Ross Procedure: Prognosis of Pulmonary Autografts

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Introduction

Sir Donald Ross performed the first pulmonary autograft replacement for the aortic valve in 1967. In his pioneer series of over 100 patients, surgery was performed using the subcoronary technique. However, due to its complexity, the procedure was not widely adopted by others at the time. The accumulated experience of surgeons using coronary buttons for aortic root operations facilitated pulmonary autograft replacement using the full-root technique, and excellent midterm results were published in the 1990s.

According to the registry of the Ross procedure, 80% of patients underwent the full-root technique, whereas subcoronary or inclusion techniques were infrequent.

Fate of Autografts

Sievers et al. described 500 Ross procedures, using the subcoronary technique, and they predicted that the reoperation rate for aortic regurgitation would be lower in the long term, compared with full-root replacement. De Kerchove et al. found that the 10-year rate of survival and freedom from reoperation were the same for both techniques. They concluded that the main causes of failure were autograft dilation and aortic valve prolapse in the full-root and inclusion groups, respectively.

Elkins described 487 Ross procedures and concluded that male sex and a primary diagnosis of aortic insufficiency negatively affected late results. David also claimed that the Ross operation provided suboptimal results in male patients with aortic insufficiency. Female patients with aortic stenosis had the best outcomes in their series of over 200 patients.

Stewart et al. described that annuloplasty for dilated aortic annulus at the time of the Ross procedure does not prevent neo-aortic regurgitation in children.

In contrast, the long term results of the Ross and Ross-Konno operation for infants and children with multilevel left ventricular outflow tract stenosis were excellent. The autografts did not become stenosed, and the incidence of regurgitation was low with reasonable enlargement of the annulus parallel to the somatic growth.

Prevention of Graft Failure

Pulmonary autografts often become gradually dilated, which seems unavoidable. Dilation of the sino-tubular junction and aortic annulus both cause aortic insufficiency.

Brown et al. described a preventive method of dilation for both sites in which the ascending aorta is replaced with a tubular Dacron graft, and also added external fixation of the aortic annulus with a Dacron strip. They also emphasized that postoperative systemic hypertension must be aggressively treated.

Ungerleider et al. completely encased the autograft in an appropriately sized tubular Dacron graft before implantation, which was a more simple modification of the Ross procedure to prevent autograft dilation. Kollar et al. applied a similar method using Goretex and Juthier et al. used a Valsalva graft for the same purpose.

These authors indicated that the prognosis of the autograft was improved for five years, postoperatively.

Reoperations after Ross Procedure for Recurrent Aortic Insufficiency

Mechanical or bioprosthetic valves have been used to replace failed pulmonary autografts with or without
aortic root replacement. However, recent progress in valve-sparing aortic root replacement has facilitated the application of this technique to addressing pulmonary autograft insufficiency. Ishizaka et al.\textsuperscript{16} described a method of aortic root remodeling to treat aortic root dilation and aortic insufficiency in children and adolescents. Luciani et al.\textsuperscript{17} applied the Yocoub technique for valve sparing aortic root replacement to treat failed pulmonary autografts and called it the Ross-Yacoub procedure. Cameron suggested that valve sparing operation is easier after the Ross procedure than for a native aortic valve, because the valve annulus is a little higher after the Ross procedure (personal communication).

**Indication for the Ross Procedure**

Infants and small children with multilevel left ventricular outflow stenosis are the most favorable candidates for the Ross and Ross-Konno procedure. Women of childbearing age with aortic stenosis are also good candidates for the Ross procedure. A method of preventing ascending aortic and aortic annular dilation must be considered for pulmonary autograft replacement in adult patients.\textsuperscript{18}

**References**


