

Brief Report

Transapical aortic balloon valvuloplasty in a 6-year-old child with unsuccessful retrograde approach

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Abstract Severely stenotic aortic valves can be treated by percutaneous techniques. However, in rare conditions it could not be possible because of vascular access and valvular passage problems due to small and eccentric orifice. Hybrid approach to balloon aortic valvuloplasty may be considered an alternative to surgery. Here, we present a case of a patient with severe aortic stenosis who has had two failed attempts of percutaneous intervention.

Keywords: Aortic stenosis; hybrid; child; transapical valvuloplasty; treatment

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PERCUTANEOUS BALLOON AORTIC VALVULOPLASTY IN most centres has become the treatment of choice for paediatric isolated severe valvular aortic stenosis.¹ However, under certain circumstances, percutaneous interventions are risky² and sometimes it is even impossible to perform the intervention, because of a patient's extremely low weight, as well as valvular passage and vascular access problems.

In this report, we present a case of a patient with severe aortic stenosis, who was treated by hybrid transapical aortic valvuloplasty after two unsuccessful percutaneous aortic balloon valvuloplasty attempts.

Case report

A 6-year-old girl, who was firstly diagnosed few weeks after birth, presented with palpitation and decreased exercise capacity. In the neonatal period, two-dimensional echocardiogram revealed severe aortic stenosis estimating a peak instantaneous pressure gradient of 80 millimetres of mercury. Percutaneous balloon aortic valvuloplasty was tried

at 2nd month after birth, but the guidewire was not passed through the orifice of the severely stenotic aortic valve. We have used multipurpose A, right coronary, cobra A1 catheters, and hydrophilic guidewires with J and straight tip but could not pass the aortic orifice. Surgery was suggested, but the parents of the patient neither accepted the advice nor attended the control visits.

After 6 years, the child presented for dyspnoea on exertion – New York Heart Association class II–III. On cardiac examination, there was III/VI high-frequency harsh systolic ejection murmur at the upper right sternal border. Her electrocardiography demonstrated sinus rhythm with left ventricular hypertrophy and T-wave inversion in left chest derivations. Echocardiography showed left ventricular hypertrophy and significant valvular aortic stenosis with a peak gradient of 120 millimetres of mercury. The second attempt at percutaneous balloon aortic valvuloplasty was unsuccessful because the guidewire was not passed through the aortic valve. We have used a similar technique as the first attempt, but could not pass the orifice. We decided to use the carotid artery puncture technique, but because of our very limited experience with this technique and its additional risks we had to abstain from performing this technique. The possible

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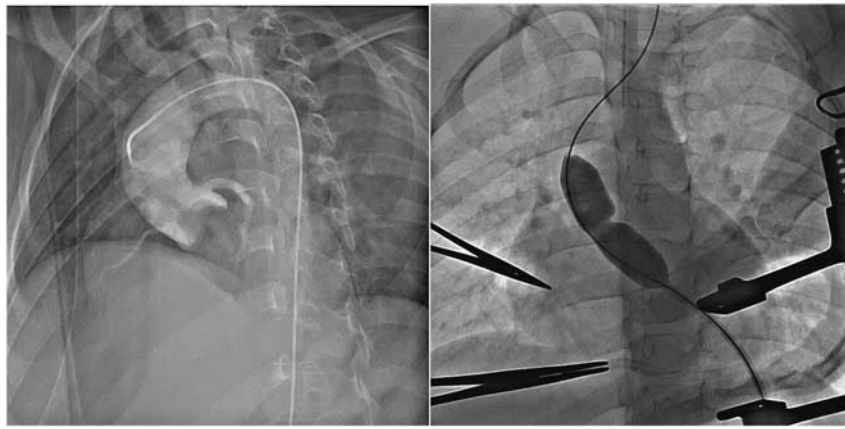


Figure 1.
Severe aortic stenosis demonstrated by aortic root angiography and transapical valvuloplasty via thoracotomy.



Figure 2.
Post-operative aortic root angiography revealing minimal aortic regurgitation.

treatment modality that could be applied in our centre was surgical valvotomy. The patient's case was discussed with an interventional cardiologist and cardiothoracic surgeon, and it was decided to attempt a minimally invasive "hybrid approach" to perform balloon aortic valvuloplasty (Supplementary Movie 1, Fig 1).

Through a left anterior thoracotomy, the cardiac apex exposed and purse string was placed around the left ventricle apex (Supplementary Movie 2). After systemic heparinisation (100 units per kilogram), a 7-French sheath was placed in the left ventricle anterior wall, and with the guidance of fluoroscopy a guidewire was advanced through the left ventricle to the aortic valve. According to the aortic annular dimension, a 16 millimetres \times 5 centimetres Tyshak II balloon dilation catheter was advanced over the wire across the aortic valve and inflations were performed on two occasions, completely eliminating

the waste on the first occasion to such an extent that no residual waste was detected on the second inflation (Supplementary Movie 3).

A 6-French catheter was placed to the left ventricle and pullback showed a 50 millimetres of mercury peak residual gradient across the valve, and angiography revealed minimal aortic regurgitation (Supplementary Movie 4, Fig 2). After surgical closure of the left anterior thoracic incision, the patient was transferred back to the paediatric intensive care unit. The time interval between advancing the sheath inside the apex of the left ventricle and aortic valvuloplasty was less than 10 minutes. The total fluoroscopy time was 7.8 minutes.

At the end of 1st month follow-up, echocardiography performed and 24-hour-Holter electrocardiography revealed better results. The exceptional dyspnoea of child was recovered and she was found to have significant reduced valvular aortic stenosis with 30 millimetres of mercury peak pressure gradient. The 24-hour-Holter electrocardiography revealed no arrhythmia.

Discussion

Although surgery remains the treatment of choice for most congenital cardiac malformations, an increasing number of simple and even complex lesions are nowadays treated by transcatheter techniques. Surgery has its limitations.³ Generally, intracardiac procedures require the use of cardiopulmonary bypass and sometimes even circulatory arrest, which is associated with adverse effects such as neurologic injury.⁴

Percutaneous balloon aortic valvuloplasty has become the treatment of choice for children with isolated severe aortic valve stenosis. Antegrade or retrograde access for aortic valvuloplasty is possible.

The retrograde approach is the easiest and the most preferred one. However, the retrograde approach can be challenging because of a patient's low weight, poor vascular access, or impossibility of retrograde passage from the aorta to the left ventricle in patients with severe aortic stenosis as in our case. Antegrade access is possible in children with patent foramen ovale/atrial septal defect, or a transseptal puncture is needed for entering to the left heart.

In hybrid procedures, the surgeon provides optimal access and the cardiologist performs the interventions. This collaborative approach helps to reduce procedural risks and improve cosmetic results.² Transapical hybrid aortic balloon valvuloplasty has been performed in low-weight infants with poor vascular access. Our patient had severe aortic stenosis with dyspnoea on exertion. Percutaneous balloon aortic valvuloplasty was attempted twice unsuccessfully, because the guidewire was not passed through the aortic valve.

The antegrade approach through patent foramen ovale – when the patient was first seen at 2 months – or via atrial septal puncture – when seen at 6 years – would be possible alternatives for our patient. However, with an excessive transvalvular gradient, a long stiff guidewire supplement is essential for positioning and controlling the balloon during valvuloplasty, which is a risk factor for mitral and aortic valve or annulus. Guidewire may injure mitral valve or apparatus and aortic valve during valvuloplasty. Using the transapical approach, we fixed the valvuloplasty balloon easily in the aortic valve position and did not face the balloon sliding problem during the valvuloplasty.

The transapical approach was used for treating a 700-gram baby with critical pulmonary valve stenosis for the first time by Holzer et al.⁵ In that case, the hybrid approach was performed because attempts at obtaining femoral and internal jugular venous access failed. In another case, hybrid aortic balloon valvuloplasty was performed for treating an 890-gram pre-term infant with critical aortic stenosis by Maschietto et al.⁶ Despite repeated trials, the guidewire could not be passed through the orifice of the severely stenotic aortic valve. This could be due to the significantly narrow aortic orifice of the patient and high pressure gradient level through the aortic valve. Furthermore, the hybrid procedure has been applied for the treatment of the critical aortic valve stenosis in the foetus.⁷

Transapical valvuloplasty for severe aortic stenosis is challenging for the paediatric interventional cardiologist, and the experience is just limited with a few case reports. We preferred the transapical technique for this case, but the transcarotid approach could also be tried. However, owing to bleeding problems and the possible air embolisation risk to the central nervous system, we did not prefer the transcarotid approach.

Until 1996, we have performed more than 160 aortic valvuloplasties in our centre, but nearly all cases were treated by the retrograde approach. We have made a few newborn cases from antegrade way, who has an atrial septal defect or a patent foramen ovale. Owing to our very limited experience about interatrial septal puncture or carotid artery access, we did not perform these techniques. The possible treatment modality that could be applied in our centre was surgical valvotomy. However, with the hybrid procedure we performed the operation with minimal invasive technique on beating heart.

In conclusion, we believe that hybrid balloon aortic valvuloplasty is an applicable alternative treatment of choice for severe cases. With increasing experience, transapical balloon valvuloplasty can be performed in even more and severe cases in order to reduce morbidity and eventually improve outcome.

Supplementary materials

For supplementary material referred to in this article, please visit <http://dx.doi.org/doi:10.1017/S1047951112000522>

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