

# Pulmonary Hypertension in Patent Ductus Arteriosus: Correlation with Ductal Size - A Single Center Experience

A. N. M. Tanvir Chowdhury<sup>1</sup>  
Md. Kashid Omar<sup>2</sup>  
Ayasha Sultana<sup>1</sup>  
Shanjeeda Shormin<sup>1</sup>  
Mir Mosharof Hossain<sup>3\*</sup>  
Md. Gaosul Azam<sup>1</sup>  
Shaharia Sharmin<sup>4</sup>  
Rebeka Akhter Rupa<sup>5</sup>

<sup>1</sup>Department of Paediatrics  
Rangpur Medical College Hospital  
Rangpur, Bangladesh.

<sup>2</sup>Department of Cardiology  
Rangpur Medical College Hospital  
Rangpur, Bangladesh.

<sup>3</sup>Department of Paediatrics  
Chittagong Medical College  
Chattogram, Bangladesh.

<sup>4</sup>Tejgao Thana Health Complex  
Tejgao, Dhaka, Bangladesh.

<sup>5</sup>OSD, DGHS  
Dhaka, Bangladesh.

\*Correspondence to:

**Dr. Mir Mosharof Hossain**  
Medical Officer  
Department of Paediatrics  
Chittagong Medical College  
Chattogram, Bangladesh.  
Mobile : +88 01795 91 20 10  
Email : dr.mosharofctg@gmail.com

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## Abstract

**Background:** Patent Ductus Arteriosus (PDA) remains one of the most common congenital heart defects, particularly affecting neonates and preterm infants. The persistence of a ductal connection beyond the neonatal period can lead to significant clinical consequences, particularly Pulmonary Hypertension (PH) which complicates the hemodynamic profile of the affected patient. This study was conducted to elucidate the correlation between the size of the PDA and the severity of pulmonary hypertension in pediatric patients. A total of 260 children diagnosed with PDA were evaluated in a single tertiary care center using echocardiographic techniques. The majority of the cohort exhibited signs of PH, particularly in cases where the ductus was classified as moderate to large. Our analysis revealed a strong correlation between the size of the PDA and the degree of PH as measured by pulmonary artery pressures. These findings underscore the importance of early identification and management of hemodynamically significant PDA to prevent irreversible vascular changes and complications. To evaluate the relationship between PDA size and the severity of PH using echocardiographic parameters.

**Materials and methods:** A cross-sectional study involving 260 children diagnosed with PDA. Patients were categorized by ductal size, and their pulmonary artery pressures were analyzed.

**Results:** PH was observed in 85% of patients, especially those with moderate and large PDAs. A strong correlation between ductal size and PH was found.

**Conclusion:** PDA size significantly influences pulmonary artery pressure. Early detection and closure of hemodynamically significant PDA is crucial to prevent vascular remodeling.

**Key words:** Echocardiography; Patent ductus arteriosus; Pediatric cardiology; Pulmonary hypertension.

## INTRODUCTION

Patent Ductus Arteriosus (PDA) is a condition where the ductus arteriosus fails to close after birth. This persistent vascular connection between the descending aorta and the pulmonary artery is normal in fetal circulation, allowing blood to bypass the non-functioning fetal lungs. In healthy full-term neonates, functional closure usually occurs within the first 48 hours after birth, followed by anatomical closure within a few weeks. Failure of this process leads to a persistent PDA. PDA is more common in premature infants due to the immaturity of the ductal smooth muscle and lower sensitivity to oxygen-induced constriction. When a PDA remains patent beyond the neonatal period, it can lead to a significant left-to-right shunt, increased pulmonary blood flow and eventual development of Pulmonary Hypertension (PH).

PH is characterized by elevated pulmonary artery pressures and can result in structural changes within the pulmonary vasculature, such as medial hypertrophy and intimal proliferation. The severity of these changes is often directly proportional to the size of the PDA and the volume of left-to-right shunting. Larger ductal diameters correlate with increased pulmonary blood flow and pressure, contributing to the early onset of symptoms, failure to thrive, recurrent respiratory infections and in severe cases, congestive heart failure.

The early identification and accurate assessment of PDA and its hemodynamic implications are vital. Echocardiography serves as the cornerstone for diagnosis, offering detailed information regarding ductal size, shunt direction and pressure gradients. This study focuses on understanding how the size of the ductus arteriosus influences the severity of PH in a pediatric cohort, providing insight into optimal management strategies.

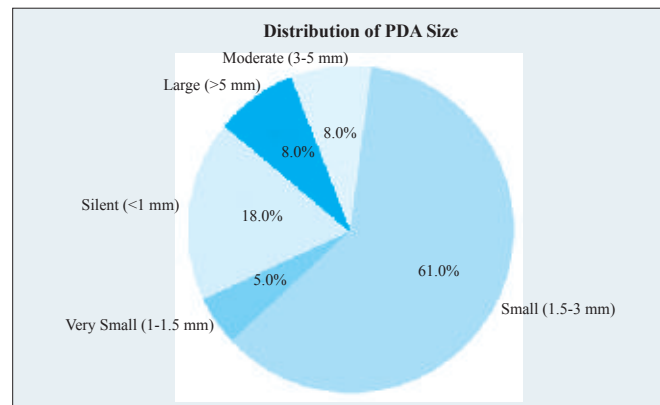
The ductus arteriosus is a fetal vascular connection that usually closes within 48 hours after birth in term infants.<sup>1</sup> Failure to close results in persistent PDA, which can cause increased pulmonary blood flow and lead to pulmonary hypertension (PH).<sup>2,3</sup> The extent of hemodynamic impact is largely determined by the size of the ductus and shunt volume.<sup>4</sup> Moderate to large PDAs pose a higher risk of PH, chamber dilatation, and eventually heart failure.<sup>5,6</sup> This study evaluates the association between PDA size and PH severity in a pediatric population using echocardiography.

**MATERIALS AND METHODS**

This cross-sectional observational study was carried out at the Department of Pediatrics and the Department of Cardiology at Rangpur Medical College Hospital over a two-year period from January 2023 to December 2024. A total of 260 pediatric patients diagnosed with PDA through echocardiographic assessment were enrolled. Inclusion criteria encompassed children under 14 years of age with a confirmed diagnosis of PDA. Patients above 14 years, those with complex congenital heart anomalies or those who did not consent to participate were excluded.

Each participant underwent a thorough echocardiographic examination using standardized parasternal short-axis and high ductal views. PDA was measured and categorized according to size: silent (<1 mm) very small (1–1.5 mm) small (1.5–3 mm) moderate (3–5 mm) and large (>5 mm). Pulmonary hypertension was assessed based on the measurement of tricuspid regurgitation velocity, with Pulmonary Artery Pressure (PAP) estimated accordingly. PH was classified as normal (<30 mmHg) mild (30–49 mmHg) moderate (50–69 mmHg) and severe (≥70 mmHg).

Demographic details, clinical presentations and echocardiographic parameters were documented systematically. Data were analyzed using SPSS version 22. Continuous variables were represented as mean ± standard deviation, while categorical variables were reported as frequencies and percentages.



**Figure 1** Distribution of PDA Size

Statistical analysis was performed using SPSS version 22. Continuous variables were expressed as mean ± SD and categorical data as frequency and percentage.

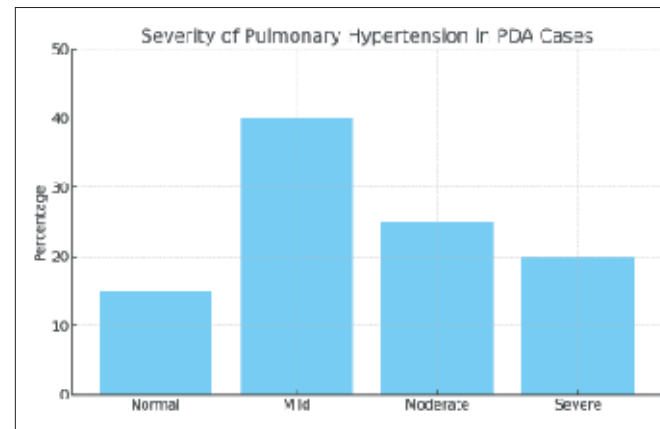
**RESULTS**

Among 260 cases, 63% were preterm. The majority had small PDAs (61%), followed by silent (18%) moderate (8%) large (8%) and very small (5%).

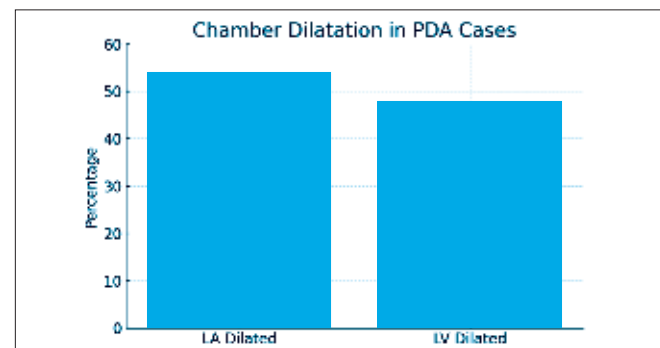
Pulmonary hypertension was present in 85%:

- Mild: 40%
- Moderate: 25%
- Severe: 20%

LA and LV enlargement were observed in 54% and 48% respectively.



**Figure 2** Severity of Pulmonary Hypertension in PDA Cases



**Figure 3** Left Heart Chamber Dilatation in PDA Patients

**DISCUSSION**

The study found a clear association between PDA size and PH severity. Most patients with moderate to large PDA had moderate to severe PH. Smaller PDAs were generally associated with normal or mildly elevated PAP, although a few showed signs of overload.<sup>8,9</sup> This is in line with studies by Chinawa et al. and Philip et al. which emphasized the role of ductal size in PH progression.<sup>10,11</sup>

Preterm infants were disproportionately affected due to delayed closure of the ductus and immature vasculature.<sup>12,13</sup> Echocardiographic surveillance plays a critical role in timely identification and intervention.

**LIMITATION**

Single center study with small sample size.

**CONCLUSION**

PDA size is a strong predictor of pulmonary hypertension severity in pediatric patients. Moderate to large ductus significantly increase pulmonary artery pressures. Regular follow-up and timely closure are essential to prevent irreversible pulmonary vascular changes.

**RECOMMENDATION**

Special attention towards proper assessment of PH should be given while dealing with each and every case of PDA.

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**DISCLOSURE**

All the authors declared no competing interest.

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