aortic valve disease was present at the first operation and ignored. Reoperation of these 19 patients underwent surgery of the aortic valve.
associated to reoperation on the mitral valve. Our present policy for associated mild aortic disease is to wait, considering that the time of aortic replacement is unpredictable.18,19

References
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