

Newborn Critical Care Center (NCCC) Clinical Guidelines

Management of the Patent Ductus Arteriosus (PDA) in Preterm Infants

INTRODUCTION

Despite extensive research with thousands of infants over several decades, uncertainty and controversy have persisted regarding the significance, assessment, and management of the PDA in preterm infants, resulting in substantial variability in clinical approach.

More recently, metaanalyses and a randomized controlled trial have shown no benefit and an increase in mortality with active pharmacologic treatment versus expectant management. In light of these findings, active pharmacologic treatment should not be routinely considered.

BACKGROUND

The PDA closes between 48-96 hours in nearly all term infants. There is a delay in closure for preterm infants with an inverse relationship between gestational age and spontaneous closure. Spontaneous closure is very likely in infants >28 weeks gestation and with birthweight >1000 grams and although more significantly delayed, up to 90% of infants born at less than 26 weeks' gestation have been found to have spontaneous closure occurring at a median of 36 weeks' postmenstrual age.

What is meant by the term hemodynamically significant PDA?

While the ductus remains open, blood typically flows left-to-right from the aorta into the pulmonary arteries. As pulmonary vascular resistance declines in the initial days after birth, there is an augmented diversion of aortic blood flow into the pulmonary circulation, known as "ductal steal." This phenomenon results in additional blood flow through the lungs, predisposing to the development of pulmonary congestion, pulmonary edema, and exacerbated respiratory failure. The diversion of blood flow from the systemic circulation may surpass compensatory increases in total cardiac output, resulting in compromised perfusion of vital organs such as the bowel, kidney, and brain.

Why, historically, the push to close the PDA early in a premature infant's clinical course?

Prolonged patency has been **associated with** multiple morbidities of prematurity. However, the extent to which these adverse outcomes are attributable to the hemodynamic consequences of ductal patency vs conditions resulting from extreme prematurity has not been defined. These associations previously prompted the hypothesis that intervention to close the ductus might prevent or reduce the severity of these complications seen more commonly in prematurity. Without clear evidence that adverse outcomes can be averted by medical, surgical, or transcatheter closure of the ductus, the hypothesis that ductal patency is causal remains unproven. It is likely that the presence of a PDA is a marker for more extreme immaturity and a biomarker for worse outcomes.

WHAT IS KNOWN

Prophylactic intervention (not guided by knowledge of PDA status) is associated with a lower risk of a symptomatic PDA and with less severe IVH, but with no effects on mortality or BPD.

All available prostaglandin inhibitor drugs are very effective in symptomatic PDA closure compared with no therapy. However, early (by 72 hours) or very early (by 7 days) treatment of a hemodynamically significant (hs) PDA vs expectant management increases the exposure to NSAIDs and does not reduce BPD, severe IVH, NEC, or surgical ligation (Mitra et al., Cochrane Database Syst Rev. 2020). Of particular concern, treatment of a hsPDA without cardiopulmonary compromise between 2 and 21 days vs expectant management increases the risk of mortality (Laughon et al., JAMA 2025).

Although surgical (ligation) closure is effective in achieving rapid and complete ductal closure, it may sometimes be followed by severe hemodynamic and respiratory collapse. Complications of surgical closure include pneumothorax, wound infection, paresis of the left vocal cord or diaphragm, chylothorax, and risk of scoliosis. Infants who undergo surgical ligation have been found to be more likely to develop BPD, ROP, and neurodevelopmental impairment.

Advances in the percutaneous device closure of the PDA have led to its widespread adoption among institutions with pediatric interventional cardiology teams. Although the procedure has risks (i.e. device embolization requiring retrieval and acute arterial occlusion), safety and efficacy have improved. What is yet to be clearly determined is whether closing the PDA by transcatheter approaches improves short-term clinical outcomes (initial hospital mortality, BPD, NEC, ROP, etc) or longer-term outcomes (neurodevelopmental impairment). The on-going PIVOTAL trial will directly address the question of whether infants with a large PDA and severe clinical symptoms would benefit from cath closure versus continued expectant management (without using medications designed to close the PDA).

DEFINING HEMODYNAMICALLY SIGNIFICANT PDA

An accurate and precise definition of a hsPDA remains elusive. The hemodynamic effects of a large left-to-right shunt associated with a PDA may be evaluated by using a combination of findings obtained via physical examination and echocardiography. Below is a suggested method for determination of an hsPDA that may be appropriate for most preterm infants:

Hemodynamically Significant PDA (hsPDA) by Clinical and Echocardiographic Parameters	
Clinical criteria (should fulfill 2 of 4 criteria)	1. High CPAP/NIMV with high FiO ₂ or moderate or high ventilator settings at any FiO ₂
	2. Hypotension needing a vasopressor
	3. Persistent oliguria or renal dysfunction
	4. Abdominal distension, feeding intolerance, poor growth despite optimization of nutrition, or history of NEC
AND	
Echocardiographic criteria (should fulfill at least one criterion)	1. Minimum PDA diameter >1.5 mm
	2. Unrestrictive left to right transductal flow (PDA Vmax <2 m/s)
	3. Left sided volume overload (>= moderate LA or LV enlargement)
	4. Decreased, absent, or reversed end diastolic flow in abdominal descending aorta
CPAP indicates continuous positive airway pressure; FiO ₂ fraction of inspired oxygen; LA, left articular; LV, left ventricular; NIMV, noninvasive mechanical ventilation; Vmax, maximum velocity	

Table adapted from Ambalavanan, et. al, 2025

RECOMMENDATIONS

1. Prophylactic medical interventions (those not guided by knowledge of PDA status) to induce PDA closure are not recommended at any age or birth weight for the purpose of reducing the risk of a symptomatic PDA, as there are no effects on mortality, BPD, or neurodevelopmental impairment.
2. Conservative (i.e., expectant) management of the PDA in preterm infants in the first few weeks after birth is recommended. Expectant management may let infants avoid medical therapy or procedural exposure, allowing spontaneous delayed closure without risk of increased adverse outcomes.
 - a. Routine treatment (pharmacologic, via transcatheter or surgically) to induce PDA closure (regardless of hemodynamic significance) in preterm infants in the first two weeks after birth is not recommended as it does not improve outcomes.
 - b. Pharmacologic treatment to induce closure of a hsPDA in preterm infants in the first three weeks is not recommended as it increases mortality.
3. There are insufficient data to determine optimal management for infants with a hsPDA beyond 3 weeks of age. Until results of the PIVOTAL trial are available, continued conservative management is recommended.

REFERENCES

1. Laughon MM, Thomas SM, Watterberg KL, et al. Expectant Management vs Medication for Patent Ductus Arteriosus in Preterm Infants: The PDA Randomized Clinical Trial. *JAMA*. Published online December 09, 2025. doi:10.1001/jama.2025.23330
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3. Namasivayam Ambalavanan, Susan W. Aucott, Arash Salavitar, Victor Y. Levy, Committee on Fetus and Newborn, Section on Cardiology and Cardiac Surgery; Patent Ductus Arteriosus in Preterm Infants. *Pediatrics* April 2025; 155 (5): e2025071425. 10.1542/peds.2025-071425