Aortic root reconstruction with a bioprosthetic valved conduit: A consecutive series of 275 procedures

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Objective: The study objective was to assess the results of aortic root reconstruction using composite conduits with stented bioprosthetic valves.

Methods: A review was conducted of 275 patients (202 were male, mean age 69 ± 11 years, range 17–88 years) who underwent aortic root replacement using conduits constructed intraoperatively from pericardial valves and impregnated Dacron grafts between September 1993 and February 2005. There were 151 patients with degenerative aneurysms and 63 patients with atherosclerotic aneurysms; 43 patients had dissections (9 acute type A), 13 patients had endocarditis, and 5 patients had other pathologic conditions. The ascending aorta alone was replaced in 154 patients, a hemiarch reconstruction was performed in 105 patients, and extensive arch reconstruction was performed in 16 patients. Hypothermic circulatory arrest and an open distal anastomosis were used in 95% of patients.

Results: Hospital mortality was 17 of 275 patients (6.2%). Four additional patients (1.5%) sustained permanent strokes. Among surviving patients, the rate of stroke was estimated as 0.85 per 100 patient-years and the rate of significant hemorrhage was estimated as 0.3 per 100 patient-years. Reoperation for valve failure occurred in only 1 patient 12 years postoperatively. Long-term survival in men was similar to that of a normal matched control population, but was significantly lower in women ($P = .002$).

Conclusions: Men who recover satisfactorily after reconstruction of the aortic root with a stented bioprosthetic valved conduit (6-month survivors) enjoy long-term outcomes equivalent to that of a normal matched population; the postoperative mortality rate in women is twice that of a normal population.

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Surgery of the ascending aorta has been remarkably successful for the last approximately 40 years. Aortic diseases that threaten catastrophic complications of rupture or dissection can now be treated with durable operations that have a low operative mortality.[1,2]

Aortic root reconstruction is warranted when a diseased aortic valve is associated with a dilated or dissected aortic root or ascending aorta. Elective surgery is also indicated in the presence of significant dilatation of the sinuses of Valsalva, the sinotubular junction, or the ascending aorta. In addition, elective root replacement may be advisable in a minimally dilated aortic root and ascending aorta if aortic

Abbreviations and Acronyms
COPD = chronic obstructive pulmonary disease
HCA = hypothermic circulatory arrest
SCP = selective cerebral perfusion

valve disease is associated with a genetic predisposition to aneurysm formation or dissection.

Since Bentall and De Bono introduced the surgical technique involving composite mechanical valved conduits in 1968, various adaptations of the original concept have been the standard therapy for patients with an aortic root aneurysm.[3,4] Because a mechanical valved conduit mandates lifelong anticoagulation, alternative strategies have been sought. Valve-sparing operations have become an increasingly appealing alternative in younger patients requiring aortic root surgery whose life expectancy exceeds the anticipated durability of an implanted biological valve. For elderly patients, in whom biological valves generally last longer, the use of a conduit constructed in the operating room by sewing a bioprosthetic valve to a vascular graft is the most attractive option.

The objective of this study was to evaluate patients who have undergone what we will refer to as a biological Bentall operation to determine whether the benefit of avoiding anticoagulation by using a biological valve in the aortic conduit is offset by the need for reoperation because of valve deterioration.

Materials and Methods

Since 1988, a composite conduit repair (a modified Bentall procedure) has been undertaken in more than 800 patients at Mount Sinai Hospital. A review disclosed 275 patients who underwent aortic root replacement with a biological valved conduit between September 1993 and February 2005. All patients received bioprosthetic conduits constructed intraoperatively from pericardial valves and impregnated Dacron grafts. The mean age was 69 years (range 17–88 years), and 73% were male (n = 202). Table 1 summarizes the clinical characteristics of the patients.

The institutional review board approved this research; additional patient consent was not required.

Indications

The principal indication for aortic root reconstruction (Table 1) was a degenerative aortic aneurysm in 151 patients (55%): of these, 9 had annuloaortic ectasia, 7 had a bicuspid valve, and 3 had Marfan syndrome. An atherosclerotic aortic aneurysm was present in 63 patients (23%); 43 patients (16%) had dissections, one quarter of which (9) were acute type A; 13 patients (5%) had aortic valve endocarditis affecting the root; and 5 patients had other pathologic conditions.

Fourteen patients underwent emergency root reconstructions (including 9 for acute type A dissection and 4 with root endocarditis). Twenty-one patients had urgent procedures because of shortness of breath, anginal pain, or syncope. The remaining 240 patients (87%) underwent elective procedures.

A total of 48 patients (18%) had undergone previous cardioaortic procedures; 27 patients (10%) had received oral anticoagulants before the root reconstruction, and 50 patients (18%) had received platelet inhibitors. At hospital admission, 85 patients (31%) were being treated for hypertension with β-adrenergic blocking agents, and 49 patients (18%) were being treated with angiotensin-converting enzyme inhibitors.

TABLE 1. Clinical profile and indication for operation

	n (%)
Demographics	
Mean age y (SD)	69.3 (±11.3)
Age >60 y	226 (82%)
Male sex	202 (73%)
Previous cardioaortic operations	48 (18%)
Timing of surgery	
Elective	240 (87%)
Urgent/emergency	21 (8%)/14 (5%)
Risk factors	
History of neurologic dysfunction	24 (9%)
History of hypertension	149 (54%)
Coronary artery disease (CAD)	96 (35%)
Smoking/diabetes/COPD	75 (27%)/17 (6%)/8 (3%)
Aortic root pathology	
Degenerative	151 (55%)
Bicuspid valve/annuloaortic ectasia/Marfan syndrome	9 (3%)/9 (3%)/3 (1%)
Atherosclerosis	63 (23%)
Dissection	43 (16%)
Acute type A dissection	14 (5%)
Acute endocarditis	13 (5%)
Other*	5 (<2%)
Aortic valve function/pathology	
Aortic regurgitation	167 (61%)
Prosthetic valve	11 (4%)
Intraoperative findings	
Clot or atheroma	24 (9%)

SD, Standard deviation; *CAD*, coronary artery disease; *COPD*, chronic obstructive pulmonary disease. *Pseudoaneurysm after ascending replacement (n = 4) and giant cell aortitis (n = 1).

Surgical Technique

Cannulation and myocardial protection. Arterial cannulation was carried out through the femoral artery (19%), the ascending aorta (18%), and, more recently, the right axillary artery (61%; Figure 1) as previously described by our group[5]; the left axillary artery or the aortic arch was cannulated in 6 cases (2%). Venous cannulation was usually through a 2-stage catheter in the right atrium, but in some patients in whom the heart was not fully exposed, the right atrium was accessed through a wire-directed catheter placed through the femoral vein. Myocardial protection was provided with cold antegrade blood cardioplegia, systemic perfusion at 20°C, and, in patients with severe coronary disease, retrograde blood cardioplegia. Cardioplegia was administered every 20 to 30 minutes during periods of myocardial ischemia.