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Editors and Contributors

Editor
John D. Buckley, MD, MPH
Program Director, Fellowship in Pulmonary Disease and Critical Care Medicine, Henry Ford Health System, Detroit, MI

Contributors
Alan D. Betensley, MD, FCCP
Assistant Professor, Senior Staff Physician, Division of Pulmonary Disease and Critical Care Medicine, Henry Ford Health System, Detroit, MI

John D. Buckley, MD, MPH
Program Director, Fellowship in Pulmonary Disease and Critical Care Medicine, Henry Ford Health System, Detroit, MI

Michael W. Domnino, MD
Clinical Instructor, Department of Emergency Medicine, Beth Israel Deaconess Hospital, Boston, MA

Rahul Kakkar, MD
Assistant Professor, Division of Pulmonary and Critical Care Medicine, University of Florida, Gainesville, FL

Joseph B. Miller, MD
Resident, Internal Medicine and Emergency Medicine, Henry Ford Health System, Detroit, MI
INTRODUCTION

Primitive methods of noninvasive positive pressure ventilation (NIPPV) were first described in the medical literature centuries ago.\(^1\),\(^2\) As a result of animal studies that revealed the risk of fatal pneumothorax with NIPPV, it was outlawed in Europe in the 19th century. Since then, great progress has been made in the fields of pneumatics, electronics, and physiology. The last century saw major advances in mechanical ventilation, marked by the success of noninvasive negative pressure ventilation during the polio epidemics in the United States and northern Europe. In the second half of the century, positive pressure ventilation with endotracheal intubation supplanted the use of noninvasive negative pressure ventilation. The improved design and material of endotracheal tubes, the emergence of large volume–low pressure cuffs, and advances in the design and technology of positive pressure ventilators proved invaluable in improving the efficacy and safety of mechanical ventilation. The resurgence of interest in NIPPV in the past 2 decades has been facilitated by the emergence of new technology, allowing better interface devices as well as improved algorithms for the delivery of the desired pressure and volume.

Mechanical ventilation utilizing an endotracheal tube exposes the patient to risks of barotrauma, tracheal injury, and, most importantly, nosocomial infection (Table 1).\(^3\)–\(^6\) Several randomized prospective trials have demonstrated that NIPPV not only effectively supports adequate respiration but also reduces complications associated with invasive mechanical ventilation. Randomized controlled trials have shown better outcomes in patients with acute respiratory failure due to chronic obstructive pulmonary disease (COPD), in patients with acute cardiogenic pulmonary edema, and in immunosuppressed patients presenting with bilateral pulmonary infiltrates.\(^7\)–\(^9\) This manual discusses the use of NIPPV in acute respiratory failure.

Important definitions pertaining to noninvasive ventilation are summarized in Table 2. Common modes for NIPPV include pressure support and assist-control ventilation. With pressure support, the physician sets the end-expiratory pressure and the driving pressure, while patient effort and respiratory system compliance determine the resulting tidal volume. With assist-control, the tidal volume is fixed by the physician. This mode has been found to be a less comfortable means of noninvasive ventilation.\(^10\) In addition, bilevel positive airway pressure (PAP) is frequently used. Bilevel PAP is the application of a higher inspiratory positive airway pressure (IPAP) and a lower expiratory positive airway pressure (EPAP) in a spontaneously breathing patient on NIPPV. (Although commonly used in a generic sense, the term BiPAP is the proprietary name for bilevel PAP devices marketed by Respironics Inc. [Murrysville, PA].) Bilevel PAP is essentially equivalent to pressure support ventilation (Table 2) but with important differences in terminology. EPAP in bilevel PAP is analogous to positive end-expiratory pressure (PEEP) in pressure support ventilation. IPAP in bilevel PAP is equivalent to the sum of pressure support and PEEP in pressure support ventilation.

EQUIPMENT AND TECHNICAL ISSUES IN NIPPV

INTERFACES

An ideal interface should be lightweight, transparent, inexpensive, easy to clean, and nonallergenic and should provide an adequate seal. Masks are the most commonly used interfaces in acute settings. Although dead space remains a theoretical concern, the flow of gases is usually sufficient to flush the expired gases accumulated in the mask.\(^10\),\(^11\) Nasal and full-face masks are equally effective.\(^18\),\(^19\) Table 3 summarizes the potential advantages and disadvantages of each.\(^20\)

Many nasal masks have forehead spacers to adjust the pressure on the nasal bridge. However, nasal masks may be difficult to use in patients with nasal obstruction or mouth breathing. Dry air causes release of vasoactive amines and leukotrienes in nasal mucosa with resultant engorgement.\(^21\),\(^22\) In addition, a mouth leak with nasal continuous positive airway pressure (CPAP) can increase nasal airway resistance.\(^23\) The use of humidified air may sometimes overcome the resultant nasal congestion.\(^24\),\(^25\) Use of a full-face mask better preserves
humidification of air, and patients report less nasal congestion. Decongestants and chin straps have been used in an attempt to counteract nasal congestion and mouth leak, respectively, but their effectiveness in patients with acute respiratory failure has not been evaluated. In most circumstances, the mask seal will not be perfect, and an air leak will exist. Because pressure-cycled ventilators are optimized to trigger and cycle with the leak specific to that manufacturer’s mask, interfaces may not be interchangeable with noninvasive ventilators made by different manufacturers.

VENTILATORS

Two types of ventilators are commonly used for NIPPV. “Critical care” ventilators are defined as those designed specifically to be used with endotracheally intubated patients. Noninvasive ventilators are designed for use with a mask rather than endotracheal tube. Critical care ventilators can be used to deliver NIPPV, although most experts recommend using a machine specifically designed for noninvasive ventilation. Early generations of noninvasive ventilators did not use an oxygen blender, but newer devices allow precise delivery of oxygen concentration (fractional concentration of oxygen in inspired gas [FiO₂]). Separate inspiratory and expiratory tubing eliminates the potential for re-breathing exhaled carbon dioxide.

The major disadvantage of the critical care ventilator is the inability to compensate for air leaks. Two problems are commonly observed with the critical care ventilator in the presence of even a very small air leak. First, the ventilator cannot deliver the target pressure if it does not have a mode that increases flow to compensate for the flow that leaks around the mask. Second, during flow-cycled ventilation, if the flow through the leak is greater than the flow threshold for cycling to exhalation, the patient will be forced to exhale while the inspiratory pressure is still being delivered. The use of a time-cycled mode (eg, pressure control) rather than a flow-cycled mode (eg, pressure support) can eliminate the second problem, but the first problem may not be remediable.

The most ubiquitous noninvasive ventilators in the acute setting are pressure-limited ventilators, also referred to as bilevel ventilators. These ventilators can generate high inspiratory flows to meet patient demand in nearly all circumstances. They are fairly lightweight and inexpensive and can compensate well for air leaks. Their disadvantages include the inability to deliver high inspiratory (> 30 cm H₂O) and expiratory (> 20 cm H₂O) pressures.

### Table 1. Comparison of Noninvasive Positive Pressure Ventilation (NIPPV) and Invasive Ventilation

<table>
<thead>
<tr>
<th></th>
<th>NIPPV</th>
<th>Invasive ventilation</th>
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<tbody>
<tr>
<td><strong>Advantages</strong></td>
<td>Less expensive equipment</td>
<td>Endotracheal cuff prevents air leaks, giving more predictable effect</td>
</tr>
<tr>
<td></td>
<td>Lower risk of nosocomial infection</td>
<td>Protects against large-volume aspiration</td>
</tr>
<tr>
<td></td>
<td>Less trauma to airway</td>
<td>Better ability to suction trachea</td>
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<tr>
<td></td>
<td>Less risk of barotrauma</td>
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<tr>
<td></td>
<td>Decreased duration of mechanical ventilation and intensive care unit</td>
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<tr>
<td></td>
<td>Preserves oral intake and verbal communication</td>
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<tr>
<td></td>
<td>Preserves ability to close glottis and cough</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Easy to discontinue and reinitiate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Improves patient comfort</td>
<td></td>
</tr>
<tr>
<td><strong>Disadvantages</strong></td>
<td>Aerophagy can occur if pressure exceeds that of the lower esophageal</td>
<td>Potential for trauma to teeth, airways, and lungs during intubation</td>
</tr>
<tr>
<td></td>
<td>sphincter (typically 30 cm H₂O)</td>
<td>Breach of glottic barrier with endotracheal tube increases risk of pneumonia</td>
</tr>
<tr>
<td></td>
<td>Air leaks can prevent accurate measurement of tidal volume and also limit the ability to use the high pressures necessary to ventilate poorly compliant lungs</td>
<td>Higher risk of sinusitis and pneumonia</td>
</tr>
<tr>
<td></td>
<td>Requires proper patient selection</td>
<td>Risk of suction trauma</td>
</tr>
<tr>
<td></td>
<td>Control of ventilatory parameters is limited</td>
<td>Risk of tracheomalacia and tracheal stenosis, especially with excessive cuff pressure or to-and-fro movement of the tube</td>
</tr>
<tr>
<td></td>
<td>Potential for rebreathing with single tubing and full-face mask if exhalation port is not open</td>
<td>Prolongs duration of mechanical ventilation and intensive care unit stay</td>
</tr>
<tr>
<td></td>
<td>Skin breakdown over pressure points of interface with prolonged use</td>
<td>Pooling of subglottic secretions</td>
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<tr>
<td></td>
<td>(usually nasal bridge)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Does not offer protection against large-volume aspiration of emesis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Limited ability for tracheal suctioning in patients without adequate cough</td>
<td></td>
</tr>
</tbody>
</table>

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Table 2. Definitions Pertaining to Noninvasive Positive Pressure Ventilation (NIPPV)

Noninvasive ventilation: the provision of ventilatory support without using an endotracheal tube
NIPPV: the use of positive pressure to drive air into the patient’s lungs
Tidal volume: volume of gas delivered to the patient with each respiration. The trigger is the variable that initiates the breath, the limit is the target variable, and the cycling mode is the variable that changes inspiration to expiration.
Pressure support mode: patient-triggered, pressure-limited, flow-cycled (most commonly used mode for NIPPV)
Assist-control mode
  a. Pressure control: patient- or machine-triggered, pressure-limited, time-cycled
  b. Volume control: patient- or machine-triggered, flow-limited, volume-cycled
Continuous mandatory ventilation (usually not an appropriate mode for NIPPV): machine-triggered, pressure- or flow-limited, volume- or time-cycled
Continuous positive airway pressure: application of a constant positive pressure during both inspiration and expiration
Bilevel (biphasic) positive airway pressure: the application of a higher inspiratory positive pressure and a lower expiratory pressure in a spontaneously breathing patient on NIPPV
Proportional assist ventilation (not licensed for use in the United States): a form of synchronized partial ventilatory support in which the ventilator generates the pressure in proportion to the patient effort and there are no preset volumes or pressure limits

H2O) pressures, although the need for this degree of pressure is unusual in settings that are appropriate for NIPPV. If dual-limb tubing is not used, the potential for rebreathing exists at low flow levels (<2–4 cm H2O). Bilevel ventilators can be set in various modes: CPAP mode, spontaneous (S) mode (pressure support), timed (T) mode (pressure control), and S/T mode (pressure assist and pressure support).

Triggering and Cycling

Triggering refers to the initiation of inspiration by the ventilator. This can be patient-triggered (eg, pressure support) or machine-triggered (eg, continuous mandatory ventilation). In assist-control mode, the patient can trigger inspiration, or if adequate respiratory drive is not present, breaths will be machine-triggered. When the patient generates an inspiratory effort, it is sensed as either a change in pressure or a change in flow. Sensitivity of the ventilator can be varied according to specific needs. Patient-triggered breaths can be either pressure-triggered or flow-triggered. Pressure-triggering may increase the work of breathing as compared with flow-triggering. Most modern noninvasive ventilators have flow sensors and a fast response time. The ventilator may fail to trigger in the presence of an inadequate effort (eg, neuromuscular disease), a delay in initiating inspiration, excessive intrinsic PEEP, or mouth breathing with a nasal interface.1,15,26

Cycling refers to the termination of inspiration by the ventilator and can be controlled by flow, timing, or volume. In pressure-support mode, ventilators are flow cycled. In flow-cycled modes, if a leak is present that is greater than the minimum flow necessary to cycle the ventilator, the ventilator may continue to deliver the inspiratory pressure, making it difficult for expiration to be initiated.27 Pressure support ventilation may result in prolonged inspiration relative to a patient’s inspiratory effort, causing patient-ventilator dysynchrony.28,29 This issue can be resolved by switching the COPD patient to pressure assist-control (labeled as pressure control on most critical care ventilators), which is a time-cycled mode of ventilation.

Prevention of Rebreathing

Rebreathing can result from a number of factors, but most commonly it results from either exhalation into the single tubing of a bilevel ventilator or the added dead space of the equipment. This problem usually can be resolved by using adequate PEEP so that a continuous flow of air during the expiratory cycle will flush out the expired gas from the tubing and mask. The addition of an exhalation valve can also eliminate rebreathing, but at the expense of added work of breathing. Using an exhalation port as close to the mouth as possible can minimize the impact of equipment dead space on carbon dioxide rebreathing.30

Use of Supplemental Oxygen

With the older generation noninvasive ventilators, the addition of supplemental oxygen can be a complex issue.31,32 The ventilator uses room air to deliver each breath, but supplemental oxygen can be “bled” into the tubing connecting the ventilator to the patient interface. Because these ventilators do not have separate limbs for inspiration and expiration, an oxygen injection port and an exhalation port are both present on this single limb of tubing. The positions of the oxygen injection port and the exhalation port can affect the final FiO2. Higher pressure settings resulting in a higher flow rate of ventilator-delivered air will decrease the
FiO₂ for any given oxygen flow rate. The highest oxygen delivery is achieved when the oxygen is injected at the mask, the leak port is in the circuit, and the inspiratory and expiratory pressures are low. Some newer machines have oxygen blenders, which eliminate these issues.

**USE OF HELIUM-OXYGEN MIXTURE**

A mixture of helium and oxygen (heliox) has been used along with noninvasive ventilation in the treatment of acute exacerbations of obstructive lung disease and upper airway obstruction. The addition of heliox has not been proven to decrease the rate of intubation or the length of stay in the intensive care unit, but it has been shown to potentially reduce the hospital length of stay. Heliox flow, ventilator settings, site of heliox infusion, and type of ventilator significantly affect the concentration of helium delivered by noninvasive ventilators, and some ventilators may function erratically with heliox.

**AEROSOL DELIVERY**

Aerosolized bronchodilators are frequently used in patients undergoing noninvasive ventilation. The aerosol delivery is determined by the position of the nebulizer and by the ventilator settings. Aerosol delivery is optimum when the delivery occurs between the leak port and the patient connection, with a higher IPAP and a lower EPAP.

**HUMIDIFICATION**

Critical care ventilators use a dry gas source and may cause more mucosal dryness as compared with portable noninvasive ventilators, which use ambient air. Dryness may cause significant nasal obstruction mediated by the release of local cytokines. Use of humidification and a full-face mask can significantly ameliorate these symptoms. Heat moisture exchangers are not recommended because they can increase work of breathing and can interfere with ventilator triggering and cycling. In addition, if the gas source is not humidified, use of the critical care ventilator may cause drying of the oral and nasal mucosa.

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**Table 3. Comparison of Nasal and Full-Face Masks**

<table>
<thead>
<tr>
<th></th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nasal mask</td>
<td>Easier to fit</td>
<td>Ineffective if mouth breathing occurs</td>
</tr>
<tr>
<td></td>
<td>Easier to maintain cushion seal</td>
<td>Can cause or worsen nasal obstruction</td>
</tr>
<tr>
<td></td>
<td>Less claustrophobic</td>
<td>Can cause rhinorrhea</td>
</tr>
<tr>
<td></td>
<td>Overcomes leak from mouth opening</td>
<td>Can cause pressure sore on nasal bridge</td>
</tr>
<tr>
<td></td>
<td>Effective when mouth breathing is present</td>
<td></td>
</tr>
<tr>
<td>Full-face mask</td>
<td>Preserves humidification better</td>
<td>Difficulty maintaining cushion seal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Increased risk of aspiration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Risk of asphyxiation with ventilator malfunction or power failure</td>
</tr>
</tbody>
</table>

**USING NIPPV IN THE INTENSIVE CARE UNIT**

**INITIATING NIPPV**

NIPPV can be initiated in the emergency department, on the respiratory ward, or in the intensive care unit. Patients with moderate or severe acidemia (pH < 7.30) are best managed in the intensive care unit. A target IPAP of at least 15 to 20 cm H₂O or the highest tolerated pressure is recommended, with an aim of delivering a tidal volume greater than 8 to 10 mL/kg. An IPAP of at least 10 cm H₂O should be used initially, as lower pressure may increase the failure rate. Earlier studies demonstrating that NIPPV was time consuming for the nursing staff have not been replicated.

**MONITORING PATIENTS RECEIVING NIPPV**

In patients receiving NIPPV, monitoring should be aimed toward evaluating the effectiveness and safety of the NIPPV trial as well as the comfort of the patient. Principles of monitoring are as follows:

1. **General comfort.** The patient’s ability to tolerate NIPPV and the subjective improvement of symptoms should be frequently monitored.
2. **Respiratory system.** The respiratory rate is one of the most sensitive indicators of a successful trial of NIPPV and should fall to below 30 breaths/min in the first 1 to 2 hours. Observation of paradoxical respirations (abdomen moves inward during inspiration) and use of accessory muscles of respiration (especially the sternocleidomastoid muscle) can provide a bedside estimate of the presence of respiratory difficulty. The
presence of excessive secretions or vomiting should
be promptly noted. Continuous pulse oximetry is
helpful for monitoring the effectiveness of NIPPV,
but it does not indicate whether hypercapnic respira-
tory failure is present. Arterial blood gases should be
monitored within the first 1 to 2 hours of initiating
NIPPV. Improvement in partial arterial pressure of
carbon dioxide (Paco₂) is a good indication of suc-
cess; however, a decrease in Paco₂ may not occur
despite improvement in respiratory rate and symp-
toms and therefore should not be interpreted in is-
olation as a failure of NIPPV.

3. **Cardiovascular system.** Continuous electrocardio-
graphy, heart rate monitoring, and frequent blood
pressure monitoring are required during NIPPV.
Changes in these parameters will help to determine
whether continuing NIPPV is safe.

4. **Neurologic status.** The patient should be observed
for claustrophobia, agitation, stupor, and, most im-
portantly, the ability to protect the airway.

5. **Equipment.** The ventilator should be frequently
checked to ensure a good tidal volume delivery, and
air leaks should be promptly detected and fixed.
When a nasal mask is used, mouth breathing can sig-
nificantly increase the nasal resistance. First, to com-
pensate for the leak, the machine increases the flow,
and second, the increased flow of dry air causes wors-
ening of nasal obstruction. It is imperative to ensure
that the ventilator is able to trigger and cycle as
required and there is no dysynchrony between the
machine and the patient.

**CONTRAINDICATIONS TO NIPPV**

Although no scientific data exist to define absolute
contraindications to NIPPV, most clinicians consider
the following as indications for invasive mechanical ven-
tilation: 73–74: cardiac or respiratory arrest, severe enceph-
aloathy, severe upper gastrointestinal bleeding, hemo-
dynamic instability or unstable cardiac arrhythmia,
facial trauma or surgery, and high risk of emesis with a
risk of aspiration due to an inability to protect the air-
way. NIPPV should not be used when intubation and
invasive mechanical ventilation are clearly indicated.78,79

**NIPPV FAILURE**

No universally accepted criteria define NIPPV fail-
ure. In general, a respiratory rate greater than
30 breaths/min, decreasing arterial pH, a partial ar-
terial pressure of oxygen (Pao₂) of less than 65 mm Hg
with an FiO₂ greater than or equal to 0.6, or the inabi-
ity to improve dyspnea within 2 to 4 hours of the initia-
tion of NIPPV should prompt switching to invasive
mechanical ventilation. Development of hemodynamic
or electrophysiologic compromise, inability to ensure a
protected airway, or the inability to tolerate the face
mask should also prompt consideration to switch to in-
vasive mechanical ventilation.80

Some patients who deteriorate after initial improve-
ment have a high rate of complications and death if
NIPPV is continued.80 A delay in the time to intubation
after failed NIPPV may lead to increased mortality.81 If
NIPPV is not effective after 2 to 4 hours, it is unlikely to
be effective and intubation is indicated.

**INDICATIONS FOR NIPPV**

**ACUTE EXACERBATION OF COPD**

Several randomized prospective studies have report-
ed the success of NIPPV in COPD patients with acute
hypercapnic respiratory failure.7,8,9,10,32–44 Reduction in
intensive care unit length of stay, reduction in hospital
mortality, and reduced incidence of infection are the
most important advantages of noninvasive ventilation
in appropriately selected patients.

The mechanisms by which NIPPV works in this set-
ing include a reduction in the work of breathing and
improved alveolar ventilation.45,46 These changes result
in decreased respiratory rate, increased tidal volume,
improved pH, and improved oxygenation without a sig-
nificant effect on ventilation-perfusion matching.
NIPPV does not significantly affect the blood pressure,
cardiac output, or pulmonary artery pressure in most
patients with COPD and acute respiratory failure.47 In a
small study of patients with acute exacerbations of
COPD, there was no significant difference in the effica-
cy of various modes of noninvasive ventilation (ie, pres-
sure support ventilation, pressure support ventilation
plus PEEP, CPAP, or volume-cycled ventilation).48
Although pressure support ventilation has been found to
be more comfortable than volume-cycled ventilation
and is the most commonly used mode for COPD
patients with acute respiratory failure.

NIPPV must be instituted early in patients with mod-
erately severe acute exacerbations of COPD, but patients
without either tachypnea or respiratory acidosis are un-
likely to benefit from NIPPV. Predictors of success include
an arterial pH greater than 7.30, a higher level of con-
sciousness, and a significant improvement in pH, respi-
ratory rate, Paco₂, and level of consciousness after 2 to
4 hours of NIPPV.49,50 A large Italian study designed to
delay the time to intubation after failed NIPPV may lead to increased mortality.81 If
NIPPV is not effective after 2 to 4 hours, it is unlikely to
be effective and intubation is indicated.
predictors of failure: pH less than 7.25, Glasgow coma score less than 11, acute physiologic and chronic health evaluation (APACHE) II score of 29 or higher, and respiratory rate 30 breaths/min or greater. Other predictors of failure include presence of pneumonia and relatively high PaCO₂ at presentation. An arterial pH less than 7.25 after 2 hours greatly increases the probability of failure (> 90% risk).

ACUTE CARDIOGENIC PULMONARY EDEMA

Acute cardiac pulmonary edema has been shown in several randomized studies to respond well to NIPPV. In a subset of patients presenting with hypercapnia, NIPPV has been shown to reduce the rate of intubation and mechanical ventilation. However, mortality, complications, duration of hospital stay, and overall outcome may not be better than with standard treatment. NIPPV increases the functional residual capacity, decreases the intrapulmonary shunt, improves oxygenation, unloads the respiratory muscles, decreases the rate-pressure product, improves the stroke volume index, decreases the cardiac preload, and decreases the afterload. Plasma brain natriuretic peptide concentrations are not altered.

Predictors of NIPPV success in acute cardiogenic pulmonary edema have not been uniformly defined. Improvement in Pao₂/Fio₂ index, respiratory rate, heart rate, and blood pressure are usually seen within the first 2 to 4 hours in a successful trial of NIPPV.

Given the risk of myocardial ischemia and the need to recognize arrhythmias promptly, patients with acute cardiogenic pulmonary edema should be managed in a high acuity environment. Both pressure- and volume-cycled ventilation are effective. Bilevel PAP and CPAP are equally effective. Earlier reports of increased risk of myocardial infarction in patients given bilevel PAP rather than CPAP have not been validated. It is reasonable to attempt NIPPV in appropriate patients with acute cardiogenic pulmonary edema, but invasive ventilation should not be delayed if there is no improvement in the first 2 to 4 hours.

IMMUNOSUPPRESSED PATIENTS WITH ACUTE RESPIRATORY FAILURE

In randomized controlled trials of immunosuppressed patients with acute hypoxemic respiratory failure, NIPPV decreased the rate of endotracheal intubation, fatal complications, length of stay in the intensive care unit, and inpatient mortality rate. Nonrandomized studies have shown similar results in patients with bilateral lung transplantation, AIDS, and hematologic malignancies and in neutropenic patients in acute respiratory failure. The major advantage of NIPPV in immunosuppressed patients seems to be a decreased rate of nosocomial infections that otherwise complicate invasive mechanical ventilation in this population.

OTHER INDICATIONS

Case control studies and case series have been published that support the use of NIPPV in carefully selected patients with neuromuscular diseases presenting with acute respiratory failure. Prospective, randomized trials have shown a reduced rate of tracheal intubation and reduced mean duration of intensive care unit stay in pneumonia patients with acute respiratory failure placed on NIPPV, although the effect on mortality is debated.

For patients presenting with an acute exacerbation of asthma, data are not sufficient to make firm recommendations regarding NIPPV. However, studies have shown beneficial effects in selected patients related to lung function, symptoms, and the need for hospitalization.

In patients with severe acute respiratory syndrome managed with NIPPV, limited data suggest a lower incidence of pneumothorax. NIPPV has not been shown to be beneficial for patients with acute respiratory distress syndrome.

A small, randomized study comparing NIPPV with oxygen alone during fiberoptic bronchoscopy demonstrated that NIPPV improved gas exchange and lessened the hemodynamic compromise following the procedure. The success of the technique has been described in other, less rigorous studies, as well.

SUMMARY

Large, randomized, prospective, controlled trials have shown NIPPV to be beneficial in acute exacerbations of COPD, acute cardiogenic pulmonary edema, and acute respiratory failure in the immunosuppressed patient. NIPPV also can assist respiration during bronchoscopy in patients with marginal respiratory function. NIPPV holds promise in the treatment of other causes of acute respiratory failure, such as asthma and pneumonia; however, more rigorous studies are needed to define its role in the treatment of these conditions. NIPPV may also be useful in facilitating weaning from mechanical ventilation in the appropriately selected patient, but this needs further study before being adopted as standard of care. Proper selection of patients, careful training of personnel, and extensive knowledge of equipment is necessary for the successful implementation of NIPPV.
Noninvasive Positive Pressure Ventilation

REFERENCES


Noninvasive Positive Pressure Ventilation


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