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EDITORIAL COMMENTARY

Getting to the (aortic) root of the problem

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Aortic valve replacement remains a process in evolution, with the ideal substitute always seemingly on the horizon. In recent years, great energy and effort have been expended

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on surgical approaches and techniques; at the end of the day, however, the procedure is only as good as the device that is used to replace the defective native valve. Despite our best efforts, the effective orifice area of the prosthetic valve will almost always be smaller than that

in the native, nondisease state, and thus a new disease is created, prosthetic aortic valve stenosis. A tissue valve can also fail in a regurgitant mode. The development of the stentless aortic valve was born from the observation that homografts seemed to have better freedom from structural valve deterioration (SVD) but were hampered by issues with availability and difficulty in implantation.¹ As with homografts, the main advantage of the stentless valve was optimization of the effective orifice area.

The sine qua non of the benefits the Freedom SOLO stentless bioprosthesis (Sorin S.p.A., Milan, Italy) is the combination of the unobstructed outflow tract, the treatment of the leaflets to reduce degradation, and the preservation of root anatomy to reduce stress on the leaflets. With these features together, it would be expected that superior reduction in SVD would be seen. In this issue of the *Journal*, Stanger and colleagues² present results which bring this expectation into question. Their study involved 149 patients followed up on average for 6 years. The hemodynamics of the valve appeared favorable, with low postoperative mean gradients (8.8 ± 3 mm Hg) and with no patients seen with severe patient-prosthesis mismatch and only 1 with moderate patient-prosthesis mismatch. Unfortunately, these relatively promising midterm results also included 26 cases of SVD, considerably higher than rates seen with stented tissue valves in this patient population and occurring earlier than previously seen with other stentless valves such as the O'Brien (CryoLife, Inc, Kennesaw, Ga), Shelhigh (Shelhigh Inc, Millburn, NJ), Biocor (St Jude Medical, Inc, St Paul, Minn), and Toronto SPV (St Jude Medical).

Stanger and colleagues² posit as an explanation that their definition of SVD is more conservative than typically applied to valves.³ Their criteria combined morphologic and hemodynamic findings, including the presence of a 3-fold increase in mean gradient. Paradoxically, with the large effective orifice areas in the implanted valves and the lack of postoperative patient-prosthesis mismatch, this set of criteria presumed "at least moderate aortic stenosis,"² with the understandable concern for left ventricular hypertrophy, complications, and mortality but without

directly demonstrating such. Errors inherent in repeated measures of longitudinal data could potentially overestimate the frequency of SVD.

Secondary possibilities include the technical aspects of implantation, which may provoke higher leaflet stress distribution, a characteristic that may unfairly indict an otherwise good valve. As recently summarized by David,⁴ the aortic root is a dynamic, *asymmetric* structure that we continue to learn more about. In an earlier article from this group, Stanger and associates⁵ cautioned against implantation of the Freedom SOLO valve in patients with bicuspid valves, in part because of the loss of a commissural landmark. The suggested technique included stay sutures at the nadir of each native cusp and top of each commissure, with corresponding sutures placed through the stentless valve. This becomes more than inserting a round peg in a round hole, because a symmetric valve is being inserted in an asymmetric root. As reviewed by Cheng and coworkers,⁶ the complex deformations of the aortic root during the cardiac cycle serve in part to assist the opening (and closing) of the valve leaflets while minimizing the stress on the leaflet tissue. The deformations are asymmetric to accommodate the asymmetric root, which may explain the findings of SVD associated with the commissure between the right and noncoronary sinuses. We are left to wonder whether a different implantation approach might have different results in a valve that theoretically should perform better.

The need for a durable, easily implantable tissue valve remains. Before we exclude players from the field, we should try to understand better the mechanisms of failure. Advances in cardiac surgery were first tried clinically and then studied experimentally. Maybe it is time to go back to the animal laboratory.

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