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Ross procedure is a safe treatment option for aortic valve endocarditis: Long-term follow-up of 42 patients

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ABSTRACT

Background: Aortic root replacement with a pulmonary autograft (Ross procedure) can be performed as a treatment of aortic valve endocarditis, avoiding prosthetic valve implantation in septic context. We sought to assess long-term outcomes of the Ross procedure in this indication.
Methods: From April 1992 to March 2009, the intervention was performed in 42 patients (mean age 34 ± 8 years) suffering from an active or ancient aortic valve endocarditis. 36% of the patients had extensive perivalvular involvement, and surgery was urgent in 18 patients (43%). We performed a prospective clinical and echocardiographic follow-up of this population.
Results: Median follow-up was 10 years (4–21 years). Overall survival at 10 and 15 years was respectively 87 ± 5% and 81 ± 8%. Perioperative mortality was 4.7% (2 patients) and no late cardiac death was reported. Eight patients (19%) underwent repeat surgery for autograft and/or homograft dysfunction at a median time of 8.4 years (3 months–18 years). Rate of recurrent endocarditis was low (7%—3 patients), including 1 in a context of persistent intravenous drug abuse. Clinical follow-up showed good functional status for all patients with NYHA ≤ II, and less than 25% of patients requiring cardiovascular medication. Late echocardiographic follow-up demonstrated well-functioning autograft and homograft, with only one severe aortic regurgitation, and one significant increase in pulmonary mean gradient.
Conclusion: The Ross procedure in aortic valve endocarditis is an interesting alternative to prosthetic valvular replacement in a selected population, with a high rate of survival free from any cardiovascular event or medication requirement.

1. Introduction

Infective endocarditis (IE) is an uncommon but not rare disease, with an incidence of 3 to 10 episodes/100,000 person-year. [1] Its most common location is the aortic valve, especially in young adults [2].

Over the past decade, surgery has taken a major place in the early treatment of this disease [3–5], and current guidelines recommend surgical management for complicated left sided IE [6].

Surgical management of aortic endocarditis raises specific issues. Conversely to mitral regurgitation, aortic repair is not a reliable option, except for very highly selected patients, with the most favourable potential in tricuspid valves and limited involvement of only one cusp [7]. Prosthetic valve replacement is currently the standard therapy, often combined with pericardial patch reconstruction of a portion of the annulus in case of extensive perivalvular destruction [8]. However the use of foreign material in infectious context still raises concerns, and should be kept to the minimum according to guidelines [6], as it may expose to recurrent endocarditis. Cryopreserved and sterilised homografts typically show low rates of reinfections, particularly in the early post-operative period. Yet their durability has been questioned, especially in young adults [9–11].

Accordingly, aortic root replacement with pulmonary autograft (Ross intervention) seems to be an interesting option in this context, allowing reconstruction in case of loss of substance. When dealing with young and active patients, this technique may provide substantial advantages over both bioprostheses, with better durability, ability to grow and lack of degeneration, and mechanical valves, with no need for chronic anticoagulation and lower rates of thrombosis. Moreover, autograft and homograft may have a good resistance to persistent or recurrent infection thanks to their vitality [12].

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We sought to assess long-term results of the Ross procedure for the treatment of aortic valve endocarditis, in a cohort of patients treated at our institution over 20 years.

2. Methods

2.1. Patients

2.1.1. Clinical characteristics

Between April 1992 and March 2009, the Ross procedure was performed on 314 patients, 42 of whom had aortic valve endocarditis. The diagnosis was made according to the modified Duke criteria, combining clinical, echocardiographic, and microbiological evaluation [13,14].

The population consisted of young patients, ranging from 13 to 48 years (mean age 34 ± 8 years), and included a majority of male (86%), with a mean body surface area of 1.9 ± 0.2 m^2, and body mass index of 26 ± 4 kg/m^2.

The preoperative EuroSCORE 1 ranged from 5 to 14 (median 7.5). Major preoperative comorbidities included renal failure in 3 patients (7%), alcoholism in 6 (14%), drug addiction in 5 (12%), HIV in 1 (2%), hepatitis C in 2 (5%), epilepsy in 2 (5%), and bipolar disorder in 1 (2%). As for cardiovascular risk factors, 7 patients (17%) suffered from hypertension, 4 (10%) from dyslipidaemia and 15 (36%) were active smokers.

Seventy-one percent of the patients had congenital cardiac malformations: 28 had bicuspid aortic valve, 1 had an associated sub-aortic membrane, 2 had ventricular septal defect. Three patients (7%) had undergone previous cardiovascular surgery (1 for coarctation of the aorta, 2 for severe aortic stenosis treated by aortic tissue valve replacement — both 11 years before endocarditis).

Endocarditis was acute in 33 patients (78%). Bivalvular endocarditis was found in 8 patients (19%) involving aortic and mitral valves in 6 patients, and aortic and tricuspid valves in 2 patients.

2.1.2. Microbiology

The most frequent endocarditis origin was dental (16 patients, 38%). Other aetiologies included: intravenous drug abuse (4 patients), gastro-intestinal origin (4 patients; among whom 1 appendicitis, 1 colonic cancer), genitourinary origin (3 patients; 1 during pregnancy, 1 after an infected hysterotomy due to caesarean delivery).

Positive blood and/or tissue cultures were obtained in 76% of the population. *Streptococcus* (48%) and *Staphylococcus* (21%) were the main causative microorganisms, and double infections were found in 3 patients (Table 1). The aetiology remained unknown in 1/3 of the population.

2.1.3. Indications for surgery

All patients but 2 had moderate or severe aortic regurgitation (95%), while 3 (7%) had a significant aortic obstruction due to large vegetations. Fifteen (36%) presented extensive perivalvular abscess, and 4 (9%) had an aortic root aneurysm. Twenty-three patients (55%) suffered from congestive heart failure, including 4 (9%) cardiogenic shocks.

Embolic events were diagnosed in 12 patients (29%). Sites of embolism were the brain (8 patients), spleen (3 patients), kidneys (1 patient), lungs (1 patient), and coronaries (1 to left anterior descending, 1 to right coronary artery), including 3 patients with multiple emboli.

The infection was not controlled in 5 patients (12%), and 3 patients (7%) had complete atrio-ventricular block.

Surgery was urgent or emergent in 18 patients (43%), as a result of the above-mentioned complications.

Table 1
Microbiological data (n = 42).

Microorganisms	*Streptococcus*	20 (48%)
	Bovis	5
	Mitis	4
	Sanguis	5
	Parasanguinis	4
	Gemmela morbillorum	1
	Enterocccus faecalis	1
	Staphylococcus	9 (21%)
	Epidermidis	2
	Saprophyticus	1
	Aureus meti S	3
	Aureus meti R	3
	Other microorganisms	3 (7%)
	Acinetobacter	1
	Actinobacillus	1
	Aspergillus	1
	Not found	10 (24%)
Simple infection		39 (93%)
Double infection		3 (7%)
	S. aureus + *Acinetobacter*	1
	Streptococcus + *Aspergillus*	1
	Enterococcus faecalis + *S. saprophyticus*	1

2.2. Preoperative echocardiographic evaluation

Diagnostic evaluation included preoperative transthoracic and transoesophageal echocardiography, as well as an intraoperative transoesophageal echocardiography.

In addition to valvular and perivalvular lesions described in the previous paragraph, large aortic vegetations (>15 mm) were found in 6 patients, aortic cusp perforations in 11, mitral valve vegetation or perforation in 6, tricuspid valve vegetation or perforation in 2, interventricular septal abscess in 1, and a fistula from aorta to right ventricle in 1.

Overall, patients had mildly impaired left ventricular function in the presence of moderate to severe aortic regurgitation (mean left ventricular ejection fraction [LVEF] was 57 ± 13%), and mildly dilated left ventricle (mean left ventricular end diastolic diameter [LVEDD] was 65 ± 9 mm, and indexed to body surface area [LVEDi]: 35 ± 8 mm/m^2). Nine patients had moderate (35–50%), and 5 had severe LVEF impairment (<35%).

2.3. Peroperative data

2.3.1. Operative findings

Operative findings correlated well with preoperative echocardiography. Active or healed aortic or bivalvular endocarditis was confirmed by the presence of aortic cusp perforations or destructions (20 patients), aortic infective vegetations (16 patients), aortic perivalvular abscess (11 patients), perforations or abscesses of mitral valve (6 patients) or tricuspid valve (2 patients), interventricular septal defect secondary to extensive abscess (2 patients).

2.3.2. Surgical procedures

All procedures were performed by a single surgeon (AP). Cardiopulmonary bypass was conducted in normothermia. Intermittent infusion of cold blood cardioplegia was conducted.

In addition to common principles, extra care was taken in this septic context: all valves were carefully examined, abscesses and necrotic tissues were widely removed to ensure complete exeresis of infected tissues, fragments excised were sent for microbiological analyses. In case of large tissue defect, an autologous pericardial patch was used to close the gap. Distal autograft suture was reinforced with a pericardial strip in 5 patients.

The Ross operation was performed according to previously described techniques [15–17]. Pulmonary autograft was reimplanted using the full root replacement technique [16] in 33 patients (78%), the subcoronary technique originally described by Ross [17] in 7 patients (17%), and a modified Ross technique with pulmonary autograft inclusion in a polyester tube [15] in 2 patients (5%). Autograft diameter ranged from 21 to 32 mm (median 26 ± 2 mm).

The right ventricular outflow tract was reconstructed with a cryopreserved homograft conduit supplied by the European Homograft Bank of Brussels (Belgium) in 27 patients (64%). Median homograft diameter was 26 mm (24 to 30 mm). When homograft was not available, a 27 mm or 29 mm stentless valve (Medtronic Freestyle®, Edwards Prima®, St. Jude Toronto® or Shelligh valve®) was implanted (15 patients — 36%).

Additional surgical procedures were performed in 14 patients (33%): mitral valve repair (6 patients), tricuspid valve replacement (1 patient: mitral cryopreserved homograft in tricuspid position), aortic root wrapping (5 patients), ventricular septal defect closure (2 patients), aorto-right ventricular fistula exclusion (1 patient).

Mean cardiopulmonary bypass time was 144 ± 28 min and mean cross-clamp time 118 ± 22 min.

2.4. Follow-up

Ninety-eight percent of patients underwent a complete follow-up. One patient was lost to follow-up after moving away from Europe.

Postoperative echocardiograms were performed within 2 weeks after surgery.

In addition, prospective late follow-up included a structured interview, clinical examination and a repeat transthoracic echocardiography. Between March 2013 and April 2014, echocardiograms were performed at our institution for 28 patients, and 6 were evaluated by their referring cardiologist as they were unable to attend an appointment at our structure.

Informed consent was obtained from each patient. The study protocol conforms to the ethical guidelines of the 1975 Declaration of Helsinki.

2.5. Statistical analysis

Statistical analyses were performed using SPSS Statistics version 22.0 (SPSS Inc., Chicago, IL). Quantitative variables are expressed as mean ± standard deviation in case of normal distribution, or median (interquartile range) otherwise. Normality of distribution was checked using Shapiro–Wilk test. Qualitative variables are expressed as frequencies and percentages.

We determined survival curves according to the method of Kaplan and Meier for overall survival, freedom from cardiac reoperation, freedom from the Ross reoperation, and freedom from recurrent endocarditis.

Statistical testing was done at the two-tailed α level of 0.05.