Percutaneous tricuspid valve replacement in childhood

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ABSTRACT

Percutaneous replacement of the tricuspid valve with a bovine jugular venous valve (melody valve) was successfully undertaken in a 9-year-old boy. The patient had a previous history of bacterial endocarditis of the native tricuspid valve in infancy. Initially, a pericardial patch valve was created, followed by surgical replacement of the valve using a biological tissue valve at 4 years of age. Progressive stenosis and regurgitation of the biological valve, with severe venous congestion and resulting hepatic dysfunction prompted percutaneous valve replacement.

Keywords: Transcatheter replacement; tricuspid valve; Melody

INTRODUCTION

Primary tricuspid valve disease is rare, and tricuspid valve replacement is rarely carried out in childhood. Mechanical valve replacement, particularly in infancy, is associated with a high incidence of complications while bioprosthetic valves tend to degenerate with time and will require replacement.[1,2] Experience with percutaneous valve placement in the tricuspid position is limited.[3] We report on successful percutaneous replacement of the tricuspid valve in a young patient.

CLINICAL SUMMARY

The patient was a 9-year-old boy, who had previously undergone two surgical procedures on the tricuspid valve. At 10 months of age, he presented with primary bacterial (*Staphylococcus aureus*) endocarditis of the tricuspid valve. The valve was excised and replaced using a pericardial patch valve.[4] Despite adequate valvar function for a period of 3 years, rapidly increasing stenosis, associated with hepatic enlargement and dysfunction, prompted replacement of the valve at 4 years of age. As the parents were not keen to have a mechanical valve with associated use of routine anticoagulation medications, a 23 mm biological valve (Edwards Perimount bioprosthesis, Edwards Lifesciences Corporation, Irvine, USA), made of three leaflets fashioned from bovine pericardium and mounted on a scaffold of steel wires covered by a Dacron cuff, was implanted surgically. The postoperative course was complicated by intermittent complete atrioventricular (AV) block, requiring dual chamber epicardial pacemaker implantation.

Four years following the second surgical procedure the patient developed progressive stenosis and insufficiency of the tricuspid valve, with hepatic venous congestion, liver dysfunction and mild protein-losing enteropathy (PLE). Further surgical procedures were declined by the parents. After informed consent was obtained, it was decided to undertake percutaneous tricuspid valve using a melody transcatheter pulmonary valve (Medtronic Inc., Minneapolis, USA) at 9 years of age (weight 30 kg).

Procedure

Cardiac catheterization via the right femoral vein was performed under general anesthesia. The mean right atrial pressure was 14 mm Hg, versus a right ventricular EDP of 5 mm Hg. Balloon sizing of the prosthetic valve was performed (measured valve diameter of 13.5 mm versus an expected diameter for age and body surface area of 22 mm) [Figure 1]. Pacemaker testing, which had been performed prior to the catheterization procedure, showed that the patient had 1:1 AV conduction at lower heart rates, but complete AV dissociation at rates >100 beats/min. A 24 mm × 2 cm Atlas balloon (Bard

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Peripheral Vascular Inc., Temple, USA) was positioned across the valve and inflated to 22 atmospheres, accepting the risk that this might exacerbate AV block. At this inflation pressure, the metal ring of the Edwards prosthesis cracked with an audible click [Figure 2a and b and Video 1]. The maximum balloon diameter achieved at the level of the metallic ring during cracking of the valve was 22 mm. Subsequently, a 26 mm × 12 mm Intra-stent Max LD (Medtronic Inc., Minneapolis, USA) was implanted across the valve ring [Figure 3], and dilated up to 22 mm in maximum diameter, using a 22 mm × 2 cm Atlas balloon [Video 2]. Following this, the Melody valve was implanted, using a 22 mm delivery system [Figure 4 and Videos 3 and 4]. The procedure was uncomplicated. The patient was prescribed oral aspirin therapy (5 mg/kg/day) for a period of 6 months.

Outpatient follow-up was performed 6 weeks post-valve implant. The patient demonstrated clear clinical improvement, with the absence of hepatomegaly, normalization of liver function parameters, and a normal serum albumin level. Echocardiography demonstrated normal valvar function, with no valve stenosis or insufficiency [Videos 5 and 6]. The inferior vena cava demonstrated normal collapsibility during respiration.

DISCUSSION

Surgical reconstruction or replacement of the tricuspid valve in young infants has an uncertain medium-term prognosis. Replacement using a mechanical prosthesis is associated with a high rate of complications, and bioprosthetic valves may be preferred, providing the annulus is of sufficient size to accommodate the valve. There has even been a report of excision of the valve, leaving the tricuspid valve orifice unguarded.[5]

Percutaneous replacement of the tricuspid valve has been infrequently performed. In all previous instances, the Melody or Edwards Sapien (Edwards Lifesciences Corporation, Irvine, USA) has been implanted in a valve-in-valve fashion, as described here.[3] Early results

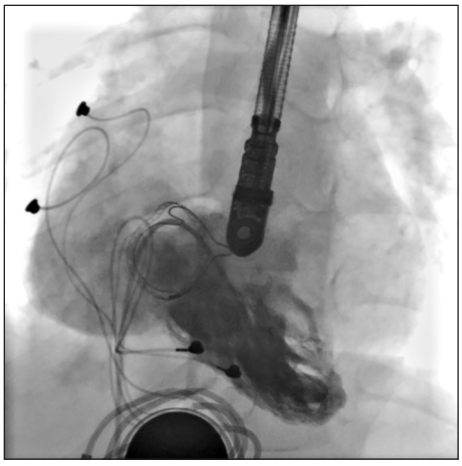

Figure 1: Preprocedure angiogram showing moderate tricuspid regurgitation with contrast filling the hepatic veins, in addition to valve stenosis

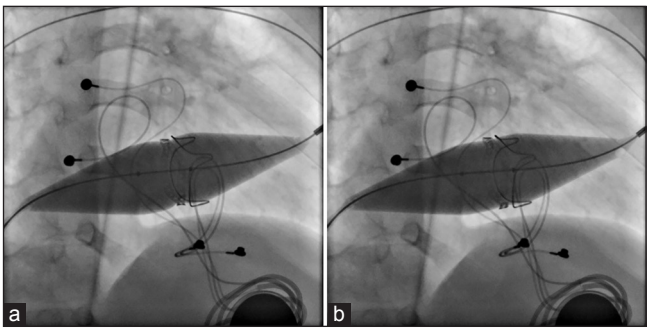

Figure 2: (a) Cracking the valve ring of the surgically implanted bioprosthesis using a high pressure balloon. At 20 atmospheres, a small residual waist can be seen on the balloon. (b) at 22 atmospheres inflation pressure, the waist on the balloon disappears, accompanied by cracking of the valve at the 6 0'clock and 12 0'clock positions of the ring

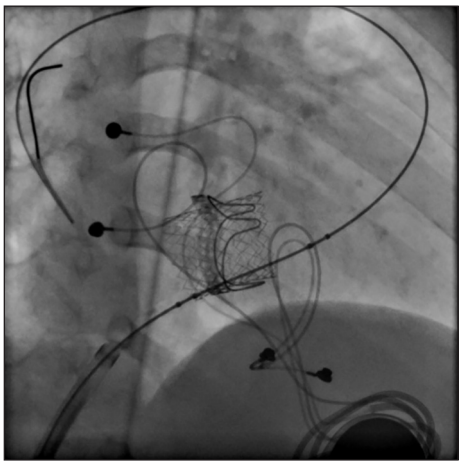

Figure 3: A large (LD Max) stent has been implanted across the valve ring, to provide the landing zone for the Melody valve

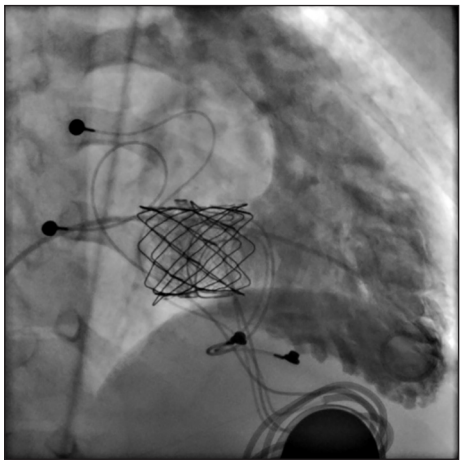

Figure 4: Postvalve implant angiogram. There is no residual tricuspid insufficiency. There was also no residual gradient across the valve

of the procedure have been encouraging, in particular with regards to procedural success. The procedure is not without complications, which have included early postprocedural death, AV block requiring pacemaker implantation, and endocarditis of the implanted melody valve.[3] However, the percutaneous implant option will certainly reduce the number of surgical procedures that such patients may have to undergo in the course of their natural life. An additional advantage, particularly in young patients, is that no anticoagulation is required following the procedure. Current technical constraints allow the melody valve to be dilated to a maximum diameter of 22 mm, to ensure maintenance of valve competence. Dilating the valve to a larger diameter can result in clinically significant valve incompetence, as has been reported.[3] The Edwards-Sapien valve, however, can be dilated to larger diameters, although the only report of its implant in the tricuspid position was as a hybrid procedure, with access obtained via a thoracotomy.[6]

In our patient, it would have been possible to implant the melody valve within the existing surgical ring. The decision to crack the metal ring using a high-pressure balloon was made in order to facilitate future percutaneous valve replacements using larger valves, should this be required. The technique of cracking the valve ring was first described for the pulmonary valve position, and we have extended the application to the tricuspid valve.[7] Our patient had demonstrated the rapid failure of his initial pericardial patch valve, following initially satisfactory performance for up to 3 years. The surgically implanted bioprosthetic valve had also failed within 4 years, but further procedures were postponed at the parents' request until the onset of PLE. In view of his clinical history, careful long-term follow-up of the melody valve is indicated. The major advantage of bioprosthetic valves is the nonrequirement of routine anticoagulation therapy, with its attendant risks and complications. While the short-term follow-up data are certainly positive, further follow-up of larger series of patients is required to assess valve integrity and longevity.

REFERENCES

1. Iscan ZH, Vural KM, Bahar I, Mavioglu L, Saritas A. What to expect after tricuspid valve replacement? Long-term results. Eur J Cardiothorac Surg 2007;32:296-300.
2. Rizzoli G, Vendramin I, Nesseris G, Bottio T, Guglielmi C, Schiavon L. Biological or mechanical prostheses in tricuspid position? A meta-analysis of intra-institutional results. Ann Thorac Surg 2004;77:1607-14.
3. Roberts PA, Boudjemline Y, Cheatham JP, Eicken A, Ewert P, McElhinney DB, *et al.* Percutaneous tricuspid valve replacement in congenital and acquired heart disease. J Am Coll Cardiol 2011;58:117-22.
4. Sreeram N, Ben Mime L, Bennink G. Pericardial patch valve in the tricuspid position in an infant. Cardiol Young 2011;21:458-9.
5. du Plessis FA, Helbing WA, Bogers AJ. Excision of the tricuspid valve in a baby with Candida endocarditis. Cardiol Young 2007;17:545-7.
6. Webb JG, Wood DA, Ye J, Gurvitch R, Masson JB, Rodés-Cabau J, *et al.* Transcatheter valve-in-valve implantation for failed bioprosthetic heart valves. Circulation 2010;121:1848-57.
7. Tanase D, Grohmann J, Schubert S, Uhlemann F, Eicken A, Ewert P. Cracking the ring of Edwards Perimount bioprosthesis with ultrahigh pressure balloons prior to transcatheter valve in valve implantation. Int J Cardiol 2014;176:1048-9.

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