**Aortic root replacement using the reimplantation technique: tips and tricks**

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Abstract

Aortic valve (AV) sparing procedures are increasingly being used to treat aortic root pathology. Reimplantation of the aortic valve, first described by Dr Tirone David, is a technically demanding procedure whose long-term results are critically dependent on perfect intraoperative restoration of valve anatomy and function. There exists significant variation in how this procedure is performed by different surgeons, which is likely contributory to the heterogeneity in reported results. We describe a systematic approach to aortic valve reimplantation procedure focusing on key technical aspects.

Keywords: Aortic valve reimplantation; Valve sparing; Surgical technique; Aortic root replacement; Aortic valve prolapse

1. Introduction

The technique of valve sparing root replacement is a desirable option for the treatment of aortic root pathology in the absence of significant aortic cusp disease. In this article, we describe a systematic approach to aortic valve sparing root replacement using the reimplantation technique, originally described by David and Feindel [1], with a focus on salient technical aspects.

2. Surgical technique

2.1. Aortotomy and exposure

The aorta is transected approximately 1 cm above the sinotubular junction starting above the non-coronary (NC) sinus. Three full-thickness 4-0 polypropylene traction sutures are placed at the level of the three commissures and the distal aorta is retracted cephalad. The valve leaflets, sinuses and annulus are examined, looking for leaflet tissue quality, mobility and evidence of cusp prolapse. Prolapse identified may be repaired at this time or after valve reimplantation.

2.2. Aortic root preparation

The key principle is to externally dissect the aortic root as low as possible, given the natural anatomic limitations i.e. where the root inserts into ventricular muscle. The root dissection is started along the NC sinus and continued towards the left coronary (LC)/NC commissure. In this area, the sub-anular region of the AV is fibrous and dissection can therefore be carried to below the level of insertion of the leaflets. Moving towards the right coronary (RC)/NC commissure as well as along the right sinus and the RC/LC commissure, the dissection is limited by non-fibrous portions of the annulus (Video 1). The sinuses of Valsalva are then resected leaving approximately 5 mm of aortic wall attached and the coronary buttons are harvested.

2.3. Prosthesis sizing

The three commissural traction sutures are pulled perpendicular to the annular plane with a slight inward motion to ensure good leaflet coaptation. When the leaflets are coapting adequately, a Hagar dilator is used to size the circle that includes the three commissures and a graft 4 mm larger is chosen as this graft will sit outside the commissural posts.

2.4. Proximal suture line

2-0 Tycron sutures with pledgets are passed from inside to outside the aorta with the pledgets on the inside, starting from the NC/LC commissure and moving clockwise. Along the fibrous portion of the aortic annulus, these sutures are inserted along the horizontal plane formed by the base of the inter-leaflet triangles. Importantly, however, along the non-fibrous portions of the annulus where the external dissection of the aortic root is limited by muscle, these sutures are inserted along the lowest portion.

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Video 1. Preparation of the aortic root.

Fig. 1. Diagram and picture demonstrating the proximal suture line.

Fig. 2. Diagram and pictures showing prosthesis preparation.

of the freely dissected aortic root making the proximal suture line slightly higher at the RC/NC and RC/LC commissures compared to the LC/NC commissure (Fig. 1).

2.5. Prosthesis preparation and fixation

A Dacron prosthesis with or without built-in neo-aortic sinuses may be used. To prevent AI, the three commissures must be attached to the prosthesis along the same plane, the new sinotubular junction. Due to external limitations of root dissection, the graft has to be tailored. First, the distance from the base of the interleaflet triangle to top of the commissure is measured at the LC/NC commissure and marked on the graft. Then, at the RC/NC and RC/LC commissures, the distance from the proximal suture to the top of the commissure is measured and used to determine the amount of graft material that needs to be trimmed (Fig. 2). Thus, the height of the trimmed portion is the difference between height of the unrestricted LC/NC commissure and the distance from the proximal suture line to the top of the respective commissure. The exact shape of the trimmed portion is less important as the prosthesis will accommodate to the external limitations of the aortic root. The pledged sutures are then passed through the base of the prosthesis, respecting the spaces between sutures and importantly, the curvilinear contour of the suture line. The commissural traction sutures are pulled up together while tying down the prosthesis to ensure appropriate seating around the aortic annulus.

2.6. Valve reimplantation

The commissures are reimplanted first using 4-0 polypropylene sutures while pulling up on the prosthesis and the native commissure and then tied into place. Radial traction is then applied on two adjacent commissural sutures and this clearly delineates the ‘line of implantation’. This running suture line is performed in small regular steps passing the suture from outside the prosthesis to inside and through the aortic wall, staying close to the annulus, and then back out of the prosthesis.

2.7. Leaflet assessment and repair

After valve reimplantation, it is critical to re-examine the leaflets for any unmasked prolapse, symmetry, and the height and depth of coaptation. Prolapse can be repaired using a variety of techniques including leaflet resection, free-edge plication or free margin shortening [3]. Cardioplegia is administered through the distal end of the graft with partial clamping to distend the new aortic root, assess root pressure and signs of LV dilatation. A limited echocardiographic view may be obtained at this time. The cardioplegia solution is then slowly aspirated out of the prosthesis without distorting the leaflets. This gives another visual assessment of AV in its physiologic closed state as well as the area and height of coaptation.

Coronary ostia are then reimplanted on the graft and the distal anastomosis is performed at the level of normal aorta.

3. Results

This technique has been applied systematically in the last 134 consecutive patients (mean age = 52±16 years; 84% male). Hospital mortality was 0.7%. AV cusp repair was required in 53% of patients and was more frequent in bicuspid AV (89% vs. 38%, P=0.005). Freedom from AV reoperation was 90±3% at 10 years and recurrent AI ( > 2+) was 89±7% at 5 years and was similar with and without cusp repair (90±9% vs. 91±8%, P=0.8).

4. Conclusion

A standard operative technique for AV reimplantation is reproducible and when applied systematically can result in consistent and excellent long-term outcome [3].
References


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We would like to congratulate the authors on their interesting message [1]. Indeed, correct understanding of functional anatomy of the aortic root, critical assessment of the aortic valve cusp, as well as regular application of these techniques can provide excellent early and long-term results.

The aortic valve-sparing reimplantation technique described by David and Feindel [2] is an established method for the surgical treatment of aortic regurgitation due to aortic root dilatation with preserved aortic leaflets. Recently, many reports have shown low operative risk and excellent freedom from thromboembolism and endocarditis with valve sparing procedure. Aortic valve function involves a complex interplay of the aortic root and cusps during the cardiac cycle. Evolution of the technique has shed light on the importance of a physiologic reconstruction of the aortic root which plays a key role in driving a correct function and durability of aortic cusps. In this report Boodhwani and colleagues [1], present their experience with 134 valve-sparing operations with low hospital mortality. The authors in the article focus on salient technical aspects. Special attention is given to the preparation of the graft tailored by the authors according to the features of an aortic root. It allows fixing the commissures along the same plane that prevents residual aortic insufficiency.

We agree with the authors, that similar preparation of the graft as well as adequate aortic cusp repair can provide stable long-term results.

References
