

Sequential Transcatheter Closure of a Patent Ductus Arteriosus and a Muscular Ventricular Septal Defect in a Child

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Abstract

Due to the developing technology in pediatric catheterization and increasing experience of pediatric cardiologists, currently transcatheter closure of multiple cardiac defects has become available. The present case report describes a patient who successfully underwent sequential transcatheter closure of patent ductus arteriosus (PDA) and muscular ventricular septal defect (VSD). Transcatheter closure of multiple defects is regarded as a reliable and efficient therapeutic option which can be an alternative to surgical treatment in appropriate cases.

Keywords: Congenital heart disease; Compound abnormalities; Interventional therapy; Sequential transcatheter closure

Introduction

It has been widely accepted that transcatheter closure of isolated cardiac shunt defect is an alternative to surgical treatment [1,2]. Treatment for multiple congenital cardiac defects usually refers to open-heart surgery or a combination of medical treatment and open-heart surgery. Nowadays, owing to development of techniques in transcatheter interventional therapy multiple defects can be treated in angiography catheterization laboratory. Recently, the benefits of an interventional procedure conducted for the treatment of combined defects were reported [3,4]. However, there are also a few studies in the literature for non-surgical treatment of multiple congenital cardiac defects [5,6].

The present case report describes a child with ventricular septal defect (VSD) and patent ductus arteriosus (PDA) who benefited from combined interventional therapy using the Amplatzer septal occluder for the VSD (AGA Medical Corporation, Golden Wallely, MN, USA) and Flipper coil (Cook Cardiology, Bloomington, Indiana, USA) for the PDA. Based on our experience, sequential closing the PDA and VSD may be a reliable and efficient therapeutic option which can be an alternative to surgical treatment in appropriate cases.

Case

An 8 month-old female patient was referred to our hospital with frequent lower respiratory tract infection and poor nourishment. Cardiomegaly and mild pulmonary congestion were detected on her chest X-ray. Transthoracic echocardiography (TTE) showed a single moderate muscular VSD and large PDA with enlarged left atrium (left atrium/aorta ratio: 1.8). Cardiac catheterization and angiography confirmed the diagnosis and revealed substantial left-to-right shunting (Qp/Qs: 3.9) with normal pulmonary arterial pressure (mean: 23 mmHg) and mild elevation of pulmonary vascular resistance index (3.2 Wood units/m²).

It was decided that PDA should be closed initially and immediately because it was thought that the existing left-to-right shunt particularly depended on PDA rather than VSD so that the closure of PDA would improve the hemodynamical features of the patient. Also, the ratio of left atrium diameter/ to aorta diameter (measured by echocardiography) was found to exceed 1.4 and this finding is generally regarded as an indication for PDA closure.

Using the standard technique, device closure of PDA was performed successfully by applying Flipper coil (5x4, Cook Cardiology, Bloomington, Indiana, USA) via transpulmonary route [7]. There was no residual leakage at post procedure aortogram (Figure 1). The closure of VSD was not performed because of the child's age was unsuitable for the device closure of VSD. She was discharged with digoxin treatment. At 6th month follow-up, she was asymptomatic and had no lower respiratory infections during follow-up. Chest X-ray indicated normalization in lung vasculature and marked reduction in heart size.

The clinical evaluation of the child at her fifth age revealed that



Figure 1: The repeat selective aortography shows the complete occlusion of patent ductus arteriosus

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she had inadequate weight gain and mild cardiomegaly on her chest X-ray. Besides, the patient was receiving digoxin for heart failure. It was decided that the patient would undergo cardiac catheterization once more because her clinical/hemodynamical status was unsatisfying and Qp/Qs ratio was computed to be over 1.5 by means of echocardiography.

Repeat catheterization showed normal pulmonary artery pressure (mean: 19 mmHg) and left-to-right shunting across the VSD (Qp/Qs: 1.6) with decreased pulmonary vascular resistance index (1.8 Wood units/m²). Along with complete closure of the PDA (without any evidence of device distortion or migration), a single moderate muscular VSD was also visualized by angiography (Figure 2). In accordance with the standard technique [8], a 4-mm Amplatzer muscular VSD occluder (AGA Medical Corporation, Golden Valley, MN, USA) was deployed across the VSD through a 6-Fr sheath. Left ventriculography and TEE were used to confirm satisfactory position of the device prior to its release.

Following the release of the device, a repeat left ventricular angiography and complete TEE study were performed so that it was checked whether the device was in correct place or there was any obstruction or regurgitation induced by the device (Figure 3). The patient was instructed to take 3 mg/kg aspirin daily for six months and to avoid contact sports for one month. She was followed up monthly during the first six months and yearly thereafter with a complete clinical examination, a TTE, a chest radiograph, and an electrocardiogram.

Discussion

Until recently, the only way of treating congenital cardiovascular abnormalities has been open heart surgery which necessitates a thoracotomy, cardiopulmonary bypass, blood transfusion in some cases, and a permanent scar. The potential risks associated with open heart surgery are complete heart block, arrhythmias, post pericardiectomy

syndrome and even death. From the time of Porstmann et al. who first reported on transcatheter interventional procedures for the closure of PDAs, clinical experience has accumulated so that ASD, VSD or PDA can be treated by transcatheter interventional procedures [7-9].

As for synchronous congenital cardiovascular abnormalities, there is not much experience about the correction order for these abnormalities [3-6]. Song et al have claimed that VSD is the first defect which should be closed in patients diagnosed with multiple congenital cardiac defects because VSD has a complicated structure and, thus, dealing with VSD can increase intra-operative and post-operative morbidity [6]. As for the present case, it was decided that PDA should be closed initially because the already existing left-to-right shunt particularly depended on PDA rather than VSD so that the closure of PDA would improve the hemodynamical features of the patient. Also, the ratio of left atrium diameter/ to aorta diameter (measured by echocardiography) was found to exceed 1.4 and this finding is generally regarded as an indication for PDA closure. If the role of VSD had been more significant than that of PDA in the already existing left-to-right shunt, open surgery would have been planned for the patient. The reason was that the age of the patient was inappropriate for VSD closure via transcatheter route at the time of PDA closure.

The management of synchronous congenital cardiovascular anomalies consists of all surgical approach, all transcatheter approach and stepwise transcatheter approach. Although reliable scientific evidence related with the efficacy and safety of these approaches till lacks, the advantages and disadvantages of both cardiovascular surgery and cardiac catheterization should be considered. The advantages of catheterization include the avoidance of morbidity and even mortality related with surgery and general anesthesia as well shortening of the hospital stay and reduction of the hospital cost. Cardiac catheterization may be the only therapeutic option for some high-risk patients. Bleeding, embolism, infection and allergic reactions account for the disadvantages of catheterization. Due to the high risk of morbidity and mortality, all surgical approach is suitable for only a limited number of patients. Stepwise transcatheter approach may be considered in children for whom spontaneous closure of the intracardiac septal defects can be anticipated until the appropriate age for cardiovascular surgery is reached. Echocardiographic and hemodynamic characteristics of the patient should be assessed carefully that the role of each component in left-to-right intracardiac shunt could be specified and the most appropriate treatment could be scheduled.

In conclusion, sequential transcatheter device closure of congenital muscular VSD and associated PDA in the presence of large shunts seems to be a safe and efficient modality of treatment modality.

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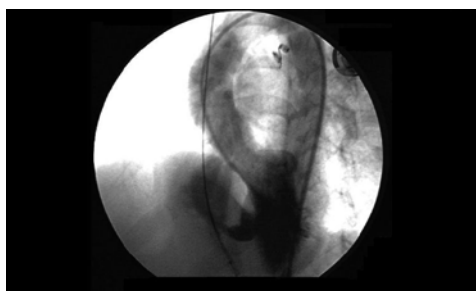


Figure 2: Left ventricle angiography demonstrates the muscular ventricular septal defect at hepatoclavicular position (40° cranial and 40° left lateral).



Figure 3: The repeat left ventricle angiography indicates the complete occlusion of ventricular septal defect by Amplatzer muscular occluder

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