New vascular graft for simplification of the aortic valve reimplantation technique

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Abstract

Achievement of optimal valve geometry in valve-sparing aortic root repairs is a prerequisite for favorable valve function and, therefore, the simplification of these procedures is of utmost importance. The aim of the study was to determine the feasibility of the new vascular graft for aortic valve reimplantation technique and evaluate the early and intermediate functional results. Five patients with different aortic root and valve pathologies (1 acute aortic dissection, 4 chronic aneurysms, and 1 bicuspid valve) of whom two patients suffered from severe (4+) aortic regurgitation, underwent valve-sparing aortic root repair using the reimplantation technique with the new graft. Three patients required, in addition to the aortic root repair, other procedures on the valve cusps. In all patients, optimal root restoration with no or slight valve insufficiency could be achieved, and these results remained unchanged over the follow-up time of up to two years. The new aortic root graft simplifies aortic root repair using the valve reimplantation technique, and despite its straight form, allows easy restoration of the aortic root, which fits perfectly with patients’ anatomy.

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Keywords: Aortic aneurysm; Aortic valve; Aortic insufficiency; Aortic root repair; Valve repair

1. Introduction

Because a crimped graft of 2.5 cm in length changes its length by about 40% after stretching, sewing the valve remnants inside the standard tube has to be performed under continuous stretching. Therefore, this step of aortic valve reimplantation is not only challenging but also risky in that the commissures can change their location and, especially, their height after surgery. Yet achievement of optimal valve geometry in valve-sparing aortic root repairs is a prerequisite for favorable valve function and, therefore, their simplification is the most important advancement that may lead to more common use of these procedures and to the improvement of surgical results.

The new vascular graft described has already been introduced into surgical practice for facilitating different aortic root repair or replacement techniques [1, 2]. The aim of this study was to determine the feasibility of the new aortic graft for aortic valve reimplantation technique. The graft (InterGard Woven Aortic Thoracic Graft; InterVascular, La Ciotat, France) designed by the author (PU) is a collagen-coated woven polyester tube that has a 3-cm-long uncrimped proximal part intended for repairing the aortic root (Fig. 1). It has been commercially available since January 2006 in five even diameters ranging from 26 to 34 mm. The uncrimped part of the graft eliminates the necessity of strong stretching during sewing of the valve remnants inside the tube and facilitates achieving a proper location of the commissures.

2. Patients and methods

From September 2006 to November 2007, five patients with different aortic root and valve pathologies underwent valve-sparing aortic root repair using reimplantation technique with a new aortic root graft at our institution. In all patients the ascending aorta was aneurysmatic, even acutely dissected in one case. One patient suffered moderate (2+) and two each had mild (1+) and severe (4+) aortic regurgitation, respectively. All relevant patient data are summarized in Table 1.

2.1. Technique

To choose the proper size of the aortic graft, the aortic annulus was measured with a valve sizer and its size defined as the same as the biggest sizer that could pass through the aortic valve. Because in bicuspid valves this passing is not possible, the sizer was only placed on the valve, and the appropriate size was judged visually. The diameter of the graft used for aortic root repair with valve reimplantation technique was approximately 5 mm bigger than the diameter of the aortic annulus.
The surgical procedure followed the steps described by David and Feindel in their original article [3]. For the bottom fixation of the graft, 10–12 subannular interrupted horizontal mattress sutures (polypropylene 4–0) were passed through the left ventricular outflow tract from inside to outside and then in the same manner from inside to outside through the edge at the uncrimped end of the graft and then tied. The number and the widths (6–7 mm) of the stitches that were generally used provided a slight narrowing of the graft around the annulus without restricting it, which could lead to a reduction of the aortic orifice area. Using the new graft with an uncrimped proximal part simplified the next step of valve reimplantation. The aortic remnants, including valve commissures, were placed within the uncrimped part of the graft and fixed to the tube with a 5–0 polypropylene continuous suture. Because the wall of the tube is smooth, the valve remnants adhered to it securing their proper location and, especially, the proper height of the commissures (Fig. 2a). The sewing of the valve remnants inside the tube was very easy because exerting strong tension to stretch the graft was not necessary (Video 1). After reimplanting the coronary ostia and before completing the procedure by anastomosing the tube to the distal ascending aorta, the graft was simply narrowed at the level of the sino-tubular junction with additional U-stitches between the tops of the commissures (Fig. 2b), and the caliber of the tube above the sino-tubular junction was gradually narrowed distalwards by excising a triangle and resewing the graft with a 4–0 polypropylene continuous suture (Video 2).

3. Results

The median aortic cross-clamp time was 130 min and ranged from 111 to 172 min. However, the cross-clamp time was determined not only by the valve-sparing root repair but also by additional complex cusp repairs in three patients. There were no perioperative complications in any of the patients, all of whom were discharged after a median hospital stay of nine days.

In all patients, optimal root restoration (Fig. 3) with no (4) or slight (1) valve insufficiency could be achieved, and

<table>
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<th>No.</th>
<th>Sex</th>
<th>Age years</th>
<th>Preoperative AI</th>
<th>Aortic diameter (mm)</th>
<th>Annulus diameter (mm)</th>
<th>Graft size (mm)</th>
<th>Cusp procedure</th>
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<td>45</td>
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<tr>
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<td>28**</td>
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<tr>
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<td>32</td>
<td>1+</td>
<td>50</td>
<td>29</td>
<td>34</td>
<td>No</td>
<td>Trivial</td>
</tr>
</tbody>
</table>

*Acute aortic dissection, **bicuspid aortic valve.
AI, aortic insufficiency; MR, free margin reinforcement; PP, pericardial patch plasty.
these results remained unchanged over the time of almost up to two years. At the follow-up time, which was a median of 17 months and ranged from 5 to 19 months, all patients were in NYHA functional class I.

4. Discussion

The aortic root dilatation process causes the sinuses to change their dimensions in the transverse as well as longitudinal axis; moreover, these changes develop differently in the separate sinuses. The distalward movement of the commissures during the progression of dilatation also develops differently, causing their different heights. On the other hand, in isolated aortic root dilatation the dimensions of the valve cusps correlate with the size of the sinuses, and the restoration of the aortic root anatomy is inevitable in order to achieve smooth valve movement after valve-sparing root repair. Because the single patch technique, introduced by the author for valve-sparing root repair, ensures the possibility of very individual reconstruction of single sinuses of Valsalva, we consider this technique as an optimal reconstruction method and have therefore established it as the standard for valve-sparing aortic root repair at our institution. However, the aortic valve reimplantation technique, which is familiar to and preferred by many surgeons, is an excellent option for patients in whom all three sinuses have to be replaced. Among 79 patients who underwent valve-sparing aortic root repair at our institution during the past two years, we selected five cases, mostly during aortic root surgery workshops, to demonstrate the suitability of the new aortic root graft also for the reimplantation technique.

In comparison to other commercially available aortic grafts, the prosthesis described considerably facilitates reimplanting the aortic valve inside the tube because the standard crimped graft has to be stretched very strongly for correct placement of the valve remnants and also for each stitch during sewing. For this reason, evaluation of the valve position inside the cramped graft, especially of the commissures height, is not easy and associated with a risk of incorrect fixation of the valve inside the tube. The ‘Valsalva graft’ [4], another vascular prosthesis for aortic root surgery, indeed closely mimics the human’s root anatomy; however, its use in patients in whom the root geometries have already changed can present difficulties [5]. Since the dimensions of the ‘Valsalva graft’ are predetermined, the individual anatomy of the patient has to be adapted to the tube in order to place the tops of the commissures exactly at the level of the sino-tubular junction, and if the patient’s commissures have a different height, which is not uncommon, it can be even impossible. On the contrary, the restoration of the aortic root anatomy that perfectly fits the patient’s anatomy, as demonstrated, can also be achieved with the new vascular graft despite its straight form.

5. Conclusion

The new vascular aortic root graft simplifies proper placement and sewing of the valve remnants inside the uncrimped part of the tube because exerting strong stretching on the graft during sewing is not necessary. It enables easy adaptation of the graft to the individual patient’s anatomy and restoration of the aortic root form, which leads to excellent operative and midterm functional results.

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References


eComment: New vascular graft for simplification of the aortic valve reimplantation technique

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The Bakoulev Center for Cardiovascular Surgery annually performs about 100 operations for ascending aorta aneurysms and dissections. The whole experience exceeds 900 procedures for the replacement of the ascending aorta and its arch. Valve-sparing operations contribute a small part (46 procedures) in comparison to composite graft usage, and we began this type of surgery early in 2000. Seventeen of them were supracoronary aortic replacement, 6 – remodeling (M. Yacoub), 24 – reimplantation (T. David). In all cases we used woven Dacron grafts (Vascutek or Interguard). We obtained excellent results with reimplantation, and suboptimal results with remodeling. The last, in our opinion, is more skill-demanding.

Like the authors of this article [1], we met difficulties in the placement of the commissures into the crimped prosthetic wall. In addition, this can create more bleeding sites at open suture lines. Dr Urbanski’s approach can enhance not only the reimplantation procedure, but also the remodeling procedure for aortic valve salvation in surgery for aneurysm of the ascending aorta.

Reference