

Review: Noninvasive positive-pressure ventilation reduces intubation and length of ICU stay in acute respiratory failure

Keenan SP, Sinuff T, Cook DJ, Hill NS. Does noninvasive positive pressure ventilation improve outcome in acute hypoxemic respiratory failure? A systematic review. *Crit Care Med*. 2004;32:2516-23.

Clinical impact ratings: Emergency Med ★★★★★☆☆ Hospitalists ★★★★★☆☆ Critical Care ★★★★★☆☆ Pulmonology ★★★★★☆☆

QUESTION

In patients with acute respiratory failure not requiring immediate ventilatory support, is noninvasive positive-pressure ventilation (NPPV) added to standard therapy (ST) better than ST alone for improving outcomes?

METHODS

Data sources: 3 databases; hand-searching conference abstracts (1990 to 2003), bibliographies of relevant studies, and personal files; and contacting authors and experts in the field. **Study selection and assessment:** Randomized controlled trials (RCTs) that included > 60% of patients with acute hypoxemic respiratory failure not associated with cardiogenic pulmonary edema (CPE) or an exacerbation of chronic obstructive pulmonary disease (COPD), and who did not require immediate ventilatory support; and which compared NPPV added to ST with ST alone. Study quality was assessed using 11 validity criteria, including randomization, concealment, and blinding. When possible, separate analyses that excluded patients with CPE or COPD exacerbation were performed.

Outcomes: Endotracheal intubation (EI), length of ICU and hospital stay, and ICU and hospital mortality.

MAIN RESULTS

8 RCTs ($n = 484$) met the selection criteria. Study quality scores ranged from 4 to 10 out

of 11. Randomization was concealed in 4 RCTs, and none were blinded. Using a random-effects model, meta-analysis of 8 RCTs showed that NPPV was associated with a lower rate of EI than ST alone (Table). Compared with ST alone, NPPV reduced length of ICU stay (7 pooled RCTs) and ICU mortality (8 pooled RCTs) (Table). Separate analyses that excluded patients with CPE or COPD showed similar results for reducing EI, length of ICU stay, and ICU mortality, but increased the length of hospital stay (Table). Groups did not differ for hospital mortality in 5 pooled RCTs that excluded patients with COPD and CPE (Table).

Noninvasive positive-pressure ventilation (NPPV) plus standard therapy vs standard therapy alone in acute respiratory failure*

Outcomes	Patient population	Number of trials (n)	Risk difference/weighted mean difference (95% CI)
Endotracheal intubation	All	8 (366)	23% (10 to 35)
	Selected patients†	6 (293)	24% (8 to 36)
Length of intensive care unit (ICU) stay (d)	All	7 (364)	-1.9 (-2.9 to -1.0)
	Selected patients†	5 (218)	-1.9 (-2.9 to -1.0)
Length of hospital stay (d)	Selected patients†	3 (135)	2.8 (0.9 to 4.7)‡
ICU mortality	All	8 (366)	17% (8 to 26)
	Selected patients†	6 (293)	16% (5 to 27)
Hospital mortality	Selected patients†	5 (218)	10% (-7 to 27)

*CI defined in Glossary. A random-effects model was used.

†No trials included patients with chronic obstructive pulmonary disease or cardiogenic pulmonary edema.

‡Favors standard therapy. All other outcomes favor NPPV.

CONCLUSIONS

In patients with acute respiratory failure, the addition of noninvasive positive-pressure ventilation to standard therapy reduces the rate of endotracheal intubation, length of intensive care unit (ICU) stay, and ICU mortality. Effectiveness may vary among patients with different clinical conditions.

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COMMENTARY

The review by Keenan and colleagues is an explicit and transparent meta-analysis of 8 RCTs. However, the RCTs shared a fundamental design bias, which was reflected in the meta-analysis. Although each of the studies considered invasive positive-pressure ventilation (IPPV) to be a failure endpoint and NPPV to be a potentially better alternative, none of the studies directly compared NPPV with IPPV. Instead, NPPV was compared with no mechanical support until patients deteriorated to respiratory failure (e.g., respiratory arrest, respiratory pauses with loss of consciousness or gasping respirations, and encephalopathy or cardiovascular instability [1]), at which point IPPV was applied. However, withholding breathing assistance from struggling patients until they are in dire need is harmful. Unfortunately, Keenan and colleagues did not include the trial by Estaban and colleagues (which supports this statement) (2) because of publication timing.

It is clear that patients who cannot breathe on their own because of acute deteriorations need mechanical support. Short-term (days) episodes of CPE and COPD exacerbation can often be treated without mechanical help or treated with NPPV. However, the acute respiratory distress syndrome (ARDS) and other causes of acute hypoxemic respiratory failure not related to CPE or COPD exacerbation usually require prolonged ventilation (≥ 1 wk) and at higher pressures than can be tol-

erated or delivered safely by NPPV. Under these conditions, IPPV has distinct advantages in treatment (e.g., a secured airway that permits enteral nutrition). In most patients with ARDS, IPPV should be viewed as necessary, life-prolonging care, and used as early as first needed. Although there may be complications associated with its use, IPPV should not be viewed as intrinsically harmful. After all, each year millions of patients receive IPPV safely as part of general anesthesia. NPPV is quick, easily provides mechanical support, and can be used liberally to assist patients with breathing difficulties. However, this study does not show that NPPV should be used in competition with IPPV in patients with ARDS. At most, it suggests that mechanical support should be provided liberally to struggling patients and that NPPV may be complementary to IPPV in selected patients.

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References

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2. Estaban A, Frutos-Vivar F, Ferguson ND, et al. *N Engl J Med*. 2004; 350:2452-60.