Non-invasive Ventilation

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Conflict of Interest Disclosure

- I have no financial relationships or other conflict of interest to disclose.

Learning objectives

- Understand indications for non-invasive ventilation
- Discuss contraindications for non-invasive ventilation
- Review literature evidence for use of non-invasive ventilation in common respiratory failures
- Know how to identify patients that are 'failing' non-invasive ventilation

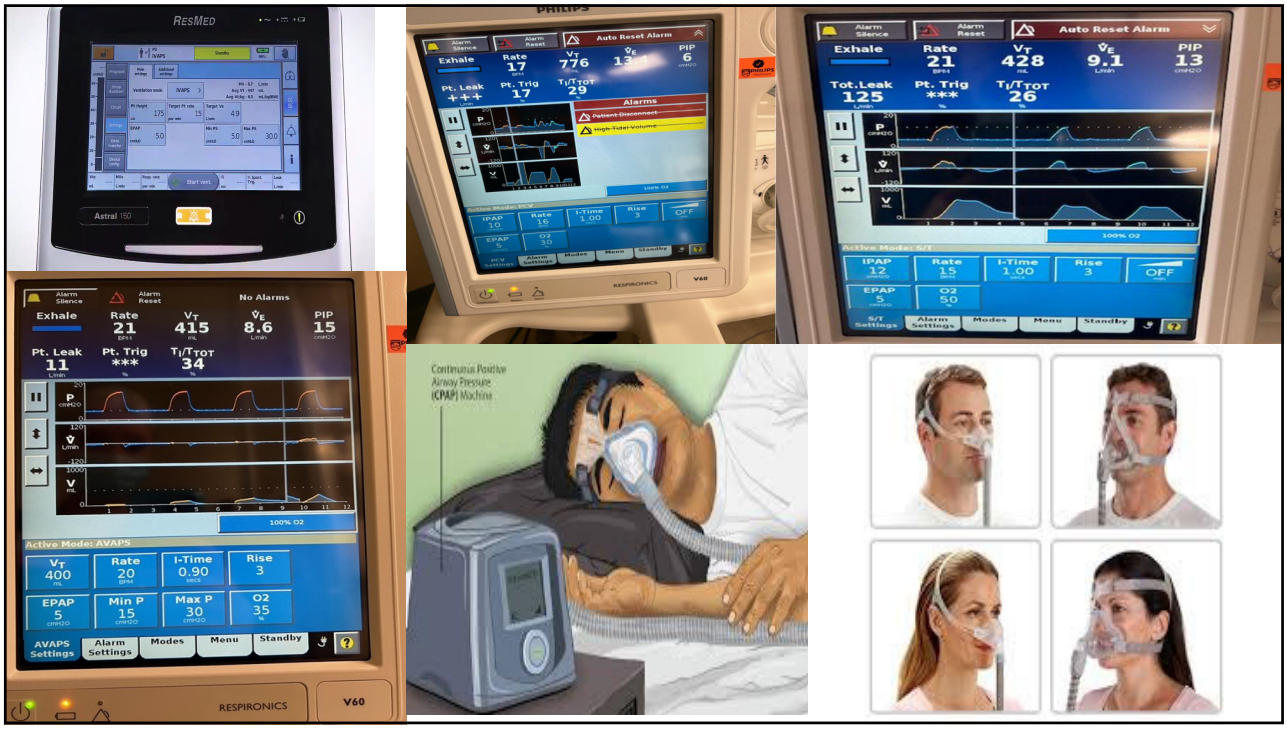
Introduction

- NIV delivering of positive pressure ventilation through either a facial/nasal mask or nasal rather than endotracheal or tracheostomy tube

- Used in patients with acute, chronic, or acute on chronic respiratory failure

Examples of commonly used NIV

- Continuous positive airway pressure (CPAP)
- Pressure support ventilation (PSV)**
- Bi level positive pressure ventilation (BiPAP)
- Average volume-assured pressure support (AVAPS or iVAPS)



Indicators that your patient may respond to NIV

- Younger age
- Lower acuity of illness
- ”okay” neurological status – alert and cooperative
- Acceptable facial anatomy – intact dentition and and able to maintain less air leak from the mask
- Moderate acidemia – pH >7.10
- Must be available to reassess your patient within two hours of initiation of NIV

Evidence supporting use of NIV

- Acute exacerbations of chronic obstructive pulmonary disease that are complicated by hypercapnic acidosis [$PaCO_2$] >45 mmHg or pH <7.35)

- Acute cardiogenic pulmonary edema

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NONINVASIVE VENTILATION FOR ACUTE EXACERBATIONS OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE

LAURENT BROCHARD, M.D., JORDI MANCEBO, M.D., MARC WYSOCKI, M.D., FRÉDÉRIC LOFASO, M.D., GIORGIO CONTI, M.D., ALAIN RAUSS, M.D., GÉRALD SIMONNEAU, M.D., SALVADOR BENITO, M.D., ALESSANDRO GASPARETTO, M.D., FRANÇOIS LEMAIRE, M.D., DANIEL ISABEY, PH.D., AND ALAIN HARF, M.D.

Abstract *Background.* In patients with acute exacerbations of chronic obstructive pulmonary disease, noninvasive ventilation may be used in an attempt to avoid endotracheal intubation and complications associated with mechanical ventilation.

Methods. We conducted a prospective, randomized study comparing noninvasive pressure-support ventilation delivered through a face mask with standard treatment in patients admitted to five intensive care units over a 15-month period.

Results. A total of 85 patients were recruited from a larger group of 275 patients with chronic obstructive pulmonary disease admitted to the intensive care units in the same period. A total of 42 were randomly assigned to standard therapy and 43 to noninvasive ventilation. The two groups had similar clinical characteristics on admission to the hospital. The use of noninvasive ventilation significantly reduced the need for endotracheal intubation (which was dictated by objective criteria): 11 of 43 patients (26 percent) in the noninvasive-ventilation group were intubated, as compared with 31 of 42 (74 percent) in the standard-treatment group ($P<0.001$). In addition, the frequency of complications was significantly lower in the noninvasive-ventilation group (16 percent vs. 48 percent, $P=0.001$), and the mean (±SD) hospital stay was significantly shorter for patients receiving noninvasive ventilation (23±17 days vs. 35±33 days, $P=0.005$). The in-hospital mortality rate was also significantly reduced with noninvasive ventilation (4 of 43 patients, or 9 percent, in the noninvasive-ventilation group died in the hospital, as compared with 12 of 42, or 29 percent, in the standard-treatment group; $P=0.02$).

Conclusions. In selected patients with acute exacerbations of chronic obstructive pulmonary disease, noninvasive ventilation can reduce the need for endotracheal intubation, the length of the hospital stay, and the in-hospital mortality rate. (N Engl J Med 1995;333:817-22.)

Annals of Internal Medicine | ARTICLE

Which Patients with Acute Exacerbation of Chronic Obstructive Pulmonary Disease Benefit from Noninvasive Positive-Pressure Ventilation?

A Systematic Review of the Literature

Sean P. Keenan, MD, FRCPC, MSc (Epid); Tasnim Sinuff, MD, FRCPC; Deborah J. Cook, MD, FRCPC, MSc (Epid); and Nicholas S. Hill, MD

Background: Over the past decade, noninvasive positive-pressure ventilation (NPPV) in the setting of acute exacerbations of chronic obstructive pulmonary disease (COPD) has increased in popularity. Although several trials have been published on the relative effectiveness of this treatment, apparent inconsistencies in study results remain.

Purpose: To assess the effect of NPPV on rate of endotracheal intubation, length of hospital stay, and in-hospital mortality rate in patients with an acute exacerbation of COPD and to determine the effect of exacerbation severity on these outcomes.

Data Sources: MEDLINE (1966 to 2002) and EMBASE (1990 to 2002). Additional data sources included the Cochrane Library, personal files, abstract proceedings, reference lists of selected articles, and expert contact. There were no language restrictions.

Study Selection: The researchers selected randomized, controlled trials that 1) examined patients with acute exacerbation of COPD; 2) compared noninvasive ventilation and standard therapy with standard therapy alone; and 3) included need for endotracheal intubation, length of hospital stay, or hospital survival as an outcome.

Data Extraction: Methodologic quality and results were abstracted independently and in duplicate.

Data Synthesis: The addition of NPPV to standard care in patients with an acute exacerbation of COPD decreased the rate of endotracheal intubation (risk reduction, 28% [95% CI, 15% to 40%]), length of hospital stay (absolute reduction, 4.57 days [CI, 2.30 to 6.83 days]), and in-hospital mortality rate (risk reduction, 10% [CI, 5% to 15%]). However, subgroup analysis showed that these beneficial effects occurred only in patients with severe exacerbations, not in those with milder exacerbations.

Conclusions: Patients with severe exacerbations of COPD benefit from the addition of NPPV to standard therapy. However, NPPV has not been shown to benefit hospitalized patients with milder COPD exacerbations.

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For author affiliations, see end of text.

Review > Cochrane Database Syst Rev. 2017 Jul 13;7(7):CD004104.
doi: 10.1002/14651858.CD004104.pub4.

Non-invasive ventilation for the management of acute hypercapnic respiratory failure due to exacerbation of chronic obstructive pulmonary disease

Christian R Osadnik [1], Vanessa S Tee, Kristin V Carson-Chahhoud, Joanna Picot, Jadwiga A Wedzicha, Brian J Smith

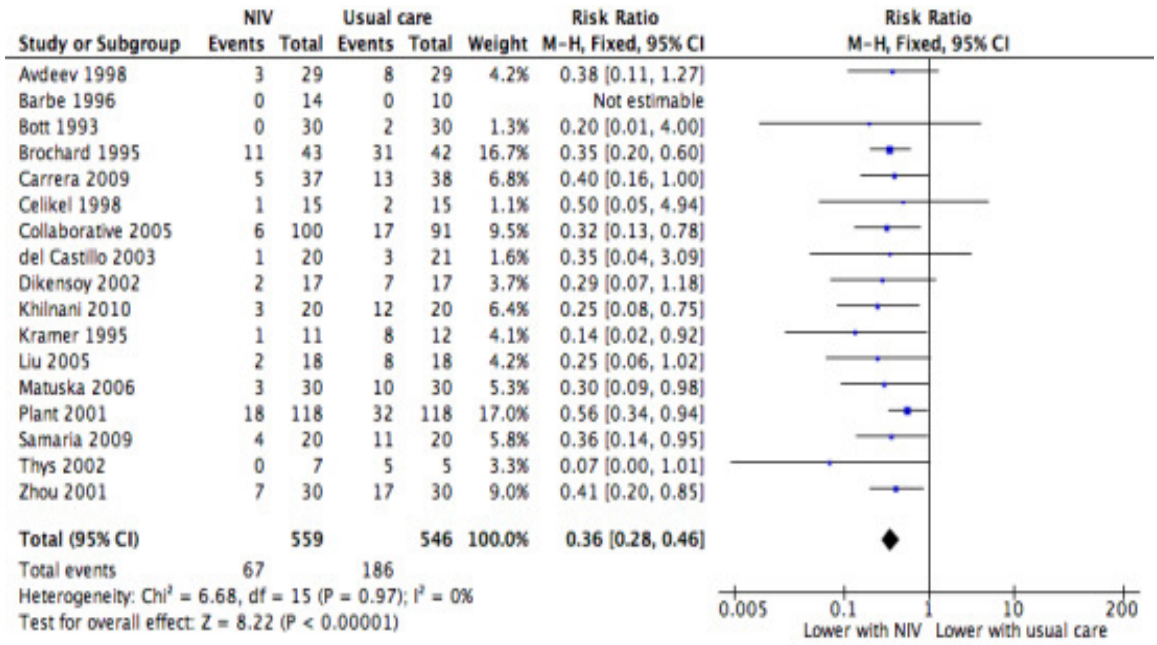
Affiliations + expand

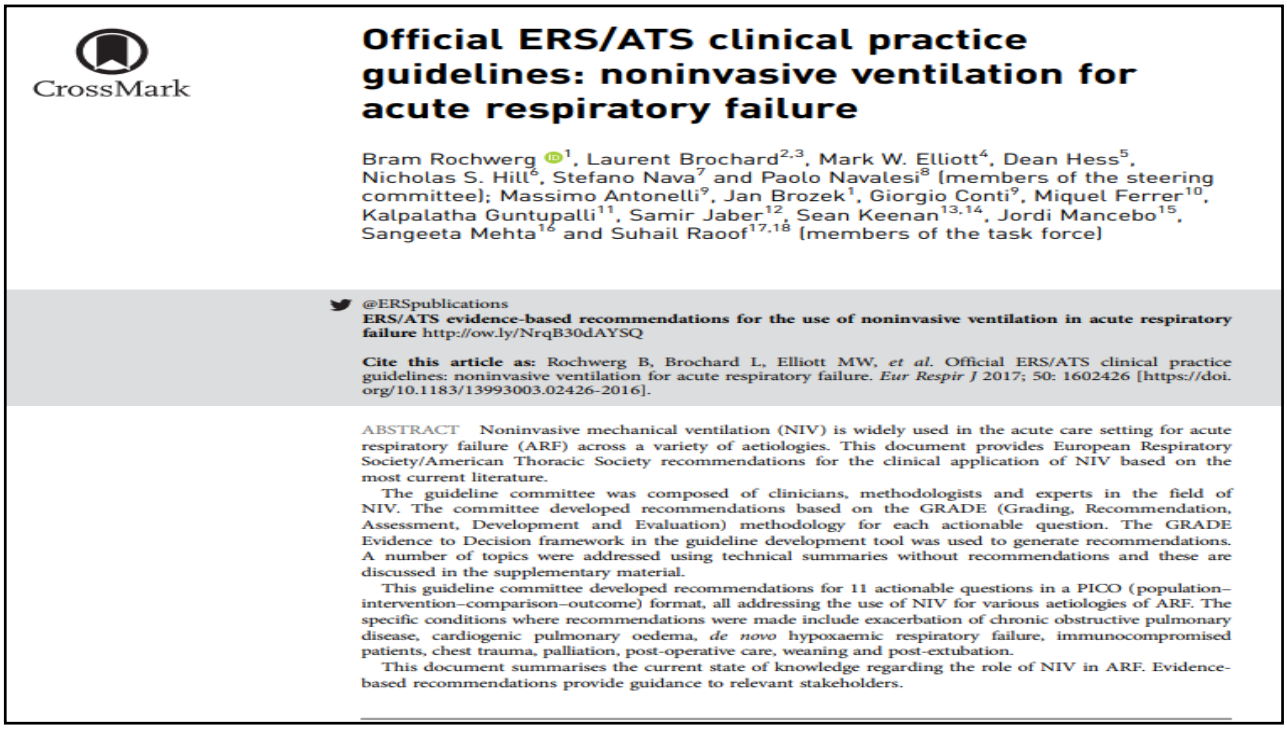
PMID: 28702957 PMCID: PMC6483555 DOI: 10.1002/14651858.CD004104.pub4
Free PMC article

Abstract

Background: Non-invasive ventilation (NIV) with bi-level positive airway pressure (BiPAP) is commonly used to treat patients admitted to hospital with acute hypercapnic respiratory failure (AHRF) secondary to an acute exacerbation of chronic obstructive pulmonary disease (AECOPD).

Objectives: To compare the efficacy of NIV applied in conjunction with usual care versus usual care involving no mechanical ventilation alone in adults with AHRF due to AECOPD. The aim of this review is to update the evidence base with the goals of supporting clinical practice and providing recommendations for future evaluation and research.





Official ERS/ATS clinical practice guidelines: noninvasive ventilation for acute respiratory failure

Bram Rochwerg[1], Laurent Brochard[2,3], Mark W. Elliott[4], Dean Hess[5], Nicholas S. Hill[6], Stefano Nava[7] and Paolo Navalesi[8] (members of the steering committee); Massimo Antonelli[9], Jan Brozek[1], Giorgio Conti[9], Miquel Ferrer[10], Kalpalatha Guntupalli[11], Samir Jaber[12], Sean Keenan[13,14], Jordi Mancebo[15], Sangeeta Mehta[16] and Suhail Raoof[17,18] (members of the task force)

@ERSpublications
ERS/ATS evidence-based recommendations for the use of noninvasive ventilation in acute respiratory failure http://ow.ly/NrqB30dAYSQ

Cite this article as: Rochwerg 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 [https://doi.org/10.1183/13993003.02426-2016].

ABSTRACT Noninvasive mechanical ventilation (NIV) is widely used in the acute care setting for acute respiratory failure (ARF) across a variety of aetiologies. This document provides European Respiratory Society/American Thoracic Society recommendations for the clinical application of NIV based on the most current literature.

The guideline committee was composed of clinicians, methodologists and experts in the field of NIV. The committee developed recommendations based on the GRADE (Grading, Recommendation, Assessment, Development and Evaluation) methodology for each actionable question. The GRADE Evidence to Decision framework in the guideline development tool was used to generate recommendations. A number of topics were addressed using technical summaries without recommendations and these are discussed in the supplementary material.

This guideline committee developed recommendations for 11 actionable questions in a PICO (population–intervention–comparison–outcome) format, all addressing the use of NIV for various aetiologies of ARF. The specific conditions where recommendations were made include exacerbation of chronic obstructive pulmonary disease, cardiogenic pulmonary oedema, *de novo* hypoxaemic respiratory failure, immunocompromised patients, chest trauma, palliation, post-operative care, weaning and post-extubation.

This document summarises the current state of knowledge regarding the role of NIV in ARF. Evidence-based recommendations provide guidance to relevant stakeholders.

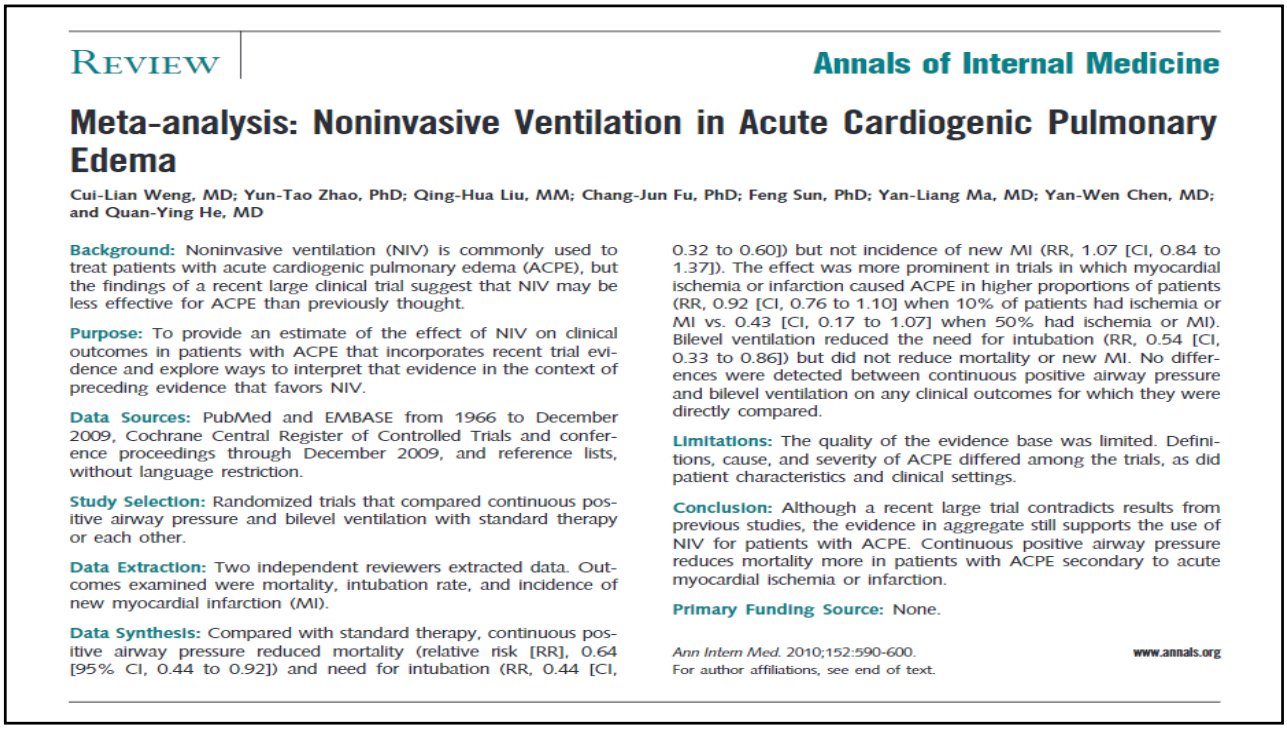
Acute cardiogenic pulmonary edema

In patients with acute cardiogenic pulmonary edema, NIV is thought to:

Reduce preload

Prevent alveolar collapse at the end of expiration

Improve cardiac output by decreasing left ventricular afterload



REVIEW | Annals of Internal Medicine

Meta-analysis: Noninvasive Ventilation in Acute Cardiogenic Pulmonary Edema

Cui-Lian Weng, MD; Yun-Tao Zhao, PhD; Qing-Hua Liu, MM; Chang-Jun Fu, PhD; Feng Sun, PhD; Yan-Liang Ma, MD; Yan-Wen Chen, MD; and Quan-Ying He, MD

Background: Noninvasive ventilation (NIV) is commonly used to treat patients with acute cardiogenic pulmonary edema (ACPE), but the findings of a recent large clinical trial suggest that NIV may be less effective for ACPE than previously thought.

Purpose: To provide an estimate of the effect of NIV on clinical outcomes in patients with ACPE that incorporates recent trial evidence and explore ways to interpret that evidence in the context of preceding evidence that favors NIV.

Data Sources: PubMed and EMBASE from 1966 to December 2009, Cochrane Central Register of Controlled Trials and conference proceedings through December 2009, and reference lists, without language restriction.

Study Selection: Randomized trials that compared continuous positive airway pressure and bilevel ventilation with standard therapy or each other.

Data Extraction: Two independent reviewers extracted data. Outcomes examined were mortality, intubation rate, and incidence of new myocardial infarction (MI).

Data Synthesis: Compared with standard therapy, continuous positive airway pressure reduced mortality (relative risk [RR], 0.64 [95% CI, 0.44 to 0.92]) and need for intubation (RR, 0.44 [CI, 0.32 to 0.60]) but not incidence of new MI (RR, 1.07 [CI, 0.84 to 1.37]). The effect was more prominent in trials in which myocardial ischemia or infarction caused ACPE in higher proportions of patients (RR, 0.92 [CI, 0.76 to 1.10] when 10% of patients had ischemia or MI vs. 0.43 [CI, 0.17 to 1.07] when 50% had ischemia or MI). Bilevel ventilation reduced the need for intubation (RR, 0.54 [CI, 0.33 to 0.86]) but did not reduce mortality or new MI. No differences were detected between continuous positive airway pressure and bilevel ventilation on any clinical outcomes for which they were directly compared.

Limitations: The quality of the evidence base was limited. Definitions, cause, and severity of ACPE differed among the trials, as did patient characteristics and clinical settings.

Conclusion: Although a recent large trial contradicts results from previous studies, the evidence in aggregate still supports the use of NIV for patients with ACPE. Continuous positive airway pressure reduces mortality more in patients with ACPE secondary to acute myocardial ischemia or infarction.

Primary Funding Source: None.

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For author affiliations, see end of text.

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New search | Conclusions changed

Non-invasive positive pressure ventilation (CPAP or bilevel NPPV) for cardiogenic pulmonary oedema

Flávia MR Vital, Magdaline T Ladeira, Álvaro N Atallah Authors' declarations of interest

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https://doi.org/10.1002/14651858.CD005351.pub3

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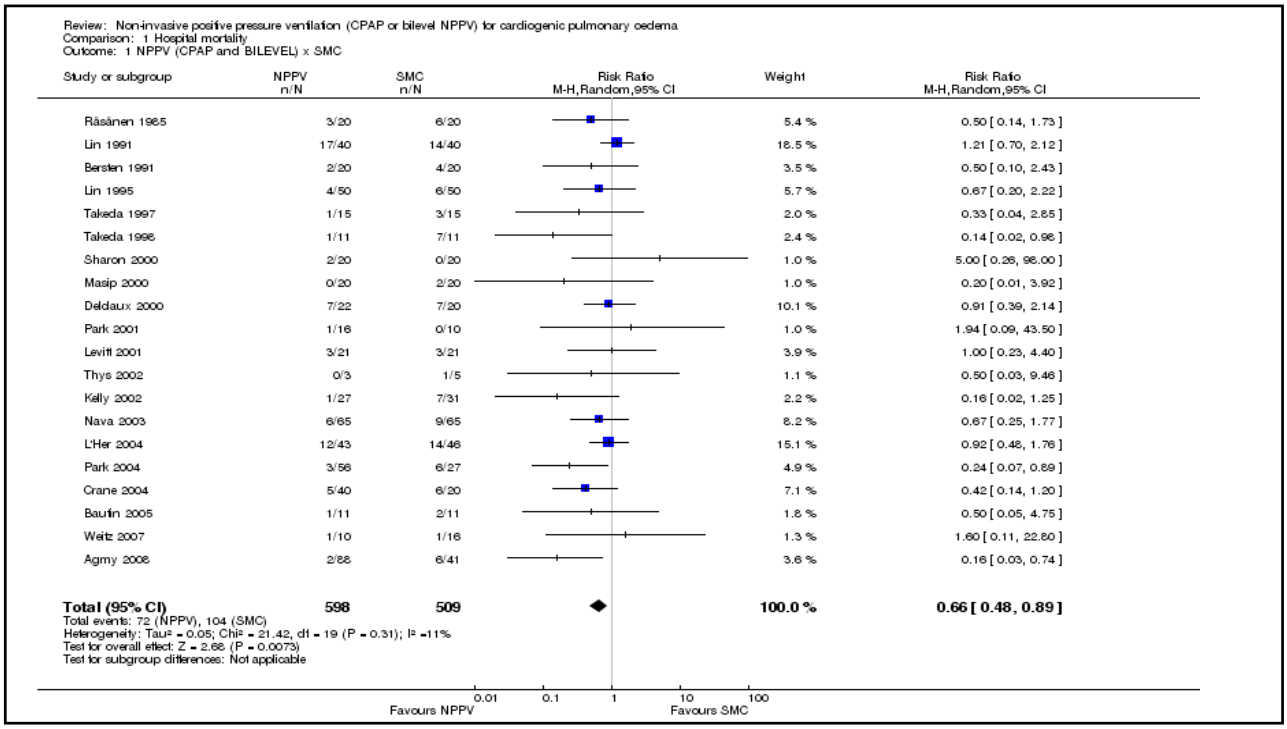
Abstract

Available in English | Español | Français | Português | 简体中文 | 繁體中文

Background

This is an update of a systematic review previously published in 2008 about non-invasive positive pressure ventilation (NPPV). NPPV has been widely used to alleviate signs and symptoms of respiratory distress due to cardiogenic pulmonary oedema. NPPV prevents alveolar collapse and helps redistribute intra-alveolar fluid, improving pulmonary compliance and reducing the pressure of breathing.

Objectives



Respiratory conditions that are less likely to benefit from NIV

- Non-hypercapnic hypoxemic respiratory failure NOT due to acute cardiogenic pulmonary edema
- Acute non-hypercapnic respiratory failure due to acute exacerbation of COPD
- Pneumonia
- Patients that are immunosuppressed
- Asthma patients
- Patients with ARDS
- Asthma exacerbation
- Post-extubation respiratory failure (more evidence on pts with chronic hypercapnia)
- Postoperative respiratory failure
- Chest trauma-induced respiratory failure

J Anesth (2017) 31:714–725
DOI 10.1007/s00540-017-2389-0

ORIGINAL ARTICLE

Effects of non-invasive ventilation in patients with acute respiratory failure excluding post-extubation respiratory failure, cardiogenic pulmonary edema and exacerbation of COPD: a systematic review and meta-analysis

Yutaka Kondo[1] · Junji Kumasawa[2,3] · Atsushi Kawaguchi[4,5] · Ryutaro Seo[6] · Eishu Nango[7] · Satoru Hashimoto[8]

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Abstract
Background This meta-analysis compared the effects of non-invasive ventilation (NIV) with invasive mechanical ventilation (InMV) and standard oxygen (O_2) therapy on mortality and rate of tracheal intubation in patients presenting acute respiratory failure (ARF).
Methods We searched the MEDLINE, EMBASE and Cochrane Central Register of clinical trials databases between 1949 and May 2015 to identify randomized trials of NIV for ARF. We excluded the ARF caused by extubation, cardiogenic pulmonary edema, and COPD.
Results The meta-analysis included 21 studies and 1691 patients, of whom 846 were assigned to NIV and 845 to control (InMV or standard O_2 therapy). One hundred ninety-one patients (22.6%) in the NIV group and 261 patients (30.9%) in the control group died before discharge from hospital. The pooled odds ratio (OR) for short-term mortality (in-hospital mortality) was 0.56 (95% CI 0.40–0.78). When comparing NIV with standard O_2 therapy, the short-term mortality was 155 (27.4%) versus 204 (36.0%), respectively. For this comparison, the pooled OR of short-term mortality was 0.56 (95% CI 0.36–0.85). When comparing NIV with InMV, the short-term mortality was 36 (12.9%) versus 57 (20.5%) patients, respectively. For this comparison, the pooled OR of short-term mortality was 0.56 (95% CI 0.34–0.90). Tracheal intubation was performed in 106 patients (22.7%) in the NIV and in 183 patients (39.4%) in the standard O_2 group, representing a pooled OR of 0.37 (95% CI 0.25–0.55). There were publication biases and the quality of the evidence was graded as low.
Conclusion Compared with standard O_2 therapy or InMV, NIV lowered both the short-term mortality and the rate of tracheal intubation in patients presenting with ARF.

Contraindications

- Need for emergent intubation
- Acute life-threatening non-respiratory organ failure
- Facial surgery or trauma
- Significant airway obstruction
- Inability to protect the airway
- Anticipated prolong duration of ventilation

Protocol for initiation of noninvasive ventilation

Initiation

- Appropriately monitored location, oximetry, respiratory impedance, vital signs as clinically indicated
- Patient in bed or chair at >30-degree angle
- Select and fit interface
- Select ventilator
- Apply headgear; avoid excessive strap tension (one or two fingers under strap)
- Connect interface to ventilator tubing and turn on ventilator

Initial settings

Bilevel NIV	CPAP	PSV
▪ Start with low pressure in spontaneously triggered mode with backup rate: Inspiratory pressure at 8 to 12 cm H_2O; Expiratory pressure at 3 to 5 cm H_2O ▪ Gradually increase inspiratory pressure (10 to 20 cm H_2O) as tolerated to achieve alleviation of dyspnea, decreased respiratory rate, increased tidal volume (if being monitored), and good patient-ventilator synchrony ▪ Provide O_2 supplementation as needed to keep O_2 saturation >90%	▪ CPAP level at 5 to 8 cm H_2O ▪ Gradually increase CPAP level as tolerated (up to 20 cm H_2O) to achieve improvement in dyspnea and reduction in respiratory rate ▪ Provide O_2 supplementation as needed to keep O_2 saturation >90%	▪ Inspiratory pressure at 8 to 12 cm H_2O ▪ Positive end-expiratory pressure at 3 to 5 cm H_2O ▪ Gradually increase inspiratory pressure to maximum of 20 cm H_2O to achieve improvement in dyspnea and reduction in respiratory rate

Follow-up

- Check for air leaks, readjust straps as needed
- Add humidifier as indicated
- Consider mild sedation (eg, intravenously administered lorazepam 0.5 mg) in agitated patients*
- Encouragement, reassurance, and frequent checks and adjustments as needed
- Monitor occasional blood gases (within 1 to 2 hours) and then as needed

NIV: noninvasive ventilation; CPAP: continuous positive airway pressure; PSV: pressure support ventilation.

* Care should be taken when using sedatives in patients with underlying lung disorders, especially those with respiratory muscle weakness or neuromuscular disorders.

Summary

- NIV can help your patient with respiratory failure
- Evidence is strongest in ARF due to AECOPD and Cardiogenic pulmonary edema
- Requires reassessment
- If patients continue to decline after two hours of NIV trial, it is time to consider transfer to ICU and intubation
- Work closely with RT and bedside nurses


ANY
QUESTIONS
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