Root Reimplantation With Leaflet Repair

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Reimplantation of the aortic valve is a procedure well recognized for its safety, excellent success in preserving the leaflets without a composite valve graft, and long-term durability. Unanswered questions are whether the procedure should be used for bicuspid valves and, if so, which ones, and also the role of leaflet repair. In our experience with just under 2000 aortic valve repairs, we found that use of a root procedure, particularly root reimplantation, resulted in excellent long-term durability. Just as with mitral valve repairs that include an annular ring, it appears that for aortic valve repairs, bracing the root is important. We have found that leaflet repair during a reimplantation procedure is not detrimental to long-term durability.

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Central Message

Aortic valve repair with reimplantation of the valve is associated with good outcomes.

Perspective Statement

Aortic root reimplantation has become a safe and durable operation. Recent studies have shown that repairing the leaflets to preserve them during reimplantation does not appear to have adverse effects. Additionally, for patients having leaflet repair, bracing the root with a reimplantation operation appears to reduce the risk of late regurgitation and reoperation.

INTRODUCTION

Reimplantation of the aortic valve as part of aortic root procedures was pioneered by Tirone David.[1–5] His initial description evolved from his understanding of the root and performing remodeling operations, which Sir Magdi Yacoub also described.[6] I was fortunate to spend time with David in Toronto, and my own technique evolved from his experience and Stanley Crawford's attempts.[7–15] The techniques are now used widely.[16,17]

Modifications include use of left ventricular outflow tract (LVOT) pledgets, because early reports described perforations of the anterior leaflet of the mitral valve and fistulae into other cardiac chambers.[15] Although there have been various descriptions of measuring leaflet heights to size the tube graft, on reviewing David's early reports, it is clear that most patients received a 30-mm tube graft.[1] Furthermore, in my early experience, it was clear that height of the commissures and symmetry were more important for a functional valve.[10,11,13] Moreover, there were descriptions of leaflet erosions, perhaps from their banging up against the tube graft, aortic valve stenosis, or tying down the LVOT sutures too tightly. On the other hand, the annulus is frequently too large, and perhaps bringing the LVOT down to a normal size would result in better durability. Hence, I started using a Hegar dilator in the LVOT to prevent it from becoming stenotic.[15]

One concern was whether use of a Hegar would still result in stenosis. We studied this and found that indexing Hegar size to body surface area (BSA) resulted in no increased gradients.[12] Thus, as described previously for the modifications, we use a Hegar diameter based on BSA. A 23-mm Hegar is used for BSA 2.0–2.5 m^2, 21-mm for 1.5–2.0 m^2, and 19-mm for <1.5 m^2 for males and sometimes for females. If the leaflets appear smaller, the size is downgraded one size.[15] For most patients, a 30-mm-diameter graft is used. For 6′10″–7′ National Basketball Association players, a 34-mm graft and 25-mm Hegar have been used, and for a short female, with Turner syndrome for example, a 28-mm is used. The Valsalva graft is not used because we have

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seen late dilatation and regurgitation. Indeed, the Hannover group, led by Axel Haverich, presented a poster at the 2018 Society of Thoracic Surgeons annual meeting demonstrating greater early and late regurgitation with these root grafts.

To perform a successful root repair, it is vital that all aspects of the root are examined.[13] The schema we use is CLASS—**C**ommissures, **L**eaflets, **A**nnulus, **S**inotubular junction, and **S**inuses. These all must function synchronously for a successful repair. Hence, a paramount part of a successful repair is the alignment and apposition of the leaflets. We aim for 3−5 mm of appositional contact area.

A number of techniques can be used to repair the leaflets, including Cabrol sutures, commissure apposition stitches, Trusler stitches, patches, plication, weave stitches, resection and repair, and running polytetrafluoroethylene sutures on the leading leaflet edge. However, the one that I use most often is a figure-of-8 suspension suture, illustrated in our paper on aortic valve repair methods.[7] To do this, a figure-of-8 over-and-over leaflet apposition stitch is used at the commissure, then this is brought through the aorta about 3−4 mm above the commissure to hitch it up at a higher level. This can be used for prolapse, asymmetry, or alignment. In the analysis of our patients who underwent aortic valve repair, this stitch was associated with better long-term durability on Kaplan-Meier analysis.[7] Furthermore, in patients undergoing reimplantation with concurrent leaflet repairs, durability was not affected.[10−12]

In regard to reimplantation for bicuspid valves, we believe that remodeling is a better procedure.[13] It allows for a large graft to be inserted, say 34 mm, with tension on the leaflets longitudinally, which is the mechanism of competence of a bicuspid valve. For a 3-leaflet valve, the opposite is true: the leaflets have to be brought together, and this is ideally done with reimplantation. In the recent study by David and his team,[18] reimplantation of bicuspid valves in 45 patients was not associated with reduced durability; however, as they stated, this was a highly selected group.[19] We have performed reimplantation in more than 105 highly selected bicuspid valve patients and are in the process of analyzing late outcomes.

In our experience, as in that of David et al and others, mortality for these procedures is less than 1%.[9,20−22] As of December 2017, we had performed 699 elective reimplantations, with only 1 death. If patients have less than moderate regurgitation, we tell them that there is a 90−95% likelihood of preserving the valve.[12] Also, as in other reports,[23] our freedom from reoperation is 95−97% at 10 years, although for patients with connective tissue disorders, for example, Marfan or Loeys-Dietz syndrome, it may be slightly lower.[4,10,21,22] Of note, in our series, only 1.4% developed a distal de novo aortic dissection, also suggesting that the operation is protective, a paramount reason for performing it.

As with the indications for mitral valve repair in asymptomatic patients, reimplantation meets the criteria for success—low risk of mortality, high likelihood of repair, and long-term durability—and is justified in young patients with large roots whenever feasible, even if it requires leaflet repair.

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