Valve-sparing aortic root reconstruction with a valveless aortic allograft

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The creation of pseudosinuses in a prosthesis used for a valve-sparing reconstruction of the aortic root is an attractive modification of the aortic valve-sparing technique. It is an effort to copy the shape of the natural aortic root, which has the theoretical advantage of optimizing valve function and prolonging valve longevity.¹⁻⁴

Dacron polyester fabric is generally applied as the prosthetic material of choice for this type of operation. The disadvantages of this material are the risk of thrombogenicity⁵ and a lack of elasticity. Moreover, the typical Z-fold wall structure and the rough surface are impeding characteristics when the prosthesis is used to create pseudosinuses. Instead, we used a cryopreserved aortic allograft without the valve to perform a valve-sparing aortic root reconstruction and describe the advantages of this alternative.

Clinical Summary

An 8-year-old girl with Marfan syndrome presented with a 38-mm aortic root at sinus level (95% normal confidence limits, 17-24) and an 18-mm annulus and distal ascending aortic diameter without aortic valve insufficiency. Because she had a family history of early sudden death, we decided to replace her aneurysmal aortic root to avoid the risk of ascending aortic dissection and rupture.

At the time of the operation, the enlarged sinuses of Valsalva were excised, leaving the crown-shaped aortic valve with the commissures and annulus in situ.¹ The coronary ostia were mobilized as buttons. A 25-mm cryopreserved aortic allograft was tailored to fit in the orthotopic position after excision of the valve cusps and redundant perivalvular tissue to compensate for complete body growth (Figure 1).

The valve was resuspended by fixing each commissure with a U-shaped polypropylene stitch into the corresponding commissural cleft of the allograft. Each allograft sinus was subsequently reinserted, as described by Sersam and Yacoub,¹ by using 3 separate running 5-0 polypropylene sutures. Finally, both coronary ostial buttons were implanted into their respective allograft coronary ostia, and the distal anastomosis between the allograft with the native ascending aorta was made with single running 5-0 polypropylene sutures.

The intraoperative transesophageal echocardiographic restudy showed a neo-aortic root of normal size and geometry, with normal distensibility and good aortic valve function without insufficiency (Figure 2).

Discussion

Reconstruction of a normally shaped aortic root is aimed to restore normal mechanical load on the aortic cusps. This might be particularly beneficial in patients with an intrinsically abnormal valve caused by a connective tissue disease, in whom early valve failure is a definitive outlook.⁶ In such patients a physiologically reconstructed aortic root might delay progression of the pathologic process and postpone valve failure and replacement.

Dacron pseudosinuses, whether tailored as tongue-shaped extensions of a tube graft^{1,2} or as separate sinus pieces with a longitudinal corrugated pattern,^{3,4} lack the surface characteristics, elasticity, and geometry of the natural sinuses. Moreover, the tailored prosthesis is

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Received for publication Oct 15, 2002; revisions requested Oct 25, 2002; revisions received Oct 28, 2002; accepted for publication Nov 1, 2002.

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J Thorac Cardiovasc Surg 2003;126:282-3

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0022-5223/2003 \$30.00 + 0

doi:10.1016/S0022-5223(03)00084-9

Figure 1. Skeletonized aortic allograft prepared for valve-sparing aortic root reconstruction seen from the ventricular side and showing the 3 separate spoon-shaped sinuses. *NCS*, Noncoronary sinus; *RCS*, right coronary sinus; *LCS*, left coronary sinus.

highly symmetric, whereas the shape of the natural aortic root is characterized by a unique asymmetry,⁷ reflecting similar dynamics.⁸

The aortic allograft constitutes the closest possible copy of the patient's own normal aortic root. It resumes its normal function and natural flow pattern when the valveless aortic allograft is correctly sized and inserted in the orthotopic position. Despite the lack of cellular viability and eventual loss of elasticity, its natural dynamic properties should at least be maintained for some years⁹ and benefit the patient by enhancing valve longevity. Finally, the postoperative use of antiplatelet drugs, as proposed by David and colleagues,⁵ can be avoided because the allograft lacks thrombogenicity.

Heart valve banks should be encouraged to accept valves with poor valve quality for this particular type of valve-sparing aortic root reconstruction.

Conclusion

Aortic valve-sparing replacement of the aortic root with a valveless aortic allograft yields a near-normal aortic root, restoring normal root physiology, enhancing aortic valve longevity, and avoiding the need for antiplatelet drugs.

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Figure 2. Short-axis echocardiogram of the aortic root before (*top*) and after (*bottom*) the operation, demonstrating the normalized dimensions of the neo-aortic root with a clover-shaped appearance at the sinus level. *Arrows* indicate neosinuses.

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