Masters of Cardiothoracic Surgery

Unicuspid valve repair—what technique, which patch for which patient?

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Introduction

The unicuspid and unicommissural aortic valve (UAV) is a rare anomaly but frequently requires surgical intervention in childhood and young adulthood due to aortic stenosis, aortic regurgitation—which may become relevant after balloon/surgical valvuloplasty—and associated aortopathy. Aortic valve replacement with a mechanical prosthesis is a standard treatment in adulthood, but its results are not satisfactory in young individuals. Therefore, a reconstructive approach should be particularly attractive in the UAV. We have proposed UAV repair by bicuspidization, creating a new commissure of normal height via adding patch material and thus applying the techniques for bicuspid aortic valve repair (1-4). The details of our UAV repair are described.

Clinical vignette

The patient is a 3-year-old boy with severe aortic stenosis and regurgitation after several balloon valvuloplasties. The transesophageal echocardiogram shows a unicuspid and UAV with only the posterior commissure being normal. The basal ring is 12 mm in diameter. Aortic valve repair with bicuspidization is planned.

Surgical techniques

Preparation

The aortic size is measured with transesophageal echocardiography. Root remodeling and ascending aortic replacement seem reasonable for patients with the sinus of Valsalva ≥43 mm and the ascending aorta ≥45 mm, respectively (3). Surgery is performed through a median sternotomy with cardiopulmonary bypass and cardioplegic arrest.

Exposition

The aorta is opened by a transverse aortotomy 5 to 10 mm above the sinotubular junction for isolated valve repair or transected at the same level in patients with aortic dilation. The sinotubular junction and sinus of Valsalva are not incised to preserve root geometry, except in root remodeling.

Operation

Valve morphology and cusp mobility are assessed. In the typical UAV, the posterior commissure between the left and noncoronary cusps has a normal height and no cusp fusion. The two commissures of the right coronary cusp (RCC) are rudimentary with variable cusp fusion. The RCC tissue is often dysplastic and may exhibit calcification. The RCC tissue is detached from the aortic insertion and either excised or preserved for refixation in the aortic root (1). The annular diameter is measured by direct intubation of Hegar sizers. Any annular size exceeding 25 mm will trigger the later use of annuloplasty. A new commissural site of the same height as the posterior commissure is marked anteriorly for symmetric orientation (2). If indicated, root remodeling is performed with a Dacron graft [body surface area (BSA) <1.8 m^2: 24 mm, 1.8 m^2≤ BSA ≤2.2 m^2: 26 mm, BSA >2.2 m^2: 28 mm] with two symmetric tongues (3).

External suture annuloplasty with an expanded

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polytetrafluoroethylene (ePTFE) suture (Core-Tex CV-0; W.L. Gore & Assoc., Munich, Germany) is performed if needed. The suture is passed around the circumference of the virtual basal ring, kept outside the aorta in the area of the membranous septum and tied around a Hegar sizer (BSA <1.8 m^2: 23 mm, BSA ≥1.8 m^2: 25 mm) (4).

Two triangular patches are prepared to bridge the gaps between preserved left or noncoronary cusp tissue and the new commissure. We have initially used glutaraldehyde-fixed autologous pericardium but aborted this material since reoperations due to patch degeneration were necessary with an incidence of 20% in 10 years (submitted). The use of 0.1 mm thick ePTFE membrane has worked well in some patients but was also associated with suture dehiscence at a rate of more than 30% (unpublished data). Since 2014, we apply decellularized xenopericardium, either CardioCel (Admedus, Perth, Australia) or Matrix Patch (Auto Tissue Berlin GmbH, Berlin, Germany). One corner of the patch is sewn with 5-0 polypropylene to the bottom of the cusp gap. The first arm of the suture is continued in a curve to the new commissure and the second arm is continued to the free edge of the respective cusp. The patch is gently stretched and its excessive tissue is trimmed. A precise determination of patch size including cusp free margin is not necessary; cusp configuration is adjusted according to the measurement of effective height.

If ascending aortic replacement is indicated, a Dacron graft (same selection as mentioned above) is anastomosed to the sinotubular junction. Subsequently, the effective height of cusps is measured. In adult-sized patients, an effective height <9 mm is considered as prolapse and corrected with plication sutures on the patches (1). In pediatric patients, effective height is adjusted approximately to 50% of geometric height.

Completion

The transverse aortotomy is closed, or the distal anastomosis of the Dacron graft is completed.

Comments

Clinical results

In this strategy, 77 patients have been operated between 2010 and 2018. The median age at operation was 26 [1–61] years. Aortic regurgitation, aortic stenosis and combined aortic regurgitation and stenosis were present in 43, 6, and 28 patients, respectively. Annuloplasty, ascending aortic replacement, and root remodeling with ascending aortic replacement were required in 44, 18, and 14 patients, respectively. Autologous pericardium and decellularized xenopericardium were used in 45 and 32 patients, respectively. There was one early death (sudden death at home) and one late death (infective endocarditis). Overall survival was 96% at 8 years. In repairs with autologous pericardium, there were 6 reoperations (suture dehiscence, 3; patch degeneration, 2; infective endocarditis, 1); freedom from reoperation was 88% at 5 years. In repairs with decellularized xenopericardium, there were 2 reoperations (suture dehiscence, 1; unknown, 1) and freedom from reoperation was 94% at 4 years. UAV bicuspidization is a safe alternative to biological valve replacement, providing acceptable freedom from reoperation particularly for children and young adults

Patient selection

In the bicuspidized aortic valve, the larger part of each cusp should be composed of native cusp tissue. The corresponding cusp tissue should have sufficient mobility and, in adult-sized patients, a geometric height of 20 mm or higher (2,3). Isolated regurgitant UAVs are generally good substrates for valve repair; stenotic UAVs may be suitable for this procedure when cusp tissue is not calcified or calcification is limited to the part resected for bicuspidization (5). A tear in the RCC after previous balloon valvuloplasty is no contraindication.

Patch selection

Valve failure after this repair has been mainly due to suture dehiscence or patch degeneration. Both are probably related to hemodynamic cusp stress and characteristics of the patch material. Whereas the former is optimized by symmetric commissural orientation and annuloplasty (submitted), the latter should have sufficient tensile strength and reduced immunogenicity. With decellularized xenopericardium as additional cusp tissue, early results have been improved compared with autologous pericardium, but longer follow-up is necessary.

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None.

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Footnote

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

References

1. Schäfers HJ, Aicher D, Riodionycheva S, et al. Bicuspidization of the unicuspid aortic valve: a new reconstructive approach. Ann Thorac Surg 2008;85:2012-8.
2. Aicher D, Bewarder M, Kindermann M, et al. Aortic valve function after bicuspidization of the unicuspid aortic valve. Ann Thorac Surg 2013;95:1545-50.
3. Franciulli M, Aicher D, Rädle-Hurst T, et al. Root remodeling and aortic valve repair for unicuspid aortic valve. Ann Thorac Surg 2014;98:823-9.
4. Schneider U, Aicher D, Miura Y, et al. Suture annuloplasty in aortic valve repair. Ann Thorac Surg 2016;101:783-5.
5. Kolesar A, Toporcer T, Bajmoczi M, et al. Aortic Valve Repair of a Stenotic Unicuspid Aortic Valve in Young Patients. Ann Thorac Surg 2018;105:1351-6.

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