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 1):1-269-1-274)

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

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.

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

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

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

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

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

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 abscesses.

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 reimplanted 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 aortic coronary bypass surgery at another institution and had a difficult postoperative course that included multiple-

![Figure 1](image-url)  
**Figure 1.** Sketches showing abscess limited to the aortic annulus (A), excision of all infected tissue (B), and reconstruction with autologous patch (C).
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

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**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).

**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 pace-
maker 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 thoracoab-
dominal 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 evi-
dence 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. Many patients, however,
develop serious complications during antibiotic ther-
apy and require surgery. New complete or incomplete
heart block is frequently associated with
aortic root abscess. Pericarditis in a patient with
active, infective endocarditis is usually an indica-
tion of annular abscess. Patients with large vege-
tations 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. Although congestive heart fail-
ure is the most common indication for surgery in
patients with aortic valve endocarditis, aortic root
abscess is present in approximately one third of
them. If the abscess is not properly debrided,
infection may persist, or the prosthetic valve may
dehisce.

Prosthetic aortic valve endocarditis is associated
with a higher incidence of aortic root abscess than is
native aortic valve endocarditis. Aortic root
abscess is almost always present in patients who die
with infected mechanical aortic valves. Endocardi-
tis in tissue valves is frequently confined to the
leaflet and has an incidence of aortic root abscess
similar to that of native aortic valve endocarditis
except in cases of early prosthetic endocarditis.

Surgical treatment of patients with aortic root
abscess has been performed since the early years of
open-heart surgery. Surgeons soon learned that
complete excision of all infected material was nec-
essary to cure patients with this problem. If the
abscess involved areas that could not be completely
extirpated, debridement of the abscess and translo-
cation of the aortic valve and coronary arteries to a
higher level in the ascending aorta was used to treat
a number of patients. With better techniques of
resection and reconstruction of the left ventricular
inflow and outflow tracts, we believe that translo-
cation 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 recon-
struct them. Most reports describing reconstruc-
tion of the left ventricular outflow tract after resec-
tion of an aortic root abscess indicate that Dacron
was used for the repair. Fiore and associates recently
reported their experience with 23 patients with aortic root abscesses. Sixteen patients
had native valve and seven had prosthetic valve
endocarditis. Dacron was used to reconstruct the
aortic root in 20 patients, and autologous pericar-
dium 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 reconstruc-
tion is perhaps not as important as aggressive
resection of all infected tissues.

Our experience with the Dacron graft for recon-
struction 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 recur-
rent infection and died. With our increased experi-
ence with aortic annulus enlargement with autolo-
gous pericardium, we then began to use pericardium
to patch different areas of the heart with excellent
results. We believed that autologous pericar-
dium was more resistant to reinflection 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 appeal-
ing features of the pericardium for use in reconstruc-
tion 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. The aortic
homograft can be used to replace either the entire
root of the aorta with reimplantation of the coro-
nary 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. Reconstruc-
tion of the left ventricular outflow tract with autolo-
gous pericardium provides excellent clinical results.

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PE, Jamieson SW, Baldwin JC, Shumway NE: Valve replace-

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PE, Jamieson SW, Baldwin JC, Shumway NE: Valve replace-
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KEY WORDS • infective endocarditis • aortic root abscess • pericardial patch