Trileaflet pulmonary valve reconstruction for pulmonary regurgitation in childhood

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Abstract

A 6-year-old boy with pulmonary regurgitation after complete repair of congenital heart disease underwent an alternative surgical repair for pulmonary valve replacement. Trileaflet pulmonary valve reconstruction using expanded polytetrafluoroethylene membrane is a clinically feasible technique for pulmonary regurgitation in such a young child in whom large-sized bioprosthetic valves cannot be implanted.

Keywords: Pulmonary valve reconstruction • Pulmonary regurgitation • Congenital heart disease

INTRODUCTION

Pulmonary valve replacement for pulmonary regurgitation (PR) is frequently performed in patients with a wide variety of congenital heart diseases. Bioprosthetic valves which are probably most commonly used, are, however, unsuitable for younger patients, because of the significant risk of early prosthetic valve failure and because they cannot accommodate adult-sized bioprostheses without the right ventricular (RV) incision. This report presents a feasible technique for reconstruction of the trileaflet valve at the pulmonary annulus in a child with progressive RV dilatation due to severe PR.

CASE REPORT

The patient, 6-year-old boy (weight 15 kg), previously underwent patch closure of a subarterial ventricular septal defect at the age of 6 months. Cardiac catheterization and magnetic resonance imaging showed severe PR and an RV end-diastolic volume index of 187 ml/m2 and an RV end-systolic volume index of 85 ml/m2. After pulmonary arteriotomy, the pulmonary valve revealed a normal left cusp, a slightly dysplastic right cusp adherent to the ventricular septal defect patch and a remarkably degenerative anterior cusp. Both the abnormal cusps had poor commissural coaptation, resulting in severe PR. First, all the leaflets were excised meticulously, and the pulmonary annular diameter was measured as 16 mm. Then, the distance between each commissure and the height of the inter-leaflet triangle (the so-called distance between the basal ring and each commissure) were measured with surgical silk threads. Three new leaflets of the sizes corresponding to these measurements were trimmed from a 0.1-mm-thick expanded polytetrafluoroethylene (ePTFE) membrane (W.L. Gore & Associates, Inc., Flagstaff, AZ, USA) (Fig. 1A). Finally, the annular margin of the new leaflet was sutured with running Gore-Tex CV-7 sutures to the remnant of each leaflet. Commisural coaptation was secured with additional Gore-Tex CV-6 sutures (Fig. 1B and C). The postoperative course was uneventful, and postoperative echocardiography at discharge demonstrated no PR. During subsequent follow-up for 11 months, the pressure gradient across the valve was less than 15 mmHg, and good valve function with trivial PR was present.

DISCUSSION

The limited durability of bioprosthetic valves in the pulmonary position as a result of structural valve deterioration due to leaflet calcification is a limitation of the use of such valves. Reportedly, age below 10 years at the time of pulmonary valve replacement is associated with a higher risk of structural valve deterioration [1]. Moreover, Ozaki et al. [2] reported that tricuspid semilunar valves could produce a larger orifice area and higher contact point of cusps even with different size cusps, than can a bicuspid valve and a quadricuspid valve. Hence, we consider tricuspidization of the pulmonary valve to be of utmost importance in this patient.

We decided the size of pulmonary cusp to be defined independently by the distance between the commissures and the height of the inter-leaflet triangle for the purpose of reconstructing the pulmonary valve as naturally and simply as possible, not...
by the diameter of the annulus or conduit [3–5]. Moreover, this procedure was able to preserve coordination between the right ventricle, pulmonary valve annulus, cusps, sinus of Valsalva and sinotubular junction, thus maximizing pulmonary valve function.

Regarding the material of the valve, the ePTFE membrane itself is resistant to the microcalcification [4], and the ePTFE leaflets experimentally show no signs of thickening or peeling after a short-time implantation [5]. However, there is still a possibility that the fibrocollagenous tissue covering the ePTFE leaflet or suture line between the ePTFE cusp and native tissue may induce decreased leaflet motion. Assessment of the long-term results with these implanted valves, especially regarding the durability and proper size of each valve, needs to be examined in the future.

Conflict of interest: none declared.

REFERENCES