between the pulmonary autograft and aortic root leads to different outcomes of these techniques remains elusive; however, the results of the aforementioned study were in line with the previous clinical trial,² which strengthened our confidence in the findings of this work. In any case, a well-designed clinical trial is warranted to verify the long-term outcomes of these modifications of the Ross procedure.

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Commentary: Preventing pulmonary autograft dilatation: Many unanswered questions

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A normal aortic root has a complex anatomy, and its components move in a dynamic fashion with coordinated changes in shape and size during cardiac cycle that allows for normal hemodynamic parameters and optimal valve function during a lifetime.¹ None of the currently available aortic valve substitutes can entirely reproduce these sophisticated functions. Although a pulmonary autograft (PA) is a living structure capable of adaptative remodeling when transposed to the systemic circulation, it has specific

Ross after 25 years: PA intact and competent, reoperation due to atherosclerotic ascending aorta aneurysm.

CENTRAL MESSAGE

Inclusion of the pulmonary autograft inside a polyethylene terephthalate graft prevents late dilatation, but adversely changes biomechanical properties that may limit long-term durability.

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morphometric features that may influence its long-term durability.²

The aortic and pulmonary valve leaflets have similar biomechanical properties, but the wall of the pulmonary artery is thinner with fewer elastic fibers, making it stiffer and less compliant when submitted to aortic pressures, predisposing it to progressive dilatation.^{2,3} Aortic valve replacement with the PA can be accomplished with different techniques, each with advantages and drawbacks.⁴ Long-term follow-up data have demonstrated that, despite

differences in modes of failure, freedom from PA dysfunction and/or the need for reoperations is relatively independent of the technique of implantation.^{4,5}

The root replacement technique became the most frequently used possibly because transposing the PA as a single unit is the easiest and most reproducible way to obtain a competent valve with no or minimal geometrical distortion.⁵ The main concern with root replacement is the vulnerability to progressive dilatation of the PA with or without aortic valve incompetence, with reported incidence of freedom from reoperations varying from 69% to 93% at 15 years.^{5,6} To avoid dilatation, some have advocated external reinforcement of the PA with polyethylene terephthalate grafts, polytetrafluoroethylene, or bovine pericardium.³ The insertion of the PA inside a rigid synthetic graft may distort the normal geometry, restricting sinus expansion and autograft distensibility, which may influence the normal leaflet opening-and-closing mechanism, coronary flow reserve, and left ventricular impedance.³

Zhu and colleagues⁷ demonstrate, in an experimental model, that placing the PA inside a polyethylene terephthalate graft was associated with markedly increased velocities during opening and closing of the valve leaflets, a finding that has already been observed after aortic valve-sparing root replacement. The addition of anticommissural plication stitches was able to partially minimize these abnormalities, but still not similar to the unsupported root controls. Excessive cusp fluttering was clearly detected in both supported groups. In addition, the authors demonstrate an increased coaptation surface with some degree of cusp redundancy during diastole.⁷ Although this may be helpful for achieving a competent valve, one might argue that this slight excess tissue may in fact be detrimental due to increased leaflet bending stresses during the cardiac cycle and may impair long-term durability.

Until the long-term data are available for polyethylene-terephthalate-reinforced PA, I favor, in selected cases, the inclusion with autologous aorta, a technique that is effective in preventing PA dilatation with 96% freedom from reoperation after 18 years.⁸ Although Zhu and colleagues⁷ have recognized that the experimental model has some limitations, they should be encouraged to further extend their investigations, including fatigue testing of the various versions of reinforced PA. Further laboratory studies coupled with animal investigations will eventually not only clarify the merits of the inclusion technique, but also help in refining different aspects of reinforced PA such as graft sizing and configurations and the use of alternative materials such as resorbable meshes.⁹

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