Valvular Heart Disease

Long-Term Results of Mitral Valve Repair in Active Endocarditis

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Background—Several investigators have reported the feasibility of mitral valve repair in active endocarditis, but the long-term results are still unknown.

Methods and Results—We reviewed 37 consecutive patients who underwent mitral valve repair with the Carpentier technique for active endocarditis in our center between 1989 and 1994. This repair involved prosthetic annuloplasty in 31 patients (84%), valve resection in 31 (84%), chordal shortening or transposition in 19 (51%), pericardial patch in 16 (43%), and direct suture of leaflet perforation in 4 (11%). Associated procedures were primarily aortic valve repair or replacement in 11 (30%) and tricuspid repair in 2 (6%). Early complications included 1 operative death (3%; 95% CI, 0 to 15.5) and 1 reoperation for pericardial patch dehiscence. Recurrence of endocarditis was observed in 1 patient (3%; 95% CI, 0 to 16). The 10-year survival rate and freedom from mitral valve reoperation were 80% (95% CI, 66 to 94) and 91% (95% CI, 81 to 100), respectively. At 10 years, most patients (96%) were in good functional status (NYHA class I to II) with no or trivial mitral regurgitation (92%) on echocardiography.

Conclusions—Mitral valve repair using Carpentier’s techniques in patients with active endocarditis offers very good long-term results with a low rate of recurrence or reoperation.

Key Words: mitral valve ■ endocarditis ■ valves

There is a general consensus for preferring mitral valve repair (MVRep) over mitral valve replacement (MVR) in the treatment of severe mitral regurgitation.1 When feasible, MVRep has been shown to reduce operative mortality and to improve long-term survival and functional status.2 Dreyfus et al3 reported on the first series of MVRep systematically performed during the acute phase of endocarditis. Since this report, others have confirmed the feasibility of MVRep for either active or healed endocarditis.4–12 However, in the setting of active endocarditis (AE), existing studies included only a few patients with relatively limited follow-up (mainly <5 years) (Table 1).

Knowledge of valve repair long-term durability and risk of endocarditis recurrence is necessary before recommending MVRep in AE. We report here, for the first time, the long-term results at 10 years of MVRep performed in the context of AE.

Methods

Study Population

Between January 1989 and December 1994, 37 patients with active native valve endocarditis underwent MVRep in our department.

Endocarditis was considered active when the operation was performed during the first 6 weeks of antibiotic therapy.1 Excluded from the study were 6 patients for whom a partial mitral homograft was used during valve surgery.

Patient age ranged from 9 to 72 years (median, 48 years). There were 29 male patients (78%) and 1 intravenous drug abuser (3%). Seventeen patients (46%) were operated on during the first 2 weeks of antibiotic therapy. The patients were in NYHA functional class NYHA I to II (46%) or III to IV (54%). The preoperative cardiac rhythm was atrial fibrillation in 2 patients (5%) and sinus rhythm in the remainder. On preoperative transthoracic echocardiography, mitral regurgitation severity was graded semiquantitatively as 1 to 2+ in 8 patients (22%) and 3 to 4+ in 29 patients (78%).

Operation was indicated before the initial full course of antibiotics was completed for 1 or several of the following results: hemodynamic deterioration (27 patients, 73%), large (>10 mm) vegetations and/or systemic emboli (17 patients, 46%), or persistent sepsis (1 patient, 3%). Our policy has changed through the years.3 Hemodynamic deterioration initially included patients with severe symptoms (NYHA class III to IV) and signs of congestive heart failure (15 patients, 41%). Secondarily, to improve the feasibility of MVRep, paucisymptomatic patients (NYHA I to II) with severe mitral regurgitation (grade 3 to 4+) were also included in the hemodynamic deterioration group (12 patients, 32%).

Underlying valve pathology was present in 12 patients (32%). The origin was rheumatic in 5 patients, degenerative in 6 patients, and congenital in 1 patient.
Bacteriology

The microorganisms responsible for endocarditis are reported in Table 2. The most common infecting organisms were streptococcus species in 20 patients (54%) and staphylococcus species in 11 (30%). Bacteria were isolated from blood culture in 30 patients (81%). Direct examination and culture of valve specimens were positive in 15 patients (41%) and 7 patients (19%), respectively.

Operative Findings and Surgical Techniques

All operations were performed through a median sternotomy on full cardiopulmonary bypass between the 2 venae cava and the ascending aorta. Mild systemic hypothermia (28°C to 30°C) was used in all cases. Myocardial protection was identical for all patients and consisted of an anterograde cold blood crystalloid cardioplegia with topical ice slush. Mitral valve exposure was achieved through either a standard left atriotomy along the interatrial groove (34 patients) or a trans-septal approach (3 patients).

Pathologic findings consisted of vegetations (86%), valve prolapse (86%) secondary to marginal chordal rupture, annular dilatation (76%), leaflet perforation (49%), and annular abscess (5%). Infection also involved the aortic valve in 8 patients (22%) and the tricuspid valve in 2 patients (5%).

All macroscopically involved tissue was widely removed without concern for the possibility of repair. Valve reconstruction was then performed according to Carpenter’s techniques.13 These included leaflet resection (84%), transposition of chordae (46%) or chordal shortening (5%), pericardial patching (43%) or direct suturing of perforation (11%). A Carpentier prosthetic ring was used in 31 cases (84%). All repairs were controlled perioperatively by transesophageal echocardiography.

Associated procedures were performed in 11 patients (30%). The aortic valve was either repaired (2 patients) or replaced (1 bioprosthesis, 1 mechanical valve, 3 aortic homografts, and 1 Ross operation). Repair of the tricuspid valve was also necessary in 2 patients.

An atrial septal defect was closed with a pericardial patch in 1 patient.

Follow-Up

Long-term follow-up data were obtained during a 4-month period through questionnaires and telephone contact with patients or relatives, physicians, and cardiologists. Information regarding cause of death was collected from physicians and cardiologists.

Long-term results were assessed on the basis of NYHA functional class, auscultation, ECG, and echocardiography. Cardiac rhythm, thromboembolic or bleeding events, recurrence of endocarditis, and reoperations were systematically recorded.

Statistical Analysis

Data were expressed as median (range) for continuous variables and as percentage for categorical variables. The 95% CI is given for most clinically relevant variables. Calculation of cumulative survival and freedom from events was performed by the Kaplan-Meier method.

Results

MVRep Feasibility

During the 5-year study, 49 consecutive patients were admitted to our department for native mitral valve AE. Among them, 6 patients (12%) underwent an MVR, and partial mitral valve homograft was used in 6 others. Thus, MVRep was possible in 75% to 85% of AE whether or not patients with partial mitral valve homograft were included.

Perioperative Morbidity and Hospital Mortality

One patient (3%; 95% CI, 0 to 15.5) died 19 days after MVRep. He developed several complications (splenic abscess, cholecystis, renal failure) leading to fatal multiple

<table>
<thead>
<tr>
<th>TABLE 1. Main Results From Surgical Series of Valve Repair in AE</th>
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<tbody>
<tr>
<td><strong>Population, n Operative Mortality, %</strong></td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>Dreyfus et al12 (1990)</td>
</tr>
<tr>
<td>Fuzellier et al9 (1994)</td>
</tr>
<tr>
<td>Podesser et al11 (2000)</td>
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<tr>
<td>Senni et al12 (2001)</td>
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<td>Sternik et al6 (2002)</td>
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*Mean follow-up (range).

<table>
<thead>
<tr>
<th>TABLE 2. Microorganisms Responsible for AE</th>
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<tr>
<td><strong>Gram-Positive Cocci</strong></td>
</tr>
<tr>
<td>(n=33, 89%), n (%)</td>
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<tr>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>Streptococcaceae, 20 (54)</td>
</tr>
<tr>
<td>Oral streptococci,* 8</td>
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<tr>
<td><em>Streptococcus bovis</em>, 7</td>
</tr>
<tr>
<td>Enterococcus faecalis, 3</td>
</tr>
<tr>
<td><em>Streptococcus pyogenes</em>, 1</td>
</tr>
<tr>
<td><em>Streptococcus agalactiae</em>, 1</td>
</tr>
<tr>
<td>Staphylococcaceae, 11 (30)</td>
</tr>
<tr>
<td><em>Staphylococcus aureus</em>, 9</td>
</tr>
<tr>
<td><em>Staphylococcus epidermidis</em>, 2</td>
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<tr>
<td>Culture negative, 2 (5)</td>
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Two bacteria were isolated from 1 patient.

*Included S sanguinis (n=3), S mitis (n=3), S mutans (n=1), and S salivarius (n=1).

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organ failure. Repeated postoperative echocardiography revealed a competent mitral valve without any signs of persistent endocarditis.

Postoperative morbidity mainly included low cardiac output syndrome (13 patients, 35%), transient complete AV block (3 patients, 8%), pericardial effusion (1 patient, 3%) requiring surgical drainage, and renal failure (1 patient, 3%) necessitating hemodialysis. No patient required placement of a permanent pacemaker. Bleeding, mediastinitis, and stroke were not observed. Median intensive care unit stay and hospital stay were 1 day (range, 1 to 28 days) and 10 days (range, 5 to 38 days), respectively.

One patient (3%; 95% CI, 0 to 15.5) was reoperated on 9 days after the first operation, which consisted of a quadrangular resection of the posterior leaflet. The valve defect was then replaced by a glutaraldehyde-treated pericardial patch. A massive mitral regurgitation, secondary to the patch dehiscence, occurred postoperatively and required emergent surgery. A repeated valvuloplasty was performed, consisting of a sliding leaflet plasty. Retrospectively, we think that the surgical valve repair performed during the first operation was inappropriate. This early reoperation was not considered a reoperation during the long-term follow-up.

Valve repair was assessed by transthoracic echocardiography in all survivors before hospital discharge. Mitral valve regurgitation was absent in 28 patients (78%). Residual mitral regurgitation was graded 1+ in 7 patients (19%) and 2+ in 1 patient (3%).

Long-Term Evaluation
Follow-up was complete in 35 patients (94%). Two patients were lost to follow-up 40 and 76 months after their operations. With the patient who died in the operative period excluded, median follow-up was 140 months (range, 12 to 183 months). Eight patients (22%) died during the follow-up period, for Kaplan-Meier survival rates (including the operative death) of 89% (95% CI, 80 to 98) at 5 years and 80% (95% CI, 66 to 94) at 10 years (Figure 1). Causes of death were cancer (n=4), sudden death (n=1), suicide (n=1), rupture of an abdominal aortic aneurysm (n=1), or unknown (n=1).

Recurrence of endocarditis was observed in 1 patient (3%; 95% CI, 0 to 16). This patient had a mitral and tricuspid valve repair during the acute phase of *Streptococcus pyogenes* endocarditis. Thirteen months later, he developed endocarditis resulting from *Staphylococcus aureus*. A mitral homograft was implanted in the mitral and tricuspid position. However, 53 months later, a new episode of endocarditis (*Streptococcus untyped*) was also diagnosed.

Four patients (11%; 95% CI, 2 to 28) were reoperated. One patient was reoperated on 88 months later for deterioration of an aortic homograft while the MVRep was satisfactory. He underwent a mechanical aortic valve replacement. Indications for mitral valve redo surgery were endocarditis (n=1; 13 months postoperatively) and mitral valve failure (n=2; 9 and 89 months postoperatively). In 1 case, mitral stenosis (small annuloplasty ring and leaflet fibrosis) occurred; in the other case, the valve failure was due to prosthetic ring dehiscence. These 2 patients underwent a mechanical MVR. Freedom from mitral reoperation was 94% (95% CI, 86 to 100) and 91% (95% CI, 81 to 100) at 5 and 10 years, respectively (Figure 2).

No thromboembolic or hemorrhagic episodes were reported during the follow-up period.

At the end of the study, 24 patients (median follow-up, 151 months; range, 117 to 180 months) were alive, not lost to follow-up, and not reoperated on for mitral valve failure or endocarditis. All except 1 patient (96%) were in NYHA functional class I to II. Atrial fibrillation was present in 1 patient, and another patient had a permanent pacemaker. The last Doppler echocardiographic studies as part of routine follow-up revealed no mitral regurgitation in 15 patients (63%). Residual mitral regurgitation was graded 1+ in 7 patients (29%) and 2+ in 2 patients (8%).

Discussion
In the present study, we have shown that MVRep performed in the setting of AE was associated with a low operative mortality (3%) and good long-term results. Ten years after the operation, 96% of the survivors were in good functional status (NYHA class I to II), and 92% had no or trivial mitral
regurgitation on echocardiography. Recurrence of endocarditis was rare (3%), and the 10-year rate of freedom from mitral reoperation was particularly high (91%).

The incidence of bacterial endocarditis in developed countries varies from 17 to 62 patients per 1 million person-years. Mitral valve endocarditis (isolated or not) accounts for 35% to 50% of valve endocarditis. In a recent French study, 46% of patients with isolated mitral valve endocarditis were operated on during their initial hospital stay. Native and prosthetic mitral valve endocarditis actually represents 3% and 1% of cases of mitral surgery, respectively.

There is still no consensus for the definition of AE. In surgical series, many authors considered “active” an endocarditis that required an operation before completion of a standard course of antibiotic treatment. Forty percent to 80% of patients with native or prosthetic mitral valve endocarditis are operated on during the acute phase. In the study of Aranki et al, this did not appear to affect the early and long-term mortality or the long-term risk of recurrent endocarditis.

As offers a large panel of lesions that can be simple or difficult to repair, depending on the location and extension of the infectious process. MVRp in AE was reported to vary from 34% to 78%. In specialized centers, MVRp is possible in 7 to 8 of 10 cases of AE by using Carpentier’s techniques. Involvement of a commissure by the infection, although frequently observed in AE (10 patients, 27%) in our series, is usually a condition feared by the surgeon. Reconstruction is usually possible, but in cases of extensive lesions involving both leaflets and 1 commissure at the mitral annulus is dilated to obtain a good surface of coaptation between the 2 valve leaflets. Although MVR with a total mitral valve homograft has been associated with a high rate of reoperation, the long-term durability of partial mitral valve homograft in AE is still unknown.

MVR in AE has been associated with 5% to 25% operative mortality. Lower rates, ranging from 0% to 9%, have been reported when an MVRp was performed. Congestive heart failure, the most frequent indication for early valve surgery in endocarditis, is a major risk factor of operative mortality. The better preservation of left ventricular function after MVRp compared with MVR may explain the lower mortality rates in AE. Conservation of the subvalvular apparatus may also reduce the degradation of left ventricular function after MVR. However, owing to the extension of the infectious process, this conservation is rarely possible in the setting of AE (≈25% of cases in the series of Lee et al). The prevalence of Staphylococcus aureus infection in our series was low (24%). A lower prevalence (12% for native valve endocarditis) has also been reported in a recent surgical series of mitral valve endocarditis. However, endocarditis resulting from Staphylococcus aureus has been associated with an increased risk of early complications in several reports. Therefore, our low operative mortality may also reflect the low prevalence of this microorganism in our study population.

In the last decade, there was a trend toward earlier operation for patients suffering from endocarditis. Early operation, before the occurrence of severe heart failure, may also reflect the lower mortality rate reported after MVRp in AE. In the study by Lung et al, only 44% of patients with AE had congestive heart failure. In our series, 41% experienced congestive heart failure. With increasing experience and good initial results, more paucisymptomatic patients (32%) were operated on as soon as possible, provided that mitral valve insufficiency was severe enough (grade >2+). Finally, early operation may also improve the feasibility of MVRp by allowing intervention before extensive leaflet destruction has occurred and thus prevent systemic embolization.

Recurrence of endocarditis is a major concern after valve replacement in AE. The rate of recurrence is <10%, but the prognosis is poor. Previous studies reported no or occasional recurrence of endocarditis in their early- or midterm follow-up after MVRp. Muehrcke et al have shown that reinfection-free survival at 6 years was better for patients who underwent MVRp for active or healed endocarditis compared with those who had MVR (95% versus 73%). In our long-term study, we observed recurrence of endocarditis in only 1 patient 15 months after the first operation. This low rate of recurrence (0.3% per year) in AE may reflect the fact that MVRp preserves viable native tissue that is probably more resistant to infection than a prosthesis.

An important surgical rule when dealing with valve surgery during AE is to avoid the use of prosthetic material as often as possible. A prosthetic ring was implanted in ~85% of our patients. Annuloplasty is recommended when the mitral annulus is dilated to obtain a good surface of coaptation. In complex MVRp, it also attenuates the mechanical stress on the suture lines. Owing to the low risk of recurrence of endocarditis in our series and in others, the advantage of using an autologous or heterologous pericardial annuloplasty ring in AE is purely speculative.

The 10-year survival was 80% (95% CI, 66 to 94) in the present study, which compares favorably with the 61% for MVR in AE reported by Alexiou et al. There were only 3 reoperations (9%) for mitral valve failure (1 endocarditis, 1 mitral stenosis, and 1 annular dehiscence). In addition to the lower rate of reoperations compared with MVR, MVRp is also associated with fewer thromboembolic or hemorrhagic events. No such complications have been observed so far in our patients. There were 2 intravenous drug abusers (5%) in our series; this proportion is similar to the 3% to 8% rate reported by other authors. In 1 patient, a partial mitral valve homograft was used because of extensive lesions of the mitral valve. The second patient had an MVRp. During the 10-year follow-up study, no mitral valve regurgitation occurred in the patient with MVRp. However, moderate regurgitation was detected 6 years after operation in the other drug abuse patient.

Present valvular substitutes have major drawbacks in the treatment of intravenous drug abusers. Poor compliance to oral anticoagulants may lead to severe thromboembolic events. The use of mitral bioprosthesis in young recipients is accompanied by a high rate of structural valve deterioration.
requiring reoperation. Total mitral valve homograft is technically more challenging, and its long-term durability is uncertain. Thus, owing to satisfactory long-term results and avoidance of long-term oral anticoagulation, MVRep (whenever feasible) appears to be a more appropriate surgical approach to mitral valve endocarditis, particularly for intravenous drug addicts.

In conclusion, MVRep in AE was possible in 3 of 4 cases of AE by using Carpentier’s techniques. MVRep was associated with a low operative mortality (3%) and very good long-term results. The mitral valve reoperation rate was low during the 10-year follow-up (9%), as was the recurrence of endocarditis (3%).

References
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