Two-patch repair of a bicuspid aortic valve with vegetation on its raphe

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Abstract

We report the successful repair of a bicuspid aortic valve with vegetation on its thickened raphe by using two pericardial patches. After excising the vegetation and thickened raphe, the first patch was sewn between the remaining leaflets. Another patch was then sewn at the base of the cusp to create sufficient geometrical height for good coaptation. Our two-patch technique may facilitate intraoperative accommodation of the 3-D shape of the new cusp.

Keywords: Aortic valve repair • Aortic operation • Aortic cusp repair • Pericardium • Bicuspid aortic valve

INTRODUCTION

The optimal repair technique for a diseased bicuspid aortic valve (BAV), especially when vegetation is present, remains controversial [1]. We report the successful repair of a regurgitant BAV with vegetation on the thickened raphe using two pericardial patches. After excising the entire thickened raphe and vegetation, the first patch was sewn between the remaining leaflets to create the body of the new cusp. Because the geometrical height of the cusp was insufficient, an incision was extended bilaterally at the base of the remaining cusp, and another patch was added to the basal cusp to create an enlarged, symmetrical bicuspid configuration.

CLINICAL SUMMARY

A 44-year-old man (height 170 cm, weight 71 kg, body surface area 1.83 m²) was referred to our hospital because of multiple thromboemboli, including bilateral occlusion of the popliteal arteries, right renal infarction and a superior mesenteric arterial thrombus. His functional status was New York Heart Association Class II. Coronary angiography findings were unremarkable. Transthoracic echocardiography revealed a BAV with the right coronary cusp fused to the non-coronary cusp. The aortic valve area measured 2.1 cm² with moderate aortic regurgitation (Supplementary Video 1). The diameters of the surgical annulus, sinus of Valsalva and sinotubular junction were 23, 30 and 27 mm, respectively. Notably, a 10 × 10-mm mass was detected on the raphe. Electrocardiography showed normal sinus rhythm. The left ventricular end-diastolic diameter and the left ventricular ejection fraction were 53 mm and 75%, respectively. Surgery was indicated for eliminating the possible source of multiple thromboemboli and aortic valve disease. Cardiopulmonary bypass was established through a median sternotomy. After a transverse aortotomy, careful examination revealed that the aortic valve was bicuspid, as shown on preoperative echocardiography. A mobile soft mass was located on the raphe between the right coronary cusp and non-coronary cusp, which appeared to be the cause of the multiple thromboemboli (Fig. 1). The raphe and the soft mass were excised en bloc. The intraoperative pathology revealed that the soft mass was old, inactive vegetation. Otherwise, the tissue quality of the aortic valve appeared normal. Direct suturing of the residual leaflet was not feasible because of insufficient leaflet length and height to match the corresponding cusp. Therefore, a piece of autologous pericardial patch was sutured between the remaining leaflets with 5-0 polypropylene. The patch was excised from the pericardium and fixed in 0.625% glutaraldehyde solution for 3 min. After suturing the first patch, the geometrical height still appeared insufficient for the corresponding cusp—the left coronary cusp in this case. Hence, we made a basal incision in the remaining cusp and extended it bilaterally. A second oval autologous pericardial patch was sewn at the base of the remaining cusp and the first patch with 5-0 polypropylene. Because the free margin of the repaired cusp was slightly prolapsed with redundant pericardium, we performed central plication of the pericardial patch with 5-0 polypropylene to create sufficient, effective height (Supplementary Video 2, Fig. 2). The absence of cusp prolapse was confirmed with an effective-height calliper. The aortic cross-clamp time was 80 min. The cardiopulmonary bypass time was 117 min. At discharge (postoperative day 10), the patient was ambulating. Echocardiography at discharge and 12 months following the operation revealed trivial aortic...
regurgitation with an aortic valve area of 1.9 cm². The left ventricular end-diastolic diameter and the left ventricular ejection fraction were 51 mm and 78%, respectively (Supplementary Video 2).

DISCUSSION

Several techniques of patch augmentation have been proposed to repair a BAV with deficient cusp tissue [1]. Previously, we reported the successful repair of a BAV with a restricted thick immobile raphe using a pericardial patch augmentation technique, in which the line of annular attachment of the neo-leaflet was smooth and symmetrical with corresponding cusp [2]. However, despite the knowledge and skills of an experienced, senior surgeon, an aortic valve repair for a bicuspid valve with endocarditis using a pericardial patch is traditionally associated with a 5-year reoperation rate as high as 40% [3]. Furthermore, no consensus exists regarding optimal raphe management.

Our two-patch technique has several advantages. First, it prevents the narrowing of the aortic annulus. To increase the coaptation area, sub-commissural annuloplasty is the technique of choice for many surgeons. However, this procedure is inevitably associated with aortic valve area narrowing. Moreover, larger tissue deficit necessitates more excessive commissural plication. Secondly, our two-patch technique is technically easy. The repair of an aortic valve with tissue deficit is usually technically challenging; however, we achieved leaflet extension by sewing a pericardial strip to the free edge of the cusp [4]. Recently, successful patch augmentation at the base of the cusp in the surgical repair of a diseased aortic root and small-sized tricuspid aortic valve was reported with a good clinical outcome [4]. However, this technique is only applicable for minor tissue deficits without a thickened raphe. To treat a BAV with a thickened raphe, the thickened portion requires excision, and tissue.

**Figure 1:** Intraoperative photo (A) and schematic presentation (B) of the diseased aortic valve through an aortotomy. The right coronary cusp and non-coronary cusp were fused, forming a thick and immobile raphe (arrow), and soft mobile vegetation (surrounded with arrowheads) was located on the raphe. R: right coronary cusp; L: left coronary cusp; N: non-coronary cusp.

**Supplementary Video 1:** Preoperative and postoperative 3-D echocardiography.

**Supplementary Video 2:** This intraoperative video clip demonstrates the evaluation and repair of the BAV with vegetation on the raphe.
deficit is considerably large. With a two-patch technique, the surgeon can refer to the corresponding cusp, meticulously adjust the free margin length when suturing the first patch and then adjust the geometrical height when suturing the second patch, which is technically easy. Thirdly, our technique has a physiological advantage. Compared with the normal valve, a BAV is associated with altered stress distribution, particularly increased stress in the basal region of the raphe [5]. A symmetrical BAV shape can help achieve normal stress distribution, especially in the repaired areas. In the repair of a BAV using our technique, after resecting the non-repairable thickened raphe, stress reduction may be achieved by creating a symmetrical cusp shape, considering the lines of annular attachment, and terminating aortic regurgitation, thus potentially contributing to a more durable repair.

In conclusion, we report the successful surgical management of a BAV with a restricted thick raphe and vegetation by using a modified patch augmentation technique. By using two patches, we achieved excellent coaptation by easily adjusting the free margin length and geometrical height. Because this technique has only been performed in this case, long-term follow-up of a significantly larger patient cohort treated using this technique is necessary to confirm its effectiveness.

SUPPLEMENTARY MATERIAL

Supplementary material is available at ICVTS online.

Conflict of interest: none declared.

REFERENCES