Noninvasive Respiratory Support During Transportation

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KEYWORDS

• Neonatal • Transport • Noninvasive • CPAP • High-flow nasal cannula
• High-frequency nasal ventilation • Nasal intermittent positive-pressure ventilation

KEY POINTS

- Noninvasive (NIV) techniques of neonatal respiratory support are increasing. Intubating all infants with significant respiratory distress for transport is no longer the only acceptable option.
- Determining the best technique requires more study. It is likely that many neonates can be transported on any of the NIV modes.
- Determining those infants who require a specific NIV mode is challenging.
- All transport teams need to collect and report data relevant to NIV transport experiences to assist in appropriate patient selection and NIV management to improve outcomes.

INTRODUCTION

During the past 10 to 15 years, there has been a steady increase in the use of noninvasive (NIV) respiratory support for all gestational age newborns.[1] This has been accomplished for multiple reasons, including (1) increased use of antenatal steroids; (2) high-risk maternal transfers to level 3 facilities; (3) surfactant replacement therapy[2]; (4) improved resuscitation protocols; and (5) improved knowledge, availability, and use of NIV modes. However, many newborns still require transfer to a higher level of care due to respiratory difficulties. Common reasons include respiratory distress syndrome (RDS), pneumonia, meconium aspiration, barotrauma, persistent pulmonary

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hypertension, and surgical issues. In the past, neonates with respiratory insufficiency who required anything more than oxygen supplementation via a hood or low-flow (<2 liters per minute [Lpm]) nasal cannula were intubated for transport.[3] This article focuses on the modes and approaches to NIV that can be used during transport, as well as the appropriate inclusion and exclusion criteria for these patients.

The use of NIV in transport starts with a recognition of appropriate selection and exclusion criteria for which neonates might be safely and effectively transported, as shown in **Box 1**. Selection criteria are guidelines; one must look carefully at each neonate individually before proceeding with NIV transport. A high success rate with both short-term and long-term neonatal transport can be achieved with appropriate patient selection (see later discussion).

Box 1
Criteria for consideration of neonatal transport via noninvasive respiratory support

Inclusion criteria

1. Acute respiratory distress
2. Chronic lung disease
3. Stable on some form of NIV support for 2 or more hours
4. Chest radiograph for adequate lung expansion
5. Fio_2 50% or less stable or decreasing
6. Arterial P_aco_2 less than 60 and stable
7. pH greater than 7.3 and stable
8. Transport team comfortable with patient status

Exclusion criteria

1. Pulmonary hypertension unresponsive to nitric oxide
2. Poor lung expansion on upper levels of NIV support
   a. HFNC 6 Lpm or greater
   b. CPAP 8 cm of water (cm H_2O) or greater
   c. NIPPV rate greater than 20 and/or PIP greater than 20 cm H_2O and/or PEEP greater than 7 cm H_2O
   d. HFNV positive airway pressure greater than 8 cm H_2O
3. Persistent apnea
4. Sepsis with poor cardiac output
5. Surgical problems
   a. Diaphragmatic hernia
   b. Tracheoesophageal fistula
   c. Bowel obstruction
   d. Necrotizing enterocolitis
   e. Gastroschisis
   f. Omphalocele
6. Significant acidosis
   a. Respiratory: pH less than 7.25 and/or $Paco_2$ greater than 60 mm Hg
   b. Metabolic: pH less than 7.20 and base deficit greater than −10 mEq/dL
7. Transport team is uncomfortable moving the patient on a NIV technique

Abbreviations: CPAP, continuous positive airway pressure; Fio_2, fraction of inspired oxygen; HFNC, high-flow nasal cannula; HFNV, high-frequency nasal ventilation; NIPPV, nasal intermittent positive pressure ventilation; PEEP, positive end-expiratory pressure; PIP, peak inspiratory pressure.