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BRIEF ANSWERS TO SPECIFIC CLINICAL QUESTIONS

Q: Does noninvasive positive pressure ventilation have a role in managing hypercapnic respiratory failure due to an acute exacerbation of COPD?

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Compared with medical therapy alone, NIPPV reduces the mortality rate

A: Yes. In selected patients with hypercapnic respiratory failure due to an acute exacerbation of chronic obstructive pulmonary disease (COPD), noninvasive positive pressure ventilation (NIPPV) is an effective adjunct to usual medical therapy. In controlled trials, it reduced the need for endotracheal intubation, the length of hospital stay, and the risk of death.

Acute COPD exacerbations are responsible for more than 500,000 hospitalizations yearly in the United States, and 6% to 34% of patients die.[1]

Many patients need invasive ventilatory assistance via an endotracheal tube, but such therapy puts the patient at risk of ventilator-associated pneumonia, pneumothorax, and tracheal stenosis.

WHAT IS NONINVASIVE POSITIVE PRESSURE VENTILATION?

With NIPPV, the patient wears a tightly fitting nasal or full facial mask, avoiding the need for an endotracheal tube, laryngeal mask, or tracheostomy (**FIGURE 1**).[2] The mask can be connected to a standard mechanical ventilator or, more commonly, to a continuous positive airway pressure or bi-level airway pressure unit. NIPPV has been used with variable success in a variety of conditions, including COPD exacerbations,[3–6] acute cardiogenic pulmonary edema,[7] hypoxemic respiratory failure,[8] and ventilator weaning.[9]

WHY IS IT BENEFICIAL?

Several mechanisms may explain why noninvasive positive pressure ventilation is beneficial in acute exacerbations of COPD.

Patients with decompensated respiratory failure lack sufficient alveolar ventilation, owing to abnormal respiratory mechanics and inspiratory muscle fatigue.[10] For these patients, breathing faster does not fully compensate. Noninvasive positive pressure ventilation partially counteracts these factors by providing a larger tidal volume with the same inspiratory effort.[10,11]

Additionally, this treatment can decrease the work of breathing by partially overcoming auto-PEEP (positive end-expiratory pressure) in certain situations.[2] Auto-PEEP is pressure greater than the atmospheric pressure remaining in the alveoli at the end of exhalation.[12] This condition is related to limited expiratory flow and is common in those with severe COPD. Noninvasive positive pressure ventilation decreases the pressure difference between the atmosphere and the alveoli, thereby reducing the inspiratory force needed for initiation of inspiratory effort, which may reduce the work of breathing. However, caution should be used when using this therapy in tachypneic patients, in whom NIPPV may not fully overcome the auto-PEEP.

Noninvasive positive pressure ventilation: An effective therapy in acute exacerbations of COPD

In selected patients with hypercapnic respiratory failure due to an acute exacerbation of chronic obstructive pulmonary disease (COPD), noninvasive positive pressure ventilation, added to usual medical therapy, reduces the need for endotracheal intubation, the length of hospital stay, and the risk of death.

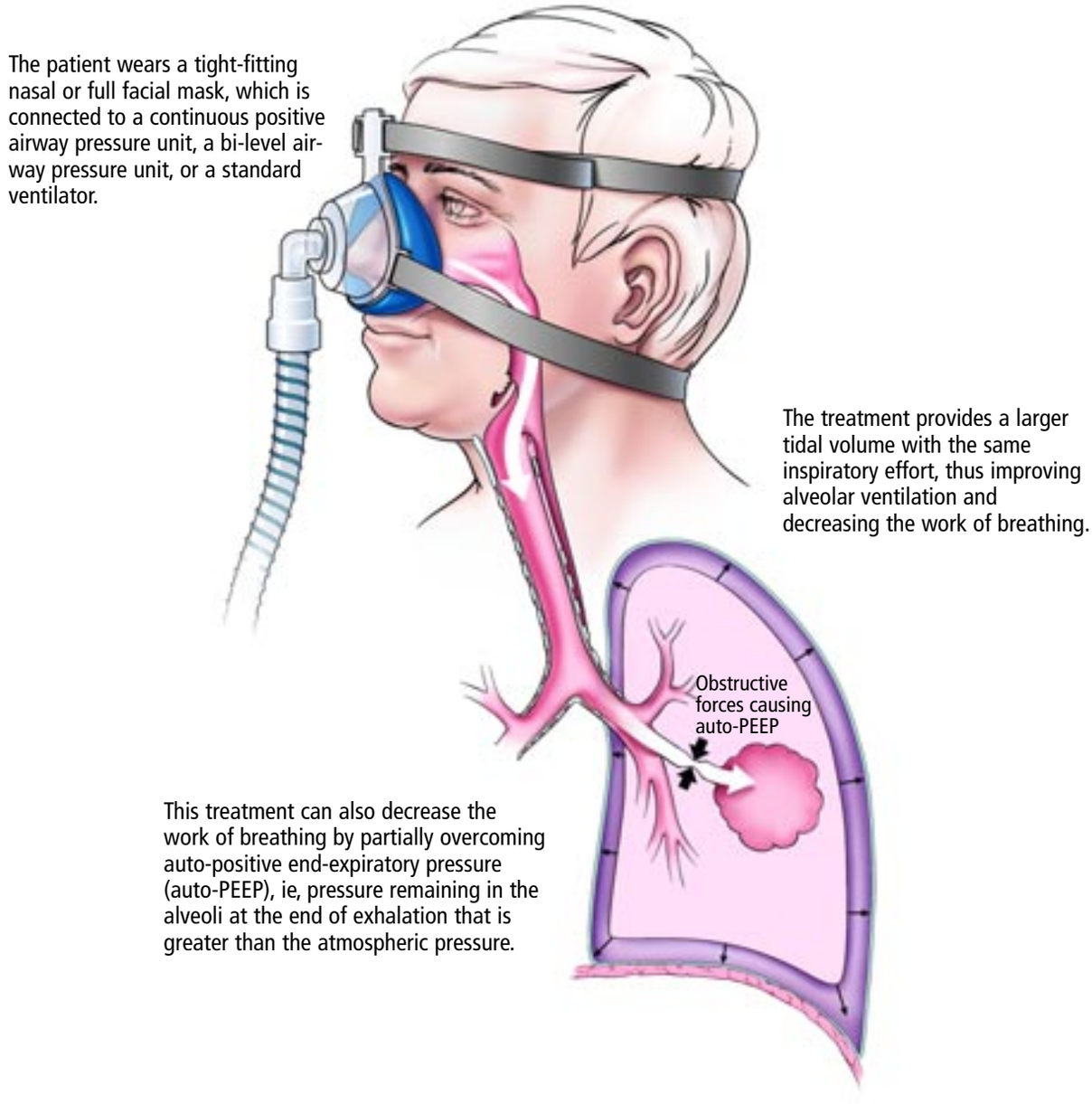

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FIGURE 1

TABLE 1

Who should receive noninvasive ventilation for acute respiratory failure in COPD

Does the patient need ventilatory assistance?
Consider noninvasive positive pressure ventilation if the patient has:
Symptoms and signs of acute respiratory distress
- Moderate to severe dyspnea, increased over usual, and
- Respiratory rate > 24, accessory muscle use, paradoxical breathing

Gas exchange abnormalities
- $Paco_2$ > 45 mm Hg, pH 7.25–7.35; or Pao_2/Fio_2 < 200

Would noninvasive ventilation place the patient at risk?
Do not use this therapy if the patient:
Has had respiratory arrest
Is medically unstable (hypotensive shock, uncontrolled cardiac ischemia or arrhythmias)
Cannot protect the airway (impaired cough or swallowing mechanism)
Has excessive secretions
Is agitated or uncooperative
Has facial trauma, burns, or surgery, or anatomic abnormalities interfering with mask fit
Has an Acute Physiology and Chronic Health Evaluation (APACHE) score > 29

DATA FROM AMERICAN RESPIRATORY CARE FOUNDATION CONSENSUS CONFERENCE. NON-INVASIVE POSITIVE PRESSURE VENTILATION. RESPIR CARE 1997; 42:364–369; CONFALONIERI M, GARUTI G, CATTARUZZA MS, ET AL. A CHART OF FAILURE RISK FOR NONINVASIVE VENTILATION IN PATIENTS WITH COPD EXACERBATION. EUR RESPIR J 2005; 25:348–355; BRITISH THORACIC SOCIETY STANDARDS OF CARE COMMITTEE. NON-INVASIVE VENTILATION IN ACUTE RESPIRATORY FAILURE. THORAX 2002; 57:192–211.

If this therapy is appropriate, it should be started without delay

WHAT STUDIES SHOWED

Several randomized trials have shown NIPPV to be beneficial in acute hypercapnic COPD exacerbations. A recent meta-analysis of eight studies[13] showed that, compared with usual care alone, this therapy was associated with:

- A lower mortality rate (relative risk 0.41; 95% confidence interval [CI] 0.26–0.64)
- Less need for endotracheal intubation (relative risk 0.42; 95% CI 0.31–0.59)
- A lower rate of treatment failure (relative risk 0.51; 95% CI 0.38–0.67)
- Greater improvements in the 1-hour post-treatment pH and $Paco_2$ levels
- A lower respiratory rate
- A shorter length of stay in the hospital.

WHICH PATIENTS SHOULD RECEIVE IT?

Consensus groups have offered guidelines for deciding who should receive NIPPV (TABLE 1).[14–16] Patients who benefit the most include those who have moderate to severe dyspnea, tachypnea, and hypercarbia and whose pH is 7.25 to 7.35. Of importance, if this treatment is appropriate it should be started without delay, as studies have shown a higher success rate when it is applied early.[17]

NIPPV is not suitable for all patients with hypercapnic respiratory failure. It should not be substituted for endotracheal intubation and mechanical ventilation if they are indicated, eg, in patients who are medically unstable because of hypotension, sepsis, hypoxia, or other life-threatening systemic illness. In addition, those who cannot protect the airway, who have had a worsening in mental status, or who have excessive secretions should not undergo NIPPV because they have a high risk of aspiration. Factors that predict that this therapy will fail include an Acute Physiology and Chronic Health Evaluation (APACHE) score of 29 or higher, a respiratory rate of 30 or higher, and a pH lower than 7.25 after 2 hours of this therapy.[15]

GENERAL WARD OR INTENSIVE CARE UNIT?

Mild to moderate COPD exacerbations (in which the pH is 7.30 or higher) can be effectively treated with NIPPV in a general ward if

the staff has appropriate expertise.[5,18] Keeping the patient in a general ward reduces cost and provides a favorable outcome in selected patients.[5,19] However, if the patient's hemodynamic or mental status deteriorates or if gas exchange, pH, respiratory rate, or dyspnea fail to improve, he or she should be transferred to an intensive care unit and endotracheal intubation should be considered.[18] The use of NIPPV in general wards should always be approached with caution and should never be attempted without adequate patient supervision and an experienced respiratory therapy team.

TAKE-HOME MESSAGE

NIPPV has been shown to be an effective adjunct in the treatment of acute hypercapnic respiratory failure secondary to a COPD exacerbation, reducing the need for endotracheal intubation, the length of hospital stay, and the mortality rate. On the basis of controlled trials, NIPPV is now considered the ventilatory therapy of choice in selected patients with this condition. However, it should not be used as a substitute for intubation and mechanical ventilation if these are needed or if the patient is at risk of aspiration.

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