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Research

Multimodality respiratory physiotherapy reduces mortality but may not prevent ventilator-associated pneumonia or reduce length of stay in the intensive care unit: a systematic review

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KEY WORDS

Respiratory physical therapy
Meta-analysis
Mortality
Prevention
Ventilator-associated pneumonia

ABSTRACT

Question: In intubated adult patients receiving mechanical ventilation, does multimodality respiratory physiotherapy prevent ventilator-associated pneumonia, shorten length of intensive care unit (ICU) stay, and reduce mortality? **Design**: A systematic review with meta-analysis of randomised controlled trials. **Participants**: Intubated adult patients undergoing mechanical ventilation who were admitted to an intensive care unit. **Intervention**: More than two respiratory physiotherapy techniques such as positioning or postural drainage, manual hyperinflation, vibration, rib springing, and suctioning. **Outcomes measures**: Incidence of ventilator-associated pneumonia (VAP), duration of ICU stay, and mortality. **Results**: Five trials were included in the meta-analysis. Random-effects models were used to calculate pooled weighted mean difference (WMD) for length of ICU stay and pooled risk ratio (RR) for incidence of VAP, and fixed-effects model was used to calculate pooled RR for mortality. The effect on the incidence of VAP was unclear (RR 0.73 in favour of multimodality respiratory physiotherapy, 95% CI 0.38 to 1.07). The effect on length of stay was also unclear (WMD –0.33 days shorter with multimodality respiratory physiotherapy, 95% CI –2.31 to 1.66). However, multimodality respiratory physiotherapy significantly reduced mortality (RR 0.75, 95% CI 0.58 to 0.92). **Conclusion**: Multimodality respiratory physiotherapy appeared to reduce mortality in ICU patients. It was unclear whether this occurred via a reduction in the incidence of VAP and/or length of stay because the available data provided very imprecise estimates of the effect of multimodality respiratory physiotherapy on these outcomes. These very imprecise estimates include the possibility of very worthwhile effects on VAP incidence and length of ICU stay; therefore, these outcomes should be the focus of further investigation in rigorous trials. **Registration**: PROSPERO CRD42018094202. **[Pozuelo-Carrascosa DP, Torres-Costoso A, Alvarez-Bueno C, Cavero-Redondo I, López Muñoz P, Martínez-Vizcaíno V (2018) Multimodality respiratory physiotherapy reduces mortality but may not prevent ventilator-associated pneumonia or reduce length of stay in the intensive care unit: a systematic review. *Journal of Physiotherapy* XX: XX–XX]**

Introduction

Ventilator-associated pneumonia (VAP) can be defined as hospital-acquired pneumonia that develops in intubated patients who have been receiving mechanical ventilation for at least 48 hours.[1] VAP is one of the highest-incidence hospital-acquired infections in intensive care units (ICU).[2] It is associated with increases in mortality, length of ICU stay, and healthcare costs.[3,4]

Many factors have been associated with an increased likelihood of developing VAP. These include pre-existing respiratory disease, supine body positioning, reduced consciousness level, type of ventilator circuit, and the presence of nasogastric, orogastric or endotracheal tubes.[5] The number of endotracheal intubations is also predictive, as are some personnel-related factors such as improper hand washing.[5]

The occurrence of VAP is closely linked to the endotracheal tube used to deliver mechanical ventilation because it produces irritation of the respiratory mucosa, and an increase in the amount of mucus as a consequence.[6] In addition, patients who receive mechanical ventilation through an endotracheal tube generally have lower levels of consciousness, which reduces their clearance of airway secretions because the cough reflex is decreased, thus increasing the risk of aspiration.[5,6]

Respiratory physiotherapy is a generic term for a range of techniques used to promote airway secretion clearance and lung expansion. The techniques that are often used in the ICU include positioning of the patient for airway secretion drainage, manual

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lung hyperinflation, and percussion or vibration of the chest wall. The aim of using these techniques is to facilitate the transport of secretions and remove them from the airways, thus improving alveolar ventilation and ventilation/perfusion matching.[7,8,9]

Although traditionally these techniques have been widely used, a Cochrane systematic review concluded that respiratory physiotherapy did not reduce mortality and had no benefit for the cure rate of pneumonia in adults.[7] However, that review considered the use of respiratory physiotherapy only as a treatment for VAP, so it did not examine the use of respiratory physiotherapy to prevent VAP.[7]

Existing publications remain unclear about the potential effects of respiratory physiotherapy on the prevention of VAP in intubated patients receiving mechanical ventilation. A systematic review published in 2013 determined that the evidence about the effects of multimodality respiratory physiotherapy for intubated adult patients undergoing mechanical ventilation remains controversial.[10] At around the same time, some clinical practice guidelines[11–13] concluded that there was not enough evidence to recommend respiratory physiotherapy routinely or as a standard preventive measure for patients known to be at risk of VAP.

Given that subsequent studies may have generated additional data, the aim of the present systematic review and meta-analysis was to synthesise the current evidence regarding whether multimodality respiratory physiotherapy prevents VAP, reduces the duration of ICU stay, and decreases mortality.

Therefore, the research question for this systematic review was:

In intubated adult patients receiving mechanical ventilation, does multimodality respiratory physiotherapy prevent ventilator-associated pneumonia, shorten length of intensive care unit stay, and reduce mortality?

Methods

The meta-analyses follow the recommendations of the Cochrane Handbook for Systematic Reviews of Interventions.[14] The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were used as a reporting structure for this systematic review.[15]

Identification and selection of studies

Five databases were searched from inception to 13 April 2018: Web of Science, EMBASE (via Scopus), the Physiotherapy Evidence Database (PEDro), Medline (via PubMed), and CINAHL. In addition, when relevant full-text articles and systematic reviews were identified in the database search results, the reference lists were hand searched for relevant studies. The search strategy combined: terms for 'chest physiotherapy'; terms for 'prevention' or 'effect'; terms for 'ventilator-associated pneumonia'; and terms for 'incidence' or 'mortality'. More details of how these terms were combined and truncated are presented in Appendix 1 on the eAddenda. The syntax of the searches was modified to suit each database. Language restrictions were not applied.

Two reviewers (DPP-C and AT-C) independently evaluated the records in the search results by title and abstract. Duplicates and records deemed irrelevant based on their title and abstract were removed. The two reviewers then retrieved the remaining articles in full text and independently determined their eligibility. The reviewers were not blinded to authors, journals or institutions. Disagreements were resolved by discussion or, if disagreement persisted, a third reviewer arbitrated (VM-V). When a study had published multiple reports, the article in which the sample was largest was included. To be deemed eligible, studies had to meet the inclusion criteria listed in Box 1.

Studies were excluded if they did not meet those inclusion criteria or if the experimental and control interventions differed only in their duration.

Box 1. Inclusion criteria.

Design
- Randomised controlled trials

Participants
- Intubated patients in an ICU
- Mechanically ventilated for more than 48 hours

Intervention
- More than two chest physiotherapy techniques
  - positioning or postural drainage
  - manual hyperinflation
  - vibration or rib springing
  - suctioning

Comparisons
- Control group that did not receive more than two chest physiotherapy techniques
- Any other co-interventions (eg, usual care) were equivalent

Outcome measures
- Incidence of VAP
- Length of ICU stay
- Mortality

ICU = intensive care unit, VAP = ventilator-associated pneumonia

Assessment of characteristics of studies

Two investigators (DPP-C and AT-C) independently reviewed each included study and extracted the citation details, study aim, and information detailed in the following four sections.

Quality

The methodological quality of studies was assessed using the Cochrane Collaboration's tool for assessing risk of bias.[16] This tool evaluates the risk of bias according to six domains: selection bias (random sequence generation and allocation concealment), performance bias (blinding of participants and personnel), detection bias (blinding of outcome assessment), attrition bias (incomplete outcome data), reporting bias (selective reporting), and other bias. In this quality assessment tool, each domain could be considered as low risk, unclear risk or high risk of bias.

Participants

The following details of the participants were extracted for each study: sample size, age, gender, and Acute Physiology and Chronic Health Evaluation II (APACHE II) scores. The APACHE II score is used to rate the clinical severity of a patient in the ICU. The country of recruitment was also noted.

Interventions

The respiratory physiotherapy techniques applied to the experimental and control groups were noted. Data about the frequency and length of the respiratory physiotherapy sessions were extracted, where reported. The overall intervention period was characterised as either the duration or the total number of respiratory physiotherapy sessions.

Outcome measures

For the outcome of VAP incidence, the number of participants who developed VAP and the total number of participants were extracted for each group. The definition of VAP was also noted, although any definition used by the authors was accepted. For the length of stay outcome, the mean (SD) number of days spent in the ICU was noted. Where the SD was not reported, the SD was calculated from the SE, 95% CI or other measure of variability, if possible. For the mortality outcome, the number of participants who died and the total number of participants were extracted for each group.

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