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MANAGEMENT OF AORTIC ROOT ABSCESS DUE TO VALVE ENDOCARDITIS: A FORMIDABLE SURGICAL CHALLENGE

Cardiology

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ABSTRACT

Aortic root abscess results when uncontrolled infective endocarditis causes aneurysm of one of the sinuses of Valsalva that is in free communication with the aortic root above the valve cusps. The risk factors for aortic root abscess in endocarditis are bicuspid aortic valve, aortic valve regurgitation, degenerative aortic stenosis and patients with multi valvular disease. In general terms, prognosis is better if surgery is undertaken early, before cardiac tissue destruction and deterioration in the overall condition of the patient increase the hazards of intervention.

KEYWORDS

Surgery, Infection, Aortic Valve endocarditis, Paravalvular abscess, Aortic root replacement, Aortic valve replacement, Cardiac transplantation

INTRODUCTION

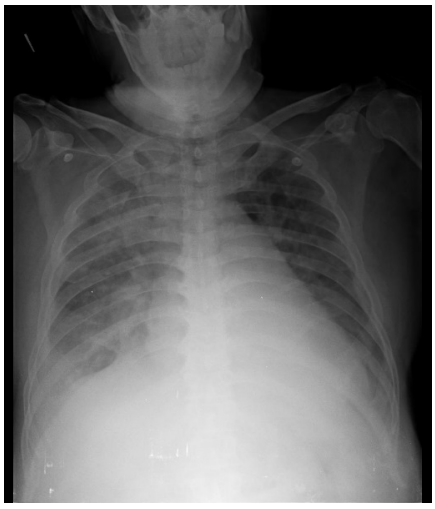
Infections of the endothelial lining of heart, assumes life threatening dimensions, inspite of newer antimicrobial agents and technological advances over the last five decades. Morbidity and mortality rates still remain high (6-33%). About 50-67% involves aortic valve and of these 70% needs surgical intervention. Onset of complications and unresponsiveness to medical therapy dictates surgical intervention. Despite phenomenal advances in interventional techniques over the last decade, open surgical intervention still forms the mainstay treatment in this group of patients since 1965.

Aortic root abscess, a severe form of infective endocarditis (IE) of the aortic valve involves adjacent tissues, manifests itself as a burrowing abscess, a cardiac fistula or a rupture into a cardiac chamber, a pseudo aneurysm, or an arrhythmia leading to hemodynamic instability. Early and extensive surgical reconstruction of major aortic root abscess is essential, because medical management alone is usually inadequate to arrest the destructive effects of the abscess. Any delay in surgery can has devastating effects.

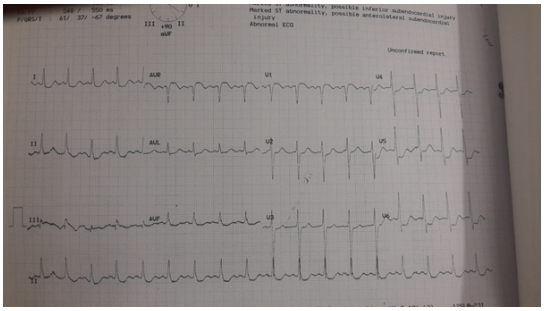
Why this article?

Brief Case Report

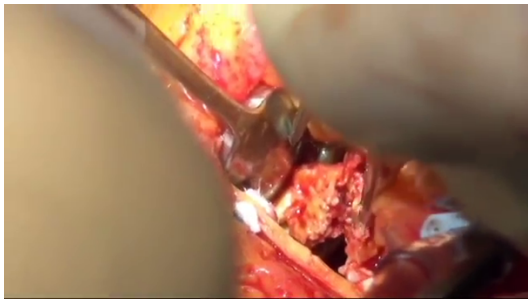
58 year old male, was referred to us with history of febrile illness and cough of 1 month duration, being treated at Government hospital Kollam. He also complained of excessive fatigue, breathlessness on lying down and chest discomfort for the last 2 days. No history of hemoptysis, hematuria, abdominal pain, headache, convulsions, skin rashes, jaundice or arthralgia. No features of distal embolism were noted. No history of drug abuse. On examination he had respiratory rate of 32/min, pallor, temp of 101F, PR- 115/min, BP 100/60mmHg, and elevated JVP.No hepatosplenomegaly. Examination showed good air entry bilaterally with bilateral basal crepitations.A short diastolic murmur was heard over the left parasternal area. CNS examination findings clinically were normal. No signs of meningeal irritation. No focal neurological deficits.ECG suggested acute ST elevation MI and CXR revealed pulmonary edema. Hemoglobin was 8.1 and total count was 19,000/mm3. Renal and liver functions were within normal limits. Trop T -178.5, BNP-6312, CRP-171.ECHO revealed severe calcific aortic stenosis with multiple vegetations, moderate regurgitation and large aortic paravalvular abscess. Coronary angiography showed 70% distal left main stenosis. He was taken up for emergency surgery. Calcified tricuspid aortic valve was noted with large vegetations and abscess cavity involving right coronary cusp extending to mid left coronary cusp and 1/3rd of non-coronary cusp, extending to intraventricular septum.4x3x4 cm deep cavity was debrided radically and reconstructed using gluteraldehyde fixed patch with annular reconstruction. Bioprosthetic (21CE) aortic valve replacement was done with coronary artery bypass with grafts to LAD and OMB2. He had an uneventful postoperative recovery and is now in sinus rhythm. Quantitative real time PCR from surgical specimen showed it to be a case of fungal endocarditis even though the initial cultures were negative.



CXR Showing Pulmonary Edema



ECG Showing Anterolateral Ischemia



Aortic Valve Vegetations And Para Annular Abscess- Figure 1

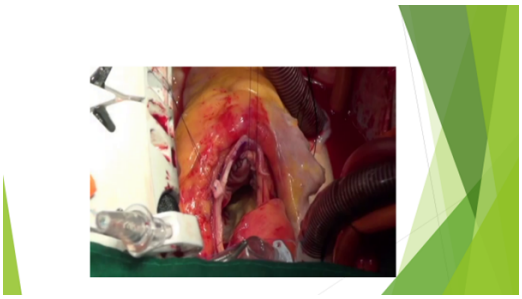


Figure 2. After Radical Surgical Debridement, Valve Excision And Annular Reconstruction

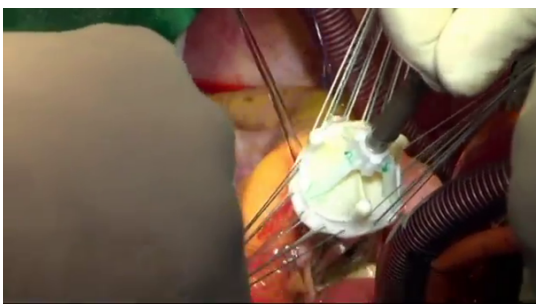


Figure 3 Bioprosthetic Aortic Valve Replacement

Trans thoracic and trans esophageal echocardiography is required in all cases. Cardiac catheterization is reserved for those with age over >40 years , postmenopausal women, and those with a history of ischemic heart disease or an adverse risk factor profile, although caution is necessary in the presence of large aortic vegetations that may be dislodged by catheter manipulation. Alternative noninvasive techniques such as multislice CT or MRI may be used if available. Intravenous unfractionated heparin is preferred to oral anticoagulation in the acute phase in our setup.

Surgical Indications

- See Table 1 for all current surgical indications

The most frequent indications are congestive heart failure (60%), refractory sepsis (40%), embolic complications (18%), and vegetation size (48%), with a combination of these factors being present in many patients.

Congestive heart failure is usually the result of acute valvular regurgitation due to perforation of a native valve or bioprosthetic valve leaflet or rupture of infected mitral chordae. Rarer causes include valve obstruction by bulky vegetations and sudden intracardiac shunts from fistulous tracts or prosthetic dehiscence. Acute aortic regurgitation is poorly tolerated and rapidly progressive. Acute mitral regurgitation is better tolerated as a consequence of offloading into the left atrium and pulmonary bed. Acute pulmonary edema develops due to rapid increase in left atrial pressure, and urgent surgical intervention is frequently required.

Periannular extension is common, affecting 10% to 40% of patients with native valve IE, and is most frequent in IE that affects the aortic valve, when abscess expansion near the membranous septum and atrioventricular node may result in heart block. Periannular in prosthetic valve endocarditis occurs in 56% to 100% of patients causing high mortality in this group. Untreated, abscess cavities may progress to create fistulous tracts with resultant intracardiac or pericardial shunts. This devastating complication was associated with a mortality rate of 41%.

The highest rates of embolic complications are seen with left-sided IE, especially when infection is related to *Staphylococcus aureus*, *Candida*, HACEK, and *Abiotrophia* organisms. Most embolic events occur before the diagnosis is made or within 2 weeks thereafter. Overall, risk of new embolism is greatest in patients with large (10 to 15 mm) mobile vegetations, especially in staphylococcal IE that involves the mitral valve. Benefits of surgery to prevent embolism are therefore greatest in 2 weeks; deferred surgery after 2 to 3 weeks for this indication alone is of little value.

The clinical spectrum of neurological complications are wide and includes ischemic or hemorrhagic stroke, transient ischemic attack, silent cerebral embolism, symptomatic or asymptomatic mycotic aneurysm, cerebral abscess, meningitis, toxic encephalopathy, and seizure. Earlier surgery may be contemplated in the occasional patient with cerebral bleeding from an isolated mycotic aneurysm, in whom neurosurgical or endovascular intervention may produce a sufficient reduction in the risk of recurrent bleeding to permit cardiopulmonary bypass. Timing of surgery is indicated in Table 2.

Considerations

The spectrum of disease may progress to involve the annulus with the development of annular abscess and may be further complicated by deeper myocardial involvement, damage to the fibrous skeleton of the heart and the conduction system, and perforation into other cardiac chambers. Prosthetic aortic valve endocarditis is a particularly devastating disease and many cases present with extensive aortoventricular damage requiring complex surgical reconstruction. Surgery for periannular extension involves drainage of abscess cavities, radical debridement of necrotic tissue, and complete removal of vegetations with closure of fistulous tracts where appropriate. Valve replacement is usually necessary, and use of aortic homografts or stentless valves may be considered when extensive destruction of periannular supporting tissues poses surgical difficulties. Complete heart block may necessitate a permanent pacemaker.

Procedure

Standard median sternotomy is used. After median sternotomy, pericardial patch is harvested. It is fixed with 0.62% gluteraldehyde solution for 5 minutes, and rinsed thoroughly with 0.9% saline solution. Arterial cannulation is performed via the ascending aorta (primary operations and in some reoperations) or via the right subclavian or femoral artery (in some reoperations). The venous cannulation was established in accordance with the accompanying cardiac procedures as unicaval or bicaval via the right atrium. The left ventricle (LV) was vented via the right superior pulmonary vein. All operations were performed with patients under cardiopulmonary bypass (CPB) in moderate or deep hypothermia (28ºC). After cross-clamping, cardiac arrest and myocardial protection were achieved by antegrade or retrograde (or both) administration of blood cardioplegia solution. Standard aortotomy is performed. Radical resection follows. The infected valve and all foreign materials were excised in preparation for the extensive debridement of infected and necrotic tissues in the abscess cavity.

When a localized abscess is limited to the size of a single cusp, it is reconstructed by plicating the defect using pledgeted mattress sutures placed just below the native aortic annulus and the sewing ring of the prosthetic stented valve during aortic valve replacement (AVR) .When a circular abscess was larger than one aortic cusp without aortoventricular dehiscence, the defect on the aortic annulus was reconstructed with use of a pericardial patch, and pledgeted sutures is placed on this patch during AVR.

Specimens should be subjected to gram staining and culture and sensitivity. When aortic valve can be salvaged, vegetectomy and reconstruction either primary or by using pericardial patch is performed. The patch is sutured to firm, fibrous tissue for a secure anastomoses or valve implantation. Pledgeted sutures are used to obliterate the abscess using a sandwich technique. It is important to properly inspect the mitral valve as it is involved in 40 -45% cases necessitating a repair or replacement. In prosthetic valve endocarditis in most cases replacement is needed except for a few in which primary repair of periprosthetic leak is possible. Ruptured mitral chordae may

be repaired with a combination of leaflet resection, chordal reattachment or transposition, and annular support, and leaflet perforations are often amenable to repair with a small pericardial patch, provided that valve integrity and motion are preserved.

When an aortoventricular dehiscence (discontinuity between the aorta and the LV of more than half the aortic circumference, after resection of all infected tissues) developed, an extended aortic root replacement is applied. After resecting the aortic annulus, only the LV outflow tract (LVOT) is left for the implantation of a prosthetic composite graft or a xenograft between the LV and the ascending aorta. Basically following resection and repair you have to restore the hemodynamic continuity.

Modified Bentall procedure (using a flanged composite graft) is one of the preferred approach for reconstruction of the destroyed aortic annulus.Subaortic ventricular septal defect (VSD) can be closed with a tongue-like extension of a flanged graft .The anterior mitral leaflets of homografts can be used in a similar fashion. In cases with pseudo aneurysm formation, sub aortic pericardial patch reconstruction without AVR or Aortic Root Replacement is needed. Concomitant Nick's posterior aortic-root enlargement and a septal myectomy may be needed because of a small aortic annulus and LVOT obstruction.

Postoperative

All patients receive at least four weeks of antibiotic therapy postoperatively. Broad spectrum antibiotics (vancomycin and aminoglycosides) are preferred in culture-negative cases. Immediate complications post-surgical include bleeding, postoperative heart block, postoperative renal dysfunction, dialysis, postoperative persistent fever, paravalvular leak or dehiscence and low cardiac output.

Hospital early mortality risk factors were recurrence and reoperation, concomitant non-aortic procedure, previous cardiac surgery, septic emboli, preoperative fever, preoperative renal dysfunction, congestive heart failure, peri prosthetic leakage, culture-negative endocarditis, operation during active phase, PVE, aortic annular involvement, mitral valve involvement, valvular destruction and emergency operation.

Factors affecting late mortality are previous cardiac surgery, septic emboli, preoperative renal dysfunction, congestive heart failure, culture-negative endocarditis, and left ventricular dysfunction, operation during active phase of infection, aortic annular involvement, mitral valve involvement, emergency operation, postoperative heart block, postoperative fever, PVE, recurrence and reoperation.

The actuarial survival rates for 1, 5, 10 and 15 years were 80.8%±3%, 77.4%±3.3%, 74.6±3.7% and 61.1±10.3%, respectively. Choice of surgical prosthesis has no influence on early or late mortality; however we have opted for bioprosthesis due to resistance to infection as they are gluteraldehyde treated and resist adhesion of microbes. Hence our recurrence rates are very low over the last 26 years. Those with history of HIV or drug abuse are prone for recurrence.

CONCLUSIONS

Surgery is potentially lifesaving and is required in 25% to 50% of cases during acute infection and 20% to 40% during convalescence, for unresponsive and complicated aortic valve endocarditis. Some of these procedures are complex cardiac reconstructions.

Emergency operation, female gender, postoperative renal failure and low cardiac output are significant risk factors for in-hospital mortality. Emergency operations in acute phase are still a major risk factor. In the surviving patients, risk for recurrence and need for reoperation is low especially after 6-9 months.

Homografts are inadequate to reconstruct the LVOT circumferentially in extensive aortoventricular dehiscence. The flanged composite graft would be the best option for reconstructing the aortic root. Ross procedure is useful when the aortic and pulmonary annular difference is less than 4. Gluteraldehyde fixed patches are best for aortic reconstruction and non fixed patched along mitral annulus in our experience. Jaults sub coronary valved conduit is another option in surgical armamentarium. Aoyagi, Masetti, Stamau are other useful methods to reconstruct the left ventricular outflow tract. Long term survival is lower in patients who had mitral valve involvement.

In general terms, prognosis is better if surgery is undertaken early, before cardiac tissue destruction and deterioration in the overall condition of the patient increase the hazards of intervention. Overall management is highly dependent on the experience of the surgical team (as well as the individual surgeon) and a strong interaction with cardiology and microbiology colleagues. Cardiac transplantation may be considered in extreme cases with recurrent prosthetic valve endocarditis. We have done over 386 cases, with 193 being aortic valve endocarditis over 26 years with 6% mortality.

Table 1 Indications for Surgery
Congestive heart failure*
CCF- severe AR/MR, by valve obstruction caused by vegetations
Severe acute AR/MR with echocardiographic signs of elevated left ventricular end-diastolic pressure or significant pulmonary hypertension
CCF as a result of prosthetic dehiscence or obstruction
Periannular extension
Most patients with abscess formation or fistulous tract formation
Systemic embolism†
Recurrent emboli despite appropriate antibiotic therapy
Large vegetations (>10 mm) after 1 or more clinical or silent embolic events after antibiotic therapy
Large vegetations and other predictors of a complicated course
Very large vegetations (>15 mm) without embolic complications, if valve-sparing surgery
Cerebrovascular complications‡
Silent neurological complication or transient ischemic attack and other surgical indications
Ischemic stroke and other surgical indications, provided that cerebral hemorrhage excluded and neurological complications are not severe (eg, coma)
Persistent sepsis
Fever or positive blood cultures persisting for >5 to 7 days despite an appropriate antibiotic regimen, assuming that vegetations or other lesions requiring surgery persist and that extra cardiac sources of sepsis have been excluded
Relapsing IE, especially when caused by organisms other than sensitive streptococci or in patients with prosthetic valves
Difficult organisms
S aureus IE involving a prosthetic valve and most cases involving a left-sided native valve
IE caused by other aggressive organisms (*Brucella, Staphylococcus lugdunensis*)
IE caused by multiresistant organisms (eg. methicillin-resistant*S aureus* or vancomycin-resistant enterococci) and rare infections caused by Gram-negative bacteria
Pseudomonas aeruginosa IE
Fungal IE
Q fever IE and other relative indications for intervention
Prosthetic valve endocarditis
Virtually all cases of early prosthetic valve endocarditis
Virtually all cases of prosthetic valve endocarditis caused by *S aureus*
Late prosthetic valve endocarditis with heart failure caused by prosthetic dehiscence or obstruction, or other indications for surgery

Table2: Timing Of Surgery: Emergency Surgery (within 24 Hours)
Native (aortic or mitral) or prosthetic valve endocarditis and severe congestive heart failure or shock
Acute valvular regurgitation,
Severe prosthetic dysfunction (dehiscence or obstruction)
Fistula into a cardiac chamber or the pericardial space
Urgent surgery (within days)
Native valve endocarditis with persisting CCF signs of poor hemodynamic tolerance, or abscess
Prosthetic valve endocarditis with persisting CCF, signs of poor hemodynamic tolerance, or abscess
Prosthetic valve endocarditis caused by staphylococci or Gram-negative organisms

Large vegetation (>10 mm) with an embolic event
Large vegetation (>10 mm) with other predictors of a complicated course
Very large vegetation (>15 mm), especially if conservative surgery is available
Large abscess and/or periannular involvement with uncontrolled infection
Early elective surgery (during the in-hospital stay)
Severe aortic or mitral regurgitation with CCF and good response to medical therapy
Prosthetic valve endocarditis with valvular dehiscence or CCF and good response to medical therapy
Presence of abscess or periannular extension
Persisting infection when extra cardiac focus has been excluded
Fungal or other infections resistant to medical cure

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