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Review

Incidence of ventilator associated pneumonia in burn patients with inhalation injury treated with high frequency percussive ventilation versus volume control ventilation: A systematic review

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ABSTRACT

Background: Pneumonia increases mortality in burn patients with inhalation injuries. We evaluated whether the use of High Frequency Percussive Ventilation (HFPV) in burn patients with inhalation injuries can decrease rates of Ventilator Associated Pneumonia (VAP) compared to Volume Control Ventilation (VCV).

Methods: Data were gathered from PubMed, EMBASE, Web of Science, reference lists, and hand search. For unpublished data we searched ClinicalTrials.gov and RePORTER. We included observational and Randomized Controlled Trials (RCTs) that compared rates of VAP with the use of HFPV and VCV in adult burn patients with inhalation injury. Two reviewers independently extracted data from the retrieved studies and assessed them for eligibility, methodology, and quality.

Results: 281 abstracts were reviewed, of which 4 studies (540 patients) were included. Two were observational and two were RCTs. All studies had moderate risk of bias. One study had low external validity while others had moderate external validity. The two observational studies found non-concordant results. One study found a 24% statistically significant reduction in the rates of VAP while the other found no difference. The two RCTs had small

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sample sizes. There was no significant difference in VAP rates between HFPV and VCV. The VCV arms of the four studies were heterogeneous. Only one study used low tidal volumes, whereas the rest used high tidal volumes in the VCV arm.

Conclusion: Evidence about decreased incidence of VAP in burn patients with inhalation injuries who are on HFPV compared to those on VCV is inconclusive. Although enhanced airway clearance by HFPV was thought to play a role in decreasing VAP in this population, high tidal volume in the VCV arms could be a confounding factor that should be eliminated in future studies before a firm conclusion can be reached. More RCTs comparing HFPV to low tidal volume VCV are needed.

Contents

1. Introduction

With the advances in the burn wounds care, the epidemiology of infection has changed and pneumonia has become the most frequent infection in this population [1]. Inhalation injuries occur in up to one third of burn patients with many receiving mechanical ventilation [2]. In December 2013, the National Healthcare Safety Network published their report about device associated infections that occurred in the year 2012 in 4444 health care facilities across the U.S.A.

Burn Critical Care Units had the highest number of VAP per ventilator days. This surpassed even trauma, neurosurgical, and major teaching hospitals' Critical Care Units [3]; the ones that are expected to have the most vulnerable patients to VAP. The incidence of pneumonia is twice as high in burn patients with inhalation injury compared to those without it [4]. There are different reasons that burn patients with inhalation injuries may represent a more susceptible population to VAP than other critically ill mechanically ventilated patients. First, many burn patients are intubated emergently in the field or in the Emergency Department (ED). Field and ED intubation has been shown to increase the incidence of VAP compared to intubations in controlled settings [5]. Moreover, inhalation injuries impair the mucociliary clearance and can injure the alveolar macrophages which are the last defense line in the respiratory tract [6]. Animal models showed that debris from inhalation injuries caused airway occlusion and atelectasis. This was followed by Bacterial colonization and bronchopneumonia [7]. The emergence of HFPV intrigued physicians caring for burn patients that it may improve secretion clearance [8,9]. InHFPV, a phasitron allows the administration of high frequency subtidal volumes in mini bursts providing a percussive effect. A continuous Positive Airway Pressure (CPAP) is usually used between these mini bursts to keep the recruited lungs open. The percussive bursts loosen secretions which get expelled outwards by the laminar flow of high frequency ventilation. The cuff of the endotracheal tube is partially deflated to aid with removal of secretions [10,11]. This review examines the incidence of VAP in burn patients with inhalation injuries when HFPV is used compared to VCV.

2. Materials and methods

Two reviewers (H.A. and G.M.) conducted the literature search, beginning on April 12th, 2015, and evaluated all relevant studies. When further information was needed three attempts were made to contact the study authors.

2.1. Inclusion and exclusion criteria

We included RCTs and observational studies in adult burn patients with inhalation injuries that compared HFPV to VCV and examined the incidence of VAP. We searched the English literature in PubMed, EMBASE, and Web of Science databases using the keywords (High Frequency Percussive Ventilation) OR (Percussive Ventilation) OR (Percussionaire) AND (Ventilator Associated Pneumonia) OR (VAP) OR (Pneumonia). However, this strategy yielded only 10 citations in PubMed, so we opted to search (High Frequency Percussive Ventilation) OR (Percussive Ventilation) OR (Percussionaire) which yielded 281