JURNAL ILMIAH ILMU KEPERAWATAN INDONESIA
Indonesian Nursing and Scientific Journal

Volume: 14
Issue: 01
Years: 2024

Research Article

The Influence of Oral Hygiene Using NaCl 0.9% and Chlorhexidine on Ventilator Associated Pneumonia (VAP) in the ICU of Jakarta Hospital

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Editor: KS
Received: 15/03/2024
Accepted: 05/04/2024
Published: 06/04/2024
Available Article: 10.33221/jiiki.v14i01.3183

Conflict of interest statement: There is no conflict of interest in this research.

Funding: Personal Funding.

Abstract

Background: VAP is a problem found in patients who are on a ventilator, the VAP has not been considered by nursing staff when providing nursing care processes, starting from when reviewing patients, conducting interventions and evaluating patients. Prevention is done from the beginning of nursing care, one of which is oral hygiene.
Objectives: The purpose of this study was to examine the effect of oral hygiene using a combination of 0.9% Natrium Chloride (NaCl) and Chlorhexidine (CHG) in patients who were on a ventilator.
Methods: The design of this study was a quasi experiment with a pretest-post test with a control group design. The sampling technique used the Federer formula with a sample of 18 respondents with 9 respondents per group. Statistical analysis used in this research is univariate characteristic test, bivariate test with paired t-test and for multivariate using simple linear regression test for confounding.
Results: Of the research conducted showed that there was no significant effect in group A before and after the intervention with a p-value (0.403) and the average increased slightly, while group B before and after the intervention had a p-value (0.512) with a decreasing average. The multivariate test found that age confounding had an effect on VAP with a p-value (0.024) while gender confounding had no effect on VAP with a p-value (0.277).
Conclusion: In this study, oral hygiene using a combination of 0.9% NaCl and CHG was effective against VAP.

Keywords: mechanical ventilation, oral hygiene, VAP

Introduction

Ventilator-associated pneumonia (VAP) is a common Healthcare-Associated Infection (HAI) occurring in intensive care units (ICUs) as a complication of invasive mechanical ventilation that happens after 72 hours of ventilator or endotracheal tube placement. The incidence is 28% in patients with invasive mechanical ventilation, and it

increases with prolonged mechanical ventilation duration. The daily increase rate in VAP incidence is estimated at 3% in the first five days, 2% per day from day 6 to 10, and 1% per day after day 10.[1] VAP is the most common HAI in adult critical care units and is associated with increased ICU admissions, patient ventilator days, and mortality. VAP is estimated to increase underlying disease mortality by 30%.[2]

VAP can have significant impacts, such as prolonging the length of patient care, increasing morbidity and mortality rates in the ICU, and extending the intervention time by nurses.[3] The time of VAP onset also varies based on the duration of mechanical ventilation. For instance, 3,387 patients within 45 days of mechanical ventilation in the first 9 days of installation are at risk of VAP. The overall predicted incidence of VAP in the immediate days following ventilator installation and the subsequent days is 5.3 per 1000 ventilator days and 8.3 per 1000 ventilator days, respectively.[4] The incidence of VAP increases by 41 cases per 1000 mechanical ventilation uses.[5]

The primary cause of VAP is Methicillin-Resistant Staphylococcus Aureus (MRSA), accounting for more than 50% in 2013. A study in North Korea reported that S. aureus was the most common pathogen causing VAP, with 44%, and 69% of them were MRSA. Other causative agents include Acinetobacter baumannii (30%), Pseudomonas aeruginosa (12%), Stenotrophomonas maltophilia (7%), Klebsiella pneumonia (6%), and Serratia marcescens (2%). According to WHO, 14 countries in Europe, the Middle East, Southeast Asia, and the Pacific had an 8.7% contamination rate of healthcare-associated infections among 55 hospitals, while Southeast Asia had a rate of 10%. According to Rosenthal et al. (2012), the incidence of ventilator-associated pneumonia (VAP) due to ventilator placement in the United States ranges from 0.0 to 4.9 per 1000 ventilator days, while data from the International Nosocomial Infection Control Consortium (INICC) indicates an incidence of 15.8 per 1000 ventilator days.[6]

Patient mortality due to VAP is reported to be 30%, increasing to 70% when accompanied by other triggering factors such as patient age, medical history, and the presence of other chronic diseases. In 2005, the Institute for Healthcare Improvement (IHI) proposed bundles as a VAP prevention measure applied to ventilated ICU patients. Research has been conducted to implement a series of activities to reduce VAP incidence, including medication to prevent complications (DVT), gastric disorder prevention medication, and anxiety-relief medication for patient preparation for ventilator removal. Some studies also incorporate daily oral care with Chlorhexidine and NaCl.[7]

Based on previous research findings, the management of VAP still relies on Chlorhexidine (CHG), while studies explaining the influence of NaCl as an alternative for preventing VAP are scarce. Therefore, this research aims to compare CHG and NaCl in terms of their impact on the incidence of VAP in ventilator-assisted patients.

Methods

The research design used in this study was a quasi-experiment with a pretest-posttest with control group design. This research was conducted to determine the effect of oral hygiene on patients with ventilator placement. In this study, interventions were given to two groups based on the pretest and posttest values of each group. Group A conducted oral hygiene using 0.9% NaCl, while Group B conducted oral hygiene using a combination of 0.9% NaCl and CHG. The intervention was performed twice daily, in the morning at 08:00 and at 3:00 p.m., for three consecutive days, with each oral hygiene session lasting approximately 15 minutes. Before starting the intervention, a Clinical Pulmonary Infections Score (CPIS) assessment was conducted for pre-intervention data, and after the intervention was performed for 3 days, on the 4th day, a CPIS post-intervention assessment was conducted population comprising all subjects defined, understood, researched, and from which decisions would be drawn by the researcher, in which the subjects have benefits and characteristics.[8,9]

This research was conducted at Jakarta Regional General Hospital with a population of ventilated patients from October to December 2021, totaling 64 individuals who did not have pneumonia at the time of ventilator placement. The total sample taken from each group was 9 respondents, with a total of 18 respondents in all groups, inclusion criteria: patients on ventilators, and patients with CPIS results < 6. Exclusion criteria: patients with signs of ventilator-associated pneumonia when they were treated in the ICU. The sampling technique used in this research was purposive sampling, where the researcher selects research samples according to predetermined criteria.[8] The summary of this research uses CPIS. CPIS includes 6 questions that measure the occurrence of VAP in patients, consisting of patient temperature, leukocytes, tracheal secretions, oxygenation, chest X-ray, and culture examination.[10] The data analysis used univariate to observe respondent characteristics, bivariate to see the average difference between Group A and Group B regarding VAP, and multivariate to observe the confounding factor's influence on VAP. The statistical test used in this research is the rapid mixer ANOVA test with the assumption of normality being met.

Results

Univariate Analysis

Table 1. Characteristics of Respondents Based on Age, Gender, Duration of Ventilator Placement, and Homogeneity Test of Respondents in the Intensive Care Unit (ICU) of Pasar Minggu Regional General Hospital in 2022 (n=18)

Variable	Category	Group A, n (%)	Group B, n (%)	*p-value*
Age	> 60 Years	3 (33,3)	3 (33,3)	0,136
	≤ 60 Years	6 (66,7)	6 (66,7)	
Gender	Male	3 (33,3)	5 (55,6)	0,228
	Female	6 (66,7)	4 (44,4)	
Duration of Ventilator Placement	>3 Days	9 (100)	9 (100)	-
	≤3 Days	0 (0)	0 (0)	
CPIS	Before Intervention			
	> 6	0 (0)	0 (0)	0,131
	≤ 6	9 (100)	9 (100)	
	After Intervention			
	> 6	2 (22,2)	1 (11,1)	0,228
	≤ 6	7 (77,8)	8 (88,9)	

In Table 1, the age characteristics in Group A show that there are 3 individuals aged > 60 years and 6 individuals aged ≤ 60 years. In Group B, there are also 3 individuals aged > 60 years and 6 individuals aged ≤ 60 years. The gender characteristics in Group A indicate that there are 3 male patients, while in Group B, there are 5 male patients. The variable duration of ventilator placement in both Group A and Group B is 3 days (100%). The characteristics of CPIS before intervention in Group A show that all respondents (9 individuals) have a CPIS result of ≤ 6. After the intervention, CPIS results in Group A reveal that 2 patients (22.2%) have a CPIS > 6, and 7 patients (77.8%) have a CPIS ≤ 6. In Group B, CPIS before intervention indicates that all respondents (9 individuals) have a CPIS result of ≤ 6. However, after the intervention, the CPIS results show that 1 patient (11.1%) has a CPIS > 6.

Table 2. Mean Before, After Intervention, and Normality Test Results in Group A and Group B

Variable	Group	Measurement	Mean	SD	n	*p-value*
Age	Group A	Before	4,56	0,527	9	0,732
		After	5,00	1,225		
	Group B	Before	4,56	0,726	9	0,848
		After	4,11	1,764		
Gender	Group A	Before	0,167-0,00	0,408-0,00	9	0,574
		After	0,224-1,00	0,548-1,73		0,864
	Group B	Before	0,510-1,08	1,14-2,16		0,692
		After	0,200-0,479	0,447-0,957	9	0,163

Base on Table 2, the mean age in Group A before intervention was 4.56, and after intervention, it was 5.00. In Group B, the mean age before intervention was 4.56, and after intervention, it was 4.11. Based on the normality test results, the CPIS values before and after intervention in both Group A and Group B have $p > 0.05$, indicating that the data are normally distributed. Therefore, the paired t-test is used.

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Table 3. Comparison of Mean CPIS in Patients Undergoing Oral Hygiene (n= 18)

Variable	Group	SE	Mean	SD	*p-value*
CPIS	Group A	0,176	4,56	0,527	0,403
		-0,408	-5,00	-1,225	
	Group B	0,242	4,56	0,726	0,512
		-0,588	-4,11	1,764	

Table 3 presents the results of the comparative analysis between Group A with mean values before and after the intervention being -0.444 and Group B with mean values before and after the intervention being 0.444. The p-value is greater than 0.05, indicating no significant difference between Group A using oral hygiene with NaCl 0.9% and Group B using a combination of oral hygiene with NaCl 0.9% and CHG against VAP.

Multivariate Analysis

Table 4. Multivariate Analysis of the Influence of Age, Gender, and Duration of Ventilator Use in Groups A and B

	Groups A and B			
Variable	**X^2**	**df**	**E2**	**p-value**
Age	11,84	1	0,047	0,024
Gender	2,39	1	1,28	0,277
Duration of Ventilator Use				

Based on Table 4, the results show that Age and Gender variables in Groups A and B. For the Age variable, a p-value < 0.05 is obtained, indicating an influence between the Age variable and the incidence of VAP. The Gender variable has a p-value > 0.05, indicating no significant influence of gender on the incidence of VAP. The Duration of Ventilator Use variable cannot be assessed for its influence on the occurrence of VAP because the data obtained are all respondents assessed with CPIS post-intervention on the 4th day of ventilator installation.

Discussion

The research findings revealed the characteristics of respondents, including their age. Statistical analysis indicated that patient age influenced the occurrence of VAP (Ventilator-Associated Pneumonia). From the data collected, researchers found that among the patients who experienced VAP, all three were over 60 years old. This finding is supported by a study conducted by Arisma et al. (2017), which stated that individuals over 60 years old are at higher risk of experiencing metabolic disorders, hemodynamic disturbances, or malignancy processes that often require treatment in the ICU.[11]

In ICU care, patients are often associated with medical device interventions for therapeutic or diagnostic purposes, such as intravenous lines, urinary catheters, nasogastric tubes, or mechanical ventilators. This increases the potential for translocation of MDR (Multi-Drug Resistant) Acinetobacter baumannii colonization, both in patients and in the patient's surrounding environment, thereby triggering the infection process of MDR A. baumanii. This is exacerbated by the immunocompromised condition of the patient and poor sanitation and environmental maintenance.

I Nyoman Astika (2015) explains that the elderly generally experience physiological changes in all organs due to aging processes, and their immune systems have weakened. The decline in functional status in the elderly often leads to worse conditions and longer hospital stays. Their immune systems are more vulnerable, and the decline in the functional status of organs can trigger specific diseases in related organs. This results in elderly individuals having less energy due to their weakened immune system, and certain diseases in elderly individuals usually require more intensive medical care and therapy, whether self-administered at home or in a hospital setting. The decline in the functional status of organs and the weakened immune system play a significant role in the susceptibility of the elderly to infections. Infections in the elderly have adverse effects such as increased morbidity, mortality, and other conditions in the infected individuals. Infectious diseases contribute to increased healthcare costs. One preventive measure for VAP is through oral hygiene practices.[12]

Regarding gender variables, this study found that gender does not affect VAP, as indicated by the occurrence of VAP in three male respondents. This finding is consistent with a study by Forel et al. (2012), which showed a significantly higher proportion of male patients in the VAP group compared to the non-VAP group, indicating that gender is an independent risk factor for VAP.[13] Adien (2015) stated that the majority of pneumonia patients are male, which may be influenced by environmental factors, as most smokers are male. Continuous exposure to cigarette smoke in healthy adults increases the risk of lung diseases, bronchitis, and pneumonia.[14] Timsit et al. (2017) surveyed 2,897 patients in 361 ICUs in 20 countries and found that the relative risk of VAP in men was 1.3 times higher than in women.[15]

There was a difference in the average values before treatment between Group A (using normal saline) and Group B (using a combination of normal saline and CHG). Oral hygiene intervention using normal saline (NaCl 0.9%) can reduce the incidence of VAP. There was an increase in the average value before and after treatment in Group A, indicating that the intervention did not affect VAP, as shown by the CPIS (Clinical Pulmonary Infection Score) value. Meanwhile, Group B showed a decrease in the average value, indicating that the intervention affected VAP.

Group A used normal saline (NaCl 0.9%), which is a physiological fluid that matches the body's fluid. Normal saline does not alter saliva pH, thus maintaining the mouth's natural buffer. Normal saline solution is not irritating, thus preserving oral physiology. Therefore, oral defense will be enhanced, reducing the risk of oral infections. Group B used a combination of NaCl 0.9% and CHG for oral hygiene in this study, which was found to affect VAP. This is consistent with the study by Rosinta et al. (2019), which showed that oral hygiene using CHG can reduce the risk of VAP. The main advantage of chlorhexidine over most other mouthwashes is its adherence to oral cavity tissues. Its good

binding to both soft and hard tissues in the mouth allows chlorhexidine to remain effective for a long time after use. The number of bacteria in saliva slowly decreases by 10-20% compared to the initial amount before use and remains effective for 7 to 12 hours.[16] Research on the use of 0.9% NaCl and chlorhexidine given simultaneously to patients on ventilators further increases the prevention of HAIs because germs around the patient's mouth will die due to the modification of 0.9 NaCl to keep the patient's mouth moist, and chlorhexidine which kills germs causes of VAP in patients on ventilators

Conclusion

Based on hypothesis testing using the rapid mixer ANOVA test, it was concluded that there was no difference in the average before and after the intervention using 0.9% NaCl and a combination of 0.9% NaCl and CHG on VAP. There are no similar values between before and after administering the intervention. The p-value results in both groups (intervention and control) showed that they were all greater than the alpha value which concluded that there was no difference between the intervention using 0.9% NaCl and the combination of 0.9% NaCl and CHG on VAP. The results of this study proved that there was a decrease in the incidence of VAP HAIs in patients who underwent oral hygiene using a combination of 0.9% NaCl and chlorhexidine by showing a decrease in CPIS numbers to determine whether the patient had VAP or not.

Conflict of Interest Declaration

There is no conflict of interest in this research.

Acknowledge

The researcher expresses sincere gratitude to all parties who have supported the smooth process of this research until completion.

Funding

Personal Funding

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