

Percutaneous atrial septal defect closure in infant weighing <10 kg and having a bilateral superior vena cava: a case report

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ABSTRACT

Percutaneous closure has become a preferred treatment for secundum atrial septal defect (ASD). However, this approach remains challenging in treating small infant weighing <10 kg because of procedure-related complications. The closure of ASD in other congenital anomalies, such as a bilateral superior vena cava (SVC), should be cautiously conducted. A 15-month-old boy with a body weight of 8 kg was diagnosed with secundum ASD (9–11 mm in diameter), residual pulmonary stenosis, and bilateral SVC. Transcatheter closure of ASD was successfully performed by using a 12 mm CeraFlex occluder device (Lifetech Scientific Corporation). Post-procedural examination showed good results without any impingement to the adjacent structure. Therefore, the transcatheter closure of ASD in infant weighing <10 kg and having bilateral SVC is technically feasible and safe.

KEYWORDS atrial septal defect, cardiac catheterization, infant

Transcatheter closure has been the preferred approach rather than surgery for treating secundum atrial septal defect (ASD).¹ The transcatheter closure of ASD by using a device is an effective procedure with a minimal complication rate and a short hospital stay.^{1,2} However, this approach remains challenging for a small infant weighing <10 kg because of procedure-related complications.¹ The procedure can also be interfered with the presence of other congenital anomalies, such as bilateral superior vena cava (SVC). Unfortunately, only a few studies have reported the safety, feasibility, and efficacy of the transcatheter closure of ASD in small

children, particularly in a group with a body weight of <10 kg.^{1,4-5} This case reported our first experience of the transcatheter closure of ASD in a patient weighing <10 kg and having a bilateral SVC.

CASE REPORT

A 15-month-old boy presented with worsening dyspnea that began when he was 1-month-old. He was diagnosed with secundum ASD and severe pulmonary stenosis (PS). Balloon pulmonary valvuloplasty was performed when he was 1-month-old due to critical PS.

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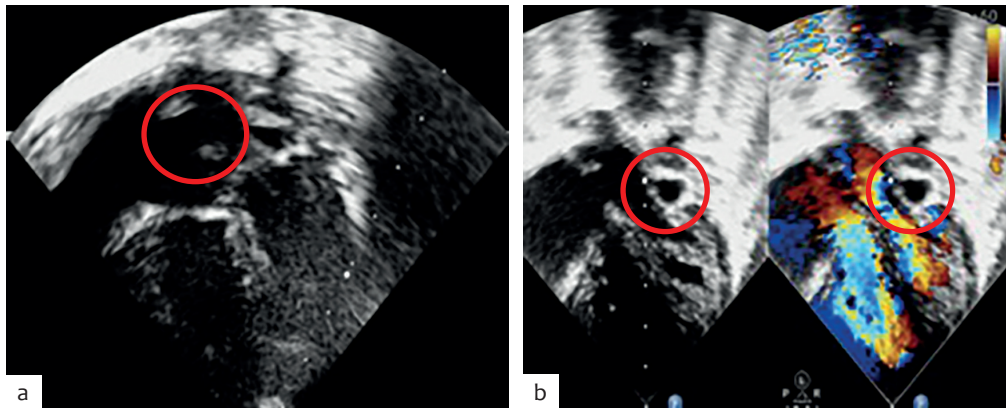


Figure 1. Pre-procedural echocardiography: (a) transthoracic echocardiography (TTE) showed a secundum atrial septal defect (ASD) with a left to right shunt (red circle); (b) visualization of a wide coronary sinus (red circle)

His body weight was 8 kg. Cardiac auscultation revealed that the first heart sound was normal, the second heart sound had a wide fixed split, and no murmur and gallop were observed. All other physical examinations were unremarkable. Transthoracic echocardiography (TTE) examination before the procedure revealed mild residual valvar PS (right ventricle-pulmonary artery gradient of 24 mmHg), secundum ASD, bilateral SVC, and mild tricuspid regurgitation (Figure 1). Cardiac catheterization followed by the transcatheter closure of ASD was scheduled.

Procedure

Right and left heart catheterization was performed under general anesthesia. The hemodynamic data showed flow ratio of 2.0, pulmonary arteriolar resistance index of 2.72 WU.m², and ratio of pulmonary vascular resistance (PVR) to systemic vascular resistance (SVR) of 0.1. Transesophageal echocardiography (TEE) was performed intra-procedural, and showed that the ASD had a diameter of 9–11 mm and favorable rims for device closure. The ASD would be closed with a 12 mm CeraFlex occluder device (Lifetech Scientific Corporation).

A 5F multipurpose (MP) catheter was inserted through the right femoral vein into the right atrium (RA) and then into the left atrium (LA) through the ASD. It was positioned in the upper left pulmonary vein (ULPV), and an 0.035-inch Amplatzer exchange guidewire was advanced to the ULPV. The 5F MP catheter and a 9F delivery sheath were pulled out. The 9F delivery sheath, along with the Amplatzer wire, was inserted into the ULPV. The CeraFlex occluder device (Lifetech Scientific Corporation, China) was subsequently

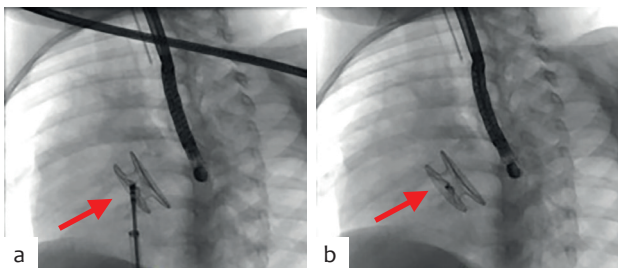


Figure 2. Atrial septal defect (ASD) occluder device; (a) pre- and (b) post-detach under fluoroscopy (red arrow)

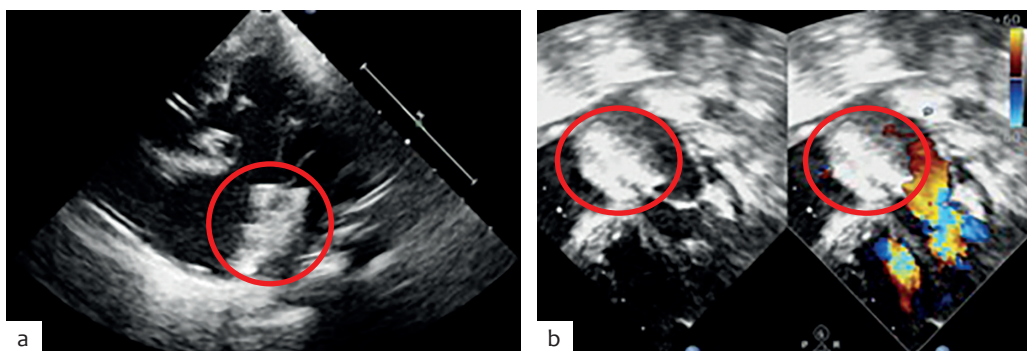


Figure 3. (a) Transthoracic echocardiography (TTE) after procedure showed that the device was stowed in place without obstruction to the adjacent structure (red circle); (b) TTE 1 week after the procedure revealed that the device was stowed in place without a residual shunt (red circle)

inserted through the 9F delivery sheath and into the ULPV. Under TEE and fluoroscopy guidance, the LA side disc of the device was inflated in the LA and pulled into the RA until the RA side disc was inflated maximally in the RA (Figure 2).

The intra-procedural TEE revealed that the device was stowed in place without residual ASD. A wiggle test was performed, and the device was detached. Post-procedural TEE and TTE showed good results without obstruction to other structures. The family had given an informed consent for a publication.

DISCUSSION

The natural history of the secundum ASD is asymptomatic in early course,¹ but severe hemodynamic compromise and symptoms usually occur when the patients reach the age of 30 years. Small infants may experience heart failure signs and symptoms, such as failure to thrive.¹ In this case report, the patient was diagnosed with mild residual valvar PS, secundum ASD, and bilateral SVC. Balloon pulmonary valvuloplasty was conducted when he was 1-month-old. However, he experienced recurrent dyspnea, recurrent respiratory tract infection, and prolonged feeding with failure to thrive. After thoroughly examining the patient, we concluded that the ASD should be closed to alleviate the symptoms. The transcatheter technique with TEE and fluoroscopy guidance was preferred as the standard and conventional procedure. Since there were several anatomical limitations to percutaneous ASD closure such as insufficient surrounding rims, multiple defects, and excessively bulging atrial septal aneurysms, TEE was needed to be performed pre- and intra-procedure to evaluate the feasibility of percutaneous ASD closure and ensure its success.^{2,3}

Although the transcatheter ASD closure in adult and older children is a well-established procedure.^{4,5} However, the transcatheter closure of ASD in small infants remains challenging. The main problems are the risk of vascular injury in small infants whose vessel sizes are smaller than the large delivery system.⁴ The maneuver of a catheter in a heart with a small dimension and a relatively small atrial septum is difficult and has an increased risk of injury to the cardiac tissue because of the manipulation of a large and stiff delivery system; therefore, this technique requires a skilled and experienced operator.²⁻⁴ The short septum in small hearts with atrial discs having a relatively excessive rim

width in devices may also increase the potential risk of device impingement to adjacent structures.^{2,4} Other cardiac anomalies, such as bilateral SVC, may interfere with the procedure. No studies have reported the transcatheter closure of ASD in cases of bilateral SVC.

Although technical problems related to the transcatheter procedure may arise, the ASD in this patient has been successfully closed with the ULPV technique.⁶ With this technique, the procedure is easily performed because the delivery system and the device can be aligned in a parallel position relative to the septum. TEE is also important for measuring the rim around the atrial septum and ensuring the alignment of the device during deployment.⁷

The symptom of prolonged feeding in the patient in this case was alleviated. However, no weight gain was observed 1 week after the procedure. Previous reports showed a significant improvement in symptoms, physical development, and cardiac hemodynamics.^{3-5,6,8} As a child grows, the implant diameter and septum length ratio decrease.^{2,3}

Besides, the small size of the device and its delivery system diameter may be further modified to increase the applicability of this procedure to infants.^{2,9} However, this result was limited to one patient and the follow-up duration was too short. Therefore, a multicenter study or a registry with adequate numbers of patients and longer follow-up are necessary to ensure its efficacy and explore potential complications. In conclusion, the transcatheter closure of ASD is potentially effective, technically feasible, and safe in infants weighing <10 kg and having secundum ASD and bilateral SVC.

Conflict of Interest

The authors affirm no conflict of interest in this study.

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