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VALUE OF CLINICAL PULMONARY INFECTION SCORE IN CRITICALLY ILL PATIENTS: BETWEEN THE USE OF CHLORHEXIDINE AND PIPER BETLE LINN MOUTHWASH

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Abstract
Background: One of the complications of ventilator use in patients in Intensive Care Unit (ICU) is Ventilator-Associated Pneumonia (VAP). Oral hygienes is one of the methods to prevent VAP.
Objective: The objective of this study was to compare the value of clinical infection score (CPIS) in critically ill patients after given oral hygiene using chlorhexidine and Piper betle Linn mouthwash.
Methods: This was an observational study with cross-sectional study design, which consisted of two intervention groups. Thirty respondents were selected using total sampling, with 15 respondents randomly assigned in each group. Independent t-test was used for data analysis.
Results: Findings showed that the mean of CPIS in the Piper betle Linn group was 3.80 and the mean of CPIS in the chlorhexidine group was 4.07.
Conclusion: CPIS in the treatment group using Piper betle Linn mouthwash was lower than the mean of CPIS in the treatment group using clorhexidine.

Keywords: chorhexidine, CPIS, Piper betle Linn, mouthwash, oral hygiene

INTRODUCTION

Airway infections associated with ventilator installations in patients in Intensive Care Unit (ICU) are known as ventilator-associated pneumonia (VAP), the most common nosocomial infection in ICU, which remains a health care problem worldwide (Fartoukh et al., 2003). Microorganisms that cause VAP is staphylococcus aureus, pseudomonas aeruginosa and enterobacteriacea. Staphylococcus aureus is a normal flora in the oral cavity that can turn into a pathogen in case of trauma or abrasion on the mucosal surface (Forbes, 2007).
The incidence of VAP in the world is quite high, varying between 9-27% and the death rate can be more than 50%. Incidence of pneumonia increased by 3-fold in patients with ventilator. Cases of nosocomial pneumonia range from 5-10 cases per 1000 clients, which its incidence increased 6-20 times in ventilator-installed patients, and mortality rates range from 20-50% (Mangunrejo, Widjaja, Kusumo, & Sutoyo, 2004). VAP numbers in Indonesia varied considerably. In General Hospital of Dr. Moh. Hoesin Palembang there are 31.69% of VAP cases in 2011-2012 (Lestari, 2014); and in Sanglah Denpasar Hospital there are 15.48% per 1000 days usage in 2012 (Azis, 2013).

Assessment of Clinical Pulmonary Infection Score (CPIS) is commonly used for ventilator-associated pneumonia examination. In addition, sputum culture examination is also used to establish ventilator-associated pneumonia. The ventilator-associated pneumonia component consists of body temperature, leucocytes, tracheal secretions, oxygenation index, and radiological examination. The initial CPIS assessment is undertaken within 48 hours from the time the client first entered the ventilator, then the CPIS assessment is performed periodically (Luna et al., 2003).

Prevention of VAP can be done by two ways, which is non-pharmacology and pharmacology (Wiryana, 2007). Non-pharmacological way is routine and standard in intensive care using chlorhexidine (Ibrahim, Ward, Sherman, & Kollef, 2000). Study reveals that chlorhexidine used in oropharyngeal decontamination can decrease the incidence of respiratory tract infections in the intensive care unit up to 69% (DeRiso, Ladowski, Dillon, Justice, & Peterson, 1996), and can reduce the colonization of the bacteria cause VAP by 53% (Fourrier et al., 2000). However, although antiseptic have been used, VAP score is still high.

On the other hand, alternative antiseptic that lately used is derived from herbal plants namely betel leaf. Betel leaf is a traditional medicinal plant known as Piper betle L (Heyne, 1987). Since 600 years BC, traditional Asian and Indian communities use betel leaves for various purposes, from customary to treatment purposes. The Indonesian people themselves have known the betel leaf as ingredients to assert with the belief that betel leaves can strengthen teeth, heal minor wounds in the mouth, remove body odor, stop gum bleeding, and as mouthwash (Moeljanto, 2003).

Previous studies revealed that the use of decoction of betel leaf and 1% povidone iodine for oral hygiene is effective in reducing aerobic and anaerobic bacteria in patients with decreased level of consciousness at Islamic Hospital of Pekalongan Pekajongan (Nuniek & Antara, 2012).

Betel leaf is used because it contains essential oil consisting of bethephenol, chavicol, sekuterpen, hidriksivakal, cavibetol, estrogen, eugenol, and karvarool. The biochemical substances in betel leaves have the power to kill germs and fungi. In addition, mouthwash of betel leaf is natural having no side effects (Hidayat, 2013). Therefore, this study aimed at comparing the value of clinical pulmonary infection score in critically ill patients between the use of chlorhexidine and Piper betle linn mouthwash.

METHODS

Study design

This was an observational study with cross-sectional study design, which consisted of two intervention groups. The first intervention was treated with oral hygiene using a factory-made betel leaf mouthwash and the second one was treated with oral hygiene with a clorhexidine solution 0.2%.

Setting

The research was conducted in ICU of the General Hospital of Prof. Dr. Margono Soekarjo, Central Java, Indonesia. The study began on 4 January 2017 until 4 February 2017.

Research subject

Thirty respondents were selected using total sampling, with 15 respondents randomly assigned in each group. The inclusion criteria included patients using ventilators with endotracheal tube intubation (ETT) in the first day. The exclusion criteria included patients with terminal disease and HIV, oxygen saturation <90%, and sepsis patients related to infection with Systemic inflammatory response syndrome (SIRS) manifestations.

Instrument

Clinical Pulmonary Infection Score (CPIS) was used and performed on the 4th day of treatment, which included: (i) body

temperature (°C) using a mercury thermometer, (ii) leukocytes (/mm^3) observed through observation of laboratory results, (iii) secret of trachea observed by seeing whether there is a secret or not, if any, purulent or not, (iv) oxygenation (PaO2/FiO2) observed through observation of laboratory results, and (v) photographs of thorax observed through observations of radiological examination results. Each score in each component is then summed and got score of CPIS from 0 to10.

Intervention

Oral hygiene was done based on the standard of operating procedure (SOP) in the hospital setting. The criteria of good oral hygiene are the mouth mucosa and the tongue looks pink, moist, intact. The gums are wet and intact, the teeth look clean, and slick, the tongue is pink and not dirty, the lips is moist, and mucosa and pharynx are clean. Oral hygiene was done twice daily by research assistant, starting from the first day of ventilator installation until the fourth day of treatment. The qualification of research assistant is having a minimum education classification of Diploma III of Nursing and working in the ICU of the General Hospital of Prof. Dr. Margono Soekarjo, Central Java at least 6 (six) months to ensure the same skill and competence in performing oral hygiene action. Betel leaf group used a 200 ml packed mouthwash contained of aqua, xylitol, piper betle (leaf) extract, melaleuca alternifolia (tea tree) leaf water, sodium benzoate, menthe viridis (spearmint) leaf oil, menthe piperita (peppermint) oil, and menthol. While chlorhexidine group used 0.2% chlorhexidine solution. Both of these antiseptic agents were administered at the time of treatment using a set of oral hygiene instruments for each respondent.

Data analysis

Statistical analysis was performed using SPSS version 21.0. Respondent characteristic data were analyzed and described using frequency and percentage. CPIS component data including body temperature, leucocytes, oxygenation, secret and chest radiographs were tested for normality as an independent test requirement of t-test and Mann Withney test.

Ethical consideration

This study has been approved by the Research Ethics Committee of Poltekkes Kemenkes Semarang (Approval Number: 285 / KEPK / Poltekkes-Smg / EC / 2016). Study permission was also obtained from the General Hospital of Prof. Dr. Margono Soekarjo. Prior to data collection, each respondent has signed an appropiate informed consent, and the researchers explained the purpose and the procedure of the study and the confidentiality and privacy of the respondents were well maintained and they were given the freedom at any time to withdraw from the research.

RESULTS

Table 1 shows that the majority of respondents aged more than 60 years (36.7%). Most of them were males (53.3%), and suffered from nervous system disease (43.3%). Table 2 shows the clinical pulmonal infection score, which body temperature in both groups ranged from 36.5 to 38.4^oC and most of respondents had no purulen secretion. Leukocyte component in the Piper betle Linn group was highest in the range of <4000 /> 11000 than leukocyte in the chlorhexidine group. In the oxygenation component, Piper betle Linn group was mostly in the category of ARDS (> 240) by 36.65%, while chlorhexidine group was mostly in the category of non-ARDS (≤ 240) by 30%. There was no localized infiltrate category in both groups.

Table 3 shows that the mean of CPIS in the Piper betle Linn group was 3.80 and mean of CPIS in the Chlorhexidine group was 4.07. It could be said that the CPIS value in the Piper betle Linn group was better than CPIS value in the chlorhexidine group.

Table 1 Characteristics of respondents based on age, gender, and type of disease (N=30)

Variable	Piper betle Linn n=15			Clorhexidine n=15		
	f	%	Mean±SD	f	%	Mean±SD
Age			57.67±19.747			40.73±18.911
Age group						
<20 years	2	6.7		1	3.35	
20-35 years	5	16.7		1	3.35	
36-45 years	1	3.35		2	6.7	
46-60 years	4	13.35		3	10	
>60 years	3	10		8	26.65	
Gender						
Male	7	23.35		9	30	
Female	8	26.65		6	20	
Diagnosis						
Respiration	0	0		1	3.35	
Heart	1	3.35		2	6.65	
Nervous	6	20		7	23.35	
Urination	3	10		2	6.65	
Digestion	1	3.35		0	0	
Others	4	13.35		3	10	

Table 2 Frequency distribution of respondents based on Clinical Pulmonal Infection Score (CPIS) (N=30)

Variable	Oral Hygiene	Range	Frequency		Mean ± SD
			f	%	
Body temperature	Piper betle Linn	36.5-38.4	8	26.65	38.280±0.6742
		38.5-38.9	2	6.65	
		<36.5/>39	5	16.65	
	Clorhexidine	36.5-38.4	10	33.3	38.080±0.5685
		38.5-38.9	3	10	
		<36.5/>39	2	6.65	
Secret	Piper betle Linn	No	2	6.65	1.20±0.676
		Yes/Not purulent	8	26.65	
		Yes/Purulent	5	16.65	
	Clorhexidine	No	0	0	1.27±0.458
		Yes/Not purulent	11	36.65	
		Yes/Purulent	4	13.35	
Leukocyte	Piper betle Linn	4000-11000	1	3.35	15464.00±3114.922
		<4000/>11000	14	46.65	
	Clorhexidine	4000-11000	5	16.65	12429.33±2514.616
		<4000/>11000	10	33.3	
Oxygenation PaO_2/FiO_2	Piper betle Linn	> 240 /ARDS	11	36.65	317.60±101.511
		≤ 240 /No ARDS	4	13.35	
	Clorhexidine	> 240 / ARDS	6	20	258.07±84.857
		≤ 240 /No ARDS	9	30	
Photographs of thorax	Piper betle Linn	No Infiltrate	11	36.65	0.27±0.458
		Diffuse Infiltrates	4	13.35	
		Localized Infiltrates	0	0	

Clorhexidine	No Infiltrate	7	23.35	0.53±0.516
	Diffuse Infiltrates	8	26.65	
	Localized Infiltrates	0	0	

*ARDS (Acute Respiratory Distress Syndrome)

Table 3 Oral hygiene using Piper Linn Mouthwash and Clorhexidine on CPIS using Independent t-test

Variable	Group		*p-value*
	Piper betle Linn	Chlorhexidine	
	Mean±SD	Mean±SD	
CPIS	3.80±1.373	4.07±1.100	0.562

DISCUSSION

Most of respondents in this study aged > 60 years as many as 36.7%. Literature said that age over 60 years is one of the risk factors for VAP. Elderly is also highly susceptible to respiratory system abnormalities, diminished neurological conditions, acute renal failure, shock, and metabolic syndrome. This is often associated with the frequency of elderly admitted to ICU due to several diseases accompanied with respiratory system disorder that requires the support of mechanical ventilator (Koenig & Truwit, 2006).

Findings of this study showed that 53.3% of respondents were males and 46.7% of them were female. Gender is a risk factor that cannot be modified. Males have twice the risk of VAP compared to females (Weinstein, Bonten, Kollef, & Hall, 2004). Of the 43.3% of respondents diagnosed with nervous system diseases, most of respondents had post craniotomy cases. A previous study showed that the highest case of patients with ventilator in ICU was a general surgical case (31.7%) (Lim et al., 2015). Similar with the other research stated that the most respondents (79.01%) had the post surgical cases (Singh, Rogers, Atwood, Wagener, & Yu, 2000). The success of the cerebral tumor craniotomy surgery was influenced by various things including perioperative management that will affect the success of the surgery. Postoperative thorough evaluation and post operative treatment facilities such as facilities in intesive care unit (ICU) including ventilator support are highly regarded in the post-operative healing process (Esteban et al., 2000).

The results of this study indicated that the treatment group of oral hygiene using Piper betle Linn mouthwash found no respondent experienced VAP based on CPIS (3.80 ± 1.373). The ethanol extract of betel leaf has an effect as a powerful antibiofilm agent that can prevent and eradicate biofilms. This shows that ethanol extract of betel leaf can be used to inhibit pathogenic bacteria present in oral area, so it can be used as an alternative in preventing mouth disease (Teanpaisan, Kawsud, Pahumunto, & Puripattanavong, 2017). Gargling using betel leaf steeping with 100% concentration for 30 seconds can give optimum antibacterial effect to Streptococcus mutans (Hidayaningtias, 2008). Phenol compounds that are also present in betel leaves are bactericidal. When the phenol compound interacts with the cell wall of the microorganism, protein denaturation occurs and increases the permeability of the microorganism. Interactions between microorganisms result in changes in the balance of protein molecules, resulting in changes in protein structure and cause coagulation. Proteins that have denaturation and coagulation cause physiological activity loss that can not function properly. Changes in the structure of proteins in the cell wall of bacteria will increase the permeability of the cell resulting in the growth of cells inhibited and then the cells become damaged (Nalina & Rahim, 2007).

In addition, betel leaf has a wide biological properties and has an effective bioactive compound. Betel leaf has been recognized to have antibacterial and antioxidant properties that are sensitive to some pathogenic bacteria in the mouth (Bhalerao et al., 2013). Thus, the betel leaf rinse can be used as an alternative antiseptic to maintain oral hygiene. Similarly, the treatment group of oral hygiens using chlorhexidine found no respondents experienced VAP based on the mean of CPIS value (4.07 ± 1.100). Previous research suggested that oral care using clorhexidine reduces the risk of developing VAP in petients with mechanical ventilation, and the use of chlorhexidine in ICU is highly recommended to prevent medical complications (Özçaka et al., 2012). Chlorhexidine at physiological pH can bind bacteria on the surface of the oral cavity, which is caused by the interaction between positive charges and chlorhexidine molecules. The wall of bacterial cell causes penetration into the cytoplasm and ultimately leads to the death of microorganisms (Patabnag, 2016).

The results of this study indicated that both antiseptics were equally well used for oral hygiene. Previous research on 144 respondents showed that oral hygiene using 2% clorhexidine was more effective in preventing VAP and colonization of oropharyngeal bacteria than with clorhexidine 0.2% (Zand et al., 2017). However, the use of clorhexidine with higher concentrations has an effect on halitosis and stains on the teeth. So, the use of 0.2% clorhexidine is effective enough to reduce the CPIS score on the patients with mechanical ventilator (Sebayang, 2010). VAP bacteria both gram positive and gram negative are very sensitive to the essential oil content of betel leaf and chlorhexidine.

CONCLUSION

Based on the results of the study, it is concluded that the mean score of CPIS in the treatment group using piper betle Linn mouthwash (3.80) was lower than the mean of CPIS in the treatment group using clorhexidine (4.07). Further study is needed to compare these two oral hygiene agents in the prevention of VAP and perform culture checks to ensure the occurrence of ventilator-associated pneumonia, and CPIS evaluation could be performed more than one time if possible to find out how effective the action of oral hygiene in lowering CPIS or preventing ventilator-associated pneumonia.

REFERENCES

Azis, A. (2013). Cuci tangan sebagai faktor risiko kejadian ventilator associated pneumonia di RSUP Sanglah Denpasar tahun 2012. *Public Health and Preventive Medicine Archive*.

Bhalerao, S. A., Verma, D. R., Gavankar, R. V., Teli, N. C., Rane, Y. Y., Didwana, V. S., & Trikannad, A. (2013). Phytochemistry, pharmacological profile and therapeutic uses of Piper betle Linn-An overview. *Rrjpp, 1*, 10-19.

DeRiso, A. J., Ladowski, J. S., Dillon, T. A., Justice, J. W., & Peterson, A. C. (1996). Chlorhexidine gluconate 0.12% oral rinse reduces the incidence of total nosocomial respiratory infection and nonprophylactic systemic antibiotic use in patients undergoing heart surgery. *Chest, 109*(6), 1556-1561.

Esteban, A., Anzueto, A., Alia, I., Gordo, F., Apezteguia, C., Palizas, F., . . . Bugedo, G. (2000). How is mechanical ventilation employed in the intensive care unit? An international utilization review. *American Journal of Respiratory and Critical Care Medicine, 161*(5), 1450-1458.

Fartoukh, M., Maître, B., Honoré, S., Cerf, C., Zahar, J.-R., & Brun-Buisson, C. (2003). Diagnosing pneumonia during mechanical ventilation: the clinical pulmonary infection score revisited. *American Journal of Respiratory and Critical Care Medicine, 168*(2), 173-179.

Forbes, J. M. (2007). *Voluntary food intake and diet selection in farm animals*: Cabi.

Fourrier, F., Cau-Pottier, E., Boutigny, H., Roussel-Delvallez, M., Jourdain, M., & Chopin, C. (2000). Effects of dental plaque antiseptic decontamination on bacterial colonization and nosocomial infections in critically ill patients. *Intensive Care Medicine, 26*(9), 1239-1247.

Heyne, K. (1987). Tumbuhan berguna indonesia. *Badan Penelitian dan Pengembangan Kehutanan, Departemen Kehutanan, 2*, 1188-1189.

Hidayaningtias, P. (2008). *Perbandingan Efek Antibakteri Air Seduhan Daun Sirih (Piper betle Linn) Terhadap Streptococcus Mutans Pada Waktu Kontak dan Konsentrasi yang Berbeda.* Faculty of Medicine.

Hidayat, T. (2013). Sirih merah budidaya dan pemanfaatan untuk obat. *Penerbit Pustaka Baru Press. Yogyakarta*.

Ibrahim, E. H., Ward, S., Sherman, G., & Kollef, M. H. (2000). A comparative analysis of patients with early-onset vs late-onset nosocomial pneumonia in the ICU setting. *Chest, 117*(5), 1434-1442.

Koenig, S. M., & Truwit, J. D. (2006). Ventilator-associated pneumonia: diagnosis, treatment, and prevention. *Clinical Microbiology Reviews, 19*(4), 637-657.

Lestari, M. I. (2014). *Relationship between chlorhexidine 0.2% and povidon iodine 1% with ventilator associated pneumonia: cohort study*. Paper presented at the Pertemuan Ilmiah Berkala PERDATIN, Makasar.

Lim, K.-P., Kuo, S.-W., Ko, W.-J., Sheng, W.-H., Chang, Y.-Y., Hong, M.-C., . . . Chang, S.-C. (2015). Efficacy of ventilator-associated pneumonia care bundle for prevention of ventilator-associated pneumonia in the surgical intensive care units of a medical center. *Journal of Microbiology, Immunology and Infection, 48*(3), 316-321.

Luna, C. M., Blanzaco, D., Niederman, M. S., Matarucco, W., Baredes, N. C., Desmery, P., . . . Apezteguia, C. (2003). Resolution of ventilator-associated pneumonia: prospective evaluation of the clinical pulmonary infection score as an early clinical predictor of outcome. *Critical Care Medicine, 31*(3), 676-682.

Mangunrejo, H., Widjaja, A., Kusumo, D., & Sutoyo, Y. F. (2004). Pedoman Diagnosis dan Penatalaksanaan di Indonesia: Asma. *Perhimpunan Dokter Paru Indonesia*.

Moeljanto, R. D. (2003). *Khasiat & manfaat daun sirih: obat mujarab dari masa ke semasa*: AgroMedia.

Nalina, T., & Rahim, Z. H. A. (2007). The crude aqueous extract of Piper betle L. and its antibacterial effect towards Streptococcus mutans. *Am J Biotechnol Biochem, 3*(1), 10-15.

Nuniek, N., & Antara, F. E. T. O. H. (2012). Povidone Iodine 1% dan Air Rebusan Daun Sirih di Pekalongan. *Jurnal Ilmiah Kesehatan, 4*(1), 62-64.

Özçaka, Ö., Başoğlu, Ö., Buduneli, N., Taşbakan, M. S., Bacakoğlu, F., & Kinane, D. F. (2012). Chlorhexidine decreases the risk of ventilator-associated pneumonia in intensive care unit patients: a randomized clinical trial. *Journal of Periodontal Research, 47*(5), 584-592.

Patabnag, W. A. (2016). Perbedaan jumlah pertumbuhan koloni bakteri rongga mulut sebelum dan sesudah menggunakan obat kumur yang mengandung chlorheksidine. *Pharmacon, 5*(1).

Sebayang, K. (2010). *PERBEDAAN EFEKTIVITAS ORAL HYGIENE ANTARA POVIDONE IODINE DENGAN CHLORHEXIDINE TERHADAP CLINICAL PULMONARY INFECTION SCORE PADA PENDERITA DENGAN VENTILATOR MEKANIK*. Diponegoro University.

Singh, N., Rogers, P., Atwood, C. W., Wagener, M. M., & Yu, V. L. (2000). Short-course empiric antibiotic therapy for patients with pulmonary infiltrates in the intensive care unit: a proposed solution for indiscriminate antibiotic prescription. *American Journal of Respiratory and Critical Care Medicine, 162*(2), 505-511.

Teanpaisan, R., Kawsud, P., Pahumunto, N., & Puripattanavong, J. (2017). Screening for antibacterial and antibiofilm activity in Thai medicinal plant extracts against oral microorganisms. *Journal of traditional and complementary medicine, 7*(2), 172-177.

Weinstein, R. A., Bonten, M. J. M., Kollef, M. H., & Hall, J. B. (2004). Risk factors for ventilator-associated pneumonia: from epidemiology to patient management. *Clinical Infectious Diseases, 38*(8), 1141-1149.

Wiryana, M. (2007). Ventilator associated pneumonia. *J Penyakit Dalam, 8*(3), 1-15.

Zand, F., Zahed, L., Mansouri, P., Dehghanrad, F., Bahrani, M., & Ghorbani, M. (2017). The effects of oral rinse with 0.2% and 2% chlorhexidine on oropharyngeal colonization and ventilator associated pneumonia in adults' intensive care units. *Journal of Critical Care, 40*, 318-322.

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