Respiratory Medicine 131 (2017) 58–64

Contents lists available at ScienceDirect

Respiratory Medicine

journal homepage: www.elsevier.com/locate/rmed

Review article

Does high-flow nasal cannula oxygen improve outcome in acute hypoxemic respiratory failure? A systematic review and meta-analysis

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ARTICLE INFO

Article history:
Received 5 March 2017
Received in revised form
16 June 2017
Accepted 7 August 2017
Available online 9 August 2017

Keywords:
High flow nasal cannula
Acute respiratory failure
Meta-analysis
Systematic review

ABSTRACT

Introduction: To evaluate the efficacy of high-flow nasal cannula (HFNC) in the rate of intubation and mortality for patients with acute hypoxemic respiratory failure.
Methods: We searched Pubmed, EMBASE, and the Cochrane Library for relevant studies. Two reviewers extracted data and reviewed the quality of the studies independently. The primary outcome was the rate of intubation; secondary outcome was mortality in the hospital. Study-level data were pooled using a random-effects model when I2 was >50% or a fixed-effects model when I2 was <50%.
Results: Eight randomized controlled studies with a total of 1,818patients were considered. Pooled analysis showed that no statistically significant difference was found between groups regarding the rate of intubation (odds ratio [OR] = 0.79; 95% confidence interval [CI]: 0.60–1.04; P = 0.09; I2 = 36%) and no statistically significant difference was found between groups regarding hospital mortality (OR = 0.89; 95% CI: 0.62–127; P = 0.51; I2 = 47%).
Conclusions: The use of HFNC showed a trend toward reduction in the intubation rate, which did not meet statistical significance, in patients with acute respiratory failure compared with conventional oxygen therapy (COT) and noninvasive ventilation (NIV). Moreover no difference in mortality. So, Large, well-designed, randomized, multi-center trials are needed to confirm the effects of HFNC in acute hypoxemic respiratory failure patients.

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http://dx.doi.org/10.1016/j.rmed.2017.08.005
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1. Introduction

Good tolerance [1–5], fewer skin breakdown [6], and a lower nurse workload [7] of high-flow nasal cannula (HFNC) has been reported compared with non-invasive ventilation (NIV), Consequently, HFNC is nowadays widely studied in the patients with hypoxemic respiratory failure. HFNC involves delivery of heated and humidified oxygen via special devices (eg, Vapotherm, Comfort Flo, or Optiflow) at rates up to 8 L/min in infants and up to 60 L/min in children and adults [8]. In patients with respiratory distress or failure, humidified high-flow nasal cannula may be better tolerated than oxygen by face mask in terms of comfort and, in observational studies, has been associated with decreased respiratory rate, decreased work of breathing, and better oxygenation in patients of all ages [8–10].

In patients with acute hypoxemic respiratory failure, high-flow oxygen therapy by nasal cannula is a reasonable alternative to standard oxygen therapy or noninvasive positive pressure ventilation. Whether HFNC can reduce the need for intubation or mortality in acute respiratory failure (ARF) patients. The first results were reported in a randomized controlled trial (RCT) which included postoperative cardiac surgery patients with ARF [11]. HFNC patients were less likely to need escalation to noninvasive ventilation (NIV) than those receiving conventional oxygen devices and also had fewer desaturations. More recently, the first large RCT to assess clinical outcomes with HFNC,conventional oxygen devices, and NIV has been published [3]. HFNC group did not result in significantly different intubation rates, but has a significantly difference in 90-day mortality. Additional RCTs including patients with acute hypoxemic respiratory failure have produced conflicting results [2,4,5,7,12–14].

Therefore, we performed a systematic literature review and meta-analysis to determine the effect of the addition of HFNC to standard therapy or NIV on intubation and mortality, using the rate of intubation as the primary outcome, and mortality as secondary outcomes.

2. Materials and methods

2.1. Data sources and search strategy

To identify studies for inclusion in this review, two authors independently searched PubMed, EMBASE, and the Cochrane Central Database of Controlled Trials for relevant studies published up to September 2016. The search was limited to studies conducted with humans. Search terms were individualized for each database. Search terms used included: [‘high-flow nasal cannula’ OR ‘nasal high flow’ OR ‘high-flow nasal oxygen therapy’ OR ‘nasal high-flow oxygen’ OR ‘high-flow nasal oxygen’ OR ‘humidified high-flow nasal cannula’ OR ‘heated and humidified high-flow nasal oxygen’ OR ‘Optiflow’ OR ‘Vapotherm’ OR ‘Comfort Flo’] AND [‘respiratory insufficiency’ OR ‘acute respiratory failure’ OR ‘acute respiratory distress syndrome’ OR ‘Ventilatory Depression’ OR ‘dyspnea’]. We also searched the proceedings of major relevant conferences, trial databases, the reference lists of identified trials, and major reviews. We had no language restrictions.

2.2. Study selection

Two reviewers (S.M. Lin and K.X. Liu) independently screened studies for inclusion, retrieved potentially relevant studies, and determined study eligibility. Any discrepancies were resolved by consensus. Analysis was restricted to randomized controlled trials (RCTs). For this meta-analysis, we considered those RCTs that compared administration of HFNC vs conventional oxygen therapy (COT) and noninvasive ventilation (NIV) in acute hypoxemic respiratory failure and not requiring immediate ventilatory support patients (such as those admitted to an ICU or emergency department), and which reported the incidence of the rate of intubation, or mortality.

2.3. Data extraction

Two authors independently extracted data from all of the enrolled studies. Extracted data included study design (e.g., year conducted, sample size), patient characteristics, study methodology (e.g., eligibility criteria, method of randomization, and blinding), intervention (e.g., gas flow rate, FIO2), and clinical outcomes (e.g., incidence of the rate of intubation, mortality, tolerability,comfort). Differences in opinion were settled by consensus or after consultation with a third investigator.

2.4. Quality assessment

We formally assessed the methodological quality of each trial using the “risk of bias” tool within RevMan Review Manager, Version 5.3. Random sequence generation, allocation concealment, blinding, incomplete data, and selective reporting were assessed; based on the method of the trials, each was graded “yes,” “no,” or “unclear,” which reflected a high risk of bias, low risk of bias, and uncertain bias, respectively. Two reviewers (S.M. Lin and K.X. Liu) independently appraised the quality of the included trials.

2.5. Statistical analysis

The meta-analysis was done using Revman version 5.3 for Windows. We computed pooled odds ratios (OR) and 95% confidence intervals (CI) from the adjusted ORs and 95% CIs reported in the RCT studies. We used the chi-square test and I2 statistics to assess the heterogeneity of study results. We predefined heterogeneity as low, moderate, and high with I2 values of above 25%, 50%, and 75%, respectively. In the analysis of heterogeneity, we considered a P value < 0.10 to be statistically significant. Study-level data were pooled using a random-effects model when I2 was >50% or a fixed-effects model when I2 was <50%.Publication bias was assessed by a funnel plot using the need for intubation as an endpoint.

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