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Patent Ductus Arteriosus Closure using an Amplatzer Ventricular Septal Defect Occluder: A Case Report

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ABSTRACT

Background and Objective: The incidence of patent ductus arteriosus (PDA) has been increased significantly over the last two decades, due to an increase in the survival rate of premature infants. The aim of this case report is to present using an amplatzer ventricular septal defect (VSD) for a large PDA closure.

Case Report: The present report describes a two-year-old girl with poor weight gain, failure to thrive and recurrent infection, referred to the Rafsanjan Ali Ibn Abi Talib Hospital, which in most visits just a form of congenital heart disease was diagnosed and treated, but in fact this case had a large PDA which was not identified in the previous transthoracic echocardiography. The diameter of PDA was equal to the diameter of the aorta. It was successfully occluded using the amplatzer muscular VSD closure device.

Conclusion: Amplatzer VSD occluder device is recommended to close a large PDA, because of its wider waist.

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Introduction

The ductus arteriosus is a physiological fetal structure that connects the descending aorta to the pulmonary artery and spontaneously occluded after birth [1]. The ductus arteriosus will close in more than 95% of infants within 48-72 hours after birth, and blood flow will change to the normal postnatal circulation. In some infants, the ductus does not close or remain partially open, known as patent ducts arteriosus (PDA) [2]. The incidence of PDA has increased significantly over the last two decades, due to an increase in the survival rate of premature infants [3].

The prevalence of PDA as the most common cardiac shunt has been reported 1 case per 2500 to 1 case per 5000 live births [4]. Large PDA will lead to pulmonary overcirculation, systemic undercirculation and usual symptoms of congestive heart failure (CHF) within weeks of birth [5].

When an atrial septal defect (ASD) is present, there is left-to-right flow across the defect throughout the cardiac cycle. In diastole, the right ventricular (RV) which is more compliant fills more easily than the left ventricular (LV) which is stiffer, resulting in RV volume loading. This RV volume traverses the lungs, overloads the left atrial, and is the driving force for left-to-right shunt when the atrioventricular valves are closed [4]. The aim of this study was to present an interesting case involving a 2-year-old girl with a large PDA that was successfully occluded with an amplatzer ventricular septal defect (VSD) closure device.

Case Report

A two-year-old girl with poor weight gain, failure to thrive and recurrent infection was referred to the Rafsanjan Ali Ibn Abi Talib Hospital. In echocardiography, there was right heart enlargement, severe tricuspid regurgitation: 90 mmHg, Secundum ASD size of 10 mm in subcostal four-chamber view.

Pulmonary pressure was 100 mmHg which must be 25 mmHg at this age (figure 1). It is clear that an atrial defect alone does not cause this high pressure. The shunt was left to right at the ASD level. No obvious PDA flow and partial anomalous pulmonary vein connection (PAPVC) were identified in different transthoracic echocardiography, performed by several cardiologists. For this reason, angiography was performed for more investigation. In angiography, pulmonary pressure was 100 mmHg, and ASD was observed.

Closure of ASD was contraindicated due to the high pulmonary pressure and risk of patient's death. Thus, further investigations were performed for this patient. When injected into the aortic arch, a large PDA was observed with a diameter equal to the diameter of the aorta.

Pulmonary pressure was measured with and without oxygen. Pulmonary pressure had decreased after oxygenation, so we did not detect Eisenmenger's syndrome (ES) in the patient. The ES occurs when the increased pressure of blood flow in the lungs becomes so great that the direction of blood flow through the shunt is reversed. Oxygen-depleted (blue) blood from the right side of the heart flows into the left side of the heart and is pumped into the body so that all organs and tissues do not receive enough oxygen. The ES is a life-threatening condition that requires careful medical monitoring, such as cardiopulmonary transplantation [5].

In the current case report, for the treatment, the PDA and ASD had to be closed in the first and second places, respectively. Because it was very large and we did not have an amplatzer for this size of PDA (no company has this size), we used the amplatzer to close the VSD (Cardi-O-Fix: Starway Medical Technology Inc., Beijing, China). This size of the amplatzer was 14, length 5 and disc 20 mm.

First, we opened the aortic side disc and pulmonary side. We waited 20 minutes and performed echocardiography in the catheterization laboratory (Cath Lab). Pulmonary pressure was reduced from 100 mmHg to 40 mmHg (figure 2). Pulmonary stenosis and aortic stenosis were not seen with amplatzer VSD. The injection was repeated in the aortic arch. The amplatzer was released, and the PDA was successfully closed. The patient was discharged the next day. Closure of the ASD was postponed to the next session. At follow-

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up at 2 weeks, 6 months and 1 year, there was no evidence of left pulmonary artery stenosis and aortic coarctation. The nondiagnosis of PDA in the various TTEs performed by multiple cardiologists, the diagnosis of this defect by angiography as well as the closure with an unusual device not specific for the defect were some of the novel aspects of this case presentation.

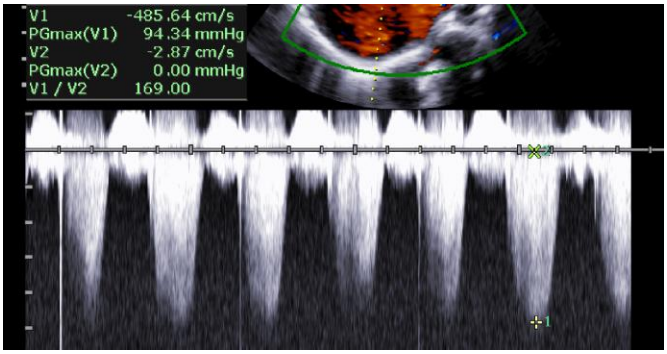

Figure 1. Before closure (Tricuspid regurgitation=90 mmHg, Pulmunary pressure=100 mmHg)

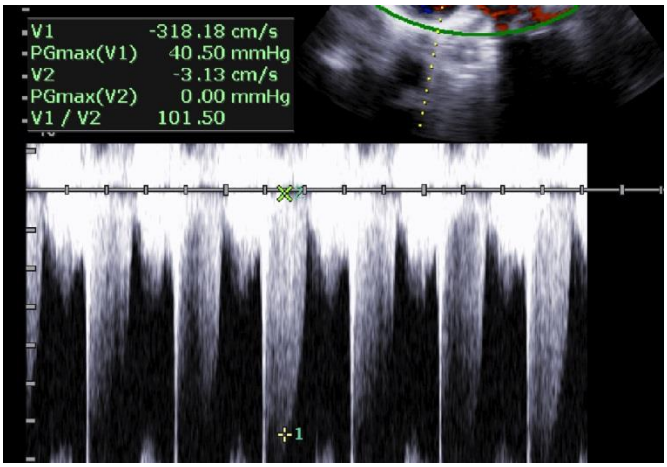

Figure 2. Post closure (Tricuspid regurgitation=40 mmHg, Pulmunary pressure=40 mmHg)

Discussion

In this case, both pathologies (ASD and PDA) were present, and because of high pulmonary pressure, despite the presence of a large PDA and a large ASD, it may not be detected on conventional TTE. We were able to successfully occlude the ASD, causing the pulmonary pressure to drop from 100 mmHg to 40 mmHg immediately after occlusion.

A percutaneous catheter technique for persistent PDA was first described by Portsmann et al. [6], who used a conical Ivalon plug in 1967, followed by Rashkind and Cuaso [7], who utilized an umbrella-type device in 1979. After clinical trials, only five devices have been approved by the Food and Drug Association: the Gianturco coil (1992), the Cook detachable coil (1994), the Gianturco-Grifka sac (1996), the Flipper detachable coil (1996) and the Amplatzer Duct Occluder (ADO) I (1996) [8].

In cases where the PDA forms an acute angle with the aorta, the disc of ADO I may protrude into the aorta and cause obstruction and hemodynamic compromise [9]. The ADO II (2009) has two retention discs at both ends to secure it to the PDA and prevent embolism. It has a flexible waist and low profile discs that adapt to the lumen and orientation of the PDA, thereby avoiding protrusion and obstruction of the aorta or pulmonary artery [10].

The amplatzer muscular VSD occluder has been approved by the Food and Drug Association for transcatheter VSD closure and has two concentric discs and a wide waist to accommodate the thicker portion of the ventricular septum. This device is more suitable to use for large PDAs, such as those observed in our patient. Consistent with this report, Fernando et al. [1] used the amplatzer muscular VSD occluder to close a PDA in a 35-year-old woman. Other studies have reported successful PDA closure with a VSD occluder [11, 12-15].

Moderate PDA may remain asymptomatic in infancy but may manifest as fatigue, dyspnea, or palpitations in childhood and adulthood. Heart failure, pulmonary hypertension and endarteritis are the most common causes of death in patients with PDA without closure [1]. Prevention of these complications was another benefit of accurate diagnosis and treatment in this case.

Conclusion

If the pulmonary pressure is high, there may be a very large PDA despite the left-to-right shunt at the level of the ASD, which was not seen on different conventional echocardiography. So, it may be advisable for pediatric cardiologists to perform 3D

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echocardiography before angiography if high pulmonary arterial pressure is present.

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Ethical approval

The study was approved by the Ethics Committee of Rafsanjan University of Medical Sciences (IR.RUMS.REC.1400.243).

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Conflict of Interests

The authors declare no conflict of interests.

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