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Commentary: Live long and prosper: Enhanced biomechanics of pulmonary autograft using inclusion technique in Ross procedure

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The Ross procedure has been demonstrated to have satisfactory long-term outcomes in children and young adults.¹ However, the risk of late failure of the pulmonary autograft is a major barrier to the widespread adoption of this procedure. The inclusion technique using a straight Dacron graft was developed to minimize the probability of late dilation, whereas anticommissural plication (ACP), by recreating neosinus geometry, is expected to have beneficial effects on stress and hemodynamics of neo-aortic valve. Given the fact that outcomes of David I procedure using a straight graft are not inferior to those performed with Valsalva prosthesis in aortic diseases,² the readers are looking forward to exploring whether these techniques, which originally derived from David modifications, are still effective in Ross operation. The investigation by de Kerchove and his colleagues³ demonstrated comparable long-term outcomes and similar autograft failure between root replacement and inclusion technique in the Ross procedure. Other studies indicated convincing results of the inclusion technique in selected patients older than 50 years of age with bicuspid aortic valves.⁴ However, barely any evidence has been published on evaluating the additional benefit of ACP in the

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CENTRAL MESSAGE

Inclusion technique with anti-commissural plication in the Ross procedure demonstrates better biomechanics and durability in an ex vivo heart simulator.

Ross procedures, although it has demonstrated a promising performance in aortic root reimplantation operation.⁵

Having said that, Zhu and colleagues⁶ present a comprehensive ex vivo biomechanical study of these techniques by using a 3-dimensional printed heart simulator and demonstrated excellent hemodynamic results and promising durability of inclusion technique with ACP in ex vivo models. We believe these ex vivo results can serve as a springboard for future in vivo studies and preliminary attempts in clinical practice, given that not only porcine specimens but also human autografts were used in a self-comparison configuration.

The authors note the discrepancy in the diameters of the right ventricle outflow tract make it challenging to select properly sized grafts. A conduit that is 6 to 7 mm larger in diameter is recommended in the current study; nonetheless, excess cusp tissue with eccentric coaptation zone still existed even in the specimens with ACP, not to mention the elevated mean gradients. We wonder if there is a more robust protocol to optimize the estimation of the appropriate graft size. Defining such a protocol is an important area of ongoing study; a simulator that can mimic physiologic waveforms is therefore indispensable for further investigation.

In a previous literature, the same faculty performed another biomechanical study of all available grafts for valve-sparing aortic root replacement using this simulator⁷; surprisingly, the grafts specifically focused on neosinus recreation failed to demonstrate better hemodynamic performance. The authors attributed this to spherical radial deformation of the commissures both in Valsalva grafts and ACP grafts. Whether the discrepancy in anatomy

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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