Very asymmetrical bicuspid aortic valve repair with the reimplantation technique: From type C to type B

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Bicuspid aortic valves (BAVs) have been recently divided into 3 different types in a repair-oriented classification1: type A or symmetrical valves, type B or asymmetrical valves, and type C or very asymmetrical valves. Very asymmetrical BAVs are nearly tricuspid valves with a very short fusion and a developed nonfunctional commissure. This is the reason why they are usually best treated as a tricuspid valve. However, the repair of a type C valve is a surgical challenge and the debate on which is the most appropriate technique is still open.

Our surgical intention has been the creation of a more symmetrical valve by moving from phenotype C to B. This newly reached 150° configuration is maintained at all the 3 levels of the valve: ventricular–aortic junction (VAJ), Valsalva sinuses, and sinotubular junction (STJ).2

SURGICAL TECHNIQUE

Since we started a systematic aortic valve repair program at our institution, 4 operations for a very asymmetrical BAV have been performed. The first 2 patients underwent surgery in 2014 and 2016, whereas the last 2 underwent surgery at the beginning of 2020. They were all male, with a mean age of 50.5 years (range, 34-59 years). The predominant surgical indication was a grade 3 aortic insufficiency with initial left ventricular dilation in all patients. Preoperative transesophageal echocardiography was mandatory to provide us precise measurements: mean aortic annulus and Valsalva sinuses diameters were 28.75 mm (range, 28-30 mm) and 45.25 mm (range, 40-50 mm), respectively, whereas mean aortic STJ and ascending aorta diameters were 35.25 mm (range, 33-38 mm) and 45 mm (range, 40-54 mm); the mean commissural orientation angle was 122° (Figure 1, A and B). Considering the aortopathy phenotype, we had 2 patients in the “no dilation”-type group and 1 patient for each of the “root dilation”- and “root and ascending dilation”-type groups.3

Valsalva graft (Terumo Vascutek, Renfrewshire) sizing was performed according to the Brussels technique.3 We used one 26 mm, two 28 mm, and one 30 mm. The overarching principles of type C bileaflet repair are as follows: the VAJ stitches are used to change both cusps’ angles: the fused cusp (FC) cusp is reimplanted in a 210° angle, whereas the nonfused cusp (nFC) will fit in a new 150° angle. Furthermore, leaflet repair is performed to end up with 2 leaflets with an effective height of 9 to 10 mm and the same free margin length. The new
210/150 configuration is also maintained at the STJ level by reimplanting the 2 valve commissures at this new (type B) orientation.

In details the very asymmetrical aortic valve was first assessed with the Schäfers caliper (MSS-1; Fehling Instruments) (Figure 2, A and B). Second, 4 2/0 Ti-Cron stitches for the nFC and 8 for the FC were then used to reimplant the Valsalva graft at the level of the VAJ. The 4 nFC Ti-Cron stitches were then passed in the Valsalva graft to fit in a new 150° angle. An opposite effect was obtained playing with the 8 Ti-Cron stitches of the FC that, starting from a 240° VAJ angle, were finally fitting a new 210° angle within the graft. The 2 true valve commissures, originally at 120° one to each other were then reimplanted in the graft at 150° (Figure 1, C). Therefore, the new 150° configuration was respected at the 3 aortic root levels: VAJ, sinuses of Valsalva and STJ.

The free margin of the nFC was then centrally plicated to reach an effective height of 9 to 10 mm. Subsequently, direct closure of the nonfused portion of the FC was performed with several 6/0 polypropylene interrupted stitches with the aim to end up with 2 leaflets with the same free margin length (Figure 2, C and D) (Video 1).

The valve-sparing root operation was then carried out in a standard fashion and the patients were all easily weaned from CPB. Intraoperative transesophageal echocardiography showed in all patients an absence or only minor residual aortic insufficiency, a mean aortic valve area of 2.62 mm²

FIGURE 1. Preoperative TEE. A, long-axis view showing grade 3 AI. B, CO angle was 122.3°. C, Short-axis TEE. The CO angle has been modified from 122° to 151°. D, Short-axis TEE showing 2.66 cm² opening area. TEE, Transesophageal echocardiography.
(range, 2.50-2.72 mm²), a peak gradient of 12 mm Hg (range, 11-13 mm Hg), and a mean gradient of 5.25 mm Hg (range, 4-7 mm Hg) (Figure 1, D).

All patients were followed-up with transthoracic echocardiography on a yearly basis. Final follow-up (mean, 4 years; range, 2-8 years) confirmed the intraoperative findings: absence or traces of residual aortic insufficiency were found in all patients, a mean aortic valve area of 2.64 mm² (range, 2.52-2.75 mm²) a peak gradient of 11 mm Hg (range, 10-12 mm Hg), and a mean gradient of 5.25 mm Hg (range, 4-7 mm Hg).

The ethics committee of the Ospedale dell’Angelo (all operations were performed there) was not asked to approve this study because of the nature of the article (surgical technique); however, we informed them of data management. The subjects provided informed written consent for the publication of the study data.

**COMMENT**

Very asymmetrical BAV repair is currently a technical challenge. Because of nonoptimal results and highly demanding surgical techniques, it has been suggested that one should be hesitant to repair a very asymmetrical valve; therefore, the threshold for replacement should be low in such scenarios.⁴ ⁵

Very asymmetrical BAVs are usually repaired as a tricuspid valve. In details, the Homburg technique for a type C valve advocates central plication of the residual

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**FIGURE 2.** Surgical technique. A, very asymmetrical BAV with a 120° CO angle. B, Intraoperative view showing the short length of fusion and the nearly tricuspid phenotype. C, nFC free margin central plication and direct closure of the nonfused portion of the FC. D, Four 2/0 Ti-Cron stitches for the nFC and 8 for the FC were passed to reimplant the valve in the Valsalva graft at the level of the VAJ. BAV, Bicuspid aortic valves.
cusp components of the FC, whereas the Brussels technique consists in the creation of a functional commissure at the place of the raphe.\(^1\)

However, a minority of very asymmetrical valves are treated in Brussels with the reimplantation technique and brought to a more bileaflet configuration.\(^1\) Our surgical intention has been the creation of a more symmetrical valve by moving from phenotype C to B. Furthermore, the reduction of the FC angle, from 240° to 210°, can also add more movement to the conjoint cusp therefore avoiding restriction.

What is unique about our specific surgical strategy over what has already been reported is that we don’t repair type C valves as a tricuspid valve according to what is currently suggested in the most recent literature.\(^1\) Moreover, we believe that this bileaflet repair strategy associated with the modification of the valve phenotype should be considered when treating this particular patient population because of the optimal short- and mid-term results.

Even if our patient population is very small, we want to report our promising experience in this fascinating surgical field. In conclusion, our reproducible results show that very asymmetrical BAVs can be treated modifying the valve phenotype with the reimplantation technique.

References

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