

Valve: Case Report

Successful Tricuspidization of Bicuspid Aortic Valve Complicated by Anomalous Coronary Artery



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Repair of an asymmetrical bicuspid aortic valve remains a complicated endeavor. Here, we present a successful aortic valve repair for severe aortic regurgitation associated with such a bicuspid aortic valve, further complicated by an anomalous coronary artery. The nonsevered dilated aortic root was reshaped by the sleeve procedure with a Valsalva graft, and the raphe was lifted up to reconstruct the functional commissure, which enabled tricuspidization. Correcting the anomalous aortic origin of the right coronary artery, which posed a risk of myocardial ischemia because of its interarterial course, was achieved by translocating it to the right sinus of Valsalva.

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Although leaflet repair techniques for bicuspid aortic valve (BAV) have become nearly standardized, addressing an asymmetrical BAV remains technically challenging. Tricuspidization for BAV can be advantageous in certain cases, allowing adequate leaflet function without stenosis.¹ In addition, anomalous aortic origin of the right coronary artery (AAORCA) is a

rare congenital anomaly that may limit procedures on the aortic root. Here, we present a successful repair of an asymmetrical BAV complicated by AAORCA using tricuspidization by the raphe suspension technique combined with the sleeve procedure along with correction of AAORCA.

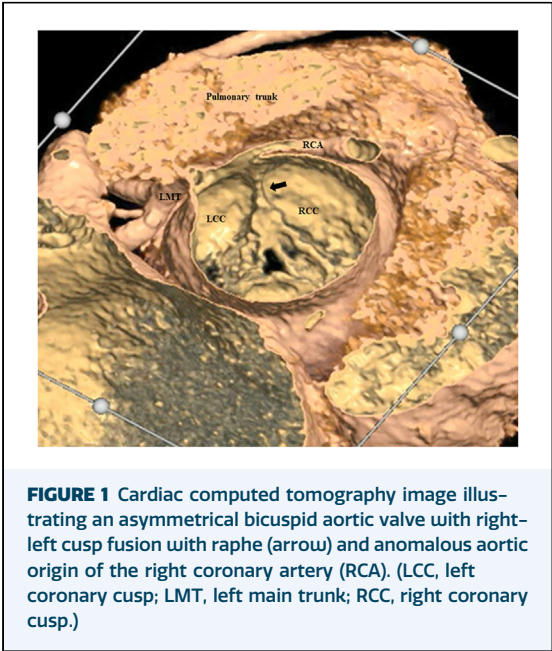
A 61-year-old man presenting with asymptomatic severe aortic regurgitation associated with BAV was referred to our hospital. Transthoracic echocardiography revealed an asymmetrical BAV with right-left cusp fusion with a raphe. Severe aortic regurgitation primarily resulted from prolapse of the right coronary cusp (RCC). Left ventricular end-diastolic and end-systolic diameters were 58 mm and 38 mm, respectively. Cardiac computed tomography (CT) confirmed the presence of a right coronary artery (RCA) that originated from the left sinus of Valsalva, separate from the left main coronary artery ostium. The RCA followed an intramural course behind the raphe (nonfunctional commissure) and an interarterial course between the aorta and the pulmonary trunk, posing a risk of myocardial ischemia (Figure 1). Aortic root configurations and valve cusps were analyzed by cardiac CT, revealing maximum diameters of the ventriculoaortic junction (VAJ), Valsalva sinus, sinutubular junction (STJ), and ascending aorta at 29.8 mm, 43.5 mm, 31.4 mm, and 35.3 mm, respectively (Figure 2). There were no other abnormal cardiovascular or physical findings or any family history that would suggest a connective tissue disorder such as Marfan syndrome or Ehlers-Danlos syndrome. The patient was scheduled for aortic valve repair and correction of AAORCA.

Intraoperatively (Video), the heart was arrested, and the ascending aorta was transected. The aortic root and the area surrounding the origin of both coronary arteries were carefully dissected up to the VAJ. Per preoperative CT findings, the RCA ostium was located adjacent to the nonfunctional commissure in the left sinus. The proximal RCA was dissected free from surrounding tissue and mobilized for a length of 3 cm, with preservation of all branches. The RCA was double clipped as it exited the aorta and transected distally. A total of

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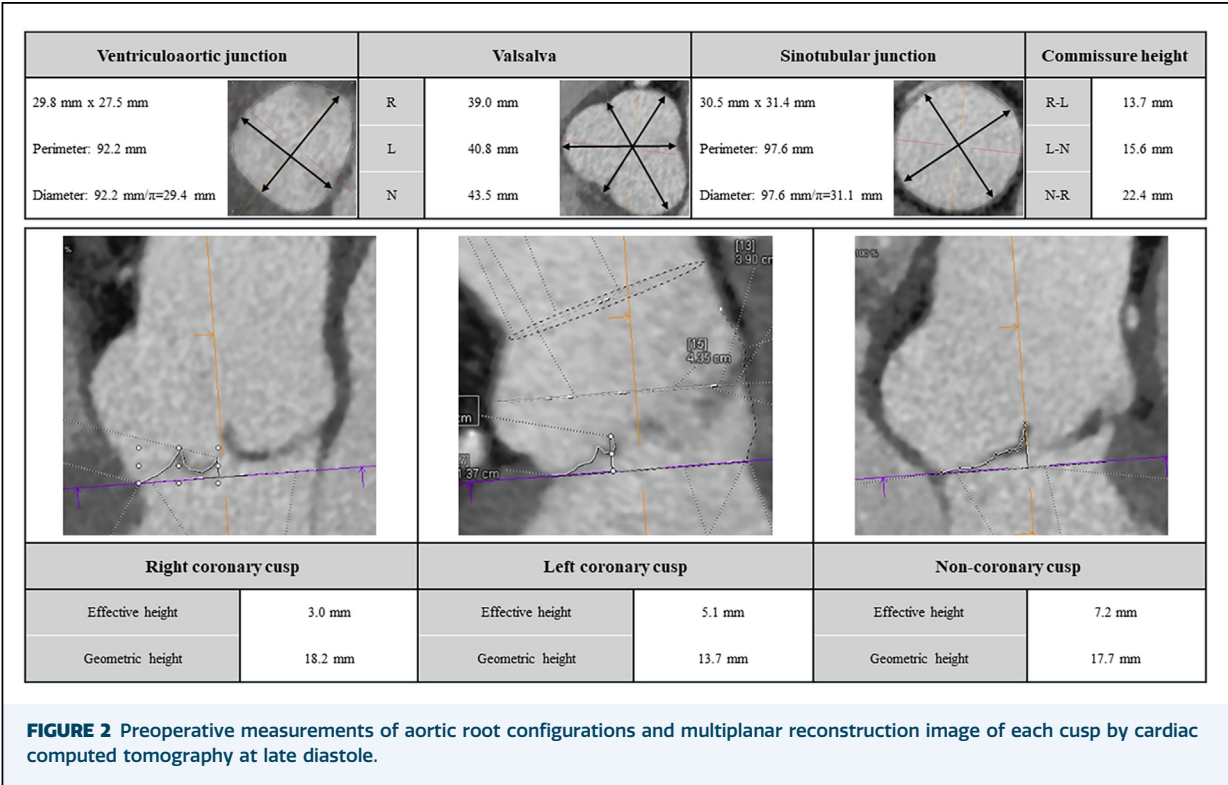
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8 horizontal mattress 2-0 braided polyester sutures were placed at the basal ring. For plication of the VAJ and the STJ and for reshaping of the aortic root, a 26-mm Valsalva graft (Gelweave; Terumo) was used to cover the entire root. An asymmetrical BAV with a commissure orientation of nearly 130 degrees

was observed, with the nonfunctional commissure located lower than the other 2 commissures. Resuspension of the nonfunctional commissure and the other 2 commissures was performed. In addition, the raphe line was lifted up and connected to the graft through the aortic wall by 5-0 polypropylene sutures to reconstruct the functional commissure and to achieve tricuspidization. This simple procedure increased the effective height of both the RCC and the left coronary cusp, with central plication added at the RCC to further increase its effective height from 3 mm to 8 mm. Moreover, the free edge of the RCC and noncoronary cusp was reinforced with CV-7 Gore-Tex suture (W. L. Gore and Associates). Subsequently, the transected RCA was anastomosed with a neo-ostium at the right sinus created with a 4-mm aortic punch through the keyhole of the graft. Postoperative aortic regurgitation was traced by intraoperative transesophageal echocardiography. The patient was uneventfully discharged without any complications, including heart block or myocardial ischemia. Transthoracic echocardiography at 20 months after operation revealed trivial aortic regurgitation and reshaping of the aortic root with diameters of Valsalva sinus measuring 29 mm and of STJ measuring 24 mm. Both left ventricular end-diastolic and end-systolic



diameters were reduced to 47 mm and 29 mm, respectively.

COMMENT

Central plication or direct closure of the nonfused portions of the raphe is a well-established and reproducible technique for BAV repair, with excellent long-term results reported.^{2,3} However, this standard repair technique sporadically results in increased systolic gradients, particularly in patients with asymmetrical BAVs.³ In response to concerns about commissural orientation, a new repair-oriented classification of BAV phenotypes has been proposed by both the Brussels and Homburg groups.⁴ They suggest that creating a functional commissure and tricuspidization may be suitable for asymmetrical BAVs.

In our case, the reconstruction of the functional commissure and tricuspidization were successfully achieved by the raphe suspension technique. However, selection of patients for this technique, especially in cases of BAV, may be limited. The raphe suspension technique requires patients with a commissural orientation close to 120 degrees, a pliable raphe, and a sufficient length of the free margin of the leaflet to ensure an adequate coaptation surface.

In our case, the right coronary ostium was located too close to the raphe, making it unsafe to detach it as a coronary button or to perform surgical unroofing technique while preserving the raphe. Preserving the raphe structure was crucial for the raphe suspension. Translocating the RCA ostium was necessary to prevent proximal RCA stenosis due to raphe suspension and the risk of myocardial ischemia due to the interarterial course. Therefore, we chose the sleeve procedure as an alternative to the reimplantation or remodeling technique, allowing both secure raphe suspension and safe translocation of the RCA ostium. The sleeve procedure enables the stabilization of

the VAJ and STJ and prevents ongoing root dilation.⁵ Postoperative echocardiography revealed dilated aortic root reshaping and good aortic valve coaptation. In addition, the lifted raphe and commissures were securely anchored to the graft, and the functional commissure was maintained at sufficient height, ensuring sufficient coaptation surface and avoiding iatrogenic cusp prolapse induced by the downsizing of the aortic root diameter. This effect might not be expected with a double annuloplasty technique instead of the sleeve procedure.

Transection and reimplantation of the anomalous coronary artery, with or without an aortic button, have been described with good anatomic results.⁶ Translocating the coronary artery requires adequate mobilization to ensure a tension-free anastomosis.

With careful selection of patients, the raphe suspension technique may be a straightforward and useful option for tricuspidization in patients with BAV, potentially mitigating postoperative aortic stenosis. The sleeve procedure not only contributed to reshaping the aortic root and securely fixing the raphe and commissures but also proved to be a reasonable approach for the safe and straightforward surgical correction of the anomalous coronary artery. Additional follow-up is needed to confirm the long-term durability of this procedure.

Institutional review board approval was not required.

The Video can be viewed in the online version of this article [<https://doi.org/10.1016/j.atssr.2024.07.018>] on <http://www.annalsthoracicsurgery.org>.

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DISCLOSURES

The authors have no conflicts of interest to disclose.

PATIENT CONSENT

Obtained.

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