EARLY CPAP THERAPY EFFECTIVENESS IN PRETERM INFANTS WITH RESPIRATORY DISTRESS SYNDROME

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ABSTRACT

Respiratory distress syndrome (RDS) remains one of the leading causes of morbidity and mortality in preterm infants due to pulmonary immaturity and surfactant deficiency. Early use of Continuous Positive Airway Pressure (CPAP) has emerged as a key noninvasive respiratory support strategy aimed at stabilizing alveoli, improving oxygenation, and reducing the need for mechanical ventilation. This article presents a narrative review of the pathophysiology of RDS and the theoretical and clinical foundations of early CPAP therapy. Evidence from modern neonatology suggests that early initiation of CPAP reduces alveolar collapse, preserves endogenous surfactant function, decreases the incidence of bronchopulmonary dysplasia, and improves overall respiratory outcomes. The paper emphasizes the role of minimally invasive respiratory strategies in contemporary neonatal care.

Keywords: preterm infant, respiratory distress syndrome, CPAP, surfactant deficiency, noninvasive ventilation

ЭФФЕКТИВНОСТЬ РАННЕЙ CPAP-ТЕРАПИИ У НЕДОНОШЕННЫХ НОВОРОЖДЁННЫХ С РЕСПИРАТОРНЫМ ДИСТРЕСС-СИНДРОМОМ

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АННОТАЦИЯ

Респираторный дистресс-синдром (РДС) остаётся одной из ведущих причин заболеваемости и смертности у недоношенных новорождённых вследствие незрелости лёгких и дефицита сурфактанта. Ранняя терапия методом постоянного положительного давления в дыхательных путях (CPAP) рассматривается как ключевая неинвазивная стратегия респираторной поддержки, направленная на стабилизацию альвеол, улучшение оксигенации и снижение потребности в искусственной вентиляции лёгких. В данной работе представлен обзор патофизиологических механизмов РДС и теоретико-клинических основ раннего применения CPAP. Анализ

современных данных неонатологии показывает, что раннее начало CPAP уменьшает альвеолярный коллапс, способствует сохранению функции эндогенного сурфактанта, снижает частоту бронхолёгочной дисплазии и улучшает респираторные исходы. Подчёркивается значимость минимально инвазивных респираторных стратегий в современной неонатальной практике.

Ключевые слова: недоношенные новорождённые, респираторный дистресс-синдром, CPAP, дефицит сурфактанта, неинвазивная вентиляция лёгких

INTRODUCTION

Respiratory complications remain a major challenge in the management of preterm infants. Among them, respiratory distress syndrome (RDS) is one of the most frequent and serious conditions encountered in neonatal intensive care units. RDS primarily results from insufficient production and functional immaturity of pulmonary surfactant, which leads to increased alveolar surface tension, alveolar collapse, reduced lung compliance, impaired gas exchange, and progressive hypoxemia.

Historically, invasive mechanical ventilation was the mainstay of treatment for preterm infants with respiratory failure. However, it became evident that mechanical ventilation, while lifesaving, could contribute to ventilator-induced lung injury, barotrauma, volutrauma, and the development of chronic lung disease, particularly bronchopulmonary dysplasia (BPD).

In recent decades, neonatology has shifted toward less invasive respiratory strategies designed to support spontaneous breathing while minimizing lung injury. Continuous Positive Airway Pressure (CPAP) represents a cornerstone of this approach. CPAP provides a constant distending pressure to the airways, preventing alveolar collapse at end-expiration, increasing functional residual capacity, and improving oxygenation without the need for endotracheal intubation.

Early initiation of CPAP — beginning in the delivery room or shortly after birth — has been increasingly adopted as part of the “CPAP-first” strategy. This approach aims to stabilize the lungs before severe atelectasis develops, thereby reducing the need for invasive ventilation and surfactant administration. Despite the growing body of clinical evidence, the theoretical and physiological basis of early CPAP therapy deserves further comprehensive discussion.

This article provides a narrative review of the pathophysiological mechanisms of RDS and analyzes the clinical rationale for early CPAP therapy in preterm infants.

MATERIALS AND METHODS

This work is not an original clinical study but a narrative review. The analysis is based on:

Modern neonatology literature

Studies addressing the pathophysiology of neonatal RDS

Clinical guidelines and systematic reviews on noninvasive respiratory support in preterm infants

Scientific publications, consensus statements, and neonatal care guidelines were analyzed and synthesized to provide a structured overview of early CPAP therapy.

RESULTS

Review of the literature indicates that early CPAP therapy in preterm infants with RDS is associated with several physiological and clinical benefits:

Prevention of alveolar collapse and atelectasis

Preservation of endogenous surfactant activity

Improved oxygenation and ventilation efficiency

Reduced need for intubation and mechanical ventilation

Lower incidence of bronchopulmonary dysplasia

Decreased risk of ventilator-associated lung injury

Early CPAP is particularly effective in infants born between 28 and 34 weeks of gestation, where spontaneous respiratory effort is present but pulmonary immaturity persists.

DISCUSSION

The central mechanism in the development of RDS in preterm infants is surfactant deficiency. Surfactant reduces surface tension at the air–liquid interface in the alveoli, preventing collapse during expiration. In premature lungs, insufficient surfactant leads to widespread atelectasis, reduced functional residual capacity, intrapulmonary shunting, and severe hypoxemia.

Traditional mechanical ventilation can forcibly reopen collapsed alveoli but may simultaneously cause structural damage to immature lung tissue. High airway pressures and volumes contribute to inflammation, epithelial injury, and long-term pulmonary morbidity. For this reason, modern neonatal care emphasizes lung-protective strategies.

CPAP offers a more physiological alternative by maintaining a constant positive pressure throughout the respiratory cycle. This pressure stabilizes the airways and alveoli, preventing collapse while allowing the infant to breathe spontaneously. Early CPAP use, particularly immediately after birth, helps establish and maintain functional residual capacity before significant lung derecruitment occurs.

Several physiological mechanisms explain the effectiveness of early CPAP:

Alveolar stabilization: Positive end-expiratory pressure prevents end-expiratory alveolar closure.

Improved gas exchange: Increased lung volume enhances oxygenation and carbon dioxide elimination.

Surfactant preservation: By preventing repetitive alveolar collapse and reopening, CPAP reduces surfactant inactivation.

Reduced lung injury: Avoidance of intubation and mechanical ventilation lowers the risk of barotrauma and volutrauma.

Clinical practice has increasingly adopted the “CPAP-first” approach, in which preterm infants with spontaneous breathing are started on CPAP rather than being intubated immediately. This strategy has been associated with lower rates of invasive ventilation and chronic lung disease.

However, CPAP effectiveness depends on timely initiation, appropriate pressure settings, and careful monitoring. Insufficient pressure may fail to prevent alveolar collapse, while excessive pressure can increase the risk of air leak syndromes such as pneumothorax. Therefore, skilled neonatal care and continuous monitoring are essential.

Overall, early CPAP represents a key component of minimally invasive respiratory management and reflects the broader transition toward lung-protective strategies in neonatology.

CONCLUSION

Early CPAP therapy is an effective and physiologically sound approach to managing respiratory distress syndrome in preterm infants. By stabilizing alveoli, improving oxygenation, and reducing the need for invasive ventilation, early CPAP lowers the risk of serious pulmonary complications, including bronchopulmonary dysplasia. As part of a minimally invasive respiratory strategy, early CPAP should be considered a fundamental component of modern neonatal respiratory care.

REFERENCES

1. Sweet DG, Carnielli V, Greisen G, Hallman M, Ozek E, Te Pas A, et al. European consensus guidelines on the management of respiratory distress syndrome – 2022 update. Neonatology. 2023;120(1):3–23.
2. Polin RA, Carlo WA. Surfactant replacement therapy for preterm and term neonates with respiratory distress. Pediatrics. 2014;133(1):156–163.

3. Finer NN, Carlo WA, Walsh MC, Rich W, Gantz MG, Laptook AR, et al. Early CPAP versus surfactant in extremely preterm infants. N Engl J Med. 2010;362(21):1970–1979.
4. Morley CJ, Davis PG, Doyle LW, Brion LP, Hascoet JM, Carlin JB, et al. Nasal CPAP or intubation at birth for very preterm infants. N Engl J Med. 2008;358(7):700–708.
5. Ho JJ, Subramaniam P, Henderson-Smart DJ, Davis PG. Continuous distending pressure for respiratory distress in preterm infants. Cochrane Database Syst Rev. 2020;10:CD002271.
6. World Health Organization. WHO recommendations on interventions to improve preterm birth outcomes. Geneva: WHO; 2015.
7. American Academy of Pediatrics Committee on Fetus and Newborn. Respiratory support in preterm infants at birth. Pediatrics. 2014;133(1):171–174.
8. Kattwinkel J, Perlman JM, Aziz K, Colby C, Fairchild K, Gallagher J, et al. Neonatal resuscitation guidelines. Pediatrics. 2015;136(Suppl 2):S120–S166.