THE COMPARISON OF THE EFFECT OF HONEY AND CHLORHEXIDINE IN PREVENTING VENTILATOR ASSOCIATED PNEUMONIA IN PATIENTS ON MECHANICAL VENTILATON

Syaukia Adini[*], Bedjo Santoso, Sarkum, Sudirman

Program Pascasarjana Magister Terapan Kesehatan Keperawatan, Poltekkes Kemenkes Semarang, Indonesia

*Corresponding author:
Syaukia Adini
Program Pascasarjana Magister Terapan Kesehatan Keperawatan
Poltekkes Kemenkes Semarang
Jl. Tirto Agung, Pedalangan, Banyumanik, Kota Semarang, Jawa Tengah, Indonesia (50268)
Email: adinisyaukia@gmail.com

Abstract
Background: Ventilator Associated Pneumonia (VAP) is one of the causes of infection in the hospital and the main cause of death due to nosocomial infection. The strategy to prevent VAP is by oral hygiene. Honey may be a good solution for oral hygiene.
Objective: This study aims to compare the effect of the use of 20% honey solution and 0.2% chlorhexidine as oral hygiene on VAP prevention in patients on mechanical ventilation.
Methods: This was a quasi-experimental study with posttest only control group design in an incentive care unit of a general hospital in Indonesia. Thirty respondents were selected using consecutive sampling, which 15 respondents assigned in a 20% honey group and 0.2% chlorhexidine group. Clinical Pulmonary Infection Score (CPIS) was used to measure Ventilator Associated Pneumonia. Data were analyzed using Independent t-test.
Results: The mean of CPIS in the honey group was 3.33 and the chlorhexidine group was 3.53. Independent t-test showed p-value 0.618 (>0.05), which indicated that there was no significant difference of the effect of honey and chlorhexidine on VAP event.
Conclusion: The 20% honey solution has the same effect with 0.2% chlorhexidine in preventing VAP events in patients on mechanical ventilation.

Keywords: 0.2% chlorhexidine; CPIS; honey; oral hygiene; VAP; ventilator

INTRODUCTION

The mechanical ventilator is a substitute for ventilation function for patients with indications of respiratory and other critical illnesses. However, the use of mechanical ventilators may lead to various complications in respiratory, cardiovascular, central nervous system, gastrointestinal, psychological and oral health. Endotracheal and oropharyngeal tubes of critical patients with intubation can be a vector for the migration of pathogenic germs to allow for infection (Morton, Fontaine, Hudak, & Gallo, 2013; Sundana, 2014).

Infection due to ventilator or known as Ventilator Associated Pneumonia (VAP) is the second cause of infection in the hospital and the main cause of death due to nosocomial infection. Patients suffering from high-risk critical disease may experience pneumonia due to ventilator, which is defined as nosocomial pneumonia in patients who

have been installed a ventilator for at least 48 hours at the time of diagnosis. The VAP patients are characterized by chest x-ray results suggesting a new (progressive) infiltration or sedentary infiltration including other symptoms such as high fever over 38^{0}C, leukocytosis, new onset of purulent sputum and cough, and a worsening gas trade (Vanhems et al., 2011).

The long-term use of mechanical ventilators is assumed to be one of the important risk factors associated with VAP events. In 2001-2009, in the 11 intensive care units in the hospitals in France found 10.8% of 3,387 patients experienced VAP in the first 9 days calculated in 45.760 days. The prediction of the VAP incidence in the first and second day (<48 hours) is 5.3 and 8.3 events. The study is performed on patients with an average age of 54.3 years with mortality rate of 21.7% (Fatmawati R, 2014).

The VAP incidence rates in Indonesia itself vary. Data at the General Hospital Center in Jakarta area found that there is an increasing trend, which the highest incidence occurred on July 2014 (21.2%) and the lowest on September 2014 (5.53%) (Rosyida, 2011). In the General Hospital of Margono in 2015, the incidence of pneumonia was about 15% (RSUD Margono, 2015).

There have been several risk factors related to VAP incidence such as suction method, age, history of lung disease, diabetes mellitus and smoking, including duration of ventilator use; while study found no significant relationship between age (p = 0.230) suction (p = 0.149), history of lung disease (p = 0.469), history of diabetes (p = 0.107), and smoking (p = 1.000) with the incidence of VAP nosocomial infection, only the duration of ventilator use (p = 0.000) has a significant correlation with VAP infection (Lorente, Lecuona, Jiménez, Mora, & Sierra, 2007).

VAP can be prevented by various strategies, including basic nursing principles such as hand washing, wearing gloves when performing nursing procedures, oral hygiene

using an antiseptic solution and mouthwash, applying a mouth moisturizer, and sucking and cleaning the secret (Vanhems et al., 2011).

The antiseptic used to clean the mouth such as chlorhexidine. Study states that oral care with chlorhexidine reduced the risk of VAP development with p value = 0.03. Another study compared the effect of hexadol and chlorhexidine resulted in 1 person (3.33%) exposed VAP in both chlorhexidine and hexadol treatment group.

Several studies have shown that antiseptics for oral hygiene can use honey. Study reveals there is a significant difference in the proportion of stomatitis stages before and after oral hygiene with honey (p = 0.000) and 0.12% chlorhexidine (p = 0.005). The use of honey as a solution for oral hygiene in children with stomatitis can decrease stomatitis stages by 75%, with 21% differences with those who did not get honey (Nurhidayatun, Allenidekania, & E, 2016). The purpose of this study was to compare the effectiveness of honey and 0.2% chlorhexidine as a solution for oral hygiene on ventilator associated pneumonia.

METHODS

Study design
This study was a quasi-experimental study with posttest only control group design.

Setting
The study was conducted from 24 January 2017 to 24 February 2017 in the Incentive Care Unit of the General Hospital of Prof. Dr. Margono Soekadjo, Central Java, Indonesia.

Research subjects
Thirty respondents were selected using consecutive sampling, which 15 respondents assigned in a 20% honey group and 0.2% chlorhexidine group. The inclusion criteria of the sample were patients with ventilator and endotracheal tube intubation (ETT) on the first day, patients who used ventilator for up

to 4 days of treatment, and no previous signs of infection such as temperature (i.e. >38⁰C). The exclusion criteria were patients with HIV and tracheostomy.

Intervention
Oral hygiene performed in both honey and chlorhexidine group was based on the same Standard of Operating Procedure in the hospital. The only difference was the solution used. For the experiment group, oral hygiene used 20% honey produced by Perhutani company that has been standardized by Indonesia , while the control group used 0.2% chlorhexidine. The intervention was conducted by researchers and assisted by four research assistants. Oral hygiene was performed twice daily in every morning and afternoon from the 1st day of using ventilator until the 4th day.

Instrument
Clinical Pulmonary Infection Score (CPIS) (Hamid, Pujiastuti, Widigdo, & Saha, 2018) was used to measure Ventilator Associated Pneumonia (VAP) including: *body temperature* (°C) (score 0 if temperature ≥36.5 and ≤38.4; score 1 if temperature ≥38.4 and ≤38.9; score 2 if temperature ≥39.0 and ≤36.0), *leukocytes* (per mm3) (score 0 if ≥ 4,000 and ≤11,000; score 1 if <4000 and >11,000), *tracheal secretions* (score 0 if no or few secrets; score 1 if having secrets and no purulent; and score 2 if having secrets and purulent), *oxygenation* (score 0 if PaO2/FiO2 >240 or ARDS; score 2 if PaO2/FiO2 ≤240 and no ARDS), *thorax photo* (score 0 if no infiltrate; score 1 if diffuse infiltrate; and score 2 if localized infiltrate). All scores are summed, if the score of CPIS is 0-5 then no VAP, and if CPIS score is ≥6-9, then VAP occurs.

While the criteria of oral hygiene were oral mucosa and tongue is pink, moist, wet gums, teeth look clean, and slippery, pink is tongue and not dirty, moist, mucosa and pharynx remain clean.

Ethical consideration
This study has been approved by the Ethical Research Committee of Poltekkes Semarang with approval number: 286/KEPK/Poltekkes-Smg/EC/2016

Statistical analysis
The statistical analysis was performed using SPSS version 18.0. The respondents' characteristic was described using frequency and percentage. Independent t-test was used to compare the results of the effect of honey and chlorhexidine on VAP with p-value <0.05 and confidence interval of 95%.

RESULTS

Table 1 shows that the majority of respondents in the honey and chlorhexidine group aged 41-60 years. Most of respondents in the honey group were females (30%) and in the chlorhexidine group was males (30%). The type of disease in the chlorhexidine group was heart disease (13.33%) and in the honey group was other diseases (13.33%).

Table 2 shows that the majority of respondents in the honey and chlorhexidine group had a body temperature ranged 36.5-38.4, had secrets with no purulent, leucocytes <4000/>11000, FiO2> 240 / ARDS, and thorax photo showed diffuse infiltrate.

Table 3 shows there was no VAP event in both honey and chlorhexidine group. And Table 4 shows that the mean of CPIS in the honey group was 3.33 and the chlorhexidine group was 3.53. Independent t-test showed p-value 0.618 (>0.05), which indicated that there was no significant difference of the effect of honey and chlorhexidine on VAP event.

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

Variable	Oral Hygiene						p
	Honey n=15			Chlorhexidine n=15			
	F	%	Mean ±SD	F	%	Mean ±SD	
Age group			2.67±0.900			2.87±0.915	1.00
11-20 years	2	6.67		1	3.33		
21-40 years	3	10		4	13.33		
41-60 years	8	26.67		6	20		
61-80 years	2	6.67		4	13.33		
Gender			1.60±0.507			1.40±0.507	1.00
Male	6	20		9	30		
Female	9	30		6	20		
Type of disease			4.87±1.807			3.53±2.066	0.56
Respiration	2	6.67		2	6.67		
Heart	2	6.67		4	13.33		
Nervous	2	6.67		3	10.00		
Urination	3	10		2	6.67		
Digestion	2	6.67		2	6.67		
Others	4	13.33		2	6.67		

Table 2 Frequency distribution of respondents based on CPIS (n=30)

Variable	Group	Range	Frequency		Mean ± SD
			F	%	
Body temperature	Honey	36.5-38.4	11	36.67	0.47± 0.834
		38.5-38.9	1	3.33	
		<36.5/>39	3	10.00	
	Chlorhexidine	36.5-38.4	10	33.33	0.40± 0.632
		38.5-38.9	4	13.33	
		<36.5/>39	1	3.33	
Secrets	Honey	No secret	0	0	1.27± 0.458
		Yes, but not purulent	11	36.67	
		Yes, purulent	4	13.33	
	Chlorhexidine	No secret	1	3.33	1.27± 0.594
		Yes, but not purulent	9	30.00	
		Yes, purulent	5	16.67	
Leucocytes	Honey	4000-11000	5	16.67	0.67± 0.488
		<4000/>11000	10	33.33	
	Chlorhexidine	4000-11000	6	20.00	0.60± 0.507
		<4000/>11000	9	30.00	
FiO2	Honey	> 240 / ARDS	13	43.33	0.27± 0.704
		≤ 240 / no ARDS	2	6.67	
	Chlorhexidine	> 240 / ARDS	11	36.67	0.53± 0.915
		≤ 240 / no ARDS	4	13.33	
Thorax photo	Honey	No infiltrate	5	16.67	0.67± 0.488
		Diffuse infiltrate	10	33.33	
		Localized infiltrate	0	0.00	
	Chlorhexidine	No infiltrate	4	13.33	0.73± 0.421
		Diffuse infiltrate	11	36.67	
		Localized infiltrate	0	0.00	

Table 3 Frequency distribution of respondents based on VAP event (n=30)

| Variable | Category | Oral Hygiene | | | | Total n=30 | |
| | | Honey n=15 | | Chlorhexidine n=15 | | | |
		F	%	F	%	N	%
VAP	VAP	0	0	0	0	0	0
	No VAP	15	50	15	50	30	100

Table 4 Effect of honey and chlorhexidine on VAP using Independent t-test (n=30)

| Variable | Group | | T | p |
	Honey Mean + SD	Chlorhexidine Mean + SD		
CPIS	3.33 ± 0.976	3.53± 1.187	0.504	0.618

DISCUSSION

The characteristics of respondents aged ranging from 41-60 years with the number of 14 respondents (46.7%). It is line with the literature states that some adults are susceptible to respiratory system disorders, decreased neurological conditions, acute renal failure, shock, and metabolic syndrome (Hunter, 2006). The other studies state that age over 60 or between 54-79 years is more susceptible to VAP events (Saragih, Amin, Sedono, Pitoyo, & Rumende, 2014). This is associated with the frequency of adult patients who enter ICU because of respiratory system disorder and requiring the assistance of a mechanical ventilator. It can be said that age <60 years or >60 years is equally at risk of VAP.

The results of this study also found that the gender of respondents was equal between men and women (50%). It is different from the other study mentioned more men than women with VAP. On the other hand, majority of the respondents with VAP had a type of disease related to cardiovascular system, which is similar with previous study (Sundana, 2014).

Some of the nosocomial pneumonia occurs after surgery, especially if mechanical ventilation is necessary. Patients with ventilators have 6-12 times higher in the risk of nosocomial pneumonia than non-ventilators patients. The main reason for the use of mechanical ventilator in surgical patients is the type of surgery, while in medical patients the use of ventilator is usually associated with a patient's illness, which is the risk of bacterial nosocomial pneumonia following cardiac and pulmonary surgery (e.g. bypass surgery and lung resection) is 38 times greater than other surgeries (Huraini, 2011).

The process of entry of bacteria in patients with ventilator is when endotracheal tube is attached to the patient. The size of ETT attached to the patient is one third of the respiratory tract, so it is possible for bacteria to enter the open breathing hole. Thus, to avoid it, oral hygiene is needed to minimize the incident of VAP. In this study, there was no significant difference between the effect of 20% honey solution and 0.2% chlorhexidine as oral hygiene on ventilator associated pneumonia in patients with mechanical ventilator seen from the component on Clinical Pulmonary Infection Score with p = 0.618 (> 0.05). Thus, it could be said that 20% honey solution and 0.2% chlorhexidine are equally good in VAP prevention. Studies have shown that honey has a function as an anti-bacterial, but it can also be antifungal and

antivirus. Honey is able to not only inhibit the growth of rubella virus, herpes virus and three species of leishmania parasite, but also inhibit the growth of dermatophyte fungi, candida albicans, C krusei, C tricosporon and C glabrata that often attack humans (Huraini, 2011).

The other study revealed that honey in the concentration of 100%, 75%, 50%, and 25% are able to inhibit the growth of bacteria, both gram positive and negative bacteria. The antibacterial activity of honey is dominated by hydrogen peroxide, When the damaged system releases a small amount of glucose and produce gluconic acid and hydrogen peroxide, the honey is then analyzed to have a low pH that may have contributed to their antibacterial activity, because low pH honey inhibits the presence and growth of microorganisms (Krishnasree & Ukkuru, 2015).

On the other hand, studies state that chlorhexidine has the ability to inhibit the formation of biofilms, a germicidal mechanism to invade the host body (Mandell et al., 2007). Oral care treatment with chlorhexidine reduces the risk of VAP (p=0.03). Supported by the other study said that the effect of chlorhexidine and hexadol is equal for VAP prevention (Tan, Banzon, Ayuyao, & de Guia, 2007).

Statistical analysis revealed that chlorhexidine was effective in preventing VAP seen from CPIS score. This is in line with previous study stated that there was a significant effect of chlorhexidine in decreasing the number of oropharyngeal bacteria from 300 ± 0.0 to 160 ± 76.625 with p-value = 0.000 (Mandell et al., 2007). Another study showed that there was a significant difference in the number of colonies of oral bacterial growth between before and after rinse with chlorhexidine with p-value <0.05 (Patabnag, 2016). In this study both honey and chlorhexidine are equally capable of killing both gram positive and negative bacteria. Thus, both materials can be used as an oral hygiene antiseptic to prevent the occurrence of VAP in patients with ventilator installed.

CONCLUSION

Based on the results of this study, it can be concluded that 20% honey solution has the same effect with 0.2% chlorhexidine in preventing VAP, which can be seen from CIPS score. However, further study is needed to add the number of days for observation until the patients no longer use ventilator or extubated. Culture inspection is also necessary to accurately see the number of bacteria related VAP.

References
Fatmawati R. (2014). *Laporan indikator mutu dan keselamatan pasien di RSUP Fatmawati [Report of indicator of quality and patient safety in fatmawati Hospital]*. Jakarta: RSUP Fatmawati.
Hamid, I. N., Pujiastuti, R. S. E., Widigdo, D. A., & Saha, D. (2018). Value of clinical pulmonary infection score in critically ill patients: Between the use of chlorhexidine and piper betle linn mouthwash. *Belitung Nursing Journal, 4*(1), 76-82.
Hunter, J. D. (2006). Ventilator associated pneumonia. *Postgraduate Medical Journal, 82*(965), 172-178.
Huraini, E. (2011). Pengaruh mobilisasi dan fisioterapi dada terhadap kejadian ventilator associated pneumonia di unit perawatan intensif [Effect of mobilization and chest physiotherapy on ventialtor associated pneumonia in the intensive care unit]. *NERS Jurnal Keperawatan, 7*(2), 121-129.
Krishnasree, V., & Ukkuru, P. M. (2015). Antibacterial activity of honeys produced by five major bee species in Kerala. *International Journal of Applied and Pure Science and Agriculture, 1*(3), 39-45.
Lorente, L., Lecuona, M., Jiménez, A., Mora, M. L., & Sierra, A. (2007). Influence of an endotracheal tube with polyurethane cuff and subglottic

secretion drainage on pneumonia. *American Journal of Respiratory and Critical Care Medicine, 176*(11), 1079-1083.

Mandell, L. A., Wunderink, R. G., Anzueto, A., Bartlett, J. G., Campbell, G. D., Dean, N. C., . . . Niederman, M. S. (2007). Infectious Diseases Society of America/American Thoracic Society consensus guidelines on the management of community-acquired pneumonia in adults. *Clinical Infectious Diseases, 44*(Supplement_2), S27-S72.

Morton, P. G., Fontaine, D., Hudak, C. M., & Gallo, B. M. (2013). *Keperawatan kritis: Pendekatan asuhan holistik [Critical nursing: Holistic care approach]* (8th ed.). Jakarta: EGC.

Nurhidayatun, Allenidekania, & E, S. (2016). Oral hygiene menggunakan larutan madu mengurangi stomatitis [Pral hygiene using honey to reduce stomatitis]. *Fatmawati Hospital Journal*. 1, 1-7.

Patabnag, W. A. (2016). Perbedaan jumlah pertumbuhan koloni bakteri rongga mulut sebelum dan sesudah menggunakan obat kumur yang mengandung chlorheksidine [Difference in the amount of bacterial colony in the oral cavity before and after using mouthwash containing chlorhexidine. *Pharmacon, 5*(1), 26-31.

Rosyida, N. I. P. (2011). *Hubungan metode suction pada pasien terpasang ventilator terkait kejadian infeksi nosokomial ventilator-associated pneumonia (VAP) tahun 2007 sampai tahun 2010 (Studi di Rumah Sakit X Surabaya) [Correlation of suction method in patients on ventilator with ventilator-associated pneumonia from 2007 to 2010 (Case study in X hospital Surabaya].* Surabaya: Universitas Airlangga.

RSUD Margono. (2015). *Laporan infeksi pneumonia [Pneumonia infection report]*. Purwokerto: Rumah Sakit Umum Daerah Margono.

Saragih, R. J., Amin, Z., Sedono, R., Pitoyo, C. W., & Rumende, C. M. (2014). Prediktor mortalitas pasien dengan ventilator-associated pneumonia di RS Cipto Mangunkusumo [Predictors of patient mortality with ventilator-associated pneumonia at RS Cipto Mangunkusumo. *eJournal Kedokteran Indonesia*.

Sundana, K. (2014). *Ventilator: Pendekatan praktis di unit perawatan kritis [Ventilator: Practical approach in the critical nursing unit].* (Vol. 1). Bandung: Cicu Publisher.

Tan, J., Banzon, A., Ayuyao, F., & de Guia, T. (2007). Comparison of CPIS (clinical pulmonary infection score) and clinical criteria in the diagnosis of ventilator associated pneumonia in ICU complex patients. *Respirology, 12*, A232.

Vanhems, P., Bénet, T., Voirin, N., Januel, J.-M., Lepape, A., Allaouchiche, B., . . . Guérin, C. (2011). Early-onset ventilator-associated pneumonia incidence in intensive care units: a surveillance-based study. *BMC Infectious Diseases, 11*(1), 236.