Editorial

Straight tube versus Valsalva graft for valve-sparing operation

Ruggero De Paulis[1], Mario Torre[2], Raffaele Scaffa[1]

[1]Department of Cardiac Surgery, European Hospital, Unicamillus University, Rome, Italy; [2]Department of Cardiac Surgery, University Federico II, Naples, Italy

Correspondence to: Prof. Ruggero De Paulis, MD. Department of Cardiac Surgery, European Hospital, Unicamillus University, Via Portuense 700, 00149 Rome, Italy. Email: rdepaulis58@gmail.com.

Keywords: Aortic valve; aortic root; aortic aneurysm

Submitted Feb 16, 2023. Accepted for publication May 30, 2023. Published online Jun 26, 2023.
doi: 10.21037/acs-2023-avs2-10
View this article at: https://dx.doi.org/10.21037/acs-2023-avs2-10

"*Nothing in nature is without reason*; *understand the reason and you don't need experience*."—Leonardo da Vinci

Introduction

Valve-sparing operations were introduced more than 30 years ago (1,2), with the common goal of the two pioneers of the era, Dr. Tirone David and Sir Magdi Yacoub, set as avoiding aortic valve replacement whenever facing the replacement of a dilated root. Preserving a normal aortic valve, although logical, has been one of the major conceptual leaps forward in the treatment of pathology of the ascending aorta. In the remodeling technique, described by Yacoub, the three sinuses are excised and replaced by three tongue-shaped extensions of a Dacron graft, while in David's reimplantation technique, the spared aortic valve is sutured inside a Dacron conduit. One of the major differences between the two techniques is the lack of sinuses of Valsalva in the reimplantation technique. In the early 2000s, we introduced the "Valsalva" graft (3) with the aim of helping the surgeons to anatomically reconstruct the sinuses of Valsalva without major modification of the original technique. This editorial highlights the advantages of the Valsalva graft versus a straight Dacron conduit in the reimplantation type of valve-sparing operations.

After the first experiences with valve-sparing operations, it was clear that the ability of replacing the root and providing neo-sinuses of Valsalva was essential in the normal functioning of the aortic cusps (4). Re-establishing the eddy currents inside the root might have beneficial effects, not only in valve-sparing surgery, but also in Bentall procedures (5). The advantages in the remodeling technique are thereby constrained, because its intrinsic characteristics already include sinus reconstruction. Nevertheless, the vertical pleat orientation of the Valsalva graft facilitates geometrical matching of the three Dacron tongues within the space between the commissures, and has been adopted from those who promote the remodeling technique (6). However, it is mostly in the reimplantation technique that the Valsalva graft is a game-changer. It adds the benefit of sinus reconstruction to a technique that is generally preferred by most surgeons due to the support provided to the whole root, along with a robust annuloplasty and is formidable hemostasis. On top of this, the space in the skirt of the Valsalva graft facilitates internal suturing. Although clinical studies have not yet demonstrated the benefit of neo-sinuses, *in-vitro* and *in-vivo* studies clearly show that the sinuses are instrumental for natural leaflet closure and for full leaflet opening (7-9). Furthermore, 4-dimensional (4D) magnetic resonance indicates that eddy currents inside the sinuses might contribute to aortic laminar flow, benefiting the downstream aortic wall (10).

A straight graft in reimplantation

It is important to highlight the difference between a straight and a Valsalva graft in the reconstruction of a normal root anatomy. A straight graft abolishes the sinuses of Valsalva. The reimplanted aortic valve works in a completely cylindrical environment, where the commissural posts and the space in-between are along the same radius of curvature. Valve opening and closure depends solely on the hemodynamics conferred by the graft, and not on the presence of the eddy currents inside the neo-sinuses that

are important in assuring a full opening in systole, and a smooth and synchronous closure in diastole. In systole, flow turbulence tends to reduce full leaflet opening, while in diastole, the aortic leaflets are closed only by the abrupt flow inversion. Choosing a larger graft might mitigate these effects, by increasing the space and the volume around the cusps. This increased space prevents not only the potential contact of the leaflets with the Dacron wall, but will also provide some form of recirculating flow. However, the commissural posts of the aortic valve sutured inside a straight graft, especially if it is a larger one, upon pressurization, will follow the graft shape, assuming a curved aspect and being at the same level of the largest graft circumference. The final effect in a short axis is that of a single larger sinus without the classic aspect of a clover. The aortic valve has a good capacity of adaptation, and it might continue to work for long time despite this suboptimal root reconstruction. At present, there is not enough clear scientific evidence showing that optimal sinus reconstruction provides increased leaflet longevity.

A Valsalva graft in reimplantation

The Valsalva graft might provide optimal sinus reconstruction without any major modification of the original technique. This specific design provides two fixed rings, one at the bottom of the graft where the valve is secured to the virtual basal ring, and another one that will act as the new sino-tubular (ST) junction, where the tops of the commissural posts are secured. By stretching the commissures and fixing them at the ST junction, we create three pillars that keep the aortic valve in a straight and cylindrical position. When suturing the valve remnants, the graft behind the commissure will be pulled to these valve remnants, while the graft between each commissure, upon pressurization, bulges out, forming three independent sinuses. In a short-axis view, the aortic root has its classical clover aspect with three indentations corresponding to the three commissures, and three sinuses bulging out (10). Differently from a straight graft, the use of the Valsalva graft requires adaption to the height of the sinus portion to the length of the commissures, so that the top of each commissure easily reaches the new ST junction. This is extremely important. Failing to do so and fixing the tops of the commissures inside the sinus portion will cause, upon pressurization, an increased radial force on the commissures with consequent tenting of the leaflets and central regurgitation. Overall, reimplanting the aortic valve is not only a matter of sinus reconstruction, but also a matter of respect of the geometrical relationship between all root components, annulus, sinuses, commissures, and ST junction.

Conclusions

The use of Valsalva graft simply improves the anatomical root reconstruction and optimizes the physiologic movement of the cusps during the cardiac cycle. Both the straight and the Valsalva graft have demonstrated good medium and long-term results when used in both types of valve-sparing procedures.

Acknowledgments

Funding: None.

Footnote

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

References

1. Sarsam MA, Yacoub M. Remodeling of the aortic valve anulus. J Thorac Cardiovasc Surg 1993;105:435-8.
2. David TE, Feindel CM. An aortic valve-sparing operation for patients with aortic incompetence and aneurysm of the ascending aorta. J Thorac Cardiovasc Surg 1992;103:617-21; discussion 622.
3. De Paulis R, De Matteis GM, Nardi P, et al. A new aortic Dacron conduit for surgical treatment of aortic root pathology. Ital Heart J 2000;1:457-63.
4. Kunzelman KS, Grande KJ, David TE, et al. Aortic root and valve relationships. Impact on surgical repair. J Thorac Cardiovasc Surg 1994;107:162-70. Erratum in: J Thorac Cardiovasc Surg 1994 Jun;107(6):1402.

5. Sadri V, Madukauwa-David ID, Yoganathan AP. In vitro evaluation of a new aortic valved conduit. J Thorac Cardiovasc Surg 2021;161:581-590.e6.
6. Lansac E, Di Centa I, Sleilaty G, et al. Remodeling root repair with an external aortic ring annuloplasty. J Thorac Cardiovasc Surg 2017;153:1033-42.
7. De Paulis R, De Matteis GM, Nardi P, et al. Analysis of valve motion after the reimplantation type of valve-sparing procedure (David I) with a new aortic root conduit. Ann Thorac Surg 2002;74:53-7.
8. Pisani G, Scaffa R, Ieropoli O, et al. Role of the sinuses of Valsalva on the opening of the aortic valve. J Thorac Cardiovasc Surg 2013;145:999-1003.
9. Salica A, Pisani G, Morbiducci U, et al. The combined role of sinuses of Valsalva and flow pulsatility improves energy loss of the aortic valve. Eur J Cardiothorac Surg 2016;49:1222-7.
10. Gaudino M, Piatti F, Lau C, et al. Aortic flow after valve sparing root replacement with or without neosinuses reconstruction. J Thorac Cardiovasc Surg 2019;157:455-65.

Cite this article as: De Paulis R, Torre M, Scaffa R. Straight tube versus Valsalva graft for valve-sparing operation. Ann Cardiothorac Surg 2023;12(4):358-360. doi: 10.21037/acs-2023-avs2-10

