

The Effectiveness of Oral Antiseptic to Ventilator Associated Pneumonia (VAP) in Mechanical Ventilation Patients: Systematic Review

Mareta Dea Rosaline^{1*}, Santi Herlina¹, Diah Tika Anggraeni¹

¹Universitas Pembangunan Nasional Veteran, Jakarta, Indonesia

*Correspondence: Mareta Dea Rosaline, Jalan Raya Limo No. 7, Limo-Depok, Indonesia; email: maretarosaline@upnvj.ac.id

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ABSTRACT

Ventilator-associated pneumonia (VAP) is pneumonia that occurs more than 48 hours or after that following endotracheal intubation and detection of a causative agent among mechanically ventilated patients. Ventilator-associated pneumonia (VAP) is one of the most common nosocomial infections, which increase the duration of mechanical ventilation and length stay of hospitalization. Oral care with the use of antiseptics, it is expected to reduce the growth of bacteria in the oropharynx and to decrease the incidence of VAP. Oral care in this study is chlorhexidine, sterile water, povidone-iodine, sodium bicarbonate, listerin, and normal saline. The purpose of this study was to systematic review the effective oral antiseptic to ventilator-associated pneumonia (VAP). Journal articles are made through several databases, including Google Scholar, Proquest, and Science Direct during the past ten years. The result showed that chlorhexidine gluconate 0,2% and 0,12% were more effective oral antiseptic than listerin, povidone-iodine 1%, sodium bicarbonate, normal saline, and sterile water to Ventilator-Associated Pneumonia (VAP).

Keywords: Mechanical ventilation, Oral antiseptic, Oral care, Ventilator-associated pneumonia

ABSTRAK

Ventilator-associated pneumonia (VAP) adalah pneumonia yang terjadi lebih dari 48 jam atau setelah pemasangan intubasi endotrakeal dan mendeteksi agen penyebab pada pasien yang terpasang ventilasi mekanik. Ventilator-associated pneumonia (VAP) adalah salah satu infeksi nosokomial yang paling umum dan dapat meningkatkan durasi ventilasi mekanis dan lama rawat inap. Perawatan mulut dengan penggunaan antiseptik diharapkan dapat mengurangi pertumbuhan bakteri di orofaring dan mengurangi kejadian VAP. Perawatan mulut dalam penelitian ini adalah chlorhexidine, air steril, povidone-iodine, sodium bicarbonate, listerin, dan normal saline. Tujuan penelitian ini adalah untuk mereview secara sistematis tentang efektivitas antiseptik oral terhadap ventilator associated-pneumonia (VAP) pada pasien yang terpasang ventilasi mekanis. Sebuah strategi pencarian diterapkan kedalam database Google Schoolar, Proquest, dan Science Direct selama sepuluh tahun terakhir. Hasil systematic review menunjukkan bahwa chlorhexidine glukonat 0,2% dan 0,12% lebih efektif sebagai antiseptik oral daripada listerin, povidone-iodine 1%, natrium bikarbonat, normal salin, dan air steril terhadap ventilator-related pneumonia (VAP) pada pasien yang terpasang ventilasi mekanis.

Kata kunci: Ventilasi mekanis, Antiseptik mulut, Perawatan mulut, Pneumonia terkait ventilator

INTRODUCTION

Ventilator-associated pneumonia (VAP) is pneumonia that occurs more than 48 hours or thereafter following endotracheal intubation, characterized by the presence of a new or progressive infiltrate, signs of systemic infection (fever, altered white blood cell count), changes in sputum characteristics, and detection of a causative agent among mechanically ventilated patients (Firouziyan & Darvishi Khezri, 2014). Ventilator-associated pneumonia is one of the most common nosocomial infections which increase the length

stay of hospitalization, duration of mechanical ventilation, and mortality in critically patient within the Intensive Care Unit (ICU) who undergo invasive mechanical ventilation (Fathy, Abdelhafeez, EL-Gilany, & Elhafez, 2013). Ventilator-associated pneumonia (VAP) occurs in 9– 27% with a mortality rate that may exceed 50% of all intubated patients and is a common complication of mechanical ventilation. VAP is a significant cause of morbidity and mortality among the critically ill (American Thoracic Society, 2015). Ventilator-associated pneumonia (VAP) is associated with a prolonged hospital stay, increased cost of treatment, and increased morbidity and mortality rate (Azab et al., 2013). Therefore, prevention of VAP is a key part of managing patients undergoing mechanical ventilation. Figures quoted by the International Nosocomial Infection Control Consortium suggest that the overall rate of VAP is 13.6 per 1000 ventilator days. However, the individual rate varies according to patient group, risk factors, and hospital setting. The average time taken to develop VAP from the initiation of mechanical ventilation is around 5 to 7 days, with a mortality rate quoted as between 24% and 76 % (American Thoracic Society, 2015). Earlier studies placed the attributable mortality for VAP at between 33-50 %, but this rate is variable and relies heavily on the underlying medical illness (Rello et al., 2013). Over the years, the attributable risk of death has decreased and is more recently estimated at 9-13 %, largely because of the implementation of preventive strategies.

Ventilator-associated pneumonia (VAP) develops from pulmonary parenchymal infections in 48 hours up to 96 hours after intubation (Hagighi et al., 2017). The microorganisms that cause VAP are normally found in the oropharynx and the gut. Mechanical ventilation allows the microorganisms to move to the lungs by aspiration past the cuff of the endotracheal or tracheostomy tube (Hoshijima et al., 2013). The oral cavity is a potential place for bacteria and microorganisms that cause VAP. The main mechanism of the development of VAP is a secret colony aspiration of oropharynx into the lower respiratory tract. The main contamination of secret oral caused by dental plaque and oropharyngeal colonization with respiratory pathogens (Khezri et al., 2014). Oral care not only decreases bacterial circulation in the mouth but also stimulate the flow of saliva which can eliminate microbial plaque, consisting of immunoglobulins which can protect and minimize the proliferation of bacteria that cause xerostomia (Scannapieco, Yu, Raghavendran, Vacanti, & Owens, 2009). Routine dental care can eliminate the microorganisms in the oral cavity, decreasing the aspiration and inhalation into the lungs (Cutler & Sluman, 2014). Adequate oral care and decontamination not only help prevent oral disease but also prevent VAP (Bassi, Senussi, & Xiol, 2017) The study reported that the implementation of oral care can decrease the incidence of VAP from 46% to nearly 90% (Hutchins et al., 2009). The study investigated the effects of decontamination of the respiratory tract by means of topical chlorhexidine (CHX) on the reduction in VAP (Koeman et al., 2016).The United States (US) Centers for Disease Control and Prevention (CDC) reported several mechanisms that may be responsible for VAP, including aspiration of oropharyngeal organisms, inhalation of aerosols that contain bacteria, hematogenous spread from distant body sites, and bacterial translocation from the gastrointestinal tract. The most significant mechanism among those reported is aspiration of oropharyngeal organisms into distal bronchi.

Oral hygiene with the use of antibiotics or antiseptics, it is expected to reduce the growth of bacteria in the oropharynx, thereby decreasing the incidence of VAP (Hoshijima et al., 2013) Oral decontamination with the use of antiseptics are preferred over the use of antibiotics. This is due to the excessive use of antibiotics can increase the risk of emergence of resistant bacteria that cause VAP (Oliveira, Zagalo, & Cavaco-silva, 2014). Antiseptic as decontamination significantly decreases the growth of germs of oropharynx caused by aerobic pathogens in patients with mechanical ventilator (Fathy et al., 2013).

Oral antiseptic in this study are chlorhexidine, sterile water, povidone-iodine, sodium bicarbonate, listerin, and normal saline. Some of these oral antiseptic give different effects to the incidence of VAP in several studies. There is considerable interest in prevention of VAP and recent evidence suggests that oral antiseptic removal of oropharyngeal secretions are evidence-based and low risk interventions to prevent VAP. Therefore, this study aims to systematically review researches about the effectiveness of oral antiseptic to ventilator associated pneumonia (VAP) in mechanical ventilation patients.

METHOD

This research uses a systematic review method using *Preferred Reporting Item for Systematic Reviews and Meta-Analyses (PRISMA) guidelines* (Liberati et al., 2009). Key search terms include words such as "mechanical ventilation," "oral antiseptic," OR "oral care," AND "ventilator-associated pneumonia" OR "VAP." All studies to be included in the review studies would have to cite any of the following applications of oral treatment using oral antiseptics on the incidence of VAP or parameters (thorax x-ray, the number of bacterial colonization) in patients on mechanical ventilation and published during the past ten years, using midline Google Scholar, Proquest, and Science Direct. These articles helped to ensure that the results were of high quality and indicative of recent research in this area. One hundred twenty reports obtained from the results of the use of keywords and article restrictions storing to the Mendeley application. The results of the selection of data collected as many as 110 materials in accordance. In the process of determining the article selection selector, we decided on the inclusion criteria between articles using oral antiseptics as an intervention instrument as well as measurements in the prevention of ventilator-related pneumonia (VAP). Reports with quantitative experiments that are experimental and observational. Reviewers who agree are determined based on predetermined criteria. After reading the reference list of titles and abstracts, get 50 articles downloaded for further selection. The downloaded material is then reselected based on inclusion and exclusion criteria. Articles that have fulfilled the full inclusions are later described narratively and found 15 articles relevant for review

RESULT

All of the 15 articles that have been discovered and studied, 14 study articles used the treatment group and the control group. Eleven study articles used the randomized control trial approach, 3 study articles used a historical control study approach, and one study used a non-randomized concurrent control trial. The study used a random sample selection as much as 9, while four other studies did not use a random sample selection. The parameters used in the study include the incidence of VAP, the number of bacteria in the oropharynx obtained by swab, the score of Clinical Pulmonary Infection Score (CPIS), secret trachea, thorax photo, and count the number and type of bacteria of the oropharynx. The parameters used are in accordance with the inclusion criteria, that incidence of VAP and parameters that indicate the occurrence of VAP. The time of the study was generally applied in 24 hours to 48 hours after patients received mechanical ventilation. That means, intervention given for the first 24 hours of patient fitted with mechanical ventilation or for the first 48 hours of patient fitted with mechanical ventilation. The duration of the intervention varies in the study, ranging from one week or until the patient into the study sample was extubated. The intensity of oral care is also an assortment of 2 times/day up to 4 times/day. Five studies were using 0.12% chlorhexidine oral antiseptic compared with listerine or placebo or regular oral care. The survey results revealed that 0.12% chlorhexidine is effective in reducing the incidence of VAP compared with listerine and daily oral care. One study that compared the use of 0.12% chlorhexidine

to 1% chlorhexidine (gel), which concluded that 1% chlorhexidine (gel) to more effectively reduce the incidence of VAP. There were six studies applying interventions in oral care with 0.2% chlorhexidine compared with 1% povidone-iodine or with H₂O₂ in Normal Saline, 0.2% chlorhexidine results to be effective in reducing the incidence of VAP compared with 1% povidone-iodine and H₂O₂ in Normal Saline. 0.2% Chlorhexidine has also to be effective in reducing the number of oropharyngeal bacteria. Laoh (2011) mentioned that either 0.2% chlorhexidine or 1% povidone-iodine viewed from the thorax photo was equally effective at reducing the incidence of VAP. One study compared the use of 2% chlorhexidine with 2% chlorhexidine + 2% Colistin, and the results were equally effective in reducing the incidence of VAP. One study compared the use of listerin, sodium bicarbonate, and sterile water, and the result of the three did not differ in reducing the incidence of VAP. It can be concluded that 0.2% chlorhexidine and 0.12% chlorhexidine used ineffective oral care to reduce the risk of VAP.

DISCUSSION

From the studies reviewed, it can be seen that chlorhexidine gluconate 0,2% and 0,12% were more effective oral antiseptic than listerin, povidone-iodine 1%, sodium bicarbonate, normal saline, and sterile water as prevention ventilator-associated pneumonia (VAP). These results can be attributed to the ability of chlorhexidine working on broad-spectrum, fast-acting, have residual activity, minimal absorption and have activity in the blood or tissues better than povidone-iodine (Khezri et al., 2014). The results showed that performed a study to determine the minimum frequency (once or twice a day) of oral decontamination with 0.12% *chlorhexidine gluconate* required to improve oral hygiene and reduce oral colonization by potential respiratory pathogens in intubated patients admitted to the trauma intensive care unit (Scannapieco et al., 2009). The use of oral chlorhexidine resulted in a quantitative reduction in the number of *S. aureus* in the dental plaque of mechanically ventilated patients (Sharma & Kaur, 2012) However, chlorhexidine did not appear to reduce the total number or proportion of other target potential respiratory pathogens in the dental plaque (*Pseudomonas*, *Acinetobacter* or enteric species). These results are similar to those demonstrated by Munro et al., (2009) in a study that aimed to examine the effects of mechanical, pharmacological, and combination oral care on the development of VAP in critically ill patients receiving mechanical ventilation. When the authors considered the entire sample, neither chlorhexidine nor teeth brushing had a significant effect on Clinical Pulmonary Infection Score values or on pneumonia incidence (CPIS \geq 6). However, in the subset of patients who did not already have a Clinical Pulmonary Infection Score (CPIS) \geq 6 on day 1, patients who received chlorhexidine had significantly lower CPIS values, and pneumonia developed in fewer patients by day 3 (Houston et al., 2012). Based on this research we choose to use a 0.12% concentration of chlorhexidine. However, recent data from a meta-analysis suggested that the concentration of chlorhexidine should be considered based on the patient population. In trials with cardiac surgery patients at low risk for developing VAP, chlorhexidine 0.12% was effective in reducing VAP, but a higher concentration may be necessary among medical or mixed intensive care populations (Coffin et al., 2008)

Our analysis failed to find that mortality was reduced through the use of chlorhexidine for oral hygiene; also no previous meta-analysis on topical chlorhexidine showed a significant reduction in mortality. The reason for this could be that the mortality rate was a secondary outcome in most trials, which would cause the accuracy of the data to be lower than that of data on a primary outcome; thus pooled analyses of these data failed to show an effect of oral care using chlorhexidine Another possible explanation is

related to our inability to distinguish the effect of topical chlorhexidine on the incidence of early- versus late-onset VAP. A previous study by Koeman et al. (2016) found no difference between the chlorhexidine and control groups in the incidence of respiratory tract infections, the total mortality rate, or the length of the ICU stay, but the time between ICU admission and onset of the first respiratory tract infection was longer in the chlorhexidine group than in the placebo group. Therefore, we hypothesized that if topical chlorhexidine is effective only against early-onset VAP, its role in mortality related to late-onset VAP may be marginal. To answer this question, further clinical trials are needed, using separate data extraction for the incidences of early- and late-onset VAP (Berry, 2013)

Studies by the above results can't be fully generalizable. There is still any possibility that it can still be biased in some studies. It can be caused due to less homogeneous of sample of the study, because of many factors that can influence the occurrence of VAP. For example, before treatment, the samples used are already experiencing a variety of pathological conditions, such as the presence of infection in patients causes the formation of excessive tracheal secretions. This is because there is a sample of tracheal secretions that is already in good shape (little tracheal secretions). Limitations of the study was not uniform diagnosis of patients' diseases in both treatment groups. In this study, it is unknown how much influence of the differences in disease diagnosis of patients to the significance of the analysis results.

This *systematic review* has implications for nursing practice. Based on study that has been examined, it showed that 0.2% chlorhexidine and 0.12% chlorhexidine proven effective in reducing the incidence of ventilator-associated pneumonia (VAP). Although there were several drawbacks and limitation in the study, but this conclusion can be drawn from some of the parameters that have been measured at the study. Most of the previously published studies used relatively low concentrations of chlorhexidine (0.12-0.2%), and higher concentrations seem to offer no additional benefit in terms of VAP prevention. The analysis of currently available evidence failed to show overall mortality reduction resulting from chlorhexidine oral hygiene in ICU patients. With the results of this review, nurses especially intensive care unit nurses can apply one way of preventing the occurrence of VAP in patients on mechanical ventilation by performing oral care using 0.2% chlorhexidine or 0.12% chlorhexidine, because with the oral antiseptic, bacterial colonies in the oropharynx that is causing VAP can be minimized and not aspirated into the lung parenchyma, that is causing VAP. In addition, the incidence morbidity of VAP can be decreased, treatment and extubation were not too long and the treatment costs can be reduced.

CONCLUSION

Oral hygiene was instrumental in the effort to reduce the incidence of ventilator-associated pneumonia (VAP) in patients with critical diseases who use mechanical ventilation. The use of oral antiseptic can reduce the number and types of bacteria that cause the occurrence of ventilator-associated pneumonia (VAP). 0.2% Chlorhexidine and 0.12% chlorhexidine as an oral antiseptic for oral treatment proven effective in reducing the bacteria that cause ventilator-associated pneumonia (VAP) and reduced the incidence of ventilator-associated pneumonia (VAP). 0.2% Chlorhexidine and 0.12% chlorhexidine can be applied as an oral antiseptic of oral care for critically ill patients who use mechanical ventilation.

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