



Guidelines Update: Noninvasive Ventilation for Acute Respiratory Failure

Article

- *Rochweg B, Brochard L, Elliott MW, et al. Official ERS/ATS clinical practice guidelines: noninvasive ventilation for acute respiratory failure. Eur Respir J 2017; 50: 1602426*

Background

- Evidence based indications for choosing non-invasive ventilation (NIV) remains controversial in many conditions.
- Traditionally, acute COPD exacerbation, CHF exacerbation, and acute respiratory failure in immunocompromised patients have been the indications with the best evidence to support its use.
- Despite general recommendations, clinical practice often extends the use of NIV to other clinical conditions such as acute asthma exacerbation, patients with mechanical respiratory problems, and other forms of undifferentiated acute respiratory failure.

Guidelines

- Objective: Provide clinicians with evidence-based decision tool to address common clinical conditions where NIV is often used for acute respiratory failure (ARF) or insufficiency. The review group reviewed landmark papers as well as newer literature through November of 2016.
- Included 143 publications
- Interdisciplinary team of largely intensivists, pulmonologists, and respiratory therapists who are experts in the fields of NIV.
- Examined the use of both BiPAP (also known as, “*bilevel*”) and CPAP. Just to review:
 - **BiPAP**: Designed to provide higher inspiratory positive airway pressure is provided over a lower continuous positive end-expiratory pressure (PEEP)
 - **CPAP**: Continuous positive airway pressure or PEEP only
- Developed PICO questions and used GRADE tool to assess quality of evidence, did not report level of evidence
- How to interpret recommendations:
 - Strong recommendation: Most individuals should receive the recommended course of action. Adherence to this recommendation could be used as a quality criterion or performance indicator.
 - Weak recommendation: Different choices are likely to be appropriate for different patients, therapy should be tailored to the individual circumstances. Those circumstances may include the patient or family’s values and preferences.

- 13 recommendations overall, we'll review 6 recommendations that are relevant to decisions made during acute illness presentations.

Select Recommendations

Hypercapnia with COPD exacerbation

- **Etiology of deterioration:** ARF develops when the respiratory muscles fail to achieve adequate alveolar ventilation despite high levels of diaphragmatic activity and pulmonary hyperinflation. Respiratory muscle fatigue leads to a rapid shallow breathing pattern, characterized by an increased respiratory rate with small tidal volumes, leads to an increase in PaCO₂ resulting in a respiratory acidosis.
- Question: Should bilevel NIV to prevent intubation, or as an alternative to first-line endotracheal intubation
 - Very well studied, 25 publications were reviewed
 - Authors found that patient response is almost universally seen within the first 1-4 hours after NIV initiation
 - Two well done studies compared NIV to invasive ventilation
 - For studies examining NIV vs. early intubation, the mean pH was 7.2 – much lower than studies examining NIV to prevent intubation
 - Important exclusions in studies examined:
 - Need for urgent intubation due to respiratory arrest
 - Apneic episodes
 - Psychomotor agitation requiring sedation
 - Heart rate < 60 beats/min
 - Systolic arterial pressure <80 mmHg
 - **Data driving recommendation:** Clear reduction in patient symptoms, intubation rates, hospital LOS, and improved survival. Reduction in respiratory and nonrespiratory infections.
- **Recommendation:** Recommend bilevel NIV for patients with ARF leading to acute or acute-on-chronic respiratory acidosis (pH ≤7.35, PaCO₂ is >45 mmHg and the respiratory rate is >20–24 breaths/min despite standard medical therapy) due to COPD exacerbation. (Strong recommendation, high certainty of evidence.)
- **Recommendation:** Recommend a trial of bilevel NIV in patients considered to require endotracheal intubation and mechanical ventilation, unless the patient is immediately deteriorating. (Strong recommendation, moderate certainty of evidence.)
 - **Note:** There does not appear to be a lower limit of pH below which a trial of NIV is inappropriate, but obviously the lower the pH, the greater risk of failure.

ARF due to cardiogenic pulmonary edema (CHF exacerbation)

- **Etiology of deterioration:** Decreased respiratory system compliance and alveolar flooding due to high capillary pressure associated with left ventricular systolic or diastolic dysfunction.
- NIV not only improves respiratory mechanics here, but also improves left ventricular workload by decreasing left ventricular afterload.
 - Largest body of evidence
 - Over 30 trials have been published on the use of NIV for CHF compared with standard therapy; a majority are small, single-center trials over the past 30 years.
 - Pre-hospital use: 6 single-center RCTs have evaluated use in pre-hospital setting. It appears that the results from these studies may be dependent on patient severity of illness or experience of ambulance attendants.
- **Data driving recommendation:** Pooled analysis demonstrated that NIV decreased mortality and need for intubation
 - Insufficient evidence to recommend BiPAP over CPAP
 - Recommendation *does not* apply to patients with cardiogenic shock or acute coronary syndrome as an increase in rates of MI have been found in NIV groups, although low certainty of evidence.
- **Recommendation:** *Recommend either bilevel NIV or CPAP for patients with ARF due to cardiogenic pulmonary edema. (Strong recommendation, moderate certainty of evidence.)*

ARF due to acute asthma exacerbation

- **Etiology of deterioration:** sudden and reversible episode of bronchoconstriction, leading to an increase in airway resistance. This sudden change in mechanical load (mainly resistive) generates hyperinflation, increased respiratory muscle effort, and dyspnea – all leading to respiratory muscle fatigue and hypercapnea.
- **Data driving recommendation:** Few uncontrolled studies and RCTs, data mostly retrospective and observational
 - Pooled analysis demonstrated that NIV has an unclear effect on mortality, intubation, or ICU length of stay
 - Studies have demonstrated a more rapid reversal of airway obstruction and a reduced need for hospitalization compared with standard therapy
- **Recommendation:** *Given the uncertainty and lack of evidence, unable to offer a recommendation on the use of NIV for ARF due to asthma.*

ARF in immunocompromised patients

- **Etiology of deterioration:** heterogeneous – the decision of NIV vs intubation is that the anticipated desirable effects of NIV in immunocompromised patients with ARF outweigh undesirable consequences of endotracheal intubation in most settings.
- Most publications are observational, uncontrolled studies in mild to moderate ARF.
- Previous recommendations based off multiple observational studies finding clinical benefit, however a more recent multicenter RCT found no clinical benefit of mortality, ICU acquired infections, duration of MV or ICU LOS.
- **Data driving recommendation:** Pooled analysis demonstrated that NIV use led to a decrease in mortality, need for intubation, and rates of nosocomial pneumonia.
- *Recommendation: Suggest early NIV for immunocompromised patients with ARF. (Conditional recommendation, moderate certainty of evidence.)*

Chest trauma associated ARF

- **Etiology of deterioration:** Significant pain as a result of chest wall contusions, rib fractures, etc. can reduce patient initiated tidal volumes leading to progressively worsening hypercapnia, atelectasis, and respiratory acidosis. Also, hypoxemia related to pulmonary contusions may lead to alveolar edema.
- Utility of bilevel NIV/CPAP investigated in 3 RCTs & a subgroup of patients in a 4th trial.
- Mostly studied in patients with multiple rib fractures, flail chest, or pulmonary contusions
- Heterogeneous trial design, different comparators and severity of illness.
- **Data driving recommendation:** Pooled analysis demonstrated a decrease in mortality, need for intubation, incidence of nosocomial pneumonia, and ICU LOS.
- *Recommendation: Suggest NIV for chest trauma patients with ARF. (Conditional recommendation, moderate certainty of evidence.)*

Undifferentiated, de novo ARF

- De novo respiratory failure refers to respiratory failure occurring without prior chronic respiratory disease.
- Goal of NIV: improved oxygenation, facilitating ventilation, decreasing work of breathing, avoiding intubation, reducing complications associated with invasive mechanical ventilation.
- Most have hypoxemic respiratory failure, significant work of breathing (RR > 30 – 35 breaths/min), pneumonia, or ARDS.
- Recommendations based on a number of heterogeneous, uncontrolled studies, along with a few RCTs, but all had different endpoints.
- **Clinical Concerns with use of NIV for *de novo* ARF:**

- Tidal volumes are not regulated, unable to provide lung protective ventilation strategies with NIV (6 cc/kg IBW, high pressure support can cause air leaks, gastric insufflation, etc.)
- Main risk of NIV for *de novo* ARF is delay to needed intubation. Risk of NIV failure include higher severity score, older age, ARDS or pneumonia as etiology for ARF, or failure to improve after 1 hour of treatment.
- NIV failure is an independent risk factor for mortality in this population
- **Data driving recommendation:** Pooled analysis demonstrated that NIV use led to a decrease in mortality and need for intubation, although these were both based on a low certainty of evidence.
- **Recommendation:** *Given the uncertainty of evidence, unable to offer a recommendation on the use of NIV for de novo ARF.*