Masters of Cardiothoracic Surgery

Isolated aortic regurgitation in normal-appearing aortic root: what do I do?

John J. Kelly, Nimesh D. Desai, Shanelle Mendes, Yu Zhao, Brittany J. Cannon, Amit Iyengar, Mikolaj Berezowski, Selim Mosbahi, Wilson Y. Szeto, Joseph E. Bavaria

Division of Cardiovascular Surgery, Hospital of the University of Pennsylvania, Philadelphia, PA, USA

Correspondence to: Joseph E. Bavaria, MD. Division of Cardiovascular Surgery, Hospital of the University of Pennsylvania, One Convention Avenue, 2 City Suite, Philadelphia, PA 19104, USA. Email: joseph.bavaria@pennmedicine.upenn.edu.

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Clinical vignette

Case 1 is a 31-year-old female with a bicuspid aortic valve (BAV) and ascending aortic aneurysm. On computed tomography (CT) angiography, the ascending aorta measured 4.8 cm, which had grown from 4.2 cm one year prior. The aortic root was normal, measuring 3.6 cm. Transthoracic echocardiography (TTE) showed normal left ventricular function and moderate-to-severe aortic insufficiency (AI). This patient was scheduled for elective BAV repair with ascending and hemiarch replacement. Case 2 is a 44-year-old with a BAV. Severe AI and decreased left ventricular function (LVEF 45%) was revealed on TTE, with significant dilatation (LVEDd 7.8 cm). On CT angiography, both the aortic root and ascending aorta were normal, measuring 4.0 cm and 3.8 cm, respectively. This patient was scheduled for elective BAV repair.

Operative technique

Under general anesthesia, a median sternotomy was performed, and the patient was cannulated for cardiopulmonary bypass. Transesophageal echocardiography (TEE) is utilized in all cases to help identify mechanisms of AI. After initiation of cardiopulmonary bypass and application of the aortic cross clamp, the aorta was opened, and the aortic valve was analyzed in its native state to assess its suitability for repair. This included measurement of the effective and geometric heights as well as an assessment of cusp quality. For those with significant leaflet body calcification, large fenestrations, restricted mobility of the reference cusp, or inadequate reference cusp surface area (geometric height <19–20 mm), repair is aborted, and prosthetic replacement is performed instead. Oftentimes, AI in those with a BAV is caused by prolapse of the conjoined cusp. To assess for discrepancy in cusp free margin lengths, interrupted 7-0 polypropylene sutures are placed in the Nodule of Arantius of each cusp. Tension on these sutures reveals the excess free margin length, which is most commonly repaired with central plication using interrupted 5-0 polypropylene. Concurrent raphe release is also often performed to increase the mobility of the conjoined cusp. Other repair techniques used less commonly include triangular resection of a thickened raphe, decalcification or debulking, and leaflet edge shortening.

Valve analysis also includes sizing of the aortic annulus, which is corroborated with the diameter obtained by the intraoperative TEE. Our institution has developed an algorithm based on annular diameter to select an annuloplasty technique for patients without aortic root aneurysm undergoing BAV repair. For those with annuli ≥28 mm, we perform an external subannular aortic ring (ESAR) with BAV repair, while those with annuli <28 mm undergo subcommissural annuloplasty (SCA) with BAV repair.

In Case 1, the annulus measured 26–27 mm, so SCA was performed. Subcommissural annuloplasty entails a "U" stitch with a 2-0 pledgeted braided polyester suture with bites 2 mm above and below the leaflet insertion. Placement of the sutures 2 mm away from leaflet insertion maintains cusp motion. By contrast, the more classic Cabrol commissural sutures restrict cusp motion. This type of

annuloplasty is typically performed at both commissures of the BAV. Tying the sutures reduces the annular diameter by 4 to 5 mm. Following repair, a valve sizer is passed to ensure that the SCA has not caused aortic stenosis (AS).

In Case 2, the annulus measured 34 mm, so ESAR was performed. After dissection to the subcoronary plane, subannular "U" sutures are placed with 2-0 pledgeted braided polyester with bites taken from inside-to-outside. We typically use six subannular sutures (three per BAV cusp). Particular care is taken adjacent to the coronary arteries to avoid injury. We cut a segment from a Dacron straight tube graft for use as the ring, which is positioned beneath the coronary arteries. The subannular sutures are passed through the ring from inside-to-outside and then tied over a dilator to prevent subannular narrowing and AS. To select a ring size, we use the formula: target annular diameter = ring size – 5 or 6 mm. Physiologic annular diameters are targeted, which correspond to 23–24 mm for men and 21–22 mm for women. Case 2 was a male patient with preoperative annulus measuring 34 mm, so we chose a 30 mm ring to obtain a 24 mm annular diameter after repair.

After the SCA and ESAR are completed, a secondary valve analysis is performed, as the annuloplasty may have altered the valve geometry. Additional leaflet repair is performed if needed. Following cross clamp removal, TEE is used to assess for residual insufficiency, new stenosis, and sufficient coaptation length (goal >7–8 mm).

Comment

Annuloplasty in BAV repair improves leaflet coaptation and also provides stabilization against subsequent annular dilation, which can lead to recurrent AI and repair failure (1). For patients with a repairable BAV and a non-aneurysmal root, we initially utilized SCA as described by El Khoury and colleagues (2). However, as experience accrued, our group and others found that a larger preoperative annulus was associated with recurrent AI, particularly for those who underwent SCA (3-5). Navarra and colleagues reported that patients with a ventriculo-aortic junction ≥30 mm preoperatively had decreased freedom from AI >1+ after SCA at six years (3). Similarly, our group found that 5-year freedom from AI >1+ after SCA was lower for those with preoperative annulus ≥28 mm versus <28 mm (5). For those with annulus ≥28 mm, valve-sparing root reimplantation (VSRR) had improved gradients and freedom from AI >1+ compared to SCA (5). Similarly, de Kerchove and colleagues reported that VSRR had greater freedom from reoperation and recurrent AI >2+ at 6 years compared to BAV repair with SCA or without annuloplasty (4).

While the circumferential annular reduction of VSRR seems to provide greater durability than the asymmetric partial annuloplasty of SCA, performing VSRR in patients without an indication for aortic root replacement is controversial. ESAR, as described by Lansac and colleagues, provides a circumferential annuloplasty analogous to the primary suture line of VSRR (1). For this reason, in 2013, we began using ESAR for patients undergoing isolated BAV repair with preoperative annulus ≥28 mm and continue to use SCA for those with annulus <28 mm. Others have utilized suture annuloplasty, an internal ring, or the addition of an external ring at the sinotubular junction. We do not have experience with those techniques.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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