Mitral valve repair for bacterial endocarditis

Twenty-two patients with mitral insufficiency resulting from native valve endocarditis underwent mitral valve repair. Six patients had acute endocarditis with positive blood cultures and active valve infection. Sixteen patients were cured of active infection, but mitral insufficiency developed as a result of prior infection. Mean age was 48.5 ± 21.7 years; 13 (59 %) were male. Mean New York Heart Association functional class was 2.6 ± 1.2. Multiple valve lesions were present in 11 (50 %) patients. Valve abnormalities included leaflet perforation in 13 patients, chordal rupture or elongation in 14, vegetations in 5; and annular abscess in 1. In patients with acute endocarditis all macroscopically infected tissue was excised. Multiple techniques were required to achieve valve competence. Suture or patch closure of perforation was done in 14 patients, chordal shortening or transfer in 9, leaflet resection and closure in 4, leaflet resection with pericardial patching in 5, and annuloplasty in 15. Mitral valvuloplasty was combined with other procedures in 11 (50 %) patients. There were two (9 %) hospital deaths, both occurring in patients with healed endocarditis. There was one (9 %) death in a patient undergoing an isolated procedure and one (9 %) in a patient undergoing a combined procedure. Mean follow-up was 24 ± 16.8 months and was complete. Seventeen (85 %) were in New York Heart Association functional class I, and three (15 %) were in class II. There were no late deaths, reoperations, recurrent endocarditis, thromboembolic events, or other valve-related morbidity. We conclude that mitral valve repair for insufficiency resulting from bacterial endocarditis (1) is possible in acute and healed disease, (2) has a low operative mortality, and (3) has resulted in patients free of recurrent infection and valve-related morbidity and mortality. Mitral valve repair is an attractive alternate to valve replacement in bacterial endocarditis. (J THORAC CARDIOVASC SURG 1992;103:124-9)

William G. Hendren, MD,a Allen S. Morris, MD,a Eliot R. Rosenkranz, MD,a Bruce W. Lytle, MD,a Paul C. Taylor, MD,a William J. Stewart, MD,b Floyd D. Loop, MD,a and Delos M. Cosgrove, MD,a Cleveland, Ohio

The role of cardiac surgery in the management of native valve endocarditis continues to evolve. Currently native valve endocarditis is managed successfully in 80% to 90% of patients with extensive antibiotic treatment1,2; however, two groups of patients with this disease require operation: (1) those with acute infective endocarditis with poor response to antibiotics, septic emboli, evidence of annular abscess, onset of conduction disturbances, or hemodynamic instability and (2) patients who are bacteriologically cured but in whom mitral insufficiency has developed as a result of valve destruction during the infection. The accepted surgical therapy for both groups is mitral valve replacement. Little data are available to support repair of the mitral valve in the treatment of endocarditis. We were encouraged by the excellent early and long-term results with mitral valvuloplasty for diseases other than endocarditis, and therefore we began performing mitral valve repair for mitral insufficiency in patients with both acute infectious and bacteriologically cured endocarditis. To evaluate the efficacy of this approach, we have reviewed our experience.

Patients and methods

Patients with mitral insufficiency resulting from documented bacterial endocarditis of the native valve were included. Acute infective endocarditis was considered present if the patient had positive blood cultures, operative findings of acute inflammation, and positive culture or Gram's stain of excised tissue. Endocarditis was considered healed and inactive if operations for mitral insufficiency occurred more than 6 weeks after the initial diagnosis, a course of antibiotics was complete, blood
cultures were negative at the time of operation, and culture and Gram's stain of excised tissue were negative.

Between January 1985 and December 1989, 1513 patients underwent procedures on native mitral valves at The Cleveland Clinic Foundation. Fifty-one (3.4%) patients had native valve endocarditis (Fig. 1). Twenty-nine (56.9%) of these patients underwent mitral valve replacement. Twenty-two patients (43.1%) with mitral insufficiency resulting from native valve endocarditis underwent mitral valve repair, six (27.3%) patients had acute endocarditis, and 16 (72.3%) had healed endocarditis.

There were thirteen male and nine female patients. Their ages ranged from 4 to 77 years (mean 48.0 ± 21.7 years). The mean interval from onset of illness to operation was 31.6 ± 27 days in the acute group and 60.6 ± 40.7 months in the healed group. Eighteen patients (82%) had isolated mitral valve disease. Four patients (three with acute endocarditis) had both mitral and aortic valve involvement. Preexisting valve disease was present in seven (44%) patients with healed inactive disease and absent in all patients with active endocarditis. In the healed group, two patients had congenital clefts, one had rheumatic valve disease, and three had degenerative valve changes.

All patients with acute endocarditis had positive blood cultures preoperatively: Streptococcus sp. in four, Enterococcus in one, and haemophilus influenzae in one. All six patients received preoperative antibiotic therapy for an average duration of 15.5 ± 13.2 days.

Preoperative echocardiography was performed in all patients. Valve dysfunction was classified according to the range of motion of the valve leaflets described by Carpentier. In the acute endocarditis group, four (66%) patients had normal leaflet motion, one (16%) had leaflet prolapse, and one (16%) had restricted leaflet motion. In patients with healed endocarditis, two (12%) had normal leaflet motion, twelve (75%) had leaflet prolapse, and two (12%) had restricted leaflet motion. Vegetations were identified by echocardiography in five (83%) patients with acute endocarditis.

Indications for operation were hemodynamic in 20 (91%) patients and uncontrolled sepsis in two (9%). Four (67%) patients with acute endocarditis underwent valve repair for hemodynamic indication; two (33%) patients had persistent sepsis. All patients with healed disease had hemodynamic indications for operation.

The mean preoperative New York Heart Association (NYHA) functional class was 2.6 ± 1.2. In the acute endocarditis group, mean NYHA class was 2.8 ± 1.5, which included two patients who were free of symptoms and operated on for persistent sepsis. In the patients with healed endocarditis, mean NYHA class was 2.5 ± 0.8.

Color flow Doppler echocardiography was used intraoperatively before repair to evaluate degree and cause of insufficiency in all patients. All operations were performed with the use of cardiopulmonary bypass with bicaval cannulation, systemic hypothermia, and cold crystalloid cardioplegia during a single period of aortic crossclamping. All valve repairs were performed transseptally.

At operation multiple lesions were found in four (66%) of the patients with acute endocarditis and in eight (50%) of those with healed disease (Table I).

Multiple techniques were then used to achieve a competent valve (Table II). Annuloplasty was performed in 15 patients, of whom 12 underwent annular remodeling with a Carpentier-Edwards ring and three had posterior annular plication with a strip of glutaraldehyde-treated bovine pericardium.

Mitral valveplasty was combined with other procedures in 11 patients. Three patients underwent aortic valve replacement. Five patients had combined myocardial revascularization, and one patient had combined myocardial revascularization and aortic valve replacement. One patient had septic mycetomy, and one patient had concurrent resection of an atrial myxoma.

Compotence of the mitral valve repair was confirmed intraoperatively after repair by transesophageal Doppler echocardiography. Patients undergoing mitral valve repair for acute endocarditis received 6 weeks of parenteral antibiotic therapy. Nine patients were discharged on a short-term regimen of sodium warfarin (Coumadin) therapy, which was discontinued after 6 weeks.

**Results**

There were two (9%) hospital deaths. Both occurred in patients with healed endocarditis. One death was in a patient undergoing isolated mitral valve repair, and the other was in a patient undergoing combined procedures. The patient with isolated mitral valve repair had nonreconstructible coronary artery disease and sustained a perioperative myocardial infarction. The second patient had triple-vessel coronary artery disease with severe left ventricular dysfunction. This patient died of a perioperative infarction. No deaths occurred in patients who underwent mitral valve repair for acute endocarditis.

Complications, occurring in five of 20 survivors, includ-

---

**Table I. Mitral valve lesions (n = 22)**

<table>
<thead>
<tr>
<th>Lesion</th>
<th>Acute</th>
<th>Healed</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major cusp perforation</td>
<td>4 (66%)</td>
<td>9 (56%)</td>
<td>13 (59%)</td>
</tr>
<tr>
<td>Chordal rupture</td>
<td>2 (33%)</td>
<td>11 (69%)</td>
<td>13 (59%)</td>
</tr>
<tr>
<td>Chordal elongation</td>
<td>—</td>
<td>1 (12%)</td>
<td>1 (5%)</td>
</tr>
<tr>
<td>Vegetations</td>
<td>4 (66%)</td>
<td>1 (6%)</td>
<td>5 (22%)</td>
</tr>
<tr>
<td>Annular abscess</td>
<td>1 (16%)</td>
<td>—</td>
<td>1 (5%)</td>
</tr>
<tr>
<td>Congenital cleft</td>
<td>—</td>
<td>2 (12%)</td>
<td>2 (9%)</td>
</tr>
</tbody>
</table>

---

**Fig. 1.** From 1985 through 1989, 1513 patients underwent surgical procedures on their native mitral valves. Endocarditis was the cause of the mitral valve disease in 3%.

ed bleeding necessitating reoperation in two cases, perioperative myocardial infarctions in two, and conduction defects necessitating permanent pacemakers in two.

Follow-up was complete at a mean of 24.0 ± 16.8 months. Of the 20 survivors, 17 (85%) remain in NYHA class I and three (15%) are in NYHA class II. There were no reoperations or cases of recurrent endocarditis. There have been no thromboembolic events or other valverelated morbidity.

Discussion

Bacterial endocarditis is one of the least common causes of mitral valve disease. It was the cause of valve dysfunction in only 3.4% of the mitral valve procedures performed at The Cleveland Clinic Foundation from 1985 to 1989. However, a reluctance to use valvuloplasty techniques for active or healed endocarditis of the mitral valve is evidenced by the lack of published data to support this approach. Before a recent report by Dreyfus and coworkers, we were only two case reports documenting the feasibility of valvuloplasty for acute mitral valve endocarditis. Dreyfus and coworkers demonstrated that mitral valve repair is possible in most patients with acute endocarditis, and they recommended early mitral valve repair. There has been little reported to support valvuloplasty for healed endocarditis.

In general, mitral valvuloplasty, when compared with mitral valve replacement, has been associated with lower operative mortality, reduced valve-related complications, decreased requirement for anticoagulation, better preservation of left ventricular function, improved long-term survival, lower prevalence of endocarditis, and decreased costs. During the study period, mitral valve replacement occurred in 56.9% of patients, reflecting surgeon preference or inexperience with valvuloplasty techniques. In patients with endocarditis, although valve replacement has dramatically improved patient survival, the operative mortality rate remains high, ranging from 9% to 34%. Replacement of the mitral valve is less frequent than replacement of the aortic valve in patients with endocarditis, and mitral valve replacement has a higher operative mortality rate ranging from 20% to 31%. In our study, the operative mortality rate for patients who underwent valve repair for endocarditis was 9%. Mortality for valve replacement in patients with acute endocarditis has generally been higher than for those with healed disease. In our series there were no early or late deaths in patients with acute disease, which is comparable to the findings for mitral valvuloplasty in acute endocarditis published by Dreyfus and coworkers.

Although our experience with valve repair for active endocarditis is limited to only six patients, it is this group in whom application of valvuloplasty may be the most advantageous. Valve-related morbidity after prosthetic valve replacement for active endocarditis is high and includes reinfection, perivalvular leak, valve failure, and thromboembolic complications. Native valve replacement for acute endocarditis has the theoretic risk of inserting prosthetic material in an infected site. This hypothesis is supported by the clinical finding of prosthetic valve endocarditis, which occurs in 15% to 20% of patients despite full-course perioperative antibiotics. Early valvuloplasty preserves viable native tissue, which is more resistant to infection than prosthetic material. The extremely low reported prevalence of endocarditis in repaired valves confirms the rationale for this approach. In this study no patients with acute endocarditis, all of whom had positive blood cultures before operation, experienced reinfection after undergoing valvuloplasty combined with postoperative antibiotics. Although experience is limited, we do not believe the decision to repair an infected valve is dictated by the bacteriologic findings. Rather, patients with organisms that are difficult to eradicate or control with valve replacement may benefit most from attempts at repair.

In our study there have been no reoperations for failed repair or thromboembolic complications. In most patients valvuloplasty obviated the need for long-term anticoagulation. This is particularly attractive in patients with endocarditis because a significant portion of the population will be noncompliant. Mitral valve repair also has the advantage of preserving subvalvular apparatus and ventricular function when compared with valve replacement. Since patients with both acute and inactive endocarditis frequently have advanced ventricular dysfunction at initial presentation, preservation of ventricular function takes on added importance and may be an adjunct in reducing operative mortality.

Long-term survival with valve replacement for bacterial endocarditis is variable. Actuarial survival at 5 years varies from 47% to 71%. Although this series does not have 5-year survival data, short-term results are favorable, with 100% survival at a mean follow-up period of 24 months. All patients are in NYHA class I or II.

<table>
<thead>
<tr>
<th>Technique</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suture closure perforations</td>
<td>12</td>
</tr>
<tr>
<td>Patch closure perforations</td>
<td>2</td>
</tr>
<tr>
<td>Leaflet resection/primary closure</td>
<td>5</td>
</tr>
<tr>
<td>Leaflet resection/path closure</td>
<td>4</td>
</tr>
<tr>
<td>Chordal shortening or transfer</td>
<td>10</td>
</tr>
<tr>
<td>Annuloplasty</td>
<td>15</td>
</tr>
</tbody>
</table>
Valve repair for both acute and healed endocarditis may improve results if performed early in the course of the disease. Progression of congestive heart failure in patients with acute infectious mitral valve disease can be as rapid as that with aortic involvement.\textsuperscript{11} Mortality was lowered when patients underwent valve replacement shortly after diagnosis.\textsuperscript{6,12} There are no operative deaths in our patients with acute endocarditis who came to us for early operation. Early repair in acute disease may limit infection to the leaflets, thus avoiding the complications that can occur with extension of infection to the anulus and thereby can make valve repair more difficult. In healed endocarditis, the indications for operation are similar to those for other cases of mitral insufficiency, and early repair may also be warranted. Waiting for progression of symptoms to NYHA class III may subject the patient to endocarditis, the indications for operation are similar to those with aortic involvement.\textsuperscript{11} Mortality was lowered operation. Early repair in acute disease may limit infection to the leaflets, thus avoiding the complications that can occur with extension of infection to the anulus and thereby can make valve repair more difficult. In healed endocarditis, the indications for operation are similar to those for other cases of mitral insufficiency, and early repair may also be warranted. Waiting for progression of symptoms to NYHA class III may subject the patient to progressive left ventricular dysfunction, which contributes to increased operative mortality and poor functional result. One of the operative deaths in this series occurred in a patient with severe left ventricular dysfunction, coronary disease, and 4+ mitral regurgitation from an episode of mitral valve endocarditis occurring 2 years previously. Earlier repair may have prevented this death.

Several technical maneuvers take on added importance in this disease entity. Exposure of the mitral valve through a small left atrium, commonly found in acute endocarditis, is facilitated by mobilization of the vena cava, lysis of pericardial adhesions, and a self-retaining retractor.\textsuperscript{15} There are significant differences in technique between patients undergoing repair for healed endocarditis and those with active endocarditis. With healed endocarditis, leaflet perforations are frequently multiple and may be patched or closed primarily. Pericardium tanned in 0.9% glutaraldehyde is used to close perforations or resected areas that are not amenable to primary closure. It has recently been demonstrated that glutaraldehyde treatment of autologous pericardium prevents shrinkage and is a reliable material for mitral leaflet reconstruction.\textsuperscript{17} With acute endocarditis, all macroscopically involved tissue must be generously excised. Mitral leaflet tissue can be radically débrided and resected, with subsequent reconstruction. Although vegetectomy plus débridement has been reported to be successful in a case of left-sided endocarditis,\textsuperscript{18} leaflet excision is preferred. Rheumatic and degenerative changes are frequently present, and techniques of valve repair can be incorporated. If infection is advanced and annular abscess is present, it must be unroofed and repaired.

Annuloplasty is indicated only in instances in which underlying valve disease dictates its need. Annuloplasty to correct posterior dilatation may be required to increase leaflet coaptation in a chronically insufficient valve. In acute endocarditis involving a previously nondiseased valve, annuloplasty may be omitted if annular dilatation does not exist. Although it has been argued that implantation of a prosthetic ring does not increase risk of an infection because acute bacterial endocarditis usually spares the anulus, ideally prosthetic material should be avoided in acute endocarditis.\textsuperscript{9} A posterior annular plication with a strip of pericardium avoids the placement of prosthetic material when an annuloplasty is required in the setting of active infection.

Mitr al valvuloplasty can be performed as part of a combined procedure. When both the mitral and aortic valves are involved, the mitral repair is preferable even if the aortic valve is replaced, because long-term survival and freedom from thromboembolic complications and reoperation are less satisfactory for double valve replacement.\textsuperscript{19} For acute endocarditis of the aortic and mitral valves combined, the optimal procedure may be homograft aortic valve replacement combined with mitral valvuloplasty, which was accomplished in one patient in this series. There was one death in the patients undergoing repair as part of a combined procedure; this death occurred in a patient with extensive coronary artery disease and poor left ventricular function.

Mitr al valve repair for mitral insufficiency resulting from bacterial endocarditis is possible in acute and healed disease in patients with low operative mortality, and it has resulted in patients free of recurrent infection and other valve-related morbidity and mortality. Mitr al valve repair is an attractive alternative to mitral valve replacement in the setting of insufficiency resulting from bacterial endocarditis.

REFERENCES
8. D'Agostino RS, Miller DC, Stinson EB, Mitchell RS, Oyer...
Valve endocarditis, and they all survived with no residual or long-term complications. You had six patients with active native valve endocarditis, and the follow-up is only 24 months. Also, you would have been in a much better position had our study included a larger number of patients. The weaknesses of our study are obvious: you had only six patients with active native valve endocarditis, and the follow-up is only 24 months. Also, you would have been in a much better position had our study included a larger number of patients.

Discussion

Dr. D. Craig Miller (Stanford, Calif.). First, it appears that the Cleveland Clinic has relatively few cases of endocarditis, and, particularly, few cases of active native valve endocarditis, something a lot of us dread. The meat of your paper is really the facts. Your paper is clear and well-written. You have a large, necrotizing abscess, could you elaborate on your actual techniques when you excise “all the macroscopically infected tissue”? What are your principles for drainage of the abscess—just widely unroof it or debridement followed by patch repair? Dr. Hendren. No special tricks.

Dr. Miller. This may well also explain the lack of early deaths in your hands in your small cohort with active native valve endocarditis and the low mortality rate in Paris reported by Carpentier’s group.

Dr. Hendren. That is an excellent point. We believe very strongly that annuloplasty is required only in instances in which the aortic annulus is dilated. You had one patient with an annular abscess; if you have a large, necrotizing abscess, could you elaborate on your actual techniques when you excise “all the macroscopically infected tissue”? What are your principles for drainage of the abscess—just widely unroof it or debridement followed by patch repair? Dr. Hendren. No special tricks.

Dr. Miller. I like your idea of a pericardial strip, avoiding synthetic material, and particularly the horseshoe shape (that is, just reinforcing the mural portion of the mitral anulus). However, why do you need this reinforcement in patients with native valve endocarditis when there usually is no preexisting annular dilatation?

Dr. Hendren. That is an excellent point. We believe very strongly that annuloplasty is required only in instances in which
there is preexisting valve disease such as annular dilatation, and it is a common misconception that annuloplasty is needed in every instance of valve repair. In this series, there were seven patients who had preexisting valvular disease, which is a common basis for the development of endocarditis in valves. Therefore we apply annuloplasty only when it is needed. In the active cases, to avoid the placement of any prosthetic material, we have resorted to using a strip of autologous pericardium tanned in glutaraldehyde.

**Dr. Miller.** I am a little worried that you might be creating some stenotic mitral valves. Do you have any intraoperative or postoperative Doppler information describing postrepair mitral mean gradients or mitral valve areas?

**Dr. Hendren.** All patients do have routine echocardiographic follow-up, and stenosis has not been a problem.

**Dr. Millera** During this 5-year period, 57% of your patients with native valve endocarditis underwent valve replacement versus 43% undergoing valve repair. Could you tell us when the last mitral valve replacement was necessary, and why? What is the current ratio of replacement to repair in 1990?

**Dr. Hendren.** The current ratio favors more valve repairs. The most important factor has been the learning curve involved with valve repair. Clearly there is surgeon inexperience and variability, which determine the ability to repair these valves. As with any other cause of mitral valve disease, we have not reached our peak in terms of the learning curve for this. Systematic attempts at valve repair are performed on all valves currently. If the valve repair is not secure as judged by intraoperative testing and transesophageal echocardiography after bypass, then valve replacement will be done.

**Dr. Arthur J. Lurie (Reno, Nev.).** Has glutaraldehyde-treated pericardium been shown to be better than nonglutaraldehyde-treated pericardium in animal work in the face of infection, or is it empiric that you chose to use glutaraldehyde?

**Dr. Hendren.** It has been shown that glutaraldehyde-treated pericardium is superior to autologous pericardium in animals for the extension of valve leaflet tissue. I also think it is a little more durable. We have tried using pericardium both with and without glutaraldehyde treatment. I do not believe there is any clear advantage to one over the other, although the majority are treated with glutaraldehyde.

**Dr. David M. Follette (Sacramento, Calif.).** Your results are very impressive, but I share Dr. Miller’s concern that the numbers are small. This question regarding the organism is very important, because *Streptococcus*, as we well know, is so easily eradicated with antibiotics. Would you care to make some speculation? If you were faced with a patient with severe staphylococcal endocarditis or fungal endocarditis, would you be as willing to perform a valve repair?

**Dr. Hendren.** Absolutely. The organisms should not affect the decision to repair a valve. We have not come across *Staphylococcus* and I hope we will never come across fungus, although it is in these patients that this may offer the greatest advantage. We are aware of the difficulty in curing fungal endocarditis on prosthetic material, and for these reasons the avoidance of prosthetic material would be even more advantageous. We would apply the same principles of excision of all macroscopically involved tissue.

**Dr. W. R. Eric Jamieson (Vancouver, B.C., Canada).** I have a question regarding repair of the anterior leaflet of the mitral valve and use of that large pericardial patch with regard to adequate support for the anterior leaflet. Have you actually done transfers from the posterior leaflet with chordal attachment to repair portions of the anterior leaflet?

**Dr. Hendren.** Absolutely. The organisms should not affect the decision to repair a valve. We have not come across *Staphylococcus* and I hope we will never come across fungus, although it is in these patients that this may offer the greatest advantage. We are aware of the difficulty in curing fungal endocarditis on prosthetic material, and for these reasons the avoidance of prosthetic material would be even more advantageous. We would apply the same principles of excision of all macroscopically involved tissue.

**Dr. W. R. Eric Jamieson (Vancouver, B.C., Canada).** I have a question regarding repair of the anterior leaflet of the mitral valve and use of that large pericardial patch with regard to adequate support for the anterior leaflet. Have you actually done transfers from the posterior leaflet with chordal attachment to repair portions of the anterior leaflet?

**Dr. Hendren.** Absolutely. The organisms should not affect the decision to repair a valve. We have not come across *Staphylococcus* and I hope we will never come across fungus, although it is in these patients that this may offer the greatest advantage. We are aware of the difficulty in curing fungal endocarditis on prosthetic material, and for these reasons the avoidance of prosthetic material would be even more advantageous. We would apply the same principles of excision of all macroscopically involved tissue.

**Dr. W. R. Eric Jamieson (Vancouver, B.C., Canada).** I have a question regarding repair of the anterior leaflet of the mitral valve and use of that large pericardial patch with regard to adequate support for the anterior leaflet. Have you actually done transfers from the posterior leaflet with chordal attachment to repair portions of the anterior leaflet?

**Dr. Hendren.** Absolutely. The organisms should not affect the decision to repair a valve. We have not come across *Staphylococcus* and I hope we will never come across fungus, although it is in these patients that this may offer the greatest advantage. We are aware of the difficulty in curing fungal endocarditis on prosthetic material, and for these reasons the avoidance of prosthetic material would be even more advantageous. We would apply the same principles of excision of all macroscopically involved tissue.

**Dr. W. R. Eric Jamieson (Vancouver, B.C., Canada).** I have a question regarding repair of the anterior leaflet of the mitral valve and use of that large pericardial patch with regard to adequate support for the anterior leaflet. Have you actually done transfers from the posterior leaflet with chordal attachment to repair portions of the anterior leaflet?

**Dr. Hendren.** Absolutely. The organisms should not affect the decision to repair a valve. We have not come across *Staphylococcus* and I hope we will never come across fungus, although it is in these patients that this may offer the greatest advantage. We are aware of the difficulty in curing fungal endocarditis on prosthetic material, and for these reasons the avoidance of prosthetic material would be even more advantageous. We would apply the same principles of excision of all macroscopically involved tissue.

**Dr. W. R. Eric Jamieson (Vancouver, B.C., Canada).** I have a question regarding repair of the anterior leaflet of the mitral valve and use of that large pericardial patch with regard to adequate support for the anterior leaflet. Have you actually done transfers from the posterior leaflet with chordal attachment to repair portions of the anterior leaflet?

**Dr. Hendren.** Absolutely. The organisms should not affect the decision to repair a valve. We have not come across *Staphylococcus* and I hope we will never come across fungus, although it is in these patients that this may offer the greatest advantage. We are aware of the difficulty in curing fungal endocarditis on prosthetic material, and for these reasons the avoidance of prosthetic material would be even more advantageous. We would apply the same principles of excision of all macroscopically involved tissue.

**Dr. W. R. Eric Jamieson (Vancouver, B.C., Canada).** I have a question regarding repair of the anterior leaflet of the mitral valve and use of that large pericardial patch with regard to adequate support for the anterior leaflet. Have you actually done transfers from the posterior leaflet with chordal attachment to repair portions of the anterior leaflet?

**Dr. Hendren.** Absolutely. The organisms should not affect the decision to repair a valve. We have not come across *Staphylococcus* and I hope we will never come across fungus, although it is in these patients that this may offer the greatest advantage. We are aware of the difficulty in curing fungal endocarditis on prosthetic material, and for these reasons the avoidance of prosthetic material would be even more advantageous. We would apply the same principles of excision of all macroscopically involved tissue.

**Dr. W. R. Eric Jamieson (Vancouver, B.C., Canada).** I have a question regarding repair of the anterior leaflet of the mitral valve and use of that large pericardial patch with regard to adequate support for the anterior leaflet. Have you actually done transfers from the posterior leaflet with chordal attachment to repair portions of the anterior leaflet?

**Dr. Hendren.** Absolutely. The organisms should not affect the decision to repair a valve. We have not come across *Staphylococcus* and I hope we will never come across fungus, although it is in these patients that this may offer the greatest advantage. We are aware of the difficulty in curing fungal endocarditis on prosthetic material, and for these reasons the avoidance of prosthetic material would be even more advantageous. We would apply the same principles of excision of all macroscopically involved tissue.