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Review article – Special issue: Structural heart disease – Aortic and mitral valves

## Current status of the Ross procedure in aortic valve surgery



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### ABSTRACT

The Ross procedure represents a unique surgical concept of unrepairable diseased aortic valve replacement by patient's own pulmonary valve (pulmonary autograft). After pulmonary valve removal, the right ventricle outflow tract is reconstructed by pulmonary allograft transplantation. Pulmonary valve in aortic position (pulmonary autograft) displays excellent haemodynamic features, viability with a growth-potential (in children) and a low risk of thromboembolism and infective endocarditis unparalleled to other heart valve substitutes. Despite the advantages of a pulmonary autograft the Ross procedure arouses controversies and surgical respect due to its technical complexity and involvement of another valve into a risk of complications and potential reoperation. Renaissance of interest in Ross procedure has been caused by recent operation standardisation, knowledge of critical procedural steps and confirmation of excellent long-term results. Ross procedure performed in dedicated centres with utmost attention to technical details securing long-term durability of both the autograft and allograft is an attractive option namely for young patients with aortic valve disease.

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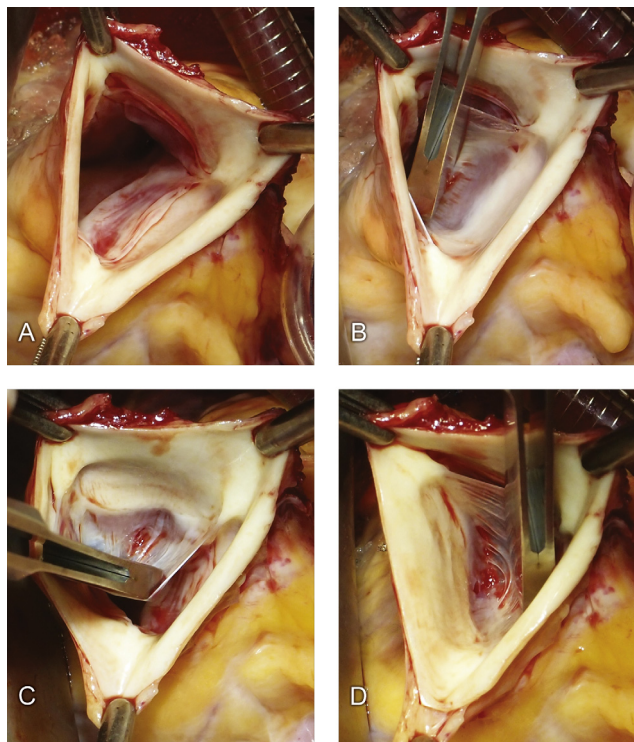
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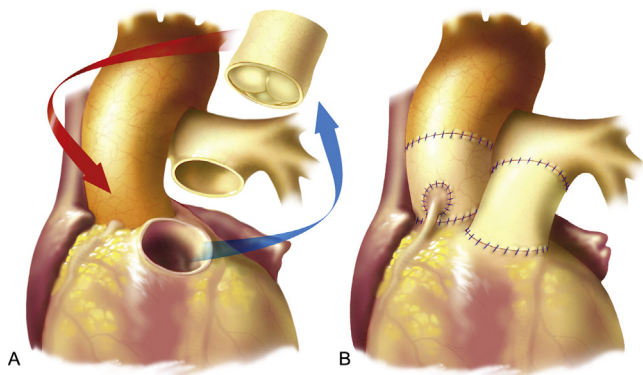
**Introduction**

Donald Ross, a South-African surgeon who took up a career in London, described the principle of the Ross procedure in 1968, almost 50 years ago [1,2]. In spite of that, this procedure has never become widely used. The principle of the operation is a replacement of an unrepairable diseased aortic valve with a pulmonary autograft (PA), which is the patient's own pulmonary valve. The pulmonary root is then replaced with a pulmonary allograft (PH), i.e. with the pulmonary valve harvested from a deceased donor. In the original procedure, the autograft was implanted in the aortic position applying a so-called subcoronary technique, i.e. in a similar manner as stentless aortic valve without the necessity to re-implant the coronary buttons. Today, however, the technique of choice in the majority of centres, is a procedure known as a "full root" technique, in which the complete aortic root is replaced with the pulmonary autograft (pulmonary root) (Fig. 1).

Advantages of the Ross procedure are indisputable. The pulmonary autograft is a viable valve which maintains its growth potential (Fig. 2). For such a reason, it is a method of choice in paediatric cardiac surgery in case of congenital aortic valve malformations requiring its replacement. PA is sometimes denominated a "living valve", which means a viable valve with preserved endothelium/endocardium and other layers of the wall and leaflets. Therefore, thromboembolic



**Fig. 2 – Inspection of the pulmonary artery valve (A) and its individual leaflets (B–D).**



**Fig. 1 – Diagram of the principle of the Ross procedure. The pulmonary artery root is explanted (A) and implanted (as autograft) in the aortic annulus by a "total root replacement" technique (B). The right ventricular outflow tract is reconstructed using the pulmonary allograft.**

complications practically do not appear in this type of valve, patients do not have to take an anti-coagulation treatment and thus they are not exposed to a risk of bleeding complications. The valve viability also guarantees a higher resistance against infections with a low incidence of infective endocarditis.

The procedure, however, has its important disadvantages. The most important one is an extension of one (aortic) disorder to two valves disorders (aortic + pulmonary valves). Therefore, both valves are exposed to the risk of failure which implies the need of reoperation. Another argument against this procedure is the fact that a rather demanding technique must be applied, which carries an increased risk of complications, including the patient's death.

For such a reason, in the nineties of the last century, after a certain enthusiasm, this procedure became less used (especially in adult patients), and such a trend can be observed until present. According to the data of the Society of Thoracic Surgeons (STS), the Ross procedure accounted for 0.09% out of

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