

# Transcatheter Closure of the Patent Ductus Arteriosus Compared to Surgical Ligation: Comparison of Respiratory Outcomes in the Extremely Preterm Infant

NICHD  
NEONATAL RESEARCH NETWORK



Valerie Y. Chock<sup>1</sup>, Shazia Bhombal<sup>1</sup>, Alexis S. Davis<sup>1</sup>, Meera N. Sankar<sup>1</sup>, Barbara T. Do<sup>2</sup>, Matthew M. Laughon<sup>3</sup>,  
Krisa P. Van Meurs<sup>1</sup>, Carl H. Backes<sup>4</sup>, Patrick J. McNamara<sup>5</sup> for the NICHD Neonatal Research Network

<sup>1</sup>Division of Neonatal and Developmental Medicine, Stanford University School of Medicine; <sup>2</sup>RTI International, Rockville, MD; <sup>3</sup>Department of Pediatrics, University of North Carolina at Chapel Hill; <sup>4</sup>The Heart Center, Nationwide Children's Hospital; <sup>5</sup>Department of Pediatrics, University of Iowa

## INTRODUCTION

Cardiac transcatheter closure of the patent ductus arteriosus (PDA) in preterm infants is an increasingly common treatment option. Characterization of the preterm population undergoing transcatheter PDA closure and assessment of respiratory outcomes are critical to understanding the effects of secular approaches to PDA management and design of future trials.

## OBJECTIVE

To determine if preterm infants <29 weeks' gestation or with birth weight <1000 g with a PDA treated with transcatheter closure compared to surgical ligation had improved respiratory outcomes

## METHODS

**Study population:** NICHD Neonatal Research Network (NRN) Generic Database from 1/1/2016 until 12/31/2020

**Study design:** Retrospective comparative evaluation of infants with a diagnosis of PDA managed with transcatheter closure compared to surgical ligation

### Outcomes:

- **Primary outcome** – total days of mechanical ventilation
- **Additional respiratory outcomes** – bronchopulmonary dysplasia (BPD), days on positive pressure, need for home oxygen, diuretics at discharge

**Statistical analysis:** Linear and logistic regression analyses adjusted for center, birth year, gestational age, and age at PDA intervention

## RESULTS

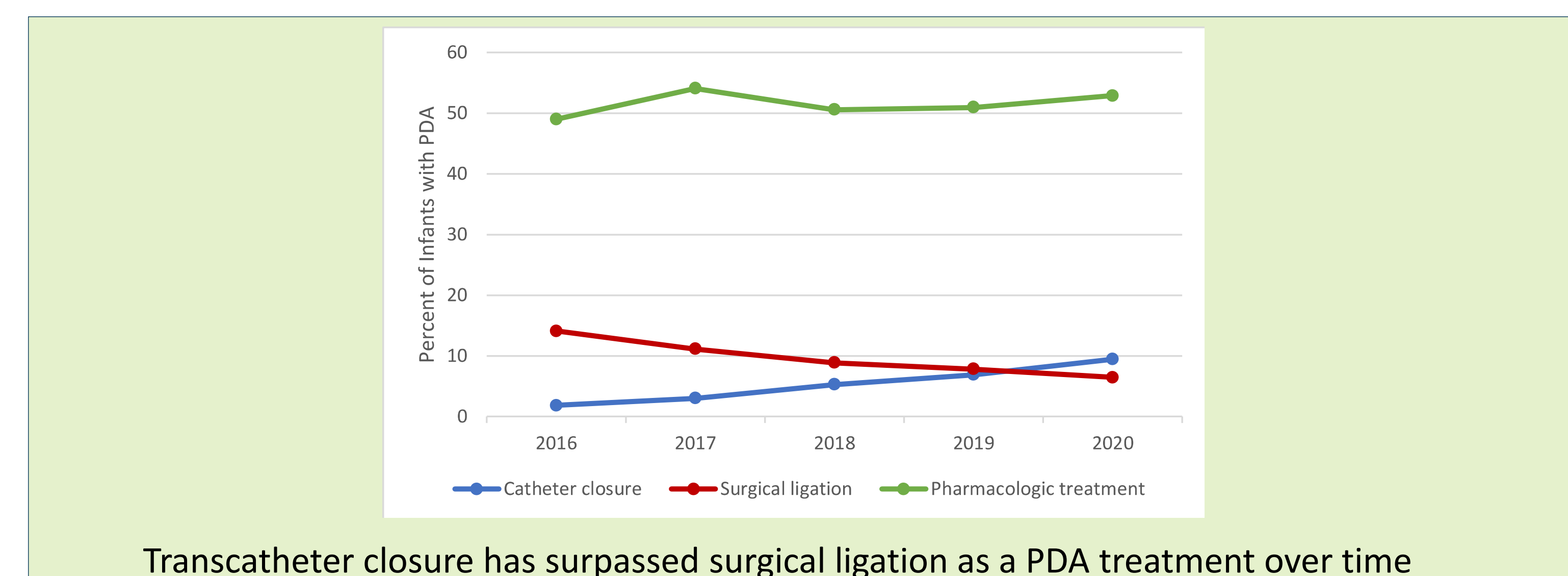
**Table 1. Neonatal and Patent Ductus Arteriosus Treatment Characteristics**

Characteristics	Catheter closure (n=202)	Surgical ligation (n=362)	p-value
Gestational age (weeks), median (IQR)	25.4 (24.1, 27.1)	24.9 (24.0, 25.9)	<0.01
Birth weight (g), median (IQR)	740 (610, 880)	685 (585, 810)	<0.01
Male	88 (44)	173 (48)	0.33
Age at intervention (days) <sup>a</sup>	59 (28)	34 (17)	<0.01
Postmenstrual age at intervention (weeks) <sup>a</sup>	34 (5)	30 (3)	<0.01
<b>Previous pharmacologic therapies to treat PDA</b>			
Indomethacin	59 (29)	145 (40)	<0.01
Ibuprofen	62 (31)	128 (35)	0.26
Acetaminophen	46 (23)	119 (33)	0.01
At least one pharmacologic treatment	139 (69)	288 (80)	<0.01
More than one pharmacologic treatment	35 (17)	150 (41)	<0.01
Prophylactic indomethacin <sup>b</sup>	15 (7)	94 (26)	<0.01
<b>Other morbidities</b>			
Necrotizing enterocolitis (NEC)	32 (16)	33 (9)	0.02
Surgical NEC	14 (7)	16 (4)	0.21
NEC before PDA closure <sup>c</sup>	27 (87)	12 (41)	<0.01
Spontaneous gastrointestinal perforation	12 (6)	33 (9)	0.18
Severe IVH (grade 3 or 4)	48 (24)	70 (19)	0.22
Culture positive sepsis	54 (27)	125 (35)	0.06
<b>Pulmonary characteristics</b>			
Pneumothorax	10 (5)	40 (11)	0.01
Pulmonary interstitial emphysema	33 (16)	77 (21)	0.16
Pulmonary hemorrhage	16 (8)	39 (11)	0.27
Use of inhaled nitric oxide	43 (21)	59 (16)	0.14
Received surfactant	189 (94)	344 (95)	0.46
Steroid use for BPD <sup>c</sup>	89 (44)	172 (49)	0.28

Data are mean (SD) or n (%). <sup>a</sup>n=199 for catheter closure group and 324 for ligation group; <sup>b</sup>n=201 for catheter closure group and 360 for ligation group; <sup>c</sup>n (%) out of 32 with NEC in catheter closure group and 31 with NEC in ligation group; <sup>d</sup>n=201 for catheter closure group and 351 for ligation group.

Compared to surgical ligation, infants with transcatheter PDA closure demonstrated no difference in respiratory outcomes including total days of mechanical ventilation, positive pressure support, BPD, home oxygen use, or diuretics at discharge.

**Figure 1. PDA Treatment in the Neonatal Research Network 2016-2020**



Transcatheter closure has surpassed surgical ligation as a PDA treatment over time

**Table 2. Respiratory Outcomes for Transcatheter PDA Closure as Compared to Surgical Ligation**

Continuous Outcomes in Survivors	Adjusted Mean (95% CI)		Adjusted p-value	
	Catheter Closure (n=202)	Surgical Ligation (n=362)		
Days on mechanical ventilation	50 (45-55)	50 (47-54)	0.91	
Days on positive pressure support	81 (77-86)	84 (81-87)	0.41	
Days in hospital	148 (136-159)	159 (151-168)	0.13	
Categorical outcomes	Catheter Closure	Surgical Ligation	Adjusted Odds Ratio (95% CI)	Adjusted p-value
Bronchopulmonary dysplasia (BPD)*				
Supplemental oxygen at 36 weeks	165 (82)	290 (83)	1.16 (0.58, 2.33)	0.67
BPD grade 1, 2, or 3	187 (93)	321 (92)	0.71 (0.24, 2.07)	0.53
BPD grade 2 or 3	150 (75)	221 (64)	1.02 (0.57, 1.84)	0.94
Death prior to discharge	6 (3)	22 (6)	0.42 (0.12, 1.47)	0.18
Death prior to discharge or supplemental oxygen at 36 weeks	166 (82)	301 (83)	1.10 (0.55, 2.20)	0.79
Death prior to discharge or BPD grade 1, 2, or 3	188 (93)	332 (92)	0.66 (0.22, 1.93)	0.44
Home oxygen at discharge	99 (55)	188 (61)	0.68 (0.38, 1.24)	0.21
Diuretics at discharge	50 (28)	120 (39)	0.90 (0.49, 1.65)	0.73

The adjusted mean or odds ratio (95% CI) and associated p-value for each outcome between catheter closure and surgical ligation groups were obtained from linear or logistic regression models adjusted for center, birth year, gestational age, and age at PDA treatment. \*BPD is defined by supplemental oxygen use or by Jensen criteria grading system of respiratory support at 36 weeks' postmenstrual age.

## DISCUSSION

- In a multicenter neonatal database, respiratory outcomes did not differ for infants treated with PDA transcatheter closure compared to surgical ligation. However, innate differences between groups exist.
- The confounding effects of lower rate of medical treatment, higher rate of pre-intervention NEC, and older age at definitive PDA closure by the transcatheter route requires prospective evaluation.
- Study limitations include absence of a standardized definition of PDA hemodynamic significance and lack of comprehensive respiratory data reflecting days of mechanical ventilation after treatment.

## CONCLUSIONS

Transcatheter PDA closure was not associated with improved respiratory outcomes for extremely preterm infants with a PDA when compared to surgical ligation. The effect of earlier intervention and shorter duration of PDA exposure on respiratory outcomes remains a knowledge gap.

**Disclosures:** The authors have no financial relationships to disclose or conflicts of interest to resolve. Any real or apparent conflicts of interest related to the content of this poster have been resolved.

**Acknowledgements:** The National Institutes of Health and the Eunice Kennedy Shriver National Institute of Child Health and Human Development provided grant support for the Neonatal Research Network. We are indebted to the infants and their parents who agreed to take part in this study and to our medical and nursing colleagues at: Brown University; Case Western Reserve University; Cincinnati Children's Hospital Medical Center; Duke University; Emory University; Nationwide Children's Hospital/Ohio State University; RTI International; Stanford University; University of Alabama at Birmingham; University of Iowa; University of New Mexico; University of Pennsylvania; University of Rochester; University of Texas Southwestern Medical Center; University of Texas Health Science Center at Houston; University of Utah.

