
Implementation Of Oral Hygiene Using 0.2% Chlorhexidine Gluconate To Reduce The Risk Of Ventilator-Associated Pneumonia In Mechanically Ventilated Patients With Pneumonia In The Intensive Care Unit: A Case Study

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Abstract

Ventilator-Associated Pneumonia (VAP) is one of the most common healthcare-associated infections in critically ill patients receiving mechanical ventilation for more than 48 hours. Bacterial colonization of the oral cavity and oropharynx contributes significantly to the development of VAP through microaspiration. Oral hygiene using 0.2% chlorhexidine gluconate is recommended as part of the Ventilator Care Bundle to reduce bacterial colonization and decrease the risk of VAP. To describe the implementation of oral hygiene using 0.2% chlorhexidine gluconate as a nursing intervention for preventing Ventilator-Associated Pneumonia in mechanically ventilated patients with pneumonia admitted to the Intensive Care Unit of RS X. A descriptive case study was conducted involving two mechanically ventilated patients diagnosed with pneumonia. Data were collected through family interviews, clinical observation, physical examination, medical record review, and assessment using the Clinical Pulmonary Infection Score (CPIS). Oral hygiene with 0.2% chlorhexidine gluconate was performed twice daily for three consecutive days according to the ICU standard operating procedure. The first patient demonstrated improved oral hygiene, decreased tracheal secretions, negative sputum culture, and a CPIS of 3, indicating a low risk of VAP. The second patient also showed improvement in oral hygiene; however, the CPIS remained 8 due to bronchopneumonia with Acute Respiratory Distress Syndrome (ARDS), severe oxygenation impairment, and persistent pulmonary inflammation. These findings suggest that oral hygiene contributes to maintaining oral cleanliness and reducing bacterial colonization, although its effectiveness in reducing VAP risk is influenced by disease severity and the patient's clinical condition. Oral hygiene using 0.2% chlorhexidine gluconate is an effective nursing intervention for maintaining oral hygiene as part of VAP prevention. However, optimal outcomes require comprehensive implementation of the Ventilator Care Bundle and appropriate management of other clinical factors associated with VAP.

Keywords: Oral Hygiene, 0.2% Chlorhexidine Gluconate, Ventilator-Associated Pneumonia, Clinical Pulmonary Infection Score, Mechanical Ventilation.

INTRODUCTION

Ventilator-Associated Pneumonia (VAP) is one of the most common Healthcare-Associated Infections (HAIs) among patients receiving mechanical ventilation in the Intensive Care Unit (ICU). VAP is defined as pneumonia that develops 48 hours or more after the initiation of mechanical ventilation via an endotracheal tube or tracheostomy. The occurrence of VAP is associated with prolonged ICU length of stay, extended duration of mechanical ventilation, increased healthcare costs, and higher mortality among critically ill patients. Although various preventive strategies have been developed, VAP remains a major challenge in intensive nursing care because it is multifactorial and influenced by patients' clinical conditions, bacterial colonization, and the quality of infection prevention practices.

One of the primary mechanisms underlying the development of VAP is the colonization of pathogenic microorganisms in the oral cavity and oropharynx, followed by microaspiration into the lower respiratory tract. In patients receiving mechanical ventilation, the cough reflex, the ability to clear secretions, and the mucociliary defense mechanism are impaired, facilitating the formation of dental plaque and biofilm on the teeth, oral mucosa, and endotracheal tube. These biofilms serve as reservoirs for pathogenic bacteria responsible for VAP. Therefore, maintaining oral hygiene is an essential component of VAP prevention.

Oral hygiene using chlorhexidine gluconate is a nursing intervention recommended in various VAP prevention guidelines because of its antimicrobial activity, which effectively reduces bacterial

colonization in the oral cavity. Several studies have demonstrated that routine oral hygiene improves oral cleanliness, reduces biofilm accumulation, and contributes to lowering the risk of VAP. However, the effectiveness of oral hygiene is influenced by several factors, including disease severity, the patient's immune status, oxygenation impairment, underlying comorbidities, and adherence to other components of the Ventilator Care Bundle. Therefore, oral hygiene should not be regarded as a standalone intervention but rather as part of a comprehensive strategy for VAP prevention.

Most previous studies on chlorhexidine oral hygiene have employed experimental or observational designs to evaluate its effectiveness in reducing the incidence of VAP across large patient populations. However, reports providing an in-depth description of nursing care through oral hygiene interventions in mechanically ventilated pneumonia patients using a case study approach remain limited, particularly those evaluating outcomes using the Clinical Pulmonary Infection Score (CPIS). A case study approach provides a more comprehensive clinical understanding of each patient's response to the intervention as well as the factors influencing the success of VAP prevention.

Based on the foregoing, this study aimed to describe the implementation of nursing care through an oral hygiene intervention using 0.2% chlorhexidine gluconate in mechanically ventilated pneumonia patients admitted to the Intensive Care Unit of Hospital X. In addition to evaluating changes in oral health status, this study assessed the risk of VAP using the Clinical Pulmonary Infection Score (CPIS) and analyzed the clinical factors influencing the outcomes of the intervention in each patient.

RESEARCH METHODS

Research Design

This study employed a descriptive case study design using the nursing care process approach. A case study design was selected because it enables an in-depth exploration of the implementation of oral hygiene using 0.2% chlorhexidine gluconate in mechanically ventilated patients with pneumonia, while evaluating each patient's clinical response to the intervention. This approach provides a comprehensive description of the implementation of evidence-based nursing practices in the prevention of Ventilator-Associated Pneumonia (VAP). The study was conducted in the Intensive Care Unit (ICU) of Hospital X from June 15 to June 17, 2026, in accordance with the data collection period for this case study.

Research Subjects

The study subjects consisted of two patients admitted to the ICU of Hospital X with a medical diagnosis of pneumonia who required mechanical ventilation via an endotracheal tube (ETT). Subjects were selected using purposive sampling, in which cases were chosen based on specific characteristics consistent with the objectives of the study.

Inclusion Criteria

Patients were included in the case study if they met the following criteria:

1. Aged 18 years or older.
2. Diagnosed with pneumonia.
3. Receiving mechanical ventilation via an endotracheal tube (ETT).
4. Undergoing mechanical ventilation for at least 48 hours.
5. Receiving oral hygiene using 0.2% chlorhexidine gluconate according to the hospital's standard operating procedures.
6. Having complete medical records, including laboratory test results, arterial blood gas analysis, chest radiographs, and nursing care documentation.
7. Having family members who provided informed consent for participation in the case study.

Exclusion Criteria

- Patients were excluded from the study if they:
1. Had severe facial trauma.
 2. Had active oral bleeding.
 3. Were transferred to another ward or died before the observation period was completed.

Research Setting

The study was conducted in the Intensive Care Unit (ICU) of Hospital X, South Tangerang, a referral hospital providing critical care services and implementing the Ventilator Care Bundle as part of its healthcare-associated infection prevention program.

Data Collection Procedures

Data were collected in stages using several methods to obtain comprehensive information.

Interview

Interviews were conducted with the patients' family members using a nursing assessment form to obtain information regarding patient identity, previous medical history, current health status, comorbidities, medication history, allergy history, and other relevant information supporting the nursing assessment.

Observation

Observations were performed daily throughout the intervention period to assess the patients' level of consciousness, general condition, mechanical ventilator use, secretion characteristics, oral cavity condition, signs of infection, and the patients' responses to the oral hygiene intervention.

Physical Examination

Physical examinations were conducted using a head-to-toe assessment covering the respiratory, cardiovascular, neurological, genitourinary, integumentary, and musculoskeletal systems. The examination focused on parameters associated with VAP risk, including breathing pattern, breath sounds, sputum characteristics, oxygen saturation, ventilator use, and oxygenation status.

Medical Record Review

Secondary data were obtained from the patients' medical records, including medical diagnoses, laboratory findings, sputum culture results, arterial blood gas analysis, chest radiographs, antibiotic therapy, supportive treatments, duration of mechanical ventilation, and patients' clinical progress.

Research Instruments

The instruments used in this study included:

Nursing Assessment Form

The nursing assessment form was used to collect patient demographic information, medical history, physical examination findings, nursing diagnoses, nursing interventions, and evaluation outcomes.

Clinical Pulmonary Infection Score (CPIS)

The risk of VAP was assessed using the Clinical Pulmonary Infection Score (CPIS) developed by Basyigit (2017). The CPIS consists of the following components: Body temperature, White blood cell count, Characteristics of tracheal secretions, PaO₂/FiO₂ ratio, Chest radiographic infiltrates, Sputum culture results

The CPIS is interpreted as follows: CPIS ≤ 6: Low probability of Ventilator-Associated Pneumonia (VAP), CPIS > 6: High probability of Ventilator-Associated Pneumonia (VAP).

Parameter	Score 0	Score 1	Score 2
Body Temperature	36.5–38.4°C	38.5–38.9°C	≥39.0°C or ≤36.0°C
White Blood Cell (WBC) Count	4,000–11,000 cells/mm ³	<4,000 or >11,000 cells/mm ³	<4,000 or >11,000 cells/mm ³ with >50% band forms (immature neutrophils)
Tracheal Secretions	None or scant	Moderate	Abundant and purulent

PaO ₂ /FiO ₂ Ratio	>240 or Acute Respiratory Distress Syndrome (ARDS)	–	≤240 without ARDS
Chest Radiograph	No infiltrate	Diffuse infiltrate	Localized infiltrate
Sputum Culture	Negative	–	Positive
Total Score	0–12		

Adapted source: Pugin et al. (1991), Basyigit (2017).

Oral Hygiene Intervention

The intervention was carried out based on the Standard Operating Procedure (SOP) of the ICU at Hospital X. Oral hygiene was performed twice daily for three days using sterile gauze soaked in 0.2% chlorhexidine, cleaning the teeth, tongue, palate, and lips. During the procedure, patient tolerance, oral mucosal condition, secretion characteristics, and the application of infection prevention principles were monitored.

Nursing Implementation

Throughout the study, oral hygiene was implemented by the researcher in accordance with the ICU SOP, while maintaining adherence to the principles of asepsis and patient safety.

Each intervention was documented in the patient's progress notes, and evaluations were conducted for: oral hygiene, amount of secretions, sputum culture results, and changes in CPIS scores.

Data Analysis

Data analysis was conducted descriptively by comparing the results of the assessment, implementation, and evaluation in the two patients. The effectiveness of the intervention was assessed based on changes in the patient's clinical condition, progress in oral hygiene, changes in secretion characteristics, supporting examination results, and the CPIS score. The study results were then compared with previous theories and research on oral hygiene using 0.2% chlorhexidine gluconate in the prevention of Ventilator-Associated Pneumonia.

Research Ethics

The study obtained permission from Hospital X and the educational institution in accordance with applicable procedures. Prior to data collection, the researcher obtained informed consent from the patient's family. All patient identities were kept confidential using initials, and the data obtained were used only for scientific purposes. The study was conducted in accordance with the principles of research ethics, including respect for persons' autonomy, beneficence, non-maleficence, and justice.

RESULTS AND DISCUSSION

Characteristics of the Study Subjects

This study involved two patients undergoing treatment in the Intensive Care Unit (ICU) of Hospital X with a medical diagnosis of pneumonia and requiring mechanical ventilation via an endotracheal tube (ETT). Both patients received oral hygiene intervention using 0.2% chlorhexidine gluconate according to ICU Standard Operating Procedures (SOP) for three days.

Table 1. Characteristics of the Study Subjects

Characteristic	Patient 1	Mr. P
Medical Diagnosis	Pneumonia	Bronchopneumonia + Acute Respiratory Distress Syndrome (ARDS)
Sex	Male	Male
Age	62 years	76 years
Mechanical Ventilation	Yes	Yes
Duration of Mechanical Ventilation	>48 hours	>48 hours

Oral Hygiene with 0.2% Chlorhexidine Gluconate	Twice daily	Twice daily
Duration of Intervention	3 days	3 days

Oral Hygiene Implementation

Oral hygiene interventions were performed twice daily for three consecutive days in accordance with the Standard Operating Procedures of the ICU at Hospital X. Prior to the procedure, the patient was placed in a semi-Fowler's position, suctioned secretions if necessary, and then the oral cavity was cleaned using 0.2% chlorhexidine gluconate on the lips, buccal mucosa, gingiva, tongue, teeth, and palate. After the procedure, the oral cavity condition, the characteristics of the secretions, and the patient's clinical condition were evaluated.

All procedures were carried out as planned without complications or side effects related to the administration of 0.2% chlorhexidine gluconate.

Results of the First Patient Evaluation

At the initial assessment, the first patient exhibited moderate tracheal secretions and poor oral hygiene due to mechanical ventilation. After three days of oral hygiene using 0.2% chlorhexidine gluconate, there was improvement in oral hygiene, a reduction in tracheal secretions, and negative sputum culture results. Evaluation using the Clinical Pulmonary Infection Score (CPIS) showed a score of 3, indicating a low risk of VAP.

Clinically, the patient also showed improvement, indicated by respiratory stability and no signs of new infections during the observation period.

Second Patient Evaluation Results

In the second patient, the initial condition indicated bronchopneumonia with Acute Respiratory Distress Syndrome (ARDS), severe impaired oxygenation, and significant secretion production. After administering oral hygiene using 0.2% chlorhexidine gluconate for three days, oral hygiene improved, the mucosa appeared cleaner, and oral secretions decreased.

However, evaluation using the Clinical Pulmonary Infection Score (CPIS) showed a score of 8, indicating a still high risk of VAP. This condition was related to the severity of the patient's underlying disease, including active pulmonary inflammation, impaired oxygenation, and persistent pulmonary infiltrates during the observation period.

Comparison of Outcomes for the Two Patients

Table 2. Comparison of Outcomes Before and After Intervention

Parameter	Patient 1	Patient 2
Oral Cavity Hygiene	Improved	Improved
Characteristics of Tracheal Secretions	Reduced	Still abundant
Sputum Culture	Negative	Positive
CPIS Score	3	8
Interpretation	Low risk of ventilator-associated pneumonia (VAP)	High risk of ventilator-associated pneumonia (VAP)
Response to Oral Hygiene	Good	Good, but influenced by the patient's clinical condition

Discussion

Implementation of Oral Hygiene Using 0.2% Chlorhexidine Gluconate in Patients on Mechanical Ventilators

Oral hygiene is one of the nursing interventions recommended in the Ventilator Care Bundle to prevent Ventilator-Associated Pneumonia (VAP). In patients on mechanical ventilators, endotracheal tube placement weakens the natural defense mechanisms of the oral cavity and airways. Decreased cough reflexes, impaired mucociliary clearance mechanisms, and reduced saliva production result in the accumulation of plaque, debris, and biofilm, which serve as a medium for colonization by

pathogenic bacteria. These microorganisms can be microaspirated into the lower airways, increasing the risk of VAP.

In this study, oral hygiene using 0.2% chlorhexidine gluconate was performed twice daily for three days according to the Standard Operating Procedure (SOP) of the ICU at Hospital X. All procedures were performed aseptically with patient safety in mind, starting with the semi-Fowler's position, suctioning secretions as indicated, and cleaning the lips, buccal mucosa, gingiva, tongue, teeth, and palate with chlorhexidine. This implementation aims to reduce bacterial colonization in the oral cavity, thereby hopefully reducing the risk of VAP.

The study findings showed that both patients experienced improved oral hygiene after oral hygiene. The mucosa appeared cleaner, oral secretions decreased, and no complications were observed during the procedure. These results indicate that oral hygiene using 0.2% chlorhexidine gluconate is effective in maintaining oral hygiene in patients unable to perform self-care due to mechanical ventilation.

These findings align with research by Haq et al. (2023) stated that chlorhexidine can inhibit biofilm formation and reduce bacterial colonization in the oral cavity, thereby reducing the source of microaspiration into the lower respiratory tract. Similarly, Haryanti et al. (2024) reported that routine oral hygiene practices contribute to reduced bacterial colonization and support the prevention of VAP in patients on mechanical ventilators.

Relationship of Oral Hygiene to the Clinical Pulmonary Infection Score (CPIS)

In this study, the evaluation of intervention success was based not only on oral hygiene but also on the Clinical Pulmonary Infection Score (CPIS) as a clinical indicator of VAP risk. The CPIS was originally developed by Pugin et al. (1991) and consists of six components: body temperature, leukocyte count, tracheal secretion characteristics, PaO₂/FiO₂ ratio, pulmonary infiltrates on chest radiographs, and microbiological culture results. The higher the CPIS score, the greater the likelihood of a patient experiencing VAP.

It's important to understand that oral hygiene does not directly reduce the CPIS score, as most CPIS components are influenced by the patient's lung infection and physiological status. Oral hygiene works by reducing bacterial colonization in the oral cavity, thereby reducing the risk of microaspiration. This impact has the potential to improve several CPIS components, particularly secretion characteristics and sputum culture results, if accompanied by improvements in the patient's clinical condition.

The results showed that the first patient experienced a decrease in the CPIS score to 3, accompanied by negative sputum culture results and a reduction in the amount of secretions. Conversely, the second patient maintained a CPIS score of 8 despite improving oral hygiene. These findings suggest that changes in the CPIS score are influenced not only by the success of oral hygiene but also by the severity of the patient's underlying disease.

Therefore, the CPIS in this study was not used as a tool to assess the success of oral hygiene, but rather as a clinical indicator to evaluate the development of VAP risk following nursing intervention.

Analysis of Response Differences in the Two Patients

The difference in outcomes between the first and second patients is a key finding in this study. Both patients received the same oral hygiene intervention procedure, but demonstrated different clinical outcomes.

In the first patient, improved oral hygiene was accompanied by a decrease in secretions, a negative sputum culture result, and a CPIS score of 3. These results indicate that in addition to good oral hygiene, the patient's clinical condition also improved, leading to a gradual improvement in the pulmonary inflammation process.

In contrast, the second patient maintained a CPIS score of 8 despite improved oral hygiene. This was due to the patient's more severe clinical condition, namely bronchopneumonia with Acute Respiratory Distress Syndrome (ARDS). ARDS causes diffuse damage to the alveolar-capillary

membrane, increased pulmonary capillary permeability, fluid accumulation in the alveoli, and severe impairment of gas exchange. As a result, the PaO₂/FiO₂ ratio remains low and pulmonary infiltrates persist, resulting in several CPIS components not improving during the observation period.

These findings indicate that oral hygiene remains beneficial in maintaining oral hygiene. However, its success in reducing the risk of VAP is greatly influenced by the severity of the disease and the patient's response to medical therapy.

Factors Affecting the Risk of Ventilator-Associated Pneumonia

Research results indicate that VAP is a multifactorial condition. Oral hygiene is an important component in preventing VAP, but it is not the sole factor determining success.

According to Bani Mohammad et al. (2024), the effectiveness of oral hygiene is influenced by the severity of the disease. Patients with severe pneumonia, sepsis, or ARDS remain at high risk of developing VAP even with optimal oral hygiene. This is consistent with the condition of the second patient in this study.

In addition to disease severity, Haq et al. (2023) explained that biofilm formation in the oral cavity and on the surface of the endotracheal tube is a major factor in the colonization of VAP-causing bacteria. Oral hygiene using chlorhexidine can reduce biofilm in the oral cavity, but it cannot eliminate biofilm that has already formed in the lower respiratory tract.

Research by Netti et al. (2024) also confirmed that VAP prevention requires the implementation of all components of the Ventilator Care Bundle, including oral hygiene, 30–45° head-of-bed elevation, hand hygiene, suctioning secretions as indicated, monitoring endotracheal tube cuff pressure, and weaning as early as possible. Therefore, the effectiveness of oral hygiene is most optimal when combined with all of these interventions.

Therefore, the failure to reduce CPIS in the second patient cannot be interpreted as a failure of the oral hygiene intervention, but rather reflects the presence of other clinical factors that more dominantly influence the development of VAP.

Implications for Nursing Practice

The results of this study provide important implications for nursing practice in the ICU. Oral hygiene using 0.2% chlorhexidine gluconate should continue as a routine intervention because it has been shown to improve oral hygiene and reduce bacterial colonization. However, evaluating its success is not solely based on oral conditions; it also requires consideration of the patient's overall clinical condition, including the development of lung infections, oxygenation status, and Clinical Pulmonary Infection Score (CPIS).

Nurses play a crucial role in integrating oral hygiene into the Ventilator Care Bundle and conducting ongoing monitoring of VAP risk factors. This comprehensive approach is expected to improve the quality of intensive care services and reduce the incidence of VAP in patients on mechanical ventilators.

CONCLUSIONS

This study demonstrates that oral hygiene using 0.2% chlorhexidine gluconate is a beneficial nursing intervention for maintaining oral hygiene in patients with pneumonia on mechanical ventilators in the Intensive Care Unit. Implementing oral hygiene according to Standard Operating Procedures (SOPs) can improve the condition of the oral mucosa, reduce the accumulation of secretions and biofilms, and help reduce bacterial colonization in the oral cavity, a source of microaspiration that causes Ventilator-Associated Pneumonia (VAP).

In the first patient, improved oral hygiene was accompanied by a decrease in secretions, negative sputum culture results, and a Clinical Pulmonary Infection Score (CPIS) of 3, indicating a low risk of VAP. Conversely, in the second patient, despite improved oral hygiene, the CPIS remained at 8 due to the effects of bronchopneumonia with Acute Respiratory Distress Syndrome (ARDS), severe oxygenation impairment, and ongoing pulmonary inflammation.

These findings indicate that oral hygiene contributes to VAP prevention, but it is not the sole factor determining the success of VAP risk reduction. The success of interventions is also influenced by disease severity, oxygenation status, response to medical therapy, comorbidities, and the implementation of all components of the Ventilator Care Bundle. Therefore, oral hygiene needs to be maintained as part of evidence-based nursing practice in efforts to prevent VAP in patients on mechanical ventilators.

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