

Risk Prevention of Ventilator-Associated Pneumonia Thorough Oral Hygiene: A Literature Review

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Abstract

Ventilator-Associated Pneumonia (VAP) is a type of nosocomial infection that mostly occurs in intensive care units, generally occurring 48 hours after intubation. Endotracheal intubation and the use of a mechanical ventilator are invasive measures by patients, having a therapeutic effect. This paper aimed to identify the use of oral hygiene materials for the incidence of pneumonia related to the use of a ventilator. The research design was by searching literature in five databases, namely PubMed, Proquest, Science Direct, Wiley Online Library, and Google Scholar, by taking all databases in English and Indonesian, published in the last ten years (2010-2020). There were six articles about the effectiveness of using oral hygiene as risk prevention for Ventilator-Associated Pneumonia (VAP) with various concentrations and volumes. Several oral health assessment tools that can be used are Oral Assessment Guide, Beck Oral Assessment Scale, or Mucosal-Plaque Score. Comprehensive implementation of oral hygiene can improve the oral health of patients with mechanical ventilation, so bacterial colonization that causes VAP can be prevented. Therefore, nurses need to understand and apply oral assessment instruments as a basis for giving intervention.

Keywords: Intensive care unit, Oral hygiene, Ventilator-Associated Pneumonia

INTRODUCTION

The mortality and disability rates in critically ill patients who are admitted to the ICU were increasing from year to year. It is due to disease conditions, care, and nosocomial infections in the hospital. One of the most common nosocomial infections in the ICU is a complication of using a ventilator was Ventilator-Associated Pneumonia (VAP).

A ventilator is a breathing device to maintain optimal ventilation and maximize oxygen transport [1]. There have been many strategies that have been implemented to prevent the incidence of VAP. One of which is oral hygiene, the most important part of nursing interventions in intensive care. However, it is necessary to consider the negative effects that will be experienced by patients. Antibiotic resistance and risk of aspiration are some of the effects that can be fatal in patients [2], so it is necessary to find alternatives in oral care regimens.

Endotracheal intubation and the use of mechanical ventilators are invasive measures by patients who are treated in intensive care, but apart from having therapeutic effects, they can also cause side effects. It was Ventilator-Associated Pneumonia, increased morbidity rates around 24-70 %, and in the length of stay 9.6 days, thus significantly increasing the cost of care and treatment at the hospital [3].

The patient condition in the care unit received several invasive measures, and the treatment caused an immunosuppressive and was prone to antibiotic resistance. The installation of an endotracheal tube causing the oral condition to become worse. The continuous open oral causes the mucosa to become dry, saliva production decreases because the mechanical function of the mouth does not play a role after all food is inserted through a nasogastric tube.

Nurses play a crucial role in performing oral hygiene interventions as measure prevention of the risk of VAP. Previous studies have widely explained that oral health is closely related to the incidence of VAP, with an incidence of up to 117 per 1000 ventilator days with 69 patients (42.6%) developing early-onset VAP at 0-48 hours of Endotracheal Tube (ETT) use [4].

The risk of VAP incidence can be prevented through maximum oral care by reducing bacterial and fungal overgrowth [5]. Good oral care will also significantly reduce plaque, salivary bacteria, and potential respiratory pathogenic cells [6], but the standards for oral hygiene in each hospital are different [7]. Interventions can be different according to the standard operating procedures of each hospital. Research revealed that chlorhexidine 0.12% is the golden standard of oral care because it has antibacterial and antiplaque effects [8].

This paper aimed to identify the effects of using oral hygiene materials on the incidence of pneumonia-related use of a ventilator as the primary outcome. The secondary outcome/point

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of review including patient characteristics, instruments used, duration of time, method, frequency, and types of bacteria isolated, so that we can recommend alternatives for nurses in a clinical service.

MATERIAL AND METHOD

This study is a literature review by taking articles from all countries in English in the last ten years (2010-2020). In searching for articles, several databases are used, including Pubmed, Proquest, Science Direct, Wiley, and Google scholar. A list of references taken manually in the last ten years (2010-2020).

Searching articles using the keywords "oral care", "oral hygiene", "oral health care", "critical patient", "intensive care unit", "ventilator-associated pneumonia", and "VAP". If there is an inaccessible article, the author does not make any search efforts. Content analysis was not

carried out if the samples were varied, the results and methods were different. For this literature review, the authors analyzed the data based on the similarity of oral hygiene interventions and their effects on oral health and colonization of types of oral bacteria.

RESULT AND DISCUSSION

The PubMed search results totaled 13 articles, ProQuest 14 articles, Science Direct 11 articles, Wiley 11 articles, Gray literature 15 articles, thus brought a total of 64 articles. The results were specified for publications in the last ten years (2010-2020) in English. Then the exclusion results, which is not a full text, non-experimental, and multiple articles were 30 articles. There 28 articles that were not accordance to the resulting study, so that only six articles were included for the final review.

Table 1. Description of Article Review

Objective	Respondents	Intervention	Results
Determine the effect of chlorhexidine plus toothbrushing gluconate oral rinse for preventing ventilator-associated pneumonia [9].	150	A dentist provided instruction and supervised oral hygiene to patients who underwent cardiac surgery and who received regular oral hygiene care.	Observed in group 1, there were no significant differences in all-cause in-hospital death between groups. A lower incidence of ventilator-associated and a shorter hospital stay. The risk of developing pneumonia after surgery was three times higher in Group 2.
Evaluate the efficacy and safety of oral care with povidone-iodine on the occurrence of ventilator-associated pneumonia in the high-risk population [10].	119	Participants were randomly assigned to received oropharyngeal care with povidone-iodine six times daily until mechanical ventilation withdrawal.	There was a significant difference between the groups for ventilator-associated tracheobronchitis: the povidone-iodine group and the placebo group.
Relationship between chlorhexidine 0.2% and povidone-iodine 1% on the incidence of VAP [11].	32	Subjects who met the inclusion criteria were divided into two groups, those who received chlorhexidine and povidone-iodine.	There was a relationship between povidone-iodine and chlorhexidine against the occurrence of ventilator-associated, but the relationship was not significant.
Comparing the effectiveness of oral hygiene using lactoperoxidase enzymes with chlorhexidine in VAP prevention [12].	127	Determined the group that to be used as an experiment, which using chlorhexidine and Oral Hygiene.	There was no significant difference in oral hygiene using Lactoperoxidase and Chlorhexidine in the prevention of ventilator-associated pneumonia.
Effect of the implementation of oral hygiene using antiseptic hexanol gargle in minimizing the incidence of Ventilator-Associated Pneumonia (VAP) in R. ICU, Tugurejo Hospital [13].	15	The pre-test and the post-test data were taken on the first day and fifth day when the ventilator was installed. They used the same antibiotic and used SOP of oral hygiene and clinical pulmonary infection score (CPIS) observation sheet.	There was a significant difference before and after oral hygiene using hexanol gargle the incidence of ventilator-associated pneumonia (VAP).
Evaluate the effects of oral hygiene with hexanol and chlorhexidine in patients with mechanical ventilators in ICU [1].	30	The subjects were divided randomly into two groups: subjects given by hexanol 0.1% and given by chlorhexidine 0.2% twice a day.	There was no significant difference in oral hygiene with the use of hexanol and chlorhexidine.

Ventilator-Associated Pneumonia (VAP)

Ventilator-Associated Pneumonia (VAP) is a type of nosocomial infection that mostly occurs in intensive care units, usually occurring 48 hours after intubation. VAP defines as a condition of the presence of a new infiltrate and permanent on the chest X-ray accompanied by one of the signs in the form of a blood or pleural culture similar to microorganisms found in sputum or tracheal aspiration, cavitation on chest radiographs according to the American College of Chest Physician. There are three symptoms, i.e. high fever, leukocytosis, and a type of nosocomial infection that most often occurs in intensive care [14]. It generally occurs after 48-72 hours after the endotracheal tube (ETT) insertion to patients who use mechanical ventilator support. If this occurs after the first four days of mechanical ventilation, then this VAP is considered early-onset, whereas late-onset occurs after the 5th day of mechanical ventilation.

Risk Factors

Risk factors incidence of VAP in the ICU, including the history of disease/comorbidity patient, such as the history of lung disease, smoking, the history of diabetes mellitus, and the suction method [5]. Besides age, gender, trauma, and the influence of antibiotic use, VAP is also closely related to patient oral hygiene [15]. Although a diagnosis of VAP is difficult to be established, its incidence increased inpatient length of stay up to 9.6 days. The increase in care and treatment costs for each patient is US\$ 40,000, which implies a high mortality rate of 24-70% of patients in ICU [16].

Pathogenesis of VAP

Ventilator-Associated Pneumonia (VAP) occurs due to disruption of the body's defense system, especially in patients with decreased consciousness. The patient loses the ability to perform care and maintain oral hygiene. It causes mechanical functions of the mouth such as chewing, biting food, and swallowing have decreased. The natural defense system cannot function properly, causing the accumulation of bacteria in the oropharynx, bronchi, and trachea [17]. Saliva production has also decreased [18]. There is a buildup of plaque on teeth and biofilms on the tooth surface, which is beneficial for bacterial growth and colonization.

According to the Clinical Practice Guideline for Hospital-Acquired Pneumonia (HAP) and VAP in adults [19], this infection occurs when the

patient is admitted to the ICU and uses mechanical ventilation for more than 48 hours, with an increased risk of incidence 3-10 times with a fairly high mortality rate between 24-50%. It can reach 76% under certain conditions when compared to patients who are not on a ventilator.

Caused of VAP

Some bacteria as the cause of VAP are generally gram-negative bacteria, including; *Pseudomonas*, *Klebsiella pneumonia*, *Enterobacter*, *Serratia* spp, and *Acinetobacter* spp. The diagnosis of VAP is established using the CPIS assessment instrument, includes purulent bronchial secretions, leucopenia $< 1000.\text{mm}^{-3}$ or leucocytosis $> 12,000.\text{mm}^{-3}$, increased body temperature $> 38^{\circ}\text{C}$ or $< 36^{\circ}\text{C}$ without cause, positive blood culture, and visible infiltrates on chest x-ray. If three of these symptoms occurred in an intubated patient, a VAP can be diagnosed [14].

Prevention of VAP

Among the VAP prevention strategies, oral care is the most crucial part for nurses in the ICU to maintain oral health and prevent the colonization of pathogenic bacteria that cause pneumonia. It stated in a study that there is a strong correlation between unhealthy oral conditions and an increased incidence of VAP [20].

Oral Hygiene

Oral hygiene is the act of cleaning the oral cavity, teeth, and tongue. This action is one of the essential interventions in intensive care, which affects patient care and recovery [20]. Prioritizing oral hygiene for patients in critical care can prevent complications that will aggravate the patient's condition. It is very important to maintain the integrity of the lips, tongue, and oral mucosa. Thus, routine oral hygiene can prevent infection of the oral cavity and moisturize mucous membranes of the mouth and lips.

Impact of Oral Hygiene

Some of the oral hygiene that is not optimal causes periodontal infections to occur, trauma to the gums, moldy/white tongue, stomatitis, gingivitis, discoloration of teeth, and caries. In critical patients, the natural defense function is impaired, making it easier for infection to occur in the respiratory tract. If no action is taken in prevention, it causes increased bacterial colonization, and bacteria can translocate to the

lower respiratory tract, which triggers pneumonia (ventilator-associated pneumonia).

Several ingredients are often used for oral hygiene, including normal saline, chlorhexidine, povidone-iodine, toothbrush and toothpaste, as well as honey. Some studies explained that added chlorhexidine to oral care will reduce infection-causing bacteria, as well as a broad-spectrum antibacterial, which will reduce the incidence of ventilator-associated pneumonia [21]. Some side effects of chlorhexidine have been reported, like dry oral mucosa, tooth staining, taste changes, and the long-term effect is resistance to certain bacteria [22].

CONCLUSION

The main intervention for the prevention of oral infections in patients on mechanical ventilators is oral hygiene. The mouth is the main gateway for bacteria that cause infection. Therefore, oral hygiene needs to be considered comprehensively by nurses who are in charge of intensive care. The frequency of implementation of oral hygiene is adjusted to the results of the oral health assessment of each patient. All of these components are intended to prevent the colonization of microorganisms, so the incidence of VAP in patients in intensive care rooms with mechanical ventilation can decrease.

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