Respiratory Medicine (2006) **100**, 2235–2238

respiratoryMEDICINE

SHORT COMMUNICATION

Is there a role for noninvasive ventilation in acute respiratory distress syndrome? A meta-analysis

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Received 6 November 2005; accepted 18 March 2006

KEYWORDS
Noninvasive positive pressure ventilation;
Noninvasive ventilation;
Acute respiratory distress syndrome;
Acute respiratory failure;
Endotracheal intubation;
Mortality;
Meta-analysis

Summary The role of noninvasive ventilation (NIV) in the management of acute respiratory distress syndrome (ARDS) is controversial. The aim of this study was to assess the effect of NIV on the rate of endotracheal intubation and intensive care unit (ICU) mortality in patients with ARDS. We searched the MEDLINE database for relevant studies published from 1980 to September 2005, and included studies if (a) the design was a randomized controlled trial; (b) patients had ARDS irrespective of the underlying etiology; (c) the interventions compared NIV and medical therapy with medical therapy alone; and (d) outcomes included need for endotracheal intubation and/or ICU survival. The addition of NIV to standard care in the setting of ARDS did not reduce the rate of endotracheal intubation (absolute risk reduction (RR) 13.5%, 95% confidence interval (CI) −5.2% to 31.3%), and had no effect on ICU survival (absolute RR 4.8%, 95% CI −12.8% to 22.1%). However, the trial results were significantly heterogeneous.

Thus, current evidence suggests that patients with ARDS are unlikely to have any significant benefits on outcome when NIV is added to standard therapy. However, this analysis is limited by the presence of significant heterogeneity; hence large randomized controlled trials are required to settle this issue.

Introduction

Noninvasive ventilation (NIV) is the application of ventilatory support without an invasive endotracheal airway. This form of ventilatory support has been successfully applied for diverse forms of respiratory failure.[1] It not only reduces the need for endotracheal intubation and the complications associated with invasive ventilation but in specific instances also decreases mortality.[2,3] However, the role of NIV in acute respiratory distress syndrome (ARDS) is at best controversial, and there is sparse

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doi:10.1016/j.rmed.2006.03.018

clinical evidence on the choice of patients who are likely to benefit from NIV.[4,5] One recently published systematic review found NIV to be efficacious in decreasing endotracheal intubation and improving intensive care unit (ICU) survival.[6] However, it did not specifically include patients with ARDS. The aim of this report was to systematically analyze the role of NIV on the rates of endotracheal intubation and ICU mortality, specifically in the subgroup of patients with ARDS.

Methods

Search strategy

We searched the National Library of Medicine's MEDLINE from 1980 to September 2005, for articles, limiting the search to randomized controlled trials and clinical trials (no language restrictions), using the keywords: NIV, noninvasive positive pressure ventilation, nasal ventilation, bipap, cpap, bilevel positive airway pressure or continuous positive airway pressure (CPAP). We reviewed the reference lists of all identified studies and reviews, and hand-searched our personal files.

Selection criteria

We used the following criteria to select articles: (a) study design was a randomized controlled trial; (b) study population with ARDS, i.e. acute onset, bilateral pulmonary infiltrates, $PaO_2/FiO_2 < 200$ on room air, no clinical evidence of cardiac cause for the pulmonary infiltrates. There were no restrictions on the proportion of patients with ARDS in a specific study; (c) the intervention included NIV and standard therapy vs. standard therapy alone; and (d) outcomes included the need for endotracheal intubation and ICU mortality (and if not available hospital mortality).

Data abstraction

Study description

Independently and in duplicate, two of the authors (R.A., C.R.) abstracted data from these trials. Information abstracted included the objective, patient population, setting, description of method used to apply NIV, outcomes, criteria and definitions used, study results, and publication status. Differences in opinion were settled by consensus or after consultation with a third author.

Analysis

For the clinical outcomes, we calculated the risk difference (RD) and 95% confidence intervals (CI) using the statistical package Review Manager (RevMan; Version 4.2.8 for Windows; Oxford, England; The Cochrane Collaboration, 2003). The RD from individual studies was pooled using the random effects model. We tested heterogeneity between trials with χ^2 tests, with $P \leqslant 0.05$ indicating significant heterogeneity. We also evaluated statistical heterogeneity using the I^2 statistic, which measures the extent of inconsistency among the studies' results and is interpreted as approximately the proportion of total variation in study estimates that is due to heterogeneity rather than sampling error. An I^2 value greater than 50% indicates significant heterogeneity. Finally, visual inspection of the Forest plots was also used to qualitatively assess heterogeneity.

Results

Study selection

Our initial electronic searches yielded 1098 studies. Of these, 693 studies were excluded as they did not evaluate NIV, 382 studies were excluded as they evaluated NIV but not acute hypoxemic respiratory failure and 20 trials were excluded as they involved acute hypoxemic respiratory failure but not specifically ARDS or were not randomized controlled trials. Only three randomized controlled trials, all fully published, met our selection criteria.[7–9]

Study description

All trials were prospective, randomized and had described their treatment protocol clearly (Table 1). Two studies had used concealed randomization,[7,8] but none were blinded. All studies provided data on endotracheal intubation and ICU and/or hospital mortality. Of the four trials, one was a multi-center[8] and two were single center studies.[7,9]

No trial specifically included patients with ARDS, and all trials included patients with varied causes of acute hypoxemic respiratory failure but provided data on the ARDS patients separately.[7–9] The patient populations with ARDS enrolled in these four trials were diverse, and included immunocompetent[7,9] and immunosuppressed patients,[8] both pulmonary[7–9] and extrapulmonary causes of ARDS.[7,8] The details regarding the noninvasive ventilators, the modes, the interfaces and the