# Spontaneous closure of patent ductus arteriosus in preterm babies after failed attempts at transcatheter device closure

**Ahmed Deniwar[1], Matthew Brown[1], Duraisamy Balaguru[2]**

[1]Division of Pediatric Cardiology, McGovern Medical School, University of Texas, Houston, Texas, USA, [2]Division of Pediatric and Congenital Cardiology, Mass General Hospital for Children, Boston, Massachusetts, USA

## ABSTRACT

**Transcatheter closure of patent ductus arteriosus (PDA) for preterm infants is increasingly performed after the Food and Drug Administration approval of the Amplatzer Piccolo Occluder device (Abbott Inc., Abbott Park, IL, USA) in the United States. We report three babies in whom transcatheter closure of PDA was unsuccessful; however, the PDA closed spontaneously in 1–5 days after the transcatheter attempt. The PDA remained closed during follow-up at 3 weeks, 10 weeks, and 17 months, respectively. Mechanical stimulation of the PDA by the wire during attempted device closure likely induced the PDA closure. Further studies are needed to evaluate whether this is a useful alternative therapy in this patient population.**

**Keywords:** Cardiac catheterization, duct occluder, low birth weight, patent arterial duct, percutaneous, preterm infants

## INTRODUCTION

Hemodynamically significant patent ductus arteriosus (PDA) in preterm babies can result in congestive heart failure, pulmonary hypertension, bronchopulmonary dysplasia, pulmonary hemorrhage, and intraventricular hemorrhage. In addition, PDA also predisposes premature babies to necrotizing enterocolitis, kidney injury, and other complications of systemic hypoperfusion.[1] The utility of therapeutic closure of hemodynamically significant PDA (either surgically or transcatheter) has been the subject of much debate in neonatal medicine.[2] Medical therapy for PDA closure, including indomethacin, ibuprofen, or acetaminophen did not demonstrate an improvement in clinical outcomes when compared to conservative management with fluid restriction, inotropic support, and positive pressure ventilation.[3,4] Furthermore, medications used to close PDA have multiple side effects, including platelet dysfunction, renal dysfunction, and failure to close PDA. In January 2019, the Amplatzer Piccolo Occluder device (Abbott Inc., Abbott Park, IL, USA) for transcatheter closure of PDA in babies weighing >700 g was approved by the United States Food and Drug Administration. Since then, there has been an increase in transcatheter closure of PDA in preterm babies.[5]

We present a series of three cases where the PDA closed spontaneously after an unsuccessful attempt at device closure and speculate that mechanical stimulation of PDA wall by the PDA closure device-induced spontaneous closure of PDA.

Access this article online

Quick Response Code:

Website: www.annalspc.com

DOI: 10.4103/apc.apc_117_21

## CASE REPORTS

### Case 1

Patient 1 was a 3-month-old girl, born at 28-week gestation. Bodyweight at the time of cardiac catheterization



**How to cite this article:** Deniwar A, Brown M, Balaguru D. Spontaneous closure of patent ductus arteriosus in preterm babies after failed attempts at transcatheter device closure. Ann Pediatr Card 2022;15:219-21.

**Address for correspondence:** Dr. Ahmed Deniwar, Division of Pediatric Cardiology, McGovern Medical School, University of Texas Health Science Center, Houston, Texas, USA. E-mail: deniwar.ahmed@gmail.com

**Submitted:** 09-Jun-2021 **Revised:** 11-Oct-2021 **Accepted:** 05-Apr-2022 **Published:** 19-Aug-2022

was 3.5 kg. She had residual tracheobronchomalacia after prior repair of tracheesophageal fistula, with clinical signs of increased pulmonary blood flow and ventilator dependence. An echocardiogram showed moderate PDA with a continuous left-to-right shunting. There was moderate left atrial and left ventricular enlargement associated with mild mitral regurgitation. Angiography (weight 3.5 kg) demonstrated a Type C tubular PDA according to previously published angiographic PDA classification.[5] The minimum diameter of PDA was 4.0 mm [Figure 1]. The Amplatzer Piccolo Occluder (5-4 size) was placed in an intraductal position in PDA. Overnight, the baby remained sedated with dexmedetomidine. On chest radiograph and echocardiogram, the following morning, the device embolization to the left pulmonary artery (LPA) was evident. Repeat catheterization was performed, and the embolized device was retrieved. The PDA appeared smaller, and the Amplatzer Duct Occluder (6/4 size) was deployed but removed before release for unsatisfactory device position. Echocardiography the following day revealed a tiny PDA. On echocardiogram, 5 days later, no PDA was noted. PDA remained closed in the echocardiogram 3 weeks later.

### Case 2

Patient 2 was a 4-week-old girl born at 30-week gestation. Weight at the time of cardiac catheterization was 1.86 kg. She was transferred from an outside hospital for transcatheter device closure of the PDA after failure of ibuprofen therapy. Echocardiography demonstrated a large PDA (Diameter 3 mm) with a left-to-right shunting, moderate left heart enlargement, and mild mitral regurgitation. An angiogram demonstrated a Type C tubular PDA with a minimum diameter of 3.5 mm. First, an Amplatzer Piccolo Occluder device (5–4 size) was deployed. As the device was too long and encroached on the aorta and LPA, the device was removed before release. A second Amplatzer Piccolo Occluder (5-2) device was attempted. On release, the device embolized to the right pulmonary artery. The device was successfully retrieved using a 10-mm goose-neck snare. The next morning, an echocardiogram showed that the PDA was significantly smaller. On repeat echocardiogram 3 days later, PDA had closed. PDA remained closed in follow-up echocardiogram after 10 weeks.

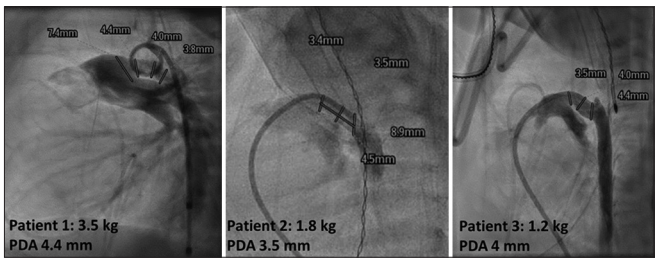


**Figure 1: Lateral view angiograms of PDA in the three patients before attempted device closure. PDA: Patent ductus arteriosus**

### Case 3

Patient 3 was 5 weeks old boy born at 28 weeks' gestation. Bodyweight at the time of cardiac catheterization was 1.26 kg. Multiple dysmorphic features led to the diagnosis of Cornelia de Lange syndrome. Echocardiography demonstrated a hemodynamically significant PDA, perimembranous ventricular septal defect partially covered by pseudoaneurysmal tissue, and mild valvar pulmonary stenosis (peak gradient 25 mmHg). Due to the presence of pulmonary congestion and the inability to wean ventilatory support, the decision was made to close the PDA using a transcatheter device. Angiography showed a Type F-hockey-stick-shaped PDA with a minimum diameter of 4 mm. An Amplatzer Piccolo Occluder (5-2) device was deployed. After echocardiographic confirmation, the device was released. On release, the device embolized into the main pulmonary artery (MPA). Attempts to retrieve the device using a goose-neck snare were complicated by a moderate pericardial effusion requiring pericardiocentesis. A sternotomy was performed for recurrence of pericardial effusion and a perforation in the right ventricular outflow tract was repaired. Echocardiogram on the following morning revealed that the PDA had closed; the embolized device was at the junction of MPA and LPA with mild LPA stenosis (peak flow velocity of 2 m/s). At 17-month follow-up, the device remains in the MPA/LPA junction. The LPA has continued to grow with trivial LPA stenosis (Doppler velocity <2 m/s), and the PDA remains closed.

## DISCUSSION

This case series of three preterm babies who had unsuccessful attempts at transcatheter device closure of PDA demonstrates that spontaneous closure of PDA can occur in the early postcatheterization with no recurrence of PDA during follow-up.

We speculate that mechanical stimulation of the wall of PDA by the device may initiate the process of spontaneous PDA closure. The factors known to induce spontaneous closure of PDA include high $pO_2$ and low circulating prostaglandins.[1] To date, there has been no mention of the role of mechanical stimulation in initiating spontaneous closure of PDA in preterm babies.

Spasm of PDA causing temporary closure from mechanical stimulation during cardiac catheterization is known to pediatric interventional cardiologists.[6] However, in these three babies, PDA did not reopen, and PDA closure was permanent without any evidence of recanalization during follow-up. In the US Amplatzer Piccolo Occluder device

clinical trial results, there was one case of spontaneous closure of PDA after a failed attempt.[5]

If mechanical stimulation is found to be effective in promoting PDA closure, watchful observation after a failed procedure closure will avoid surgical closure of PDA with its attendant morbidity and complications. After observing the PDA become smaller on the day after the failed procedures in patients one and two and complete closure in patient three overnight, our institutional strategy is to observe such babies for 24–48 h before proceeding to surgical closure.

Further studies, including animal models, are needed before determining if mechanical stimulation of PDA is an alternative therapeutic option, particularly the type of mechanical stimulation, reliability of such mechanical stimulation in inducing spontaneous PDA closure across different gestational ages.

## CONCLUSION

Spontaneous PDA closure can occur following unsuccessful attempts at transcatheter device closure of PDA. Mechanical stimulation of the PDA wall from transcatheter device manipulation is a possible mechanism.

**Financial support and sponsorship**

Nil.

**Conflicts of interest**

There are no conflicts of interest.

## REFERENCES

1. Hamrick SE, Sallmon H, Rose AT, Porras D, Shelton EL, Reese J, *et al.* Patent ductus arteriosus of the preterm infant. Pediatrics 2020;146:e20201209.
2. Sathanandam S, Justino H, Waller BR 3rd, Radtke W, Qureshi AM. Initial clinical experience with the Medtronic Micro Vascular Plug™ in transcatheter occlusion of PDAs in extremely premature infants. Catheter Cardiovasc Interv 2017;89:1051-8.
3. Mitra S, Florez ID, Tamayo ME, Mbuagbaw L, Vanniyasingam T, Veroniki AA, *et al.* Association of placebo, indomethacin, ibuprofen, and acetaminophen with closure of hemodynamically significant patent ductus arteriosus in preterm infants: A systematic review and meta-analysis. JAMA 2018;319:1221-38.
4. Clyman RI, Liebowitz M. Treatment and nontreatment of the patent ductus arteriosus: Identifying their roles in neonatal morbidity. J Pediatr 2017;189:13-7.
5. Sathanandam SK, Gutfinger D, O'Brien L, Forbes TJ, Gillespie MJ, Berman DP, *et al.* Amplatzer Piccolo Occluder clinical trial for percutaneous closure of the patent ductus arteriosus in patients≥700 grams. Catheter Cardiovasc Interv 2020;96:1266-76.
6. Batlivala SP, Glatz AC, Gillespie MJ, Dori Y, Rome JJ. Ductal spasm during performance of transcatheter ductal occlusion. Catheter Cardiovasc Interv 2014;83:762-7.