**Case
Report**

Autograft Valve-Sparing Root Replacement for Late Ross Failure during Quadruple-Valve Surgery

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Approximately 25% of patients require reoperation within 15 yrs of a Ross procedure. Increasing experience with valve-sparing root replacement (VSRR) has led some surgeons to spare the autograft valve. Here, we demonstrate that all valves can be surgically repaired or replaced safely during autograft VSRR. As more patients are considered for this operation, coexistent mitral, tricuspid, and pulmonic valve dysfunction should not preclude salvage of the autograft valve, nor should autograft leaflet prolapse.

Keywords: Ross procedure, valve-sparing root replacement, aortic valve

Introduction

Delayed pulmonary autograft failure is the principal limitation of the Ross procedure. Although the neo-aortic valve is typically replaced during reoperation, techniques for autograft valve preservation are increasingly employed.^{1,2)} Leaflet prolapse and asymmetry are deterrents to valve preservation in this technically complex surgical population, but do not preclude repair.¹⁾ Furthermore, at the time of reoperation, coexistent mitral, tricuspid, and pulmonary valve disease may require surgical correction. We describe how to safely perform an autograft valve-sparing root replacement (VSRR) with autograft cusp repair in the setting of quadruple valve disease.

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Case Report

A 67-year-old man who underwent a Ross procedure for aortic stenosis and mitral valve repair at age 51 was referred for a 5.5 cm ascending aortic aneurysm and 4.8 cm aortic root aneurysm (5.2 cm at the sinotubular junction); the aortic arch and descending aorta were normal in diameter. Echocardiography revealed moderate aortic regurgitation without stenosis and a normal aortic valve annulus (2.4 cm), severe mitral regurgitation through a prior annuloplasty ring with a moderately dilated left atrium, moderate tricuspid regurgitation with severe annular dilatation, and moderate pulmonic regurgitation with leaflet prolapse. Both left and right ventricular function were mildly decreased.

Upon safe mediastinal reentry, the distal ascending aorta, superior and inferior vena cava were cannulated for cardiopulmonary bypass. After cross-clamping, the ascending aorta and autograft root were resected, and the coronary buttons were mobilized (**Fig. 1A**). Inspection of the autograft valve revealed intact leaflets with prolapse of the left coronary cusp.

The mitral valve was then accessed through the interatrial septum after right atriotomy. The prior annuloplasty ring was removed and replaced with a #28 Profile 3D ring

Fig. 1 (A) Pulmonary autograft aneurysm and root resected. (B) Prior mitral annuloplasty ring removed and replaced. (C) Sub-annular sutures placed circumferentially. (D) Left coronary autograft leaflet shortened. (E) Pulmonary valve replacement with patch augmentation of the outflow tract. (F) Tricuspid valve repaired with annuloplasty ring.

(Medtronic, Minneapolis, MN, USA) to account for the diminutive, retracted posterior leaflet (**Fig. 1B**).

Sub-annular VSRR sutures were then placed circumferentially around the sub-annulus and out through the autograft root (**Fig. 1C**). A #32 straight graft was minimally narrowed in the 3 anti-commissural positions and sutured to the sub-annulus in coronet fashion. The graft was seated and tied down loosely. The autograft commissures were then posted at the appropriate heights, and the residual autograft root was anastomosed to the inside of the graft. The free margin of the left coronary leaflet was then shortened at the left/right commissure to address prolapse (**Fig. 1D**), followed by orthotopic reimplantation of the coronary ostia. Three graft neosinuses were generated using narrowing sutures at the

anti-commissural positions. After beveling, the graft was anastomosed to the distal ascending aorta to complete the ascending aortic replacement.

The homograft was incised to reveal the severely stenotic right ventricular outflow tract (RVOT); the incision was carried from the RVOT up to the left pulmonary artery. A #25 Magna biologic valve (Edwards Lifesciences, Irvine, CA, USA) was sutured to the posterior aspect of the pulmonary artery. Next, a pericardial patch was anastomosed to the proximal left pulmonary artery. With a running 4-0 polypropylene, we used the patch to augment the pulmonary artery and RVOT, and secure the prosthetic pulmonic valve anteriorly (**Fig. 1E**). Finally, the tricuspid valve was repaired with a #32 MC3 ring (Edwards Lifesciences) (**Fig. 1F**). Ischemic and bypass times were 270 and 372 min, respectively.

After separation from bypass, echocardiography demonstrated normal autograft leaflet motion with trivial aortic regurgitation. No regurgitation was noted through the mitral, tricuspid, or pulmonic valves and ventricular function was normal. The patient's postoperative course was uncomplicated; he was extubated on postoperative day 1 and discharged home on postoperative day 13. Two months after surgery, the patient was exercising and free of shortness of breath, chest pain, or peripheral edema.

Discussion

Recent data suggest that 20% to 25% of patients require reoperation within 15 yr of a Ross procedure.^{3,4} Often, the autograft valve is replaced during the reoperation. However, growing experience with VSRR has translated to some choosing to salvage the autograft valve.^{1,2}

Reports of autograft VSRR demonstrate low operative mortality, often with rates lower than that of the index Ross procedure.² Furthermore, retaining the autograft valve reduces risk of thromboembolism, hemorrhage, and infection. The variant of the VSRR likely impacts durability.² We favor the reimplantation technique in all scenarios, regardless of complexity.⁵ We have also had early success with direct autograft leaflet repair to enhance repairability.¹

In the largest series to date, approximately 20% of patients required concomitant surgery to correct RVOT stenosis.² Here, we demonstrate that all valves can be surgically repaired or replaced safely during autograft

VSRR. As more patients are considered for VSRR, coexistent mitral, tricuspid, and pulmonic valve dysfunction should not preclude salvage of the autograft valve, nor should autograft leaflet prolapse.

Conclusion

When the pulmonary autograft fails after a Ross procedure, autograft VSRR is a promising alternative to aortic root replacement. Quite often, other valves require reconstruction or replacement at the time of the redo procedure. We believe that concomitant valve disease, even of all four valves, should not preclude consideration for an autograft VSRR.

Disclosure Statement

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References

- 1) Goldstone AB, Woo YJ. Pulmonary autograft leaflet repair and valve sparing root replacement to correct late failure of the ross procedure. *J Card Surg* 2013; **28**: 496-9.
- 2) Mookhoek A, de Kerchove L, El Khoury G, et al. European multicenter experience with valve-sparing reoperations after the ross procedure. *J Thorac Cardiovasc Surg* 2015; **150**: 1132-7.
- 3) Mastrobuoni S, de Kerchove L, Solari S, et al. The ross procedure in young adults: over 20 years of experience in our Institution. *Eur J Cardiothorac Surg* 2016; **49**: 507-12; discussion 512-3.
- 4) Miskovic A, Monsefi N, Karimian-Tabrizi A, et al. A 17-year, single-centre experience with the Ross procedure: fulfilling the promise of a durable option without anticoagulation? *Eur J Cardiothorac Surg* 2016; **49**: 514-9; discussion 519.
- 5) Goldstone AB, Woo YJ. Valve-sparing root replacement for failed pulmonary autografts: should a David repair a Ross? *J Thorac Cardiovasc Surg* 2015; **150**: 1138-9.