Semi-recumbent position versus supine position for the prevention of ventilator-associated pneumonia in adults requiring mechanical ventilation (Protocol)

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Semi-recumbent position versus supine position for the prevention of ventilator-associated pneumonia in adults requiring mechanical ventilation

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ABSTRACT

This is the protocol for a review and there is no abstract. The objectives are as follows:

To assess the effectiveness and safety of semi-recumbent positioning versus supine positioning to prevent ventilator-associated pneumonia (VAP) in adults requiring mechanical ventilation.

BACKGROUND

Description of the condition

Ventilator-associated pneumonia (VAP) is a nosocomial pneumonia that can occur in patients receiving mechanical ventilation for a prolonged period (Kollef 2005), typically 48 to 72 hours after endotracheal intubation (Pieracci 2007). Early-onset VAP occurs 48 to 96 hours after intubation and late-onset VAP is usually seen 96 hours after intubation (Beth 2007).

VAP is a leading cause of death in patients on mechanical ventilation and is also associated with increased length of hospital stay and healthcare costs (Safdar 2005; Van Nieuwenhoven 2006; Warren 2003). The incidence of VAP varies between 9% and 27% in Europe and the USA (Craven 2000; Klompas 2007; Rea-Neto 2008) and is up to 41% in low-income countries (Rosenthal 2006). Data from the United States’ National Nosocomial Infection Surveillance (NNIS) system showed that 31% of nosocomial infections were nosocomial pneumonia (Richards 1999). Of those, 95% were associated with the use of mechanical ventilation (Ayesh 2012).

VAP is attributable to 20% to 50% of deaths in patients on mechanical ventilation; the mortality rate can be up to 70% in patients with multi-resistant infections (Rea-Neto 2008). One study reported that the mortality rate of patients with VAP is twice as high as patients without VAP (Safdar 2005). Therefore, preventing the development of VAP is critical in patients using mechanical ventilation.
Description of the intervention

Many strategies are available to reduce the incidence and serious complications of VAP (Caruso 2009; Dennis 2001; Subirana 2007; Van Nieuwenhoven 2004). Physical strategies include using the orotracheal route of intubation, airway humidification, using a closed endotracheal suctioning system, and continuous aspiration of subglottic secretions; and positional changes include the use of semi-recumbent positioning and prone positioning. Alternative strategies include pharmacological interventions (e.g. antibiotics) and system-level approaches, including strict infection control and microbiologic surveillance (El-Khatib 2010; Mohamad 2010; Muscedere 2008).

Several guidelines from the American Thoracic Society, the Infectious Diseases Society of America, the Centers for Disease Control and Prevention (CDC) and others have recommended semi-recumbent positioning (i.e. elevation of the head-of-bed to 45 degrees) for the prevention of VAP in mechanically ventilated patients (ATS-IDSA 2005; CDC 1997; Dodek 2004; El-Khatib 2010; Muscedere 2008). A randomised cross-over trial using radioactively-labelled gastric contents revealed that ventilated patients in a semi-recumbent position can reduce reflux of contaminated gastric contents and aspiration (Torres 1992). It also suggested that aspiration of contaminated oropharyngeal secretions and gastric contents is a major risk factor for VAP. Another randomised trial showed a threefold reduction in the incidence of VAP in mechanically ventilated patients using a semi-recumbent versus a supine position (Drakulovic 1999).

How the intervention might work

Contamination of oropharyngeal secretions and gastric contents with subsequent aspiration to lower airways are pathogenic factors for VAP (Orozco-Levi 1995). Supine positioning, gastric tubes and stomach contents lead to the reflux of gastric contents, aspiration and as a result, cause VAP. Semi-recumbent positioning may help avoid these problems and reduce VAP (Keeley 2007). Using radioactively-labelled enteral feeding, the risk of gastroesophageal reflux and aspiration was lower among patients in a semi-recumbent position than those in a completely supine position (Orozco-Levi 1995; Torres 1992).

Why it is important to do this review

While strategies for preventing VAP have been focused on the prevention of gastric colonisation and aspiration of infected gastric secretions (Collard 2003), semi-recumbent positioning has the advantage of being very convenient and of little cost to implement (Keeley 2007). A multi-centre observational study revealed that the majority of mechanically ventilated patients are positioned with their head-of-bed angle at less than 30 degrees (Reeve 1999). A head-of-bed positioning of less than 30 degrees was probably associated with an increased risk for VAP and mortality during the first 24 hours of mechanical ventilation (Fernández-Crehuet 1997; Kollef 1993). However, the finding was inconclusive.

OBJECTIVES

To assess the effectiveness and safety of semi-recumbent positioning versus supine positioning to prevent ventilator-associated pneumonia (VAP) in adults requiring mechanical ventilation.

METHODS

Criteria for considering studies for this review

Types of studies
We will include all randomised controlled trials (RCTs). We will also include abstracts and unpublished data. We will exclude cluster-randomised trials and cross-over trials because of the concern about ‘herd effect’ in cluster-randomised trials and ‘carry-over’ effect in cross-over trials.

Types of participants
We will include adult patients (18 years or older) undergoing endotracheal intubation and mechanical ventilation. We will exclude studies which enrolled patients ineligible for semi-recumbent position, e.g. abdominal surgery, obesity (body mass index (BMI) greater than 30 kg/m²) (WHO 2000).

Types of interventions
We will include studies comparing semi-recumbent positioning versus supine positioning in mechanically ventilated patients. We will use the trial authors’ definition regarding the semi-recumbent position. Because of the potential variations in defining semi-recumbent position across studies (i.e. head-of-bed angles assigned to patients), we will conduct a subgroup analysis to examine the impact of the variations. The supine position is defined as 0 to 10 degrees of the angle between the patient’s body above the horizontal floor. We will also include studies comparing different degrees of body positioning.
Types of outcome measures

Primary outcomes
1. Clinically-suspected VAP, defined as a new, persistent or progressive radiographic infiltrate with at least two of the following criteria: fever (temperature > 38 °C or < 35 °C); leucocytosis or leucopenia (leucocytes > 10 × 10^9/L or < 3 × 10^9/L); and a positive culture of tracheal secretion (CDC 1997).
2. Microbiologically-confirmed VAP, diagnosed according to the following: 10^3 cfu/mL in protected specimen brush cultures; 10^4 cfu/mL in bronchoalveolar lavage (El-Ebiary 1993); and 10^5 cfu/mL in tracheobronchial aspirate (Meduri 1992).
3. Composite of clinically-suspected and clinically-confirmed VAP.

Secondary outcomes
1. Duration of ventilation.
2. Length of intensive care unit (ICU) stay.
3. Length of hospital stay.
4. Any other adverse events reported by study authors, such as device-related adverse events (sore throat, laryngitis, discoloured tongue, dysphagia and laryngospasm) and aspiration.

Search methods for identification of studies

Electronic searches
We will search the Cochrane Acute Respiratory Infections (ARI) Group's Specialised Register, which is part of the Cochrane Central Register of Controlled Trials (CENTRAL) (The Cochrane Library, latest issue), MEDLINE (1950 to present), EMBASE (1974 to present), CINAHL (1981 to present) and the Chinese Biomedical Literature Database (CBM) (1978 to present).

We will use the search strategy in Appendix 1 to search CENTRAL and MEDLINE. We will adapt the MEDLINE search strategy and the Cochrane Highly Sensitive Search Strategy for identifying randomised trials in MEDLINE (Lefebvre 2011) to search EMBASE, CINAHL and CBM. We will not apply any language, date or publication restrictions. We will contact authors and researchers in order to obtain further details about published and unpublished studies.

Searching other resources
We will retrieve the reference lists of included studies, reviews and conference proceedings to identify all eligible studies. We will search for unpublished studies and clinical trials on the following sites.
1. World Health Organization International Clinical Trials Registry Platform (www.apps.who.int/trialsearch/).
2. ClinicalTrials.gov (www.clinicaltrials.gov/).

Data collection and analysis

Selection of studies
Two review authors (XL, QY) will independently select titles and abstracts as follows, and a third review author (LW) will resolve any disagreements.
1. We will merge and de-duplicate the searched reports from multiple databases using Endnote software.
2. We will review titles and abstracts for potential eligibility.
3. We will retrieve full-texts of potentially eligible studies.
4. We will allocate a single study code for multiple reports of a same study.
5. We will review full-text reports for final eligibility criteria.

Data extraction and management
Two review authors (XL, QY) will independently extract data as follows, and a third review author (LW) will resolve any disagreements.
1. General study information: title, authors, contact address, publication source, publication year.
2. Study characteristics: design, study setting, inclusion and exclusion criteria, total sample size, sample size per group, number of groups.
3. Characteristics of study population: age, sex, smoking, disease (e.g. trauma or emergency surgery, chronic obstructive pulmonary disease (COPD), acute respiratory distress syndrome), clinical pulmonary infection score (CPIS), APACHE II score, use of muscle relaxants, continuous sedation, coma.
4. Risk of bias: random sequence generation, allocation concealment, blinding of patients, caregivers and outcome assessors, incomplete outcome data and selective outcome reporting.
5. Intervention characteristics: positional types, head-of-bed angles, durations and settings of interventions, co-interventions (e.g. type and route of endotracheal intubation, type of endotracheal suctioning system, antibiotics).
6. Outcomes measures: clinically-suspected VAP, microbiologically-confirmed VAP and the composite of clinically-suspected and clinically-confirmed VAP, mortality, length of ICU stay, length of hospital stay, adverse events.
Assessment of risk of bias in included studies
Two review authors (XL, QY) will independently assess the risk of bias, and a third review author (LW) will resolve any disputes. We will assess the risk of bias of each included study using the criteria from the Cochrane Handbook for Systematic Reviews of Interventions (Higgins 2011), including random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data and selective outcome reporting. We will judge each of these domains as ‘high risk’ of bias, ‘low risk’ of bias or ‘unclear risk’ of bias.

Measures of treatment effect
We will use risk ratios (RRs) and 95% confidence intervals (CIs) for each dichotomous outcome (e.g. VAP, mortality) and mean difference (MD) or standardised mean difference (SMD) with 95% CIs for continuous data (e.g. duration of ventilation). We will use hazard ratios (HRs) and 95% CIs for time-to-event data (e.g. length of ICU stay and length of hospital stay), if applicable.

Unit of analysis issues
Because we will only include parallel RCTs, the unit of analysis will be the individual participant.

Dealing with missing data
We will contact trial authors to request missing data. We will analyse missing data according to strategies suggested in the Cochrane Handbook for Systematic Reviews of Interventions (Higgins 2011).

Assessment of heterogeneity
We will use the Chi^2 test and the I^2 statistic to assess heterogeneity among trials in each analysis (Higgins 2003). We will consider an I^2 statistic between 0% to 30% as trivial or small heterogeneity, 31% to 50% as moderate heterogeneity, 51% to 75% as substantial heterogeneity, and 76% to 100% as considerable heterogeneity. If we identify substantial or considerable heterogeneity, we will explore it by prespecified subgroup analysis and sensitivity analyses.

Assessment of reporting biases
We will use a funnel plot to assess risk of reporting bias if 10 or more studies are included in a meta-analysis. We will also use Egger’s test to assess funnel plot asymmetry (Egger 1997).

Data synthesis
Two review authors (XL, QY) will perform the data entry in duplicate using Review Manager 5 (RevMan 2011). We will pool data using the random-effects model. We will summarise and report evidence in a ‘Summary of findings’ table, using GRADEpro software (Guyatt 2011; Schünemann 2011).

Subgroup analysis and investigation of heterogeneity
We will use a small number of prespecified subgroup analyses to explore the source of heterogeneity.
1. Duration of mechanical ventilation (< 96 hours versus >= 96 hours).
2. Head-of-bed angle of semi-recumbent position (< 30º versus >= 30º).
3. Allocation concealment (yes versus no).
4. Blinding (yes versus no).

Sensitivity analysis
We will examine the robustness of estimates using different effect measures (risk ratio (RR) versus odds ratio (OR)) and statistical models (random-effects model using Mantel-Haenszel method versus inverse variance method).

Acknowledgements
We would like to thank the National Natural Science Foundation of China (Project No. 71073105) and China Medical Board of New York for providing funding support for undertaking this study and staff training. The funding organisations had no role in the design and conduct of this systematic review, or in the preparation of, or decision to submit the protocol. We also wish to thank the following people for commenting on the draft protocol: Manal Kassab, Lee Morrow, Francisco Baigorri, Viviana Rodriguez and Allen Cheng.
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Appendix 1. MEDLINE search strategy

1 Pneumonia, Ventilator-Associated/
2 vap.tw.
3 exp Pneumonia/
4 pneumon*.tw.
5 3 or 4
6 exp Respiration, Artificial/
7 exp Ventilators, Mechanical/
8 (ventilat* or respirat*).tw.
9 or/6-8
10 5 and 9
11 1 or 2 or 10
12 exp Posture/
13 posture*.tw.
14 Patient Positioning/
15 position*.tw.)
16 Supine Position/
17 supine*.tw.
18 (semi-recumbent* or semirecumbent*).tw.
19 (head* adj5 (elevat* or rais*)).tw.
20 or/12-19
21 11 and 20

HISTORY


CONTRIBUTIONS OF AUTHORS

<table>
<thead>
<tr>
<th>Draft the protocol</th>
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<td>Lijing Deng, Qiang Yuan</td>
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DECLARATIONS OF INTEREST

None known.

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• No sources of support supplied

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