CASE REPORT

SEMI RECUMBENT POSITIONING FOR PREVENTING VENTILATOR ASSOCIATED PNEUMONIA IN ADULTS REQUIRING MECHANICAL VENTILATION

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ABSTRACT

Background: Ventilator associated pneumonia (VAP) is term to describe pneumonia that develops in a patient who has been on mechanical ventilation for more than 48 hours. VAP has been associated with increased mortality, morbidity, length of intensive care unit stay and duration of mechanical ventilation. VAP can be prevented with put patients in a right postion. Based on the literature, semi recumbent positioning has the advantage of convenience and almost no cost to implement. The purpose of this study is to conduct a evidence based case report to date comparing semi recumbent positioning with supine positioning to clarify their current role in the prevention of VAP.
Method: Literature search was performed on the PubMed, Cochrane library, Proquest, Elsevier, and EBSCO. Inclusion criteria of this literature searching was meta analysis, systematic review, and randomized control trial articles, adult requiring mechanical ventilation, compare semi recumbent and supine position. The exclusion criteria was language used other than English or Indonesian
Result: Two meta analysis included in this study. semi recumbent postioning has a significant reduction in clinically suspected VAP and a trend toward a reduction of all cause mortality. Even though, results of this review need to be interpreted cautiously due to the risk of bias.
Conclusion: There is no associated nursing cost in applying semi recumbent position and potential benefit of reducing clinically suspected VAP, so Semi recumbent position (>30o) should be applied if no contraindications are present

Keywords: ventilator associated pneumonia, semi recumbent, supine, mechanically ventilated

ABSTRAK

Latar belakang: pneumonia terkait ventilator merupakan kondisi dimana terjadi infeksi paru pada pasien yang memakai ventilator mekanik lebih dari 48 jam.kondisi ini berhubungan dengan peningkatan mortalitas, morbiditas, lama rawat di perawatan intensif dan durasi penggunaan ventilasi mekanik. Kondisi ini dapat dicegah dengan menempatkan pasien pada posisi yang tepat. Berdasarka nliteratur, posisi semi rekumben memiliki manfaat dan tidak mengeluarkan biaya ekstra untuk implementasinya. Tujuan dari tulisan ini adalah untuk mengumpulkan bukti berbasis literatur untuk membandingkan posisi semi rekumben dengan supinasi untuk menentukan manfaatnya dalam mencegah pneumonia terkait ventilator
Metode: penelusuran literatur pada PubMed, Cochrane library, Proquest, Elsevier, dan EBSCO. Kritera inklusi pada pencarian adalah meta analisis, review sistematik, uji klinis terkontrol acak, populasi dewasa yang membutuhkan ventilasi mekanik, dan membandingkan posisi semi rekumben dan supinasi. Kriteria eksklusi adalah bahasa yang digunakan selain bahasa Inggris dan Indonesia.
Hasil: pencarian mencakup dua meta analisis. Posisi semi rekumben memiliki manfaat signifikan dalam mengurangi kejadian pneumonia terkait ventilator dan penurunan angka mortalitas. Walaupun demikian, angka bias dalam kedua meta analisis ini masih tinggi sehingga harus diinterpretasikan dengan hati hati.
Kesimpulan: tidak terdapat peningkatan biaya dalam mengaplikasikan posisi semi rekumben. Selain itu, terdapat manfaat potensial dalam mengurangi kejadian pneumonia terkait ventilator. Oleh sebab itu, posisi semi rekumben dapat diaplikasiakn apabila tidak terdapat kontraindikasi

Kata kunci: pneumonia terkait ventilator, semi rekumben, supinasi, ventilasi mekanis

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CASE ILLUSTRATION

A 46-year-old male came to emergency department in our hospital with shortness of breath since three days before admission. Shortness of breath was felt continuously, same with all position and worsen with physical activity. Since two days before admission, he starts coughing. Cough was accompanied with white phlegm. There was no history of fever, decreased body weight, and night sweat. He had no history of hypertension, diabetes, autoimmune disease, kidney disease, heart disease, liver disease, and no using of routine drugs before. There was no history of same complain, lung disease, hypertension, diabetes, autoimmune disease, kidney disease, heart disease, and liver disease in his family.

On physical examination, he was fully alert, with blood pressure 150/100 mmHg, heart rate 120 beats per minute, regular, respiration rate 38 times per minute, axilla temperature 36,6^{o}C, and peripheral oxygen saturation 80% with oxygen from non rebreathing mask fifteen litres per minute. From lung examination, pattern of breathing is abdominothoracic, we found vesicular sound of both of lung, with rhonchi heard in all field of lung. Heart examination and abdominal examination was within normal limit.

Laboratory examination showed leucocytosis (leucocyte count 18100/uL), hypoalbuminemia (2,84 g/dL), increase in CRP (60,8 mg/L), increase of lactic acid (4,8 mmol/L) and increase in procalcitonin (10,33 ng/mL). Blood gas test showed pH 7,267, pCO2 40,6 mmHg, PO2 30,2 mmHg, HCO3 18,7, and O2 saturation 56%. Electrocardiogram examination found normal result. There was heterogen consolidation in both of lung from chest x-ray examination.

He was diagnosed with respiratory failure type 1, pneumonia severe with suspect of probable COVID19, and hypoalbuminemia. He was planned to have a mechanical ventilator. Patient intubated in emergency department. After that, patient is mobilized to intensive care unit.

From literature, incidence of ventilator associated pneumonia is high, both in emergency department and intensive care unit. We planned to put a patient in a semi recumbent position to prevent ventilator associated pneumonia, but the effectiveness is unknown.

CLINICAL QUESTION

Based on case illustration, we formulated PICO and clinical question as follows:

Patient : Adult requiring mechanical ventilation
Intervention : Semi recumbent position
Comparison : Supine position
Outcome : Ventilator associated pneumonia

In adult requiring mechanical ventilation, does semi recumbent position better than supine position to prevent ventilator associated pneumonia?

SEARCHING STRATEGY

We conducted literature search on five search engines, included PubMed, Cochrane library, Proquest, Elsevier, and EBSCO. The searching strategy was described in table 1. Article eligible for critical appraisal should meet our inclusion criteria as follow: (1) study design: meta analysis, systematic review, and randomized control trial articles (2) adult (18 years or older) requiring mechanical ventilation (3) compare semi recumbent and supine position. The exclusion criteria in this literature searching was language used other than English or Indonesian.

Table 1. Searching strategy on December 22, 2020

Search engine	Search term
Pubmed	(((adults[MeSH Terms]) AND (semi recumbent[MeSH Terms])) AND (supine[MeSH Terms])) AND (ventilator associated pneumonia[MeSH Terms])
Cochrane library	Adults AND semi recumbent AND supine AND ventilator associated pneumonia
Proquest	Adults AND semi recumbent AND supine AND ventilator associated pneumonia

Elsevier	Adults AND semi recumbent AND supine AND ventilator associated pneumonia
EBSCO Host	Adults AND semi recumbent AND supine AND ventilator associated pneumonia

LITERATURE SEARCH

From literature searching, we retrieved 264 records. From title screening, we excluded 258 articles. Four articles were excluded because of duplication. Three articles were eligible for critical appraisal.

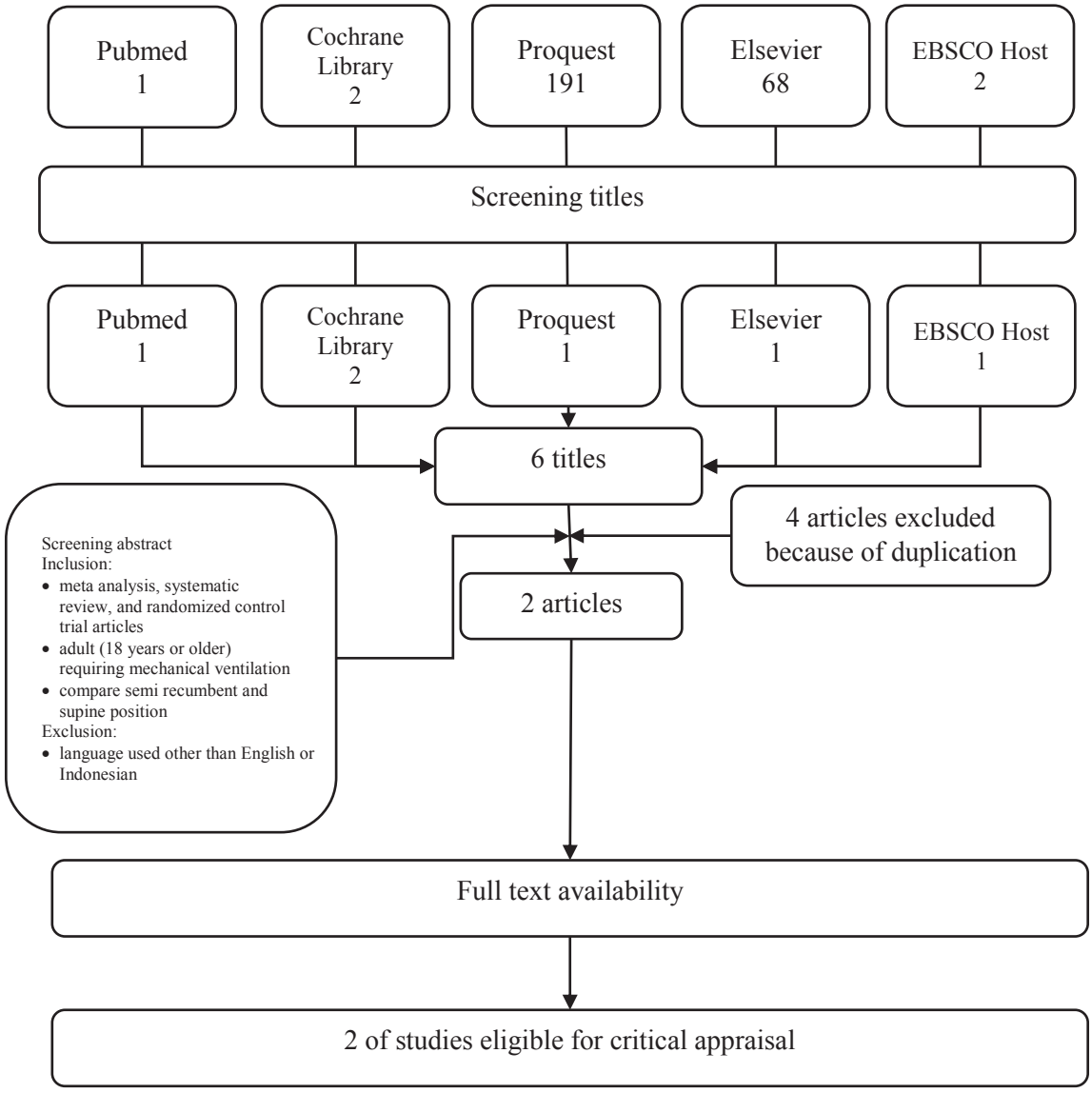


Figure 1. Literature search based on PRISMA flowchart

CHARACTERISTICS OF SELECTED STUDIES

Characteristics of domain, determinant, outcome, and study design are shown in table 1. All of the studies are meta analysis.

Table 2. Characteristics of selected studies by Wang L, et al[7]

Article 1	
Author	Wang L, et al

Title	Semi-recumbent position versus supine position for the prevention of ventilator-associated pneumonia in adults requiring mechanical ventilation (review)
Domain	Randomised controlled trials with adults participant (18 years or older) with exclusion on trials with cluster randomisation, cross over design, and quasi trial.
Determinant	Semi-recumbent positioning versus supine positioning in mechanically ventilated patients
Outcomes	Clinically suspected VAP, microbiologically confirmed VAP, composite of clinically suspected and clinically confirmed VAP, intesive care unit mortaliy (ICU), hospital mortality, length of ICU stay, duration of ventilation, use of antibiotics, any adverse event.
Design	Meta analysis
Sample size	Ten trials involving 878 participants

Table 3. Characteristics of selected studies by Alexiou, et al[6]

	Article 2
Author	Alexiou VG, et al
Title	Impact of patient position on the incidence of ventilator-associated pneumonia: a meta analysis of randomized controlled trials
Domain	Randomised controlled trials comparing prone or semirecumbent 45^{o} to supine position of mechanically ventilated patients and reporting on clinical outcomes.
Determinant	Prone or semi recumbent positioning versus supine positioning
Outcomes	Incidence of VAP, all cause mortality during the study period, length of ICU stay, and duration of mechanical ventilation
Design	Meta analysis
Sample size	Three randomised controlled trials studying semi recumbent 45^{o} and four randomised controlled trials studying prone position with total of 3377 and 1018 patients.

CRITICAL APPRAISAL Critical appraisal was assessed using FAITH tool

Table 4. Critical appraisal of Wang L, et al[7]

	Article 1
Internal Validity	
Does the systematic review address a focused question (PICO)?	Yes ***"Types of studies*** *We included randomised controlled trials (RCTs). We excluded trials with cluster-randomisation or with a cross-over design because of the concern about 'herd eMect' in cluster-randomised trials and 'carry-over' eMect in cross-over trials. We also excluded quasi-RCTs due to the potential problems with imbalanced prognosis and the failure to conceal the treatment allocation. We did not exclude any studies on the basis of language of publication.* ***Types of participants*** *We included adult patients (18 years or older) undergoing endotracheal intubation and mechanical ventilation. We excluded studies among which more than 15% of patients were ineligible for semi-recumbent positioning, e.g. abdominal surgery, obesity (body mass index (BMI) greater than 30 kg/m2) (WHO 2000).* ***Types of interventions*** *We included studies comparing semi-recumbent positioning versus supine positioning in*

	mechanically ventilated patients. We used the authors' definition regarding the semi-recumbent position. The supine position is defined as the body positioning with 0° to 10° head-of-bed elevation. We also included 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 ℃or < 35 ℃); leucocytosis or leucopenia (leucocytes > 10 × 109/L or < 3 × 109 / L); and a positive culture of tracheal secretion (CDC 1997).* 2. *Microbiologically confirmed VAP, diagnosed according to the following: 103 cfu/mL in protected specimen brush cultures; 104 cfu/mL in bronchoalveolar lavage (El-Ebiary 1993); and 105 cfu/ mL in tracheobronchial aspirate (Meduri 1992).* 3. *Composite of clinically suspected and clinically confirmed VAP.* 4. *Intensive care unit (ICU) mortality.* 5. *Hospital mortality.* ***Secondary outcomes*** 1. *Length of ICU stay.* 2. *Length of hospital stay.* 3. *Duration of ventilation.* 4. *Use of antibiotics.* 5. *Any adverse events reported by study authors, such as device-related adverse events (sore throat, laryngitis, discoloured tongue, dysphagia and laryngospasm), aspiration, venous thromboembolism, pressure ulcers and haemodynamic instability (e.g. hypotension, hypertension, abnormal heart rate, etc)."*
... and use it to direct the search and select articles for inclusion?	Yes ***"Appendix 1. MEDLINE (Ovid) 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 semi-recumbent*).tw.* *19 (semi-reclin* or semireclin*).tw.* *20 (semisupin* or semi-supin*).tw.* *21 half-sitting.tw.* *22 ((head* or bed or backrest) adj5 (elevat* or rais* or inclin* or angle)).tw.* *23 or/12-22* *24 11 and 23***"**
Did the search find all the relevant evidence?	Yes *"Electronic searches* *We searched the Cochrane Central Register of Controlled Trials (CENTRAL 2015, Issue 10) (accessed 27 October 2015), which includes the Cochrane Acute Respiratory Infections Group's* *Specialised Register, MEDLINE (1946 to October 2015), EMBASE (2010 to October 2015), CINAHL (1981 to October 2015) and the Chinese Biomedical Literature Database (CBM) (1978 to October 2015).*

	We used the search strategy in Appendix 1 to search CENTRAL and MEDLINE (Ovid). We combined the MEDLINE search strategy with the Cochrane Highly Sensitive Search Strategy for identifying randomised trials in MEDLINE: sensitivity- and precisionmaximising version (2008 revision); Ovid format (Lefebvre 2011). We adapted the search strategy for MEDLINE to search EMBASE (Appendix 2), CINAHL (Appendix 3) and CBM (Appendix 4) from the inception to 27 October 2015. *Searching other resources* *We retrieved the reference lists of included studies, reviews and conference proceedings to identify all eligible studies. We also searched for unpublished studies and clinical trials on the following sites.* *1. World Health Organization (WHO) International Clinical Trials Registry Platform (ICTRP) (www.apps.who.int/trialsearch/).* *2. ClinicalTrials.gov (www.clinicaltrials.gov/).”*
Have the studies been critically appraised?	Yes ***“Selection of studies*** *Two review authors (XL, XT) independently and in duplicate screened titles and abstracts for initial eligibility, as well as full texts for final eligibility. A third review author (LW) was consulted to resolve disagreements. We identified and excluded duplicates and collated multiple reports of the same study so that each study rather than each report is the unit of interest in the review. We recorded the selection process in suMicient detail to complete a PRISMA flow diagram (Figure 1) (Moher 2009), and 'Characteristics of excluded studies' table. We did not impose any language restrictions.”*
Did they only include high quality studies?	Yes ***“Assessment of risk of bias in included studies*** *Two review authors (XL, ZY) independently and in duplicate assessed the risk of bias and a third review author (LW) was consulted to resolve discrepancies. We assessed the risk of bias of included trials using the criteria from the Cochrane Handbook for Systematic Reviews of Interventions including random sequence generation, allocation concealment, blinding of participants and caregivers, blinding of outcome assessors, incomplete outcome data and selective outcome reporting (Higgins 2011). We judged each of these domains as high, low or unclear risk of bias.*”
Have the results been totaled up with appropriate summary tables and plots?	Yes In summary tables and forrest plot
...and heterogeneity between studies assessed and explained?	Yes ***“Assessment of heterogeneity*** *We used the Chi2 test and the I2 statistic to assess heterogeneity among trials in each meta-analysis (Higgins 2003). We considered an I2 statistic between 0% to 30% as trivial or low heterogeneity; 31% to 50% as moderate heterogeneity; 51% to 75% as substantial heterogeneity; and 76% to 100% as considerable heterogeneity.”*
Result	
What measure was used, how large was the effect (could it have been due to chance)?	Semi recumbent position (30^o-60^o) versus supine position (0^o-10^o) Clinically suspected VAP: Risk ratio 0,36 (CI95 0,25;0,5) Microbiologically confirmed VAP: Risk ratio 0,44 (CI95 0,11;1,77)
How are the results presented?	In forrest plot

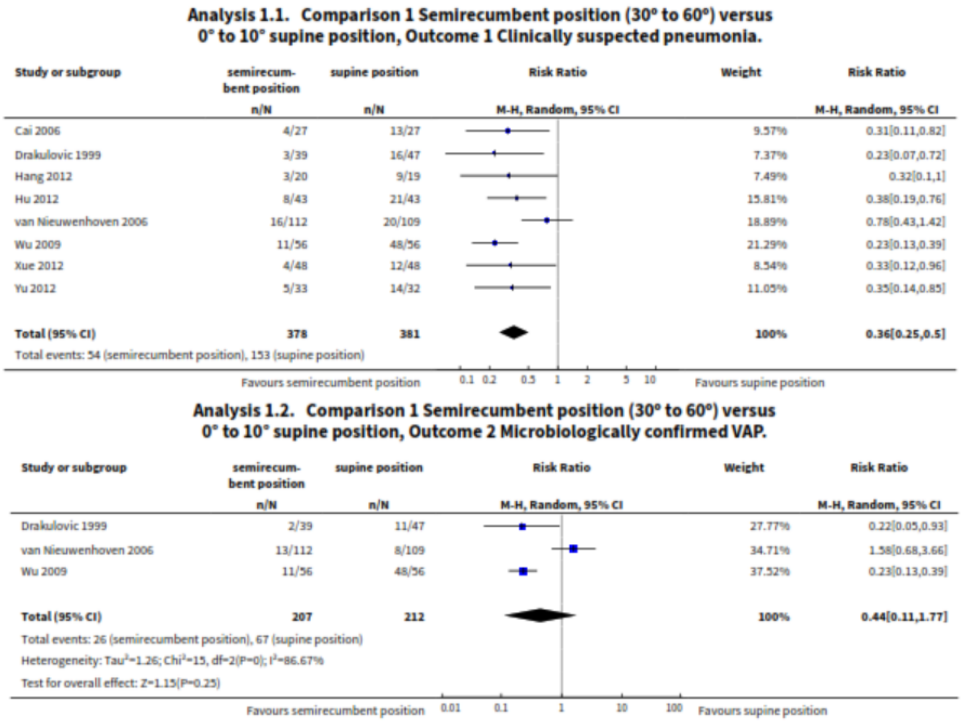
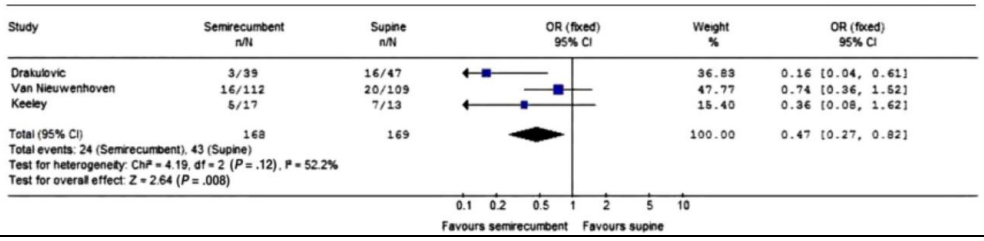


Table 5. Critical appraisal of Alexiou, et al[6]

	Article 2
Internal Validity	
Does the systematic review address a focused question (PICO)?	Yes *"Objective: The aim of this study is to summarize the effect of position (prone and semirecumbent 45°) of mechanically ventilated patients on the incidence of ventilator-associated pneumonia (VAP) and other outcomes."*
... and use it to direct the search and select articles for inclusion?	Yes *This meta-analysis was conducted according to the guidelines issued by the "quality of reporting of metaanalyses" conference [13]. To identify relevant RCTs, we systematically searched PubMed (until December 2007) and Cochrane Central Register of Controlled Trials by using the following keywords: "prone" or "semirecumbent" using as a limit "type of article: Randomized Controlled Trial."*
Did the search find all the relevant evidence?	No *"Furthermore, we reviewed the references of the included RCTs. Abstracts of conference proceedings were not sought."*
Have the studies been critically appraised?	Yes *"Two reviewers independently collected the following data from all eligible articles: study design, year of publication, type of ICU and study population, number of patients enrolled, position of patients, and cultures required for confirmation of VAP diagnosis in each of the included RCTs. Data on incidence of VAP, mortality, length of ICU stay, and duration of mechanical ventilation were also extracted. In addition, we individually assessed the following components: randomization, generation of random numbers, details of double-blinding procedure, information on withdrawals, and concealment of allocation to evaluate the methodological quality of each RCT according to a modified Jadad score. One point was awarded for the specification of each criterion; the maximum score that a study could achieve was 5."*
Did they only include high quality studies?	Unclear
Have the results	Yes

been totaled up with appropriate summary tables and plots?	In summary table and forrest plot
…and heterogeneity between studies assessed and explained?	Yes *"Statistical analyses were performed using Review Manager (RevMan version 4.2.10; Copenhagen: Nordic Cochrane Center, Cochrane Collaboration, 2003). The heterogeneity between RCTs was assessed by using both the I2 test; a P value lower than .10 was defined to note statistical significance in the analysis of heterogeneity. Publication bias was not assessed because of the small number of included RCTs in this meta-analysis. Continuous outcomes were analyzed using weighted mean differences (WMDs) and 95% confidence intervals (CIs). Pooled odds ratios (ORs) and 95% CI for all outcomes of this meta-analysis were calculated by using fixed effects model or the DerSimonian-Laird random effects model in the case that statistically significant heterogeneity was noted. statistic and a χ2"*
Result	
What measure was used, how large was the effect (could it have been due to chance)?	Odds ratio: 0,47 (CI95 0,27;0,82)
How are the results presented?	In forrest plot



DISCUSSION

Both of meta analysis showed that semi recumbent position significantly reduce the incidence of clinically suspected ventilator associated pneumonia. Wang L, et al showed that semi recumbent position with 30^o to 60^o has a 64% relative risk reduction, corresponding to 25,7% reduction in absolute risk. This literature also showed that semi recumbent position has a number needed to treat to benetif 4. So, every four patients nursed in semi recumbent position resulted in one patient free from clinically suspected VAP compared to supine position (0^o to 10^o). altough, there are no statistical significance in reduction of microbiologically confirmed VAP, hospital mortality, intensive care unit mortality, length of ICU stay, length of hospital stay, use of antibiotics, and duration of ventilation.[7]

There are some limitations among the trials in this meta analysis. It remains uncertain which degrees of semi recumbent positioning are optimal, because of the very limited evidence, there is no significant difference between alternative degrees of semi recumbent positioning (45^o versus 25^o or 30^o). Some of the trials included also not described randomisation details (because it was not possible to blind patients and caregivers), and loss follow up was high). Because of that, the results of this review need to be interpreted cautiously due to the risk of bias. Adverse event were rarely reported. Only one literature included that reported pressure ulcer with no significant difference between 45^o and 10^o supine position.[7]

Alexiou, et al showed that odds of developing clinically diagnosed VAP were significantly lower among patients positioned semi recumbently 45^o compared to patients positioned supinely with odds ratio 0,47, confidence interval 95% 0,27-0,82. Alexiou, et al concluded that patients

positioned semi recumbently 45^{o} have significantly lower incidence of clinically diagnosed VAP compared to patients positioned supinely.[6]

This study also found from subanalysis that, the incidence of microbiologically documented VAP, the length of ICU stay, and the duration of mechanical ventilation in patients positioned semi recumbently 45^{o} have a moderate trend toward better clinical outcome compared to patinets positioned pronely. [6]

This intervention might be work because semi recumbent positioning may prevent contamination of oropharyngeal secretion and gastric content, pathogenic factors for VAP. Both of study suggest that, bacterial colonization of the stomach and gastroesophageal aspiration is promoted by the supine body position. Some of the study using radioactive labeled enteral feeding already showed that endotracheal aspiration of gastric contents occurred more frequently among patients positioned supinely rather than semi recumbently.[6,7]

Both of this meta analysis are having consistent results that semi recumbent postioning has a significant reduction in clinically suspected VAP and a trend toward a reduction of all cause mortality. Altough, other outcomes like microbiologically confirmed VAP, ICU mortality, and length of ICU or hospital stay didn't meet statistical significant. [6,7]

Given the fact there is no associated nursing cost in applying semi recumbent position and potential benefit of reducing clinically suspected VAP and semi recumbent position is one of the most easy and cost effective measures for the prevention of VAP, semi recumbent position (>30^{o}) should be applied if no contraindications are present (patients with recent thoracic, abdominal, or spine surgery or injury)

In clinical setting, target of semi recumbent position maybe difficult to achieved. This is because of patients change position frequently. Nieuwenhoven et al showed that position of 45^{o} was not achieved 85% of the study time. So, an increased ICU nurse to patient ratio and dedicated nurse for the control and maintenance patients' positioning may improve the prompt application of this measure. [10]

CONCLUSION

- Semi recumbent postioning has a significant reduction in clinically suspected VAP and a trend toward a reduction of all cause mortality.
- Because of risk of bias, the results need to be interpreted cautiously.
- There is no associated nursing cost in applying semi recumbent position and potential benefit of reducing clinically suspected VAP
- Semi recumbent position (>30^{o}) should be applied if no contraindications are present (patients with recent thoracic, abdominal, or spine surgery or injury)

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