

Understanding the Risks and Benefits of Delivery Room CPAP for Term Infants

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Neonatal resuscitation is dependent on the successful transition from in utero circulation and placental respiration to reliance on pulmonary circulation. This focus on ventilation has been a hallmark of the Neonatal Resuscitation Program (NRP) since its inception >30 years ago.¹ Continuous positive airway pressure (CPAP) was incorporated as a consideration into the algorithm of the NRP in the sixth edition of the program.² In this month's issue of *Pediatrics*, Smithhart et al³ evaluated >200 000 births from a single center and found an increase in pneumothorax in the late preterm and term population that received CPAP in the delivery room (DR) after the implementation of those guidelines. The risk of pneumothorax in this population was particularly increased in those infants receiving CPAP with 21% oxygen.³ This study raises the question of the safety of CPAP in the term and late preterm populations.

Newborn transitional physiology is key to understanding why the results in the Smithhart et al³ study might be anticipated. Establishment of functional residual capacity (FRC) of the lungs is a critical step in normal transition of respiration and physiologic stability. However, finding the ideal FRC between atelectasis and overdistention is challenging in the transitioning, fluid-filled newborn lung.^{4,5} CPAP functions to increase intra-alveolar pressure and assist with establishing FRC and ventilation-perfusion matching in spontaneously breathing infants.⁶

CPAP has been found to be particularly useful in preterm infants with surfactant deficiency and a resultant decreased compliance. CPAP for preterm infants in the DR has been the focus of several large randomized trials, which has helped guide the resuscitation practices for these infants.⁷⁻⁹ CPAP use in term infants has not been studied with the same rigor.¹⁰ Important differences between the physiology of term and preterm infants include higher surfactant load at delivery, lower surface tension, and higher compliance.¹¹

Not only is the compliance unpredictable in the term lung, the distribution of the fluid through the lung is not homogenous during initial respirations. The timing of fluid movement from alveoli to interstitium is not consistent across the lung tissue. The lung therefore has varying compliance across airspaces during resuscitation in the DR. We currently have no way to monitor and adjust support according to dynamic compliance. A provider's impatience with the normal progress of transition, allowing for a newborn's retractions, "slow" saturation improvement, and temporary tachypnea, may move us to provide CPAP early to achieve "normal" respiratory effort faster. With increased compliance and an uneven distribution of alveolar fluid, the term lung is at particular risk of acute injury when CPAP is applied. The arbitrary application of 5 cm H₂O pressure may move some term infants, particularly

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Opinions expressed in these commentaries are those of the authors and not necessarily those of the American Academy of Pediatrics or its Committees.

DOI: <https://doi.org/10.1542/peds.2019-1720>

Accepted for publication May 24, 2019

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PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

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FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

COMPANION PAPER: A companion to this article can be found online at www.pediatrics.org/cgi/doi/10.1542/peds.2019-0756.

To cite: Claassen CC and Strand ML. Understanding the Risks and Benefits of Delivery Room CPAP for Term Infants. *Pediatrics*. 2019;144(3):e20191720

those without a supplemental oxygen requirement, into the overdistended end of the compliance curve. Alternatively, those infants requiring CPAP with supplemental oxygen may have decreased lung compliance at resuscitation. Those infants may benefit from CPAP, although this current study underscores the need for vigilance when providing pressure to the transitioning lung.

This was not the first study in which an association between CPAP in the DR and air leaks in term and late preterm infants was found.^{12,13} This study does, however, have the strength of a large number of infants, a cohort with extensive data for >9000 subjects, and a 4-part statistical adjustment to minimize the bias inherent in all retrospective studies. The results of this study further implore the neonatal community to investigate the role of CPAP in term infant resuscitation.

It was >10 years ago when Alan Jobe implored us to “don’t just do something, stand there!” in the DR with premature infants, advocating for a trial of CPAP over routine intubation.¹⁴ His message that resuscitation is sometimes used when, in fact, support of transition adaptation is called for may apply to the term population as well. In newborn resuscitation, CPAP is a support strategy that, per the NRP, may be helpful for a newborn who “is breathing spontaneously and has a heart rate at least 100 bpm, but has labored respirations or low oxygen saturation.”¹⁵ It is important to differentiate between a newborn who needs resuscitation and one who is slowly but successfully making his or her way along the road of newborn transition. This insight comes with years of experience and patience to

let nature progress at its own pace. Newborn care providers need to understand the underlying physiology of transition to appropriately assess the newborn’s progress in moving toward effective respiration and helping the newborn establish ideal FRC.

ABBREVIATIONS

CPAP: continuous positive airway pressure
 DR: delivery room
 FRC: functional residual capacity
 NRP: Neonatal Resuscitation Program

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Pediatrics 2019;144;

DOI: 10.1542/peds.2019-1720 originally published online August 9, 2019;

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The online version of this article, along with updated information and services, is located on the World Wide Web at:

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