



Valve-sparing procedure for a dilated pulmonary autograft

Karen B. Abeln, Tristan Ehrlich, Alexander Hess, Hans-Joachim Schäfers

Department of Thoracic and Cardiovascular Surgery, Saarland University Medical Center, Homburg, Germany

Correspondence to: Hans-Joachim Schäfers, MD, PhD. Department of Thoracic and Cardiovascular Surgery, Saarland University Medical Center, Homburg, Germany. Email: h-j.schaefers@uks.eu.



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Clinical vignette

This thirty-nine-year-old male underwent a Ross procedure ten years ago as the primary cardiac operation. He presented with exercise-induced dyspnea, reduced left ventricular ejection fraction and aortic regurgitation of the pulmonary autograft. The preoperative echocardiogram showed dilatation of the sinuses and sinotubular junction (STJ).

Reoperation was necessary for prognostic reasons. Due to his age and preference regarding anticoagulation, repair of the autograft, including root replacement appeared to be the best solution.

Surgical technique

Preparation

Intraoperative transesophageal echocardiography (TEE) is performed to confirm the aortic diameters and analyze the regurgitant jet, thus defining the likely mechanism of regurgitation. A repair plan is based upon this analysis.

The root diameters trigger the need for specific approaches; we follow the same concept as in native aortic aneurysm and regurgitation (1). A dilated STJ is corrected by tubular ascending aortic replacement. A maximum sinus diameter of >42 to 45 mm (depending on the size of the patient) or the need to modify commissural orientation, will trigger root replacement. We prefer root remodeling as our standard as it requires less annular dissection than aortic valve reimplantation, which is beneficial after failed Ross operations because of the scarring in the annular area. An annular diameter of >26 mm will be treated by a suture annuloplasty. The cusps are similarly managed as in aortic valve repair. A geometric cusp height of >17 mm usually allows for its preservation; effective height is adjusted so

that it is 40% to 45% of geometric height (1).

In this case, there is abnormal orientation of the commissures, with a commissural angle of the right sinus less than 90°. There is also moderate dilatation of the root, suggesting root replacement as a strategy to normalize dimensions and commissural orientation. There are two regurgitant jets, indicating two separate mechanisms of regurgitation. The jet eccentricity implies a high probability of cusp prolapse.

Operation

The chest is reopened by median sternotomy and adhesions are mobilized. On bypass, the heart is mobilized completely. The aorta is clamped and opened by a transverse incision; blood cardioplegia is given directly into the coronary ostia.

Under cardioplegic arrest the root is dissected further and all old foreign material carefully removed. The cusps are checked for integrity and geometric height. In this case the geometric height of all three cusps is 20 to 21 mm. Thus, the valve is a suitable substrate for repair. There is a healed perforation in the right cusp.

The aortic sinuses are resected, leaving a rim of autograft wall adjacent to the cusp insertion lines. The coronary orifices are mobilized sufficiently. Intubation of the annulus shows a diameter of 27 to 28 mm. A vascular graft is chosen according to the patient's size; in our experience, a 26 mm graft is adequate for most patients. Three tongues are created and the graft is sutured to the cusp insertion lines, preserving maximum height of the native commissures. If present, as in this case, perforations of cusps are closed with a pericardial patch (Autotissue, Berlin, Germany).

The dilated annulus (>26 mm) is managed by an external suture annuloplasty with an expanded polytetrafluoroethylene

(ePTFE) suture (Gore-Tex CV-0; W. L. Gore & Associates, Munich, Germany) (2). The suture is tied around a 23 mm Hegar dilator.

After completion of root replacement, the configuration of the autograft cusps is assessed by visual inspection and measurement of effective height (1,2). In this case, there is pronounced prolapse of the noncoronary cusp with an effective height of 0 mm. While prolapse is generally treated by central plication of the free margin until all are at the same level and have an effective height of 9 mm, here, triangular resection of cusp tissue is necessary for extreme redundancy.

Finally, the coronaries are reimplemented into the vascular prosthesis. The graft is shortened and anastomosed to the ascending aorta. The heart is deaired and the cross-clamp removed. Intraoperative TEE is mandatory to control valve function. The autograft is now competent; form and function have thus been normalized.

Comments

Clinical results

Between 1997 and 2020, reoperation for failed autograft replacement was performed in twenty-eight patients, and the autograft was preserved in twenty-five cases (89%; aged sixteen to sixty-one years). The root was replaced in twelve, other forms of repair performed in thirteen instances. Median CPB and cross-clamp times were 121 and 89 minutes, respectively, and thus comparable to standard valve preservation. So far there has been no perioperative complication or death. Follow-up ranges from 0.6 to eighteen years (mean four years). All patients remain alive; two patients have required a reoperation. One patient developed infective endocarditis and underwent mechanical valve replacement two years postoperatively. The second patient underwent aortic valve re-repair for cusp prolapse after sixteen years. Both patients are alive and well.

Discussion

The Ross procedure achieves excellent results in experienced high-volume centers (3). Autograft regurgitation, however, may occur over time due to cusp deformation or root dilatation (3,4). Because of reoperation complexity (5), they are often performed as replacement of the aortic valve and/or root (4).

In order to preserve the advantages of the Ross procedure,

we routinely perform a valve-sparing procedure in a failed autograft whenever cusp substance is preserved. We simply apply the principles of aortic valve repair and choose the approach according to the pathology encountered, employing established repair techniques. Thus, root geometry is restored, and valve function normalized.

So far there has been no perioperative death or relevant complication in our experience. CPB and cross-clamp times have not been excessive; early and late survival are excellent. Relevant autograft regurgitation has affected only one patient. This may be attributable to our systematic use of root replacement (where necessary), intraoperative measurement of effective height and external annuloplasty.

In summary, the valve-preserving operation after a failed Ross shows excellent results and maintains the advantages of autologous valve tissue. It is reproducible in the majority of cases. Long-term durability will have to be studied further.

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Footnote

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

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