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Successful percutaneous closure of a large ventricular septal defect (VSD) in a 9-month-old Infant: A case report

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Abstract

Ventricular septal defect (VSD) is a common congenital heart defect. In large VSDs with significant left-to-right shunting, percutaneous closure can be an effective alternative to surgical repair. In some cases, percutaneous closure of septal defects is a successful treatment. Our main objective in this case report is to discuss the transcatheter closure of ventricular septal defects in a low-birth-weight infant. We are presenting the case of a 9-month-old male infant who is experiencing failure to thrive (FTT) alongside a significant ventricular septal defect (VSD). The patient successfully underwent percutaneous closure of the VSD using an antegrade approach with a symmetric device. Follow-up evaluations after the procedure confirmed that the closure was effective, the device was in the correct position, and pulmonary hypertension had resolved. As far as we know, this case represents one of the youngest and lowest-weight infants reported in Iran for successful percutaneous VSD closure instead of open surgery.

Keywords: Ventricular Septal Defect; Percutaneous Closure; Congenital Heart Disease; Infant; Pulmonary Hypertension; Case Report

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Introduction

Ventricular septal defect (VSD) is a common congenital heart defect[1]. In large VSDs with significant left-to-right shunting, percutaneous closure can be an effective alternative to surgical repair[2-4].

Case Report

Case Presentation

A 9-month-old male infant weighing 5 kg was referred to our clinic for further management of a large ventricular septal defect (VSD), presenting with failure to thrive and a systolic murmur. The VSD had been diagnosed at 2 months of age, and the patient had been treated with captopril, furosemide, and digoxin since then. Upon clinical examination, the patient exhibited tachycardia, failure to thrive, and a grade III/VI systolic murmur at the left sternal border. His general condition, vital signs, and cardiac auscultation were thoroughly evaluated. Transthoracic echocardiography confirmed the presence of a large perimembranous VSD with significant left-to-right shunting (Figure 1).

Chest X-ray showed cardiomegaly and increased pulmonary vascular markings. Electrocardiography demonstrated sinus rhythm (rate: 120 bpm) and signs of left ventricular hypertrophy (LVH). Transthoracic echocardiography revealed a large membranous-muscular VSD measuring 9 mm, enlargement of the left ventricle (LV) and left atrium (LA), pulmonary hypertension, and a dilated pulmonary artery. Hemoglobin was 11 g/dL, and other hematologic parameters were within normal range.

Procedure

The patient was admitted for cardiac catheterization and underwent percutaneous ventricular septal defect (VSD) closure using an antegrade approach. The procedure was performed under general anesthesia via a 5F femoral venous sheath. A 12 mm symmetric Amplatzer device was selected based on the 9 mm VSD size measured by echocardiography and confirmed by angiography. Fluoroscopy, performed using a Siemens Artis Q system, guided device deployment with a total fluoroscopy time of approximately 12 minutes and a radiation dose of 150 mGy, ensuring minimal exposure while confirming appropriate device placement across the defect (Figure 2). Device stability was assessed through push-pull maneuvers, and post-deployment angiography in the LAO, lateral, and RAO views confirmed proper positioning with no residual shunt.

Findings

The procedure involved deploying a 12 mm symmetric device using an antegrade approach. Angiographic findings before the closure revealed a pulmonary artery pressure (PAP) of 45 mmHg and a systemic saturation step-up of

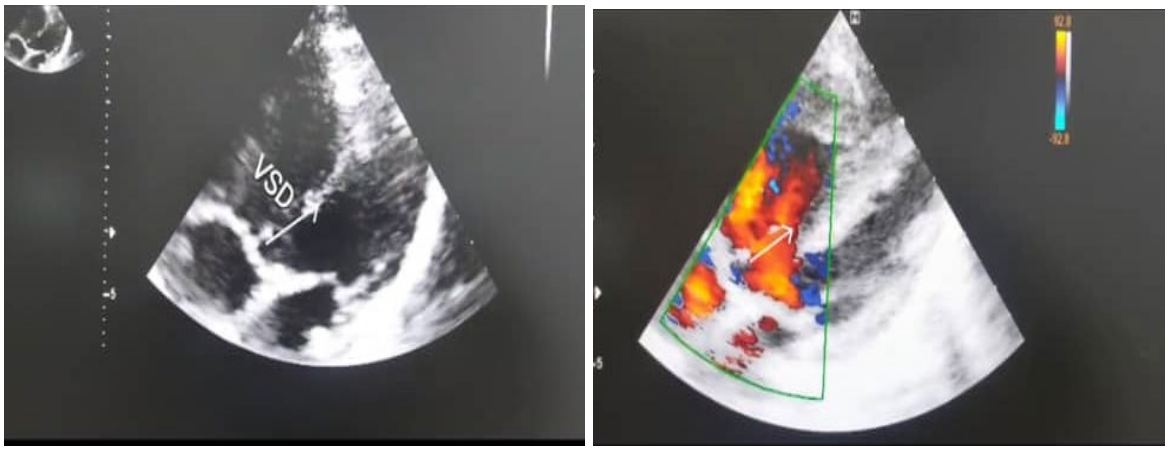


Figure 1. Echocardiographic image of VSD before closure

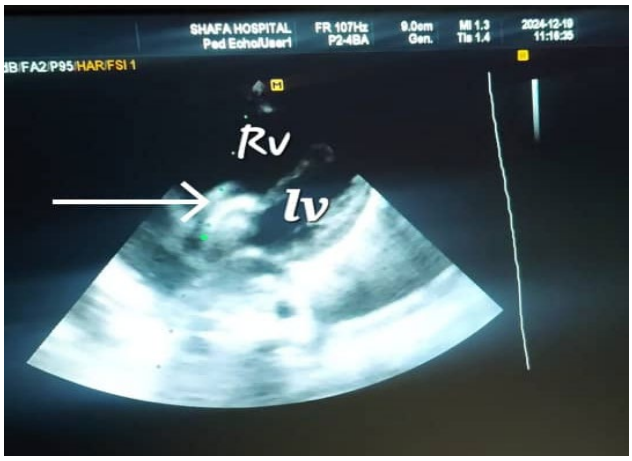


Figure 2. Echocardiographic image of VSD after closure

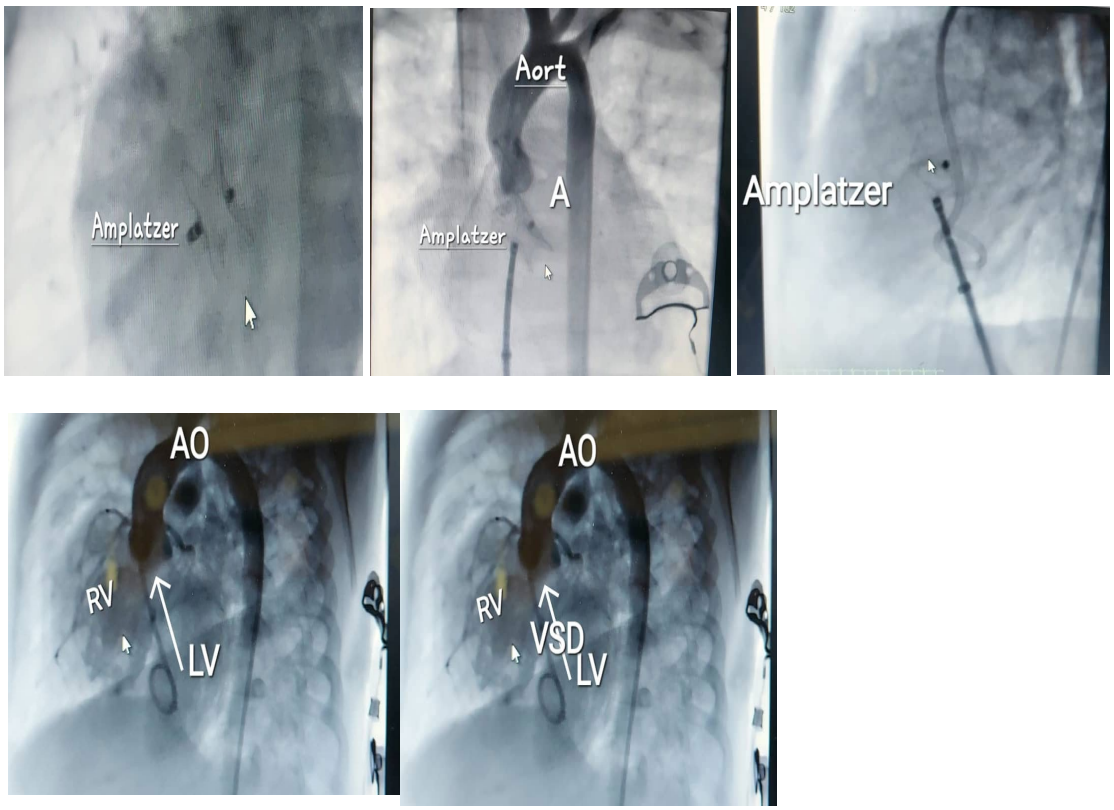


Figure 3. Percutaneous VSD closure

20%, confirming the presence of a significant ventricular septal defect (VSD). The Qp/Qs ratio, representing the ratio of pulmonary blood flow (Qp) to systemic blood flow (Qs), was elevated before closure (approximately 2:1, indicative of a significant left-to-right shunt), confirming an abnormal increase in pulmonary blood flow due to the VSD. After device deployment, stability was assessed through push-pull maneuvers, confirmed by angiography in the LAO, lateral, and RAO views. Post-deployment angiography demonstrated the proper position of the device with no residual shunt. The Qp/Qs ratio normalized following closure (approximated to 1:1), confirming balanced pulmonary and systemic blood flow restoration.

Table 1. Hemodynamic and Angiographic Findings Before and After VSD Closure

Parameter	Before Closure	After Closure
Pulmonary Artery Pressure (PAP)	Elevated (approx. 45 mmHg)	Normalized
Systemic Oxygen Saturation	Step-up of 20%	No residual shunt detected
Qp/Qs Ratio	Significantly >1 (indicative of left-to-right shunt)	Approximated to 1 (normalized flow balance)
Ventricular Septal Defect (VSD)	Large (9 mm), membranous-muscular	Completely closed with a symmetric 12 mm device
Device Stability	Not applicable	Confirmed by push-pull maneuver and angiography
Residual Shunt	Present	None detected
Tricuspid Regurgitation	Not assessed	Mild
Aortic Valve Function	No AS/AI	Unchanged (no AS/AI)
Rhythm (ECG)	Sinus rhythm (rate: 120 bpm)	Normal Sinus rhythm

Echocardiographic evaluation during the procedure confirmed proper device placement with no residual shunt. Following the procedure, echocardiography showed mild tricuspid regurgitation (TR), but the device position remained stable, and there was no evidence of aortic stenosis (AS) or aortic insufficiency (AI). Normal sinus rhythm was observed after the closure, minimizing the risk of heart block. Post-procedural echocardiography showed complete closure of the defect without residual shunt (Figure 3). The key paraclinical findings, including echocardiographic, angiographic, and hemodynamic data, are summarised in Table 1.

The patient was discharged the following day for aspirin therapy. Follow-up echocardiography at 2 weeks confirmed complete closure of the ventricular septal defect (VSD), normalization of pulmonary artery pressure, and stable device position. During the one-month follow-up, the patient's body weight increased from 5 kg to 6.5 kg, representing a significant weight gain of 1.5 kg (30% of initial body weight). This improvement in growth is particularly notable for a 9-month-old male infant with a pre-procedure diagnosis of failure to thrive (FTT). At baseline, the patient's weight (5 kg) was below the 5th percentile for age and sex based on World Health Organization (WHO) growth standards[5], indicative of severe growth impairment due to the hemodynamic burden of the VSD. The 1.5 kg weight gain within one month post-procedure surpasses the expected monthly weight gain of 0.4–0.6 kg for healthy 9-month-old boys, reflecting catch-up growth following the elimination of the left-to-right shunt. Echocardiographic examination at one month confirmed no residual shunt and normal cardiac function, further supporting the clinical success of the intervention in promoting optimal growth and development.

Discussion

This case highlights the feasibility and success of percutaneous closure of a large ventricular septal defect (VSD) in a 9-month-old infant using an antegrade approach. The patient experienced no complications, and early intervention contributed to preventing further hemodynamic deterioration and promoting optimal growth and development. Several reports have demonstrated the safety and efficacy of transcatheter closure of VSDs in infants; however, such procedures are more commonly performed in older children due to concerns about procedural complexity and size limitations in younger patients. For instance, a case series reported in Dublin demonstrated successful closures in infants as young as

7 months[6], indicating that age alone may not be a strict limitation if anatomical criteria are met.

Previous studies have demonstrated the feasibility and safety of percutaneous VSD closure even in infants and toddlers with low body weight. For instance, a study by Taşcı et al. (2023) in Turkey and a case report from India by Munde et al. (2025) described successful transcatheter closure of ventricular septal defects in infants with low body weight, demonstrating improved growth and supporting the feasibility of this intervention in younger age groups[7,8]. The 1.5 kg weight gain observed in our 9-month-old infant aligns with the improved growth reported in these studies, further confirming the efficacy of this technique in reversing failure to thrive[7,8].

To the best of our knowledge, this may be the first reported case of successful percutaneous closure of a large VSD in an infant under one year old in Iran. This case emphasizes the growing feasibility of this technique in younger age groups when managed by experienced teams. Our case reaffirms that, with careful patient selection and appropriate device choice, percutaneous closure can be a safe and effective alternative to surgery, even in infants with relatively low body weight and a large defect.

Limitations

This report is limited by the absence of long-term follow-up data beyond one month post-procedure. Additionally, the exact numeric Qp/Qs ratio was not documented, which may limit the quantitative assessment of shunt severity before and after intervention.

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Conflict of interests

The authors declare no conflict of interest.

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Author's Contributions

Study Conception or Design: RD
Data Acquisition: RD
Data Analysis or Interpretation: RD
Manuscript Drafting: FDM
Critical Manuscript Revision: FDM
All authors have approved the final manuscript and are responsible for all aspects of the work.

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