

Should I Consider Treating Patients With Acute Cardiogenic Pulmonary Edema With Noninvasive Positive-Pressure Ventilation?

EBEM Contact Commentator

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SYSTEMATIC REVIEW SOURCE

This is a systematic review abstract, a regular feature of the *Annals'* Evidence-Based Emergency Medicine (EBEM) series. Each features an abstract of a systematic review from the Cochrane Database of Systematic Reviews and a commentary by an emergency physician knowledgeable in the subject area.

The source for this systematic review abstract is: Vital FMR, Saconato H, Ladeira MT, et al. Non-invasive positive pressure ventilation (CPAP or bilevel NPPV) for cardiogenic pulmonary edema. *Cochrane Database Syst Rev.* 2008;(3):CD005351. DOI: 10.1002/14651858.¹

The *Annals'* EBEM editors assisted in the preparation of the abstract of this Cochrane review.

OBJECTIVE

The primary objective of this systematic review was to determine the safety and effectiveness of noninvasive positive-pressure ventilation in adult patients presenting with acute or acute-on-chronic cardiogenic pulmonary edema.

DATA SOURCES

An extensive search of the following databases was used in April 2005: CENTRAL, EMBASE, MEDLINE, CINAHL, DARE, and LILACS. Reference lists of retrieved articles were reviewed. Content experts were contacted, as well as equipment manufacturers and the Cochrane Heart Group to maximize collection of relevant articles. There were no language restrictions.

STUDY SELECTION

Blinded and unblinded randomized or quasi-randomized trials (trials in which randomization may not have been concealed) were selected that included the treatment of adult patients with acute or acute-on-chronic cardiogenic pulmonary edema with noninvasive positive-pressure ventilation

(continuous positive airway pressure or bilevel noninvasive positive-pressure ventilation) and standard medical therapy compared with standard medical therapy alone. Acute cardiogenic pulmonary edema was defined with criteria from both the American Heart Association and the European Society of Cardiology.^{2,3} If these criteria were not applicable to a particular study, the definition was expanded to include signs and symptoms, including dyspnea, cough, normal or increased blood pressure, presence of pulmonary rales, pallor, cyanosis, and cool clammy skin. The diagnosis had to be supported by chest radiography, ECG, serum biomarkers consistent with acute myocardial infarction, or echocardiography.

DATA EXTRACTION AND ANALYSIS

Two authors independently selected articles and performed data extraction with standardized data collection forms. Study quality was assessed, with an emphasis on allocation concealment, adherence to an intention to treat analysis, and lost to follow-up.

MAIN RESULTS

Twenty-one studies were included, resulting in pooled analysis of 1,071 patients. In patients who were treated with noninvasive positive-pressure ventilation for acute cardiogenic pulmonary edema, there were significant decreases in endotracheal intubation rates and in hospital mortality, with no differences in the rate of myocardial infarction (Table). Additionally, although there was no difference in total hospital length of stay, there was a 1-day reduction in ICU length of stay (weighted mean difference = -1.07; 95% confidence interval [CI] -1.60 to -0.53).

CONCLUSION

Noninvasive positive-pressure ventilation in addition to standard medical therapy is safe and effective in the treatment of adults with acute cardiogenic pulmonary edema.

Table. Summary results of key clinically relevant outcomes.

Outcome	Pooled RR (95% CI)	NNT
Hospital mortality	0.60 (0.45–0.84)	13
Endotracheal intubation	0.53 (0.34–0.83)	8
Myocardial infarction		
During NPPV	1.24 (0.79–1.95)	
After NPPV	0.82 (0.09–7.54)	

RR, Relative risk; NNT, number needed to treat; NPPV, noninvasive positive-pressure ventilation.

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COMMENTARY: CLINICAL IMPLICATION

Acute cardiogenic pulmonary edema is a potentially fatal complication of heart failure commonly encountered in the emergency department (ED). In 2006, heart failure was present in 5.7 million Americans, with approximately 670,000 new cases being diagnosed annually.⁴ According to the Acute Decompensated Heart Failure National Registry, the in-hospital mortality rate for patients in the United States with acute heart failure was 4% and 10.6% in those requiring treatment in an ICU.⁵ One year after hospital discharge, the mortality rate for this cohort was 36%.^{5,6} Prompt recognition and treatment of this disorder is an important determinant in obtaining favorable outcomes.

Noninvasive positive-pressure ventilation has been touted as an important method of therapy for patients who present to the ED with acute heart failure and can be delivered in one of 2 ways: continuous positive airway pressure or bilevel positive airway pressure. These methods of ventilation assist in improving oxygenation by keeping fluid-filled alveoli open while improving preload, afterload, and cardiac output by increasing intrathoracic pressure.⁷ Additionally, noninvasive positive-pressure ventilation minimizes some of the complications associated with invasive ventilatory measures such as pneumonia and pneumothorax.^{1,8}

The integration of this modality into standard ED practice has remained controversial. Promising results from numerous small randomized controlled trials seemed to clearly show that noninvasive positive-pressure ventilation was a beneficial therapeutic intervention for patients with acute cardiogenic pulmonary edema. However, a randomized controlled trial by Mehta et al⁹ in 1997, comparing continuous positive airway pressure with bilevel positive airway pressure, was stopped early because of safety concerns when it was discovered that patients randomized to the bilevel positive airway pressure group experienced a significantly higher rate of myocardial infarction.

This Cochrane systematic review directly addresses the issues of therapy discussed above by pooling data from 21 methodologically sound randomized controlled trials for a total population of 1,071 patients (including the trial by Mehta in 1997). Their pooled analysis showed clinically significant reductions in mortality (number needed to treat=13) and intubation rates (number needed to treat=8). There was also a statistically significant reduction in ICU length of stay. Perhaps more important, there is no evidence that the rate of myocardial infarction increases in those receiving noninvasive positive-pressure ventilation and standard therapy compared with those receiving standard therapy alone.

TAKE-HOME MESSAGE

Early institution of standard pharmacologic therapy combined with noninvasive positive-pressure ventilation improves outcomes for several important clinically relevant outcomes and should be considered in the routine treatment of these patients.

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REFERENCES

- Vital FMR, Saconato H, Ladeira MT, et al. Non-invasive positive pressure ventilation (CPAP or bilevel NPPV) for cardiogenic pulmonary edema. *Cochrane Database Syst Rev.* 2008;(3): CD005351.
- Guidelines for the evaluation and management of heart failure. Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Evaluation and Management of Heart Failure). *J Am Coll Cardiol.* 1995;26:1376-1398.
- Nieminen MS, Bohm M, Cowie MR, et al. Executive summary of the guidelines on the diagnosis and treatment of acute heart failure: the Task Force on Acute Heart Failure of the European Society of Cardiology. *Eur Heart J.* 2005;26:384-416.
- Lloyd-Jones D, Adams R, Carnethon M, et al. Heart disease and stroke statistics—2009 update: a report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. *Circulation.* 2009;119:e21-181.
- Adams KF Jr, Fonarow GC, Emerman CL, et al. Characteristics and outcomes of patients hospitalized for heart failure in the United States: rationale, design, and preliminary observations from the first 100,000 cases in the Acute Decompensated Heart Failure National Registry (ADHERE). *Am Heart J.* 2005;149:209-216.
- Dar O, Cowie MR. Acute heart failure in the intensive care unit: epidemiology. *Crit Care Med.* 2008;36(1 suppl):S3-8.
- Allison RC. Initial treatment of pulmonary edema: a physiological approach. *Am J Med Sci.* 1991;302:385-391.
- Bach BP Jr, Hess DR, Hill NS, et al. Consensus statement: noninvasive positive pressure ventilation. *Respir Care.* 1997;2: 365-369.
- Mehta S, Jay GD, Woolard RH, et al. Randomized, prospective trial of bilevel versus continuous positive airway pressure in acute pulmonary edema. *Crit Care Med.* 1997;25:620-628.