Surgical Treatment of Aortic Root Abscess

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A significant number of patients with infective aortic valve endocarditis develop aortic annular abscess. Although antibiotics may occasionally sterilize an aortic root abscess, most patients require surgical intervention. A review of our experience with 21 consecutive patients surgically treated for aortic root abscess disclosed that 13 patients had prosthetic valve and eight had native aortic valve endocarditis. The predominant microorganism was *Staphylococcus aureus*, particularly in those patients with native aortic valve endocarditis. The abscess was limited to the aortic annulus in 10 patients and was either multiple or had perforated the left ventricular outflow tract in 11 patients. Most patients were desperately ill at the time of operation. Repair was accomplished by aggressive debridement of all apparently infected tissue and reconstruction of the left ventricular outflow tract with autologous pericardium. Although postoperative complications were common, only one patient died in hospital. Operative survivors have been followed up from 3 to 68 months (mean, 29 months). One patient died of complications of repair of a thoracoabdominal aneurysm 34 months after surgery; his prosthetic aortic valve and patch were intact at autopsy. No patient has experienced recurrent infection, pericardial patch aneurysm, or prosthetic valve dehiscence. (*Circulation* 1989;80(suppl I):I-269–I-274)

Aortic root abscess is encountered in approximately one third of all patients with acute infective endocarditis of the native aortic valve[1,2] and in more than one half of all patients with prosthetic aortic valve endocarditis.[3,4] Although antibiotics alone may occasionally sterilize an abscess cavity, most of these patients die of congestive heart failure, sepsis, or both without surgical intervention.[1-5]

The surgical treatment of patients with aortic root abscess can be a challenge, depending on the location and extent of the abscess. Small and well-localized abscesses such as those near the noncoronary sinus are easily remedied by excision and reconstruction of the aortic annulus with a patch. Multiple, annular abscesses or a large, single abscess, extending into the left ventricular muscle with erosion into the right side of the circulation or destruction of the mitral or tricuspid annuli, can be technically difficult to manage. A conservative surgical approach in these cases invariably results in recurrent infection, prosthetic dehiscence, or both.

During the past 5 years, we have treated patients with aortic root abscesses by aggressive debridement of the abscess cavity and surrounding tissue and by reconstruction of the left ventricular outflow tract with autologous pericardium. The results have been most gratifying.

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Methods

Patients

A review of our Cardiac Valve Surgery Registry from July 1983 to June 1988 disclosed 21 patients with infective endocarditis and aortic root abscess. There were 17 men and four women whose mean age was 45.6 years (range, 22–71 years). Table 1 summarizes the clinical data for each patient. Although the microorganism responsible for the infection was identified in the blood of all patients, three patients required surgical treatment before the results of blood culture were available. The indications for surgery were septic shock in four patients, cardiogenic shock in two, intractable sepsis in five, recurrent emboli in two, and congestive heart failure in eight. Only two patients underwent coronary angiography before surgery, but the coronary anatomy was known in four other patients, as they had undergone coronary angiography before a recent, elective, valvular replacement. Two of these four patients had already been surgically treated for infective endocarditis before being transferred to our institution. The preoperative diagnosis of aortic root abscess was made in seven patients by echocardiography. Four patients had communication between the aortic root and the right side of the heart, and three showed evidence of a periannular cavity. In addition, two other patients were suspected of having an abscess because they devel-

TABLE 1. Clinical Data of Patients With Aortic Root Abscess

Patient no.	Aortic valve type	Microorganism	Clinical presentation
1	Native	*Streptococcus viridans*	Fever, stroke, CHF
2	Native	*Erysipelothrix rhusiopathiae*	Fever, tibia osteomyelitis
3	Native	*Staphylococcus aureus*	Cardiogenic shock due to AI
4	Hancock	Group B *Streptococcus*	Fever, splenic and hepatic infarctions
5*	Björk-Shiley	*Streptococcus faecalis*	Septic shock, renal failure
6†	Mitroflow	*Staphylococcus epidermidis*	Septic shock, coagulopathy
7	Ionescu-Shiley	*Pseudomonas stutzeri*	Fever, anemia
8†	Ionescu-Shiley	*Staphylococcus aureus*	Hepatorenal failure, septic shock
9†	Björk-Shiley	Group C *Streptococcus*	Fever, multiple emboli
10†	St. Jude Medical	*Staphylococcus aureus*	Fever, hepatic and splenic infarctions
11	Native	*Streptococcus faecalis*	Fever, CHF
12	Native	*Staphylococcus aureus*	Cardiogenic shock due to AI
13	Native	*Staphylococcus aureus*	Septic femoral embolism, CHF, fever
14	Native	*Staphylococcus aureus*	Stroke, fever, CHF
15	Björk-Shiley	*Staphylococcus epidermidis*	Fever, CHF
16	Hancock	*Staphylococcus aureus*	Septic shock, CHF, fever
17	Native	*Streptococcus viridans*	Fever, CHF
18*	St. Jude Medical	*Actinobacillus actinomycetem-comitans*	Stroke, multiple leg emboli with abscesses
19	Starr-Edwards	α-Hemolytic *Streptococcus*	Fever, CHF
20	Native	*Staphylococcus aureus*	Fever, CHF
21	Björk-Shiley	*Streptococcus viridans*	Stroke, fever

CHF, congestive heart failure; AI, aortic insufficiency.
*Denotes patients with composite aortic valve and ascending aortic graft.
†Denotes early prosthetic valve endocarditis (<3 months).

oped heart block during antibiotic treatment of infective endocarditis of the native aortic valve.

Table 2 summarizes the intraoperative data and outcomes of surgery. All patients were receiving intravenous antibiotics at the time of operation and continued to receive appropriate antibiotics for 4 additional weeks after surgery. In five patients from whom material excised at surgery failed to grow any bacteria, antibiotics were discontinued after 7–10 days. In the remaining 16 patients, culture of the surgical specimen revealed the same microorganism as did the preoperative blood cultures. Two patients who had infected, composite, aortic valve and ascending aortic grafts were sent home while being maintained on oral antibiotic therapy.

All patients were seen for a follow-up at the third and sixth postoperative months and annually thereafter. All patients have undergone postoperative, Doppler echocardiographic studies.

Operative Technique

All patients underwent operation with cardiopulmonary bypass, hemodilution, and moderate, systemic hypothermia. Cold-blood cardioplegia was used for myocardial protection. The operative techniques described below were used in one or more of our patients with aortic root abscess. The complete operative procedure in each patient is mentioned in Table 2. After the native or prosthetic aortic valve was excised, the aortic annulus was carefully inspected, and any granulation tissue was aggressively debrided. When the abscess was limited to the aortic annulus and did not perforate the aortic wall, simple excision of that portion of the annulus and corresponding sinus was performed. Reconstruction of the left ventricular outflow tract was performed with a properly tailored patch of autologous pericardium secured to the healthy tissue around the defect by a continuous, running, 4-0 polypropylene suture. When the abscess extended through the aortic wall into other tissues or cavities, a more extensive resection was performed. If the interventricular septum was involved, no serious consideration was given to conduction pathways, as the primary concern was to extirpate all necrotic and potentially infected tissues around the abscess cavity. This approach resulted in permanent heart block in three patients. Regardless of the extent of resection, reconstruction was always performed with an autologous pericardial patch. In cases where the abscess was in the ventricular muscle, the patch was secured to the left ventricular endocardium with a running, 4-0 polypropylene suture. An aortic valve prosthesis was then secured to the aortic annulus in unresected areas and to the pericardial patch in areas where the annulus had been reconstructed (Figure 1).

In several patients with noncoronary sinus abscess, the inflammation extended into the fibrous skeleton that anchors the base of the anterior leaflet of the

TABLE 2. Intraoperative Data and Outcome of Surgery

Patient no.	Site of abscess	Operation performed	Outcome
1	RCS, LCS, NCS	Circumferential patch; AVR; RCA	Survived; CHB
2	RCS	Patch of RCS; AVR; RAA	Survived; leg amputation
3	RCS, LCS	Patch of RCS, LCS; AVR	Survived
4	RCS, LCS, NCS	Circumferential patch; AVR; RCA	Survived
5	Graft annulus	Circumferential patch; composite AVR and RAA	Survived; CHB
6	NCS, mitral valve	Triangular patch; MVR; AVR; patch LA	Survived
7	LCS, mitral valve	Triangular patch; MVR; AVR; patch LA	Survived
8	RCS, RV, PA	Patch RCS, IVS, PA; AVR; TVR; PVR	Died; hepatic coma
9	RCS, LCS	Circumferential patch; AVR; LCA; RCA	Survived
10	NCS	Patch of NCS; AVR	Survived
11	RCS	Patch RCS; AVR	Survived
12	NCS	Patch NCS; AVR	Survived
13	RCS	Patch RCS; AVR	Survived
14	RCS, LCS, NCS	Circumferential patch; composite AVR and RAA	Survived
15	RCS	Patch RCS; AVR	Survived; CHB
16	RCS with VSD	Patch RCS, IVS; AVR	Survived
17	RCS, NCS	Circumferential patch; composite AVR and RAA	Survived; leg amputation
18	Graft annulus	Patch RCS, NCS; AVR	Survived
19	RCS	Patch RCS; AVR	Survived
20	NCS	Patch NCS; AVR	Survived
21	LCS, NCS	Patch LCS, NCS; AVR; LCA	Survived

RCS, right coronary sinus; LCS, left coronary sinus; NCS, noncoronary sinus; AVR, aortic valve replacement; RCA, reimplantation of right coronary artery; CHB, complete heart block; RAA, replacement of ascending aorta; MVR, mitral valve replacement; LA, left atrium; IVS, interventricular septum; PA, pulmonary artery; TVR, tricuspid valve replacement; PVR, pulmonic valve replacement; LCA, reimplantation of left coronary artery.

mitral valve, and sometimes, the inflammation had also destroyed most of this leaflet. In these patients, after the abscess was excised, the aortic and mitral annuli became a single orifice, and reconstruction was done with a triangular-shaped, pericardial patch as shown in Figure 2. The roof of the left atrium also needed to be reconstructed with a separate patch in some patients because that portion of the heart had also been excised with the abscess.

Multiple, aortic annulus abscesses were managed by debridement and reconstruction of the left ventricular outflow tract with a 1–3-cm-high circumferential pericardial patch. One or both coronary arteries needed to be reimplantated into this patch in several patients. In some patients, the ascending aorta also needed to be replaced, and this procedure was done by suturing a composite graft with an aortic prosthesis directly to the pericardial patch as illustrated in Figure 3.

One patient had multiple abscesses in the aortic annulus that extended into the pulmonic and tricuspid valve rings. In this patient, all three annuli were reconstructed with autologous pericardial patches with most satisfactory hemodynamic results.

The following prostheses were used for aortic valve replacement: St. Jude Medical in seven patients, Björk-Shiley in two, Hancock II in 10, and aortic valve homografts in two.

Results

Only one patient died after surgery. This man had undergone aortic valve replacement and aortocoronary bypass surgery at another institution and had a difficult postoperative course that included multiple-

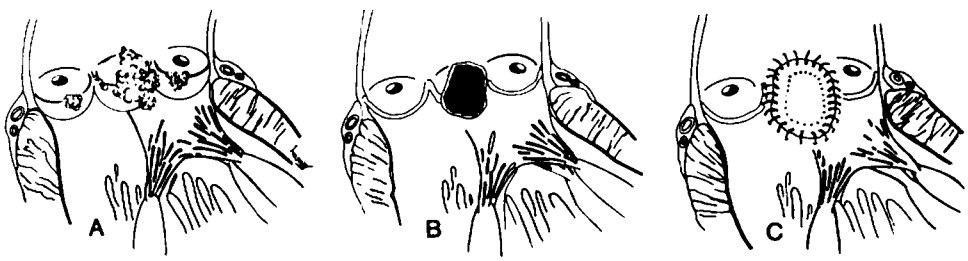

FIGURE 1. *Sketches showing abscess limited to the aortic annulus* (A), *excision of all infected tissue* (B), *and reconstruction with autologous patch* (C).

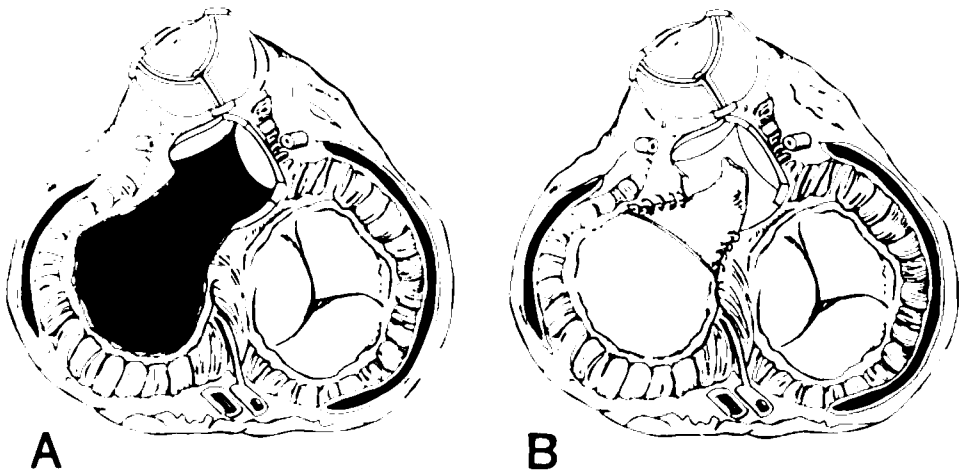

FIGURE 2. *Sketches showing abscess of the fibrous skeleton, with the destruction of the mitral valve. After debridement, mitral and aortic annuli become a single orifice* (A). *Reconstruction can be accomplished with a triangular patch of autologous pericardium* (B).

organ failure and prosthetic valve endocarditis due to *Staphylococcus aureus*. He was transferred to us for further surgery and was found to have multiple aortic, pulmonic, and tricuspid ring abscesses. He survived surgery but died on the 20th postoperative day in hepatic coma. Autopsy showed intact patches and prostheses in all three positions and no evidence of infection. He had, however, advanced cirrhosis of the liver with superimposed recent necrosis.

Postoperative complications were rather common in these patients. Four patients required reexploration of the mediastinum because of excessive bleeding; in all patients, it was found to be due to coagulopathy. Two patients developed late tamponade requiring reoperation. Three patients required

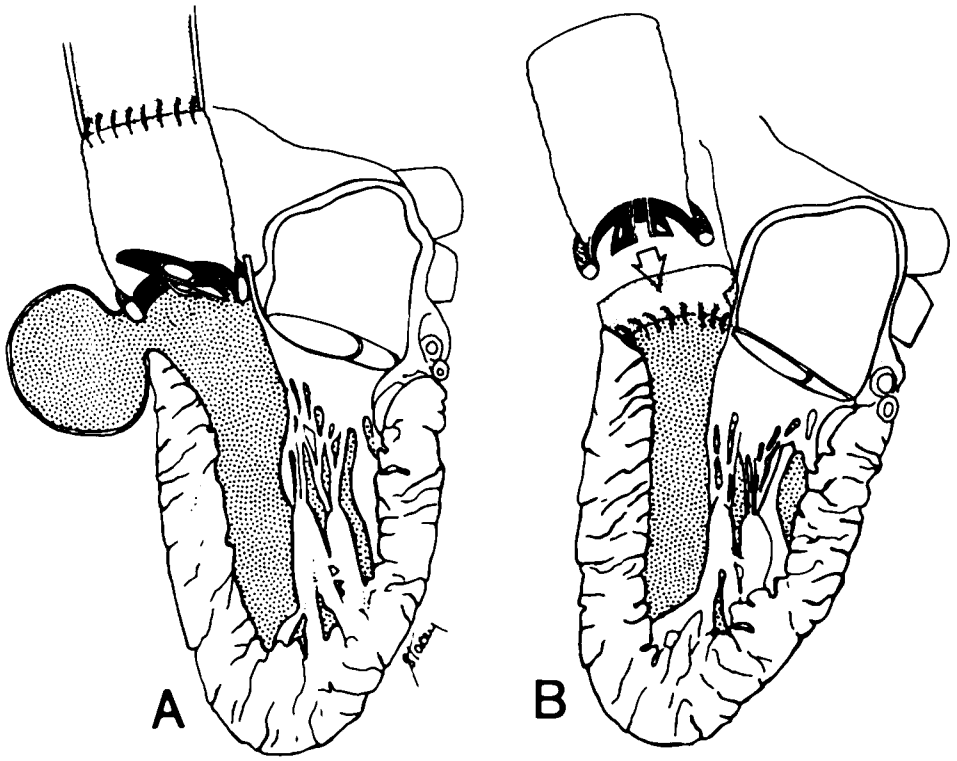

FIGURE 3. *Sketches showing abscess between a composite aortic valve and ascending aortic graft and the aortic annulus* (A). *After proper debridement, the entire aortic annulus is reconstructed with a circumferential patch of autologous pericardium. A new composite graft is sutured to this patch* (B).

implantation of a permanent, transvenous pacemaker because of complete heart block. Four patients required dialysis. The mean stay in the surgical intensive care unit was 5.4 days, and the mean hospital stay after surgery was 34 days. Patients were followed up from 3 to 68 months (mean, 29 months). One patient died at 34 months as a result of complications of surgery for repair of a thoracoabdominal aneurysm. Autopsy revealed an intact aortic prosthesis, patch, and ascending aortic graft. The other surviving patients remain well. No patient has experienced recurrent infection or has shown evidence of aneurysm formation of the pericardial patch or prosthetic valve dehiscence. With the exception of two patients who have been assigned to New York Heart Association (NYHA) functional class II, all others are in NYHA class I.

Discussion

Native aortic valve endocarditis can usually be cured with antibiotics.[5,6] Many patients, however, develop serious complications during antibiotic therapy and require surgery.[1,3-6] New complete or incomplete heart block is frequently associated with aortic root abscess.[2] Pericarditis in a patient with active, infective endocarditis is usually an indication of annular abscess.[7] Patients with large vegetations on the aortic valve are more likely to require surgery because of a higher incidence of congestive heart failure, recurrent systemic embolization, or resistant infection.[8] Although congestive heart failure is the most common indication for surgery in patients with aortic valve endocarditis, aortic root abscess is present in approximately one third of them.[1] If the abscess is not properly debrided, infection may persist, or the prosthetic valve may dehisce.[5,9,10]

Prosthetic aortic valve endocarditis is associated with a higher incidence of aortic root abscess than is native aortic valve endocarditis.[1-4] Aortic root abscess is almost always present in patients who die with infected mechanical aortic valves.[4] Endocarditis in tissue valves is frequently confined to the leaflets and has an incidence of aortic root abscess similar to that of native aortic valve endocarditis except in cases of early prosthetic endocarditis.[4,11,12]

Surgical treatment of patients with aortic root abscess has been performed since the early years of open-heart surgery.[13,14] Surgeons soon learned that complete excision of all infected material was necessary to cure patients with this problem. If the abscess involved areas that could not be completely extirpated, debridement of the abscess and translocation of the aortic valve and coronary arteries to a higher level in the ascending aorta was used to treat a number of patients.[15,16] With better techniques of resection and reconstruction of the left ventricular inflow and outflow tracts, we believe that translocation of the aortic valve is seldom necessary. It is possible to resect the entire inflow and outflow areas of the left ventricle and to successfully reconstruct them.[17,18] Most reports describing reconstruction of the left ventricular outflow tract after resection of an aortic root abscess indicate that Dacron was used for the repair.[9,10,16,19-21] Fiore and associates[21] recently reported their experience with 23 patients with aortic root abscess. Sixteen patients had native valve and seven had prosthetic valve endocarditis. Dacron was used to reconstruct the aortic root in 20 patients, and autologous pericardium was used in three patients. Only three patients died, one of ventricular dysrhythmias and two of multiple-organ failure. None of their survivors showed evidence of recurrent infection. These results suggest that the material used for reconstruction is perhaps not as important as aggressive resection of all infected tissues.

Our experience with the Dacron graft for reconstruction of infected areas in the left ventricular outflow tract is limited to four patients who were operated on during our early experience with this disease. Two of these four patients developed recurrent infection and died. With our increased experience with aortic annulus enlargement with autologous pericardium, we then began to use pericardium to patch different areas of the heart with excellent results.[17,18] We believed that autologous pericardium was more resistant to reinfection than the Dacron graft. This is probably not the case, as many surgeons who use Dacron grafts in these patients have reported results as good as ours. The appealing features of the pericardium for use in reconstruction are its easy handling characteristics and its impermeability to blood. We have recently used glutaraldehyde-preserved bovine pericardium for reconstruction of the left ventricular inflow and outflow tracts in a number of patients with results as satisfactory as with autologous pericardium.

Another alternative is to use aortic homografts to reconstruct the left ventricular outflow tract after extirpation of an aortic root abscess.[22,23] The aortic homograft can be used to replace either the entire root of the aorta with reimplantation of the coronary arteries or simply the aortic valve. In either case, parts of the homograft such as the anterior leaflet of the mitral valve can be employed to patch the defect created by resection of the abscess. We employed aortic valve homografts to replace the aortic valve in two of our patients with aortic root abscess, but the left ventricular outflow tract was repaired with autologous pericardium.

In summary, it seems that the important aspects in the management of patients with aortic root abscess are early surgical intervention, aggressive debridement of all infected material, and proper reconstruction of the aortic annulus. Reconstruction of the left ventricular outflow tract with autologous pericardium provides excellent clinical results.

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KEY WORDS • infective endocarditis • aortic root abscess • pericardial patch