Cardiology in the Young

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Patent ductus arteriosus rupture during percutaneous device closure: a case report

Hyun Ho Kim[1,2] and Jihye You[1,2]

[1]Department of Pediatrics, Jeonbuk National University Children's Hospital, Jeonju, Korea and [2]Research Institute of Clinical Medicine of Jeonbuk National University, Jeonju, Korea

Brief Report

Cite this article: Kim HH and You J (2025) Patent ductus arteriosus rupture during percutaneous device closure: a case report. *Cardiology in the Young* **35**: 1040–1042. doi: 10.1017/S1047951125001313

Received: 11 November 2023
Revised: 3 January 2025
Accepted: 5 February 2025
First published online: 17 March 2025

Keywords:
Patent ductus arteriosus; intervention; complication; infants

Corresponding author:
Jihye You; Email: shilanep@gmail.com

Abstract

Patent ductus arteriosus is a common condition in preterm neonates, often necessitating medical or surgical intervention. This report presents a case of a preterm neonate born at 27 gestational weeks and who experienced patent ductus arteriosus rupture during a device closure procedure. Patent ductus arteriosus rupturing during device closure is rare and life threatening but can be successfully managed with prompt recognition and intervention.

Introduction

Patent ductus arteriosus is an essential vascular conduit during fetal development, typically undergoing spontaneous closure following birth.[1] However, the trajectory of this closure can exhibit considerable variation depending upon the infant's gestational age.[2,3] Compared with full-term infants, premature infants often manifest a protracted delay in achieving spontaneous and permanent patent ductus arteriosus closure.[2,3]

Patent ductus arteriosus-related clinical complications are intricate. The primary indications for patent ductus arteriosus closure arise from the pronounced symptoms engendered by a significant left-to-right shunting through the patent ductus arteriosus.[3,4] Therapeutic intervention targeting shunt elimination can markedly attenuate pulmonary blood flow and pulmonary arterial pressures, thereby alleviating potential ensuing complications.[5,6]

Despite technological advancements in patent ductus arteriosus devices tailored for preterm infants, numerous complications continue to be reported.[7] Among these complications, patent ductus arteriosus rupture, although rare, is life-threatening, demanding immediate attention. This report details a case of a preterm neonate who underwent a patent ductus arteriosus closure procedure following the surgical management of necrotising enterocolitis and the medical management of pulmonary hypertension. Notably, patent ductus arteriosus ruptured during the procedure. This outcome is a rare and complex complication that significantly complicates management, especially considering the delicate condition of preterm neonates.

Case description

A male neonate was born prematurely at 27 weeks and 1 day of gestation following an emergency caesarean section because of premature uterine contractions and preterm premature rupture of membranes. The neonate's birth weight was 810 g (below the 10th percentile), while his length was 51 cm (25th–50th percentiles).

On hospital day 18, the infant underwent loop ileostomy for necrotising enterocolitis. Concurrently, an echocardiogram indicated the presence of a patent ductus arteriosus with a bidirectional shunt and pulmonary hypertension. Thus, the patient was administered with sildenafil, which eventually improved pulmonary hypertension. Despite the patient's stabilised condition, a surgical intervention for ileostomy take-down was deemed necessary before discharge. Given our concerns about the potential exacerbation of pulmonary hypertension after ileostomy, we opted for a patent ductus arteriosus device closure on hospital day 88, when the patient's weight was 2460 g. The patent ductus arteriosus, as shown in Figure 1A and B, measured approximately 5.39 mm at the aortic end (A) and 2.22 mm at the pulmonary end (B), displaying a tubular and elongated shape consistent with Krichenko Type E morphology. This type of anatomy presents a relatively uniform diameter throughout the ductus, making it suitable for device closure. However, complications occurred after the insertion of a 5F delivery system using 032 stiff wire and deployment of the the Amplatzer Duct Occluder (Abbott Medical Devices, Abbott Park, IL) (5 × 4 mm) (Figure 2A). These complications included a sudden drop in heart rate, prompting the device's detachment. An echocardiogram revealed pericardial effusion. After pericardiocentesis was initiated, draining approximately 25 mL of bloody effusion (Figure 2B). Notably, active bleeding ceased after device placement. After the procedure, chest X-ray taken upon transferring the patient to the neonatal ICU revealed signs of pulmonary haemorrhage (Figure 2C). After considering sheath stiffness, brief lower-extremity

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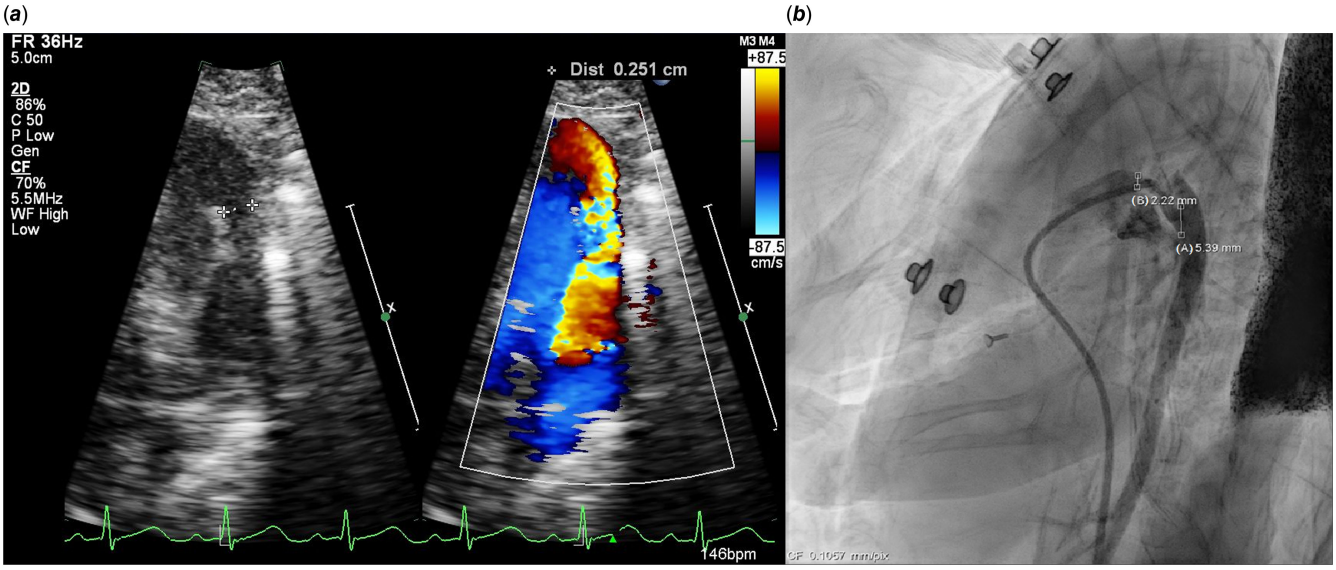


Figure 1. Echocardiographic and angiographic findings of the patent ductus arteriosus. (***a***) Echocardiographic color Doppler image demonstrating a patent ductus arteriosus (PDA) with bidirectional flow. (***b***) Angiographic image depicting PDA measurements before device closure, showing dimensions of 5.39 mm at the aortic end and 2.22 mm at the pulmonary.



Figure 2. Fluoroscopic and chest X-ray images after PDA device closure. (***a***) Fluoroscopic image demonstrating the deployment of the patent ductus arteriosus (PDA) closure device (indicated by an arrow). (***b***) Angiographic image following device placement, showing its final positioning. (***c***) Chest X-ray taken post-procedure, revealing signs of pulmonary hemorrhage (black arrow), suggestive of complications related to PDA closure.

saturation disturbances after sheath insertion, lung and pericardial bleeding, and active bleeding cessation post-patent ductus arteriosus device placement, we surmised the occurrence of a patent ductus arteriosus rupture.

In the following days, the patient's vital signs remained stable. On hospital day 129, the patient was discharged and has been progressing well. He demonstrated catch-up growth and development without the need for pulmonary hypertension medication.

Discussion

The incidence of a patent ductus arteriosus rupture during its closure, as seen in this case, is notably rare and seldom documented, emphasising the unique nature of this complication and underscoring the importance of careful management in complex cardiac conditions among preterm neonates. We hypothesise that the rupture occurred due to the acute angle from the MPA to the patent ductus arteriosus, which may have caused the dilator of the Amplatzer delivery system to scrape the vessel wall during insertion. Additionally, no further haemorrhage occurred after the patent ductus arteriosus device was deployed, and the pulmonary haemorrhage observed immediately after device implantation suggests that the bleeding likely originated from the patent ductus arteriosus. This explanation highlights the need for caution when navigating complex anatomy in preterm neonates.

Traditionally, patent ductus arteriosus ligation or division was the mainstay of treatment in neonates and infants.[8] However, device-based interventions have been increasingly applied, with emerging global reports highlighting their efficacy.[9]

The ductus arteriosus in extremely-low-birth-weight infants tends to be uniquely more elongated and winding than that in older infants,[10] potentially compromising the efficacy of these devices in the extremely-low-birth-weight population. Preterm neonates

https://doi.org/10.1017/S1047951125001313 Published online by Cambridge University Press

have structurally immature and fragile cardiovascular tissues, making them susceptible to injury during medical interventions. The combination of this inherent fragility with the haemodynamic changes induced by device placement might contribute to the risk of rupture. In this case, the Amplatzer Duct Occluder device was selected due to its availability at the time, despite its known limitations in preterm neonates. We acknowledge that the Amplatzer Duct Occluder device is not Food and Drug Administration approved for infants weighing less than 3 kg, and its off-label use in this case highlights the associated risks. The choice was influenced by the patent ductus arteriosus's anatomy and the need to minimise complications, such as left pulmonary artery stenosis. However, we recognise that a Piccolo device, which is Food and Drug Administration approved for infants weighing as little as 700 g, would have been more appropriate given its design and flexibility.[9] Supply issues precluded its use at the time of the procedure. This case underscores the importance of selecting devices specifically designed for small infants to reduce procedural risks. It also highlights the need for vigilant monitoring and rapid intervention to address complications, as demonstrated in this case.

The sudden drop in heart rate and the subsequent discovery of pericardial effusion and pulmonary haemorrhage were critical in diagnosing the patent ductus arteriosus rupture. This case underscores the necessity for vigilant monitoring during and after cardiac interventions in neonates. Timely echocardiographic assessments and other imaging modalities played a pivotal role in diagnosing and managing the rupture. Interestingly, the cessation of bleeding following device placement suggests that the closure itself may have helped seal the rupture, although this remains a speculative observation requiring further study.

This case highlights the importance of selecting the most appropriate patent ductus arteriosus closure device. The occurrence of rupture during the procedure emphasises the need for meticulous consideration when choosing a device, particularly in preterm neonates. Factors such as the infant's size, ductal anatomy, and the material and design of the device must all be weighed carefully to minimise the risk of complications while ensuring effective closure.

Acknowledgements. The English language quality of this manuscript was enhanced with the assistance of OpenAI's ChatGPT.

Author contributions. Conceptualisation: You JH. Data curation: Kim HH. Formal analysis: You JH. Funding acquisition: Kim HH, You JH. Investigation: You JH. Validation: Kim HH. Visualisation: Kim HH. Writing - original draft: Kim HH, You JH. Writing—review and editing: Kim HH, You JH

Financial support. This research was supported by the Bio&Medical Technology Development Program of the National Research Foundation, funded by the Korean government (MSIT) (No. RS-2023-00236157).

Jihye You was supported the Fund of the Biomedical Research Institute, Jeonbuk National University Hospital. The content is solely the responsibility of the authors and does not necessarily represent the official views of the Agency for Healthcare Research and Quality. The other author has no potential conflicts of interest to disclose.

Competing interests. The authors declare no conflicts of interest in preparing this article.

Ethical standards. The Institutional Review Board of Jeonbuk National University Hospital approved this study. (IRB No. 2023-09-049) The informed consent was waived.

References

1. Hamrick SEG, Sallmon H, Rose AT, et al. Patent ductus arteriosus of the preterm infant. Pediatrics 2020; 146: e20201209.
2. Gillam-Krakauer M, Reese J. Diagnosis and management of patent ductus arteriosus. Neoreviews 2018; 19: e394–e402.
3. Koch J, Hensley G, Roy L, Brown S, Ramaciotti C, Rosenfeld CR. Prevalence of spontaneous closure of the ductus arteriosus in neonates at a birth weight of 1000 grams or less. Pediatrics 2006; 117: 1113–1121.
4. Rios DR, Bhattacharya S, Levy PT, McNamara PJ. Circulatory insufficiency and hypotension related to the ductus arteriosus in neonates. Front Pediatr 2018; 6: 62.
5. Braulio R, Gelape CL, Araújo FD, et al. Indicators of surgical treatment of patent ductus arteriosus in preterm neonates in the first week of life. Rev Bras Cir Cardiovasc 2013; 28: 504–508.
6. Schneider DJ, Moore JW. Patent ductus arteriosus. Circulation 2006; 114: 1873–1882.
7. Sathanandam S, Gutfinger D, Morray B, et al. Consensus guidelines for the prevention and management of periprocedural complications of transcatheter patent ductus arteriosus closure with the amplatzer piccolo occluder in extremely low birth weight infants. Pediatr Cardiol 2021; 42: 1258–1274.
8. Bixler GM, Powers GC, Clark RH, Walker MW, Tolia VN. Changes in the diagnosis and management of patent ductus arteriosus from 2006 to 2015 in united states neonatal intensive care units. J Pediatr 2017; 189: 105–112.
9. Sathanandam SK, Gutfinger D, O'Brien L, et al. Amplatzer piccolo occluder clinical trial for percutaneous closure of the patent ductus arteriosus in patients ≥ 700g. Catheter Cardiovasc Interv 2020; 96: 1266–1276.
10. Philip R, Waller BR, Agrawal V, et al. Morphologic characterization of the patent ductus arteriosus in the premature infant and the choice of transcatheter occlusion device. Catheter Cardiovasc Interv 2016; 87: 310–317.

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