

Non-invasive ventilation in neonates: Indications, benefits and challenges

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Abstract

Non-invasive ventilation (NIV) has become a cornerstone in the management of neonatal respiratory distress, particularly in preterm infants. It offers effective respiratory support while avoiding the complications associated with invasive mechanical ventilation. This narrative review aims to summarize current evidence regarding the indications, benefits, and challenges of NIV in neonates. Various modalities, including continuous positive airway pressure (CPAP), bilevel positive airway pressure (BiPAP), and high-flow nasal cannula (HFNC), are widely used in neonatal intensive care units. NIV has been shown to reduce the need for intubation, decrease the incidence of bronchopulmonary dysplasia, and improve overall outcomes. However, challenges such as optimal timing, patient selection, and interface-related complications remain. Understanding these aspects is essential for optimizing neonatal respiratory care, especially in low-resource settings. Further research is needed to standardize protocols and improve long-term outcomes.

Keywords: Neonates; Non-invasive ventilation; CPAP; Respiratory distress; Preterm infants; HFNC

1. Introduction

Respiratory distress is one of the most common reasons for admission to neonatal intensive care units, particularly among preterm infants. Traditionally, invasive mechanical ventilation was widely used to manage respiratory failure in neonates. However, it is associated with significant complications, including ventilator-induced lung injury and bronchopulmonary dysplasia [1].

In recent years, non-invasive ventilation (NIV) has emerged as a preferred strategy for providing respiratory support while minimizing lung injury. NIV refers to the delivery of ventilatory support without the need for endotracheal intubation. Common modalities include continuous positive airway pressure (CPAP), bilevel positive airway pressure (BiPAP), and high-flow nasal cannula (HFNC) [2].

The increasing use of NIV has significantly changed neonatal respiratory care practices worldwide. It is now widely recommended as first-line therapy in many cases of neonatal respiratory distress. Several studies have demonstrated that early use of CPAP reduces the need for intubation and mechanical ventilation [3].

Despite its benefits, several challenges remain regarding its optimal use, particularly in resource-limited settings. This review aims to provide an overview of the indications, benefits, and challenges associated with non-invasive ventilation in neonates.

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2. Methods

This narrative review was conducted using a literature search in electronic databases including PubMed and Google Scholar. Articles published in English between 2005 and December 2024 were considered.

The search included keywords such as “neonatal respiratory distress,” “non-invasive ventilation,” “CPAP,” “HFNC,” and “preterm infants.” Relevant studies, including clinical trials, observational studies, and international guidelines, were reviewed.

Articles were selected based on their relevance to the indications, benefits, and challenges of non-invasive ventilation in neonates.

2.1. Indications of Non-Invasive Ventilation

Non-invasive ventilation is widely used in neonatal care for several clinical conditions.

The main indications include:

- Respiratory distress syndrome (RDS), particularly in preterm infants [1–3]
- Apnea of prematurity [4]
- Post-extubation respiratory support [5]
- Transient tachypnea of the newborn (TTN)
- Mild to moderate respiratory distress

Continuous positive airway pressure (CPAP) is considered the first-line non-invasive ventilation modality in preterm infants with respiratory distress syndrome [1–3]. High-flow nasal cannula (HFNC) is increasingly used as an alternative due to its ease of use and better tolerance [6].

2.2. Benefits of Non-Invasive Ventilation

Non-invasive ventilation offers several important advantages in neonatal respiratory care.

It has been shown to significantly reduce the need for endotracheal intubation and invasive mechanical ventilation [7,8]. By avoiding intubation, NIV helps decrease the risk of ventilator-induced lung injury and reduces the incidence of bronchopulmonary dysplasia [9].

In addition, non-invasive ventilation preserves natural airway defenses and reduces the need for sedation, which is particularly beneficial in preterm infants. Early use of continuous positive airway pressure (CPAP) has been associated with improved respiratory outcomes and, in some cases, reduced mortality [8].

Furthermore, modalities such as high-flow nasal cannula (HFNC) are easier to apply, better tolerated, and associated with improved patient comfort [6].

3. Challenges and Limitations

Despite its advantages, non-invasive ventilation (NIV) presents several challenges and limitations in neonatal care.

One of the main complications is nasal trauma, including skin breakdown and septal injury, which may occur due to prolonged use of nasal interfaces [10]. Air leak syndromes, such as pneumothorax, may also occur, particularly in cases of inappropriate pressure settings [11].

Gastric distension is another commonly reported issue, which can interfere with diaphragmatic movement and respiratory efficiency. In addition, treatment failure remains a significant concern, especially in extremely preterm infants, requiring escalation to invasive mechanical ventilation [7].

Another limitation is the lack of standardized protocols regarding initiation, monitoring, and weaning of non-invasive ventilation. This variability may lead to inconsistent clinical outcomes.

In low-resource settings, additional challenges include limited availability of equipment, lack of trained healthcare personnel, and difficulties in continuous monitoring, which may negatively impact the effectiveness of NIV.

4. Discussion

Non-invasive ventilation has significantly transformed neonatal respiratory care over the past decades. Its ability to provide effective respiratory support while minimizing lung injury has made it a preferred strategy in many neonatal intensive care units worldwide.

Continuous positive airway pressure (CPAP) remains the most widely used modality, particularly for the management of respiratory distress syndrome in preterm infants. Strong evidence supports its early use in reducing the need for intubation and invasive mechanical ventilation [8]. In addition, CPAP has been associated with a lower incidence of bronchopulmonary dysplasia and improved clinical outcomes.

High-flow nasal cannula (HFNC) has emerged as an alternative to CPAP due to its ease of application and better tolerance. However, studies comparing HFNC and CPAP have shown variable results, and CPAP remains the standard of care in many clinical situations [6]. The choice between different NIV modalities often depends on clinical experience, available resources, and patient characteristics.

The success of non-invasive ventilation depends on several key factors, including early initiation, appropriate patient selection, and careful monitoring. Early application of NIV in the delivery room has been shown to improve respiratory outcomes in preterm infants. Conversely, delayed initiation or inappropriate settings may increase the risk of treatment failure.

Despite its benefits, non-invasive ventilation is not without risks. Complications such as nasal trauma, gastric distension, and air leak syndromes must be carefully monitored. In addition, some neonates, particularly extremely preterm infants, may fail NIV and require escalation to invasive ventilation.

Another important limitation is the lack of standardized protocols regarding initiation, monitoring, and weaning of non-invasive ventilation. This variability may lead to inconsistent practices and outcomes between different neonatal units.

In resource-limited settings, the use of non-invasive ventilation presents additional challenges. Limited availability of equipment, lack of trained personnel, and inadequate monitoring systems may reduce its effectiveness. However, simple interventions such as staff training and protocol implementation can significantly improve outcomes.

Overall, non-invasive ventilation represents a major advancement in neonatal care, but its optimal use requires careful clinical judgment and adaptation to local resources.

5. Conclusion

Non-invasive ventilation has become a cornerstone in the management of neonatal respiratory distress. It provides effective respiratory support while reducing the need for invasive mechanical ventilation and its associated complications.

Continuous positive airway pressure remains the first-line modality in most clinical situations, while high-flow nasal cannula is increasingly used as an alternative in selected cases. Despite its clear benefits, non-invasive ventilation presents several challenges, including the risk of complications and the lack of standardized protocols.

Optimizing the use of non-invasive ventilation requires early initiation, appropriate patient selection, and careful monitoring. In addition, improving staff training and implementing standardized guidelines are essential, particularly in resource-limited settings.

Further research is needed to refine clinical protocols and improve long-term outcomes in neonates receiving non-invasive ventilation.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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