

The use of non-invasive ventilation during acute respiratory failure due to pneumonia

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Purpose of the review:

The purpose of this review article was to examine the role of non-invasive ventilation (NIV) in patients with acute respiratory failure secondary to pneumonia and to identify which subgroups may benefit from its use. While NIV is well established in COPD exacerbations and cardiogenic pulmonary edema, its effectiveness in pneumonia-related hypoxemic respiratory failure is less consistent, with higher reported failure rates. The article emphasizes that patient selection is important, as outcomes vary significantly depending on the presence of underlying COPD, cardiac disease, or immunosuppression.

Note: NIV means providing ventilatory support without an endotracheal tube. Examples: BIPAP, CPAP

Core problem:

The reasoning behind why NIV may be less reliably effective in patient's with acute respiratory failure due to pneumonia lies in the underlying pathophysiology of the disease. For example, in COPD respiratory failure is primarily due to airflow obstruction and hypercapnia, and NIV directly improves ventilation by unloading respiratory muscles and enhancing CO₂ clearance. In contrast, pneumonia typically causes primary hypoxemic respiratory failure (ie in patients without underlying chronic lung disease) driven by intrapulmonary shunt physiology, where alveoli are filled with inflammatory exudate and remain perfused but not ventilated. Therefore NIV may only transiently improve oxygenation because positive pressure can't reverse alveolar consolidation.

Key findings:

1. **NIV failure is common in pneumonia**

A. Multiple ICU studies demonstrate:

- a. Univariate analysis assessing predictors of NIV failure found pneumonia as the cause of COPD exacerbation associated with higher failure of NIV
 1. Pneumonia was the cause of 38% unsuccessful episodes vs 9% successful
 2. While failure rate of patients with other causes of COPD exacerbation was 16%, the failure rate of patients with pneumonia was 56%
- b. Pneumonia independently predicts NIV failure
- c. ****Mortality increases when intubation is delayed after failed NIV**

2. **Subgroups that benefit from NIV include: COPD with hypercapnic respiratory failure and cardiac disease**

- A. Patients with underlying COPD and hypercapnic respiratory failure, as well as those with cardiogenic pulmonary edema demonstrate lower intubation rates, better short-term outcomes, and improved gas exchange because NIV corrects hypoventilation, dynamic hyperinflation, and cardiac preload/afterload compared to those without underlying COPD or cardiac disease

3. **There is a clear benefit of NIV in immunosuppressed patients**

- A. NIV in pneumonia is beneficial in patients with hematologic malignancy, neutropenia, transplant recipients, and HIV patients.
- B. In this population, NIV reduces the need for intubation (which is crucial because intubation in immunocompromised patients carries very high mortality), and decreases ICU and hospital mortality

4. **CPAP vs NIV**

- A. CPAP improves oxygenation by increasing functional residual capacity, reducing shunt, and recruiting alveoli BUT improved oxygenation does not mean improved survival in immunocompetent pneumonia patients

- B. Tissue oxygen delivery depends on cardiac output, hemoglobin, and perfusion, and excessive PEEP may actually reduce venous return and impair cardiac output

Applying the review to my patient from H&P #3: 81 YOM with hx of COPD, admitted for acute hypoxic respiratory failure in the setting of pneumonia. ABG on 6 L NC: 7.45/43/78/29

Pt's ABG demonstrates normocapnic hypoxemia, indicating primary hypoxemic respiratory failure rather than hypercapnic ventilatory failure. According to the article, NIV is most beneficial in hypercapnic COPD and cardiogenic pulmonary edema, and has higher failure rates in pneumonia-related hypoxemic respiratory failure due to its physiology. Given this patient did not demonstrate CO₂ retention, management with high flow nasal cannula rather than BIPAP or CPAP is consistent with the considerations in the article.