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ORIGINAL ARTICLE

The effect of oral care using honey as an additional topical agent on oral health status of intubated patients in the intensive care unit

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Abstract
Background: Patients using endotracheal tubes are at high risk of oral health status dysfunction due to impaired natural airway defence, oral flora composition changes and protective substances of the teeth, medication causing xerostomia. Oral care has not been enough to manage oral mucosal dryness, so an additional topical agent is needed to protect oral mucosa to maintain oral health. Honey is one of the recommended topical agents.
Objective: This study aims to identify the effect of oral care with honey as topical agents on the oral health status of patients using endotracheal tube in the Intensive Care Unit.
Methods: This was an experimental study with a randomized pretest and posttest design. The sample was adult intubated patients, consisting of 36 patients. The data were analysed using the parametric test, and dependent and independent *t*-test.
Results: The oral health score in the control group was found to be pre & post mean score11.94 and 13.28 ($p = .004$) respectively, while in the intervention group 11.89 and 8.33 ($p < .001$). Mean differences in both groups were 4.95 ($p < .001$) and the BOAS subscale differences were seen on the lips, gums & mucosa, and tongue ($p < .05$).
Conclusion: Oral care with honey as a topical agent can improve the oral health status of intubated patients on the lips, gum, mucosa, and tongue subscale. Therefore, honey as an additional topical agent can be a moisturizer to maintain the oral mucosa for intubated patients in the Intensive Care Unit. Furthermore, good mucosal health will help prevent the infection and colonization of microorganisms.

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PALABRAS CLAVE
Miel;
UCI;
Cuidados bucales;
Salud bucal

Efecto del cuidado bucal con miel como agente tópico adicional sobre el estado de salud bucal de pacientes intubados en la unidad de cuidados intensivos

Resumen
Antecedentes: Los pacientes en los que se emplean tubos endotraqueales tienen un alto riesgo de padecer afectación de su salud bucal debido a la deficiencia de la defensa natural de la vía aérea, los cambios en la composición de la flora bucal y las sustancias protectoras de los dientes, ya que la medicación causa xerostomía. Los cuidados bucales no han sido suficientes para manejar la sequedad de la mucosa oral, por lo que es preciso un agente tópico para proteger dicha mucosa con vistas a mantener la salud bucal. La miel es uno de dichos agentes tópicos.
Objetivo: El objetivo de este estudio es identificar el efecto de los cuidados bucales con miel como agente tópico en el estatus de la salud bucal de los pacientes en los que se han empleado tubos endotraqueales en la unidad de cuidados intensivos.
Métodos: Estudio experimental con un diseño aleatorizado de pretest y postest. La muestra se compuso de 36 pacientes adultos intubados. Los datos fueron analizados utilizando una prueba paramétrica y la prueba «t» independiente.
Resultados: La puntuación de la salud bucal en el grupo control reflejó una media pretest y postest de 11,94 y 13,28 ($p = 0,004$) respectivamente, mientras que en el grupo de intervención fue de 11,89 y 8,33 ($p < 0,001$). La media de las diferencias en ambos grupos fue de 4,95 ($p < 0,001$), pudiéndose apreciar las diferencias de la subescala BOAS en los labios, encías y mucosa y en la lengua ($p < 0,05$).
Conclusión: Los cuidados bucales con miel como agente tópico pueden mejorar la salud bucal de los pacientes intubados en la subescala de labios, encías y mucosa y lengua. Por tanto, la miel como agente tópico adicional puede ser un agente hidratante para mantener la mucosa bucal en los pacientes intubados de la unidad de cuidados intensivos. Además, la buena salud de la mucosa ayudará a prevenir las infecciones y la colonización de microorganismos.

What is known?/What it contributes?

Intubated patients will be at risk of oral health problems due to impaired mucociliary function, xerostomia, and changes in flora composition in the oropharynx. The use of Chlorhexidine as decontamination and bronchodilator will also worsen xerostomia. Poor mucosal conditions will increase the risk of Ventilator-associated Pneumonia. Therefore, an additional topical agent in oral care is needed.

Implication of the study

The result of this study is to improve the oral health status of intubated patients in the ICU, especially to increase the moisture of the lips, gums, mucosa, and tongue. A good mucosal condition will prevent infection and colonization of microorganisms. It is one of the nurses' responsibilities as part of Ventilator-associated Pneumonia bundle care.

Introduction

Oral health is an important aspect of overall wellness. On the other hand, diseases of the oral cavity can cause infection, inflammation, and other serious impacts on general health.[1,2] Aspiration of pathogenic bacteria in the oral cavity can cause pneumonia, especially in patients in the intensive care unit. Pneumonia is a serious problem for it acts as a major cause of patient morbidity and mortality in the Intensive Care Unit (ICU).[3]

Oral health problems in patients with endotracheal tube (ETT) can be influenced by several factors, such as an imbalance of natural airway defense, changes in the composition of normal oral flora, and dental protective substances. Patients with tracheal intubation experience an imbalance in natural airway defense due to impaired mucociliary function due to mucosal damage during intubation. Furthermore, critical patients will experience alterations in the flora of the oropharynx within 48 h, resulting in germ-negative organisms.[4]

Critically ill patients also experience loss of a protective substance on the tooth surface called fibronectin. Thus, it can be a conducive place for pathogenic organisms to colonize.[5] Moreover, patients with tracheal intubation will

experience dryness of the oral mucosa (xerostomia) due to long-term open mouth and patient status with nothing by mouth which results in the inability of the protective role of saliva.[6]

The presence of an ETT in the patient's mouth in the ICU can also be a way of entry and colonization of bacteria that have the potential to cause infection.[3,7] Besides, the use of drugs such as bronchodilators, antihistamines, antihypertensives, diuretics, atropine, and beta-blockers, also has side effects of xerostomia. These factors can deteriorate the oral health of critical ill patients, increasing the risk of oral infections and the incidence of ventilator-associated pneumonia (VAP).[8–10]

Nurses as caregivers and advocates for patients have full responsibility for the care of critical patients in the ICU.[11,12] Most critically ill patients experience decreased consciousness and the inability to meet basic needs.[13] The nurse's role as a caregiver to critically ventilated patients is to perform oral care actions to maintain oral health. Furthermore, as advocates, nurses have a responsibility to protect patients from infections, such as VAP during treatment.[14]

American Association of Critical Care Nurse and Institute for Healthcare Improvement assert that a comprehensive oral care program is one of the strategies in the VAP Bundle to address the incidence of VAP in the ICU.[15] Several studies suggest the importance of using antiseptics in the implementation of oral care. *Chlorhexidine gluconate* has become the gold standard agent used because it has high antibacterial, antiviral, and antifungal activity with a broad spectrum.[16,17] In general, *Chlorhexidine* is safe for decontamination, but it has side effects such as irritation and mucosal desquamation and causes dry mouth.[18–20] This indicates that there is a need for additional alternative agents to optimize oral care for patients with ETT.

Some studies recommend the use of honey as a topical agent to treat oral problems. *In vitro* studies showed that honey was effective in inhibiting the growth of *Porphyromonas gingivalis, Pseudomonas aeruginosa, Staphylococcus aureus,* and *Klebsiella pneumonia*. These bacteria were found in the sputum culture of tracheal intubated patients.[21–23] Honey has functioned as an anti-inflammatory, anti-oxidant, *autolytic debridement*, and actibalm for mucosal hydration.[24–26] The purpose of oral care in mechanically ventilated patients besides providing antiseptic also maintains mucosal integrity because good mucosa will help prevent infection and colonization of microorganisms that cause VAP.[13] This study aims to analyze the effect of oral care using honey as an additional topical agent on the oral health status of intubated patients in the ICU.

Methods

Study design, sample & setting

This study was an experimental study with a randomized pretest-posttest control group design. On enrollment, the patients were randomized into one of two groups according to balanced randomization using simple randomization with a random table. Treatment allocations remained blinded until the oral care equipment was opened. The sample of this study was conscious or sedated intubated patients aged 18–70 years old. The exclusion criteria were patients who needed specific oral care due to dental/maxillary trauma, patients who were mechanically ventilated through a tracheostomy, and who suffered an autoimmune disease.

To inform power calculations, the study was designed as a feasibility study. Based on similar studies about the effect of oral care protocol on oral health status have standard deviation was 1.17 with a sample size of 30.[27] By using the Lameshow (1997) formula with the hypothesis test of the average difference of two independent groups with a 95% Confidence Interval and a test power of 90, the research sample size was 16 patients for each group. To prevent dropout, the researcher added 10% of the result, so that the sample required was 18 patients for each group.[28]

The study was conducted in the ICU in Bandung, West Java, Indonesia for two months, April to May 2018. Data were collected by authors and critical care nurses as research assistants. The author and research assistance conducted a common perception of the oral care procedures and instruments.

This research has been developed from the first research entitled the effect of oral care intervention (combination between tooth brushing and swabbing) on the oral health status of intubated patients.[29] The results of the previous study were the control group of this study.

Data collection

Data collected relating characteristics included age, sex, disease severity, usage of drugs causing xerostomia, and assessment of oral health status. The disease severity was assessed using the APACHE II score.[30] It was categorized into low severity (<16), moderate (16–25), severe (26–30), and extremely severe (>30).

Oral health status assessment used a modified Beck Oral Assessment Scale (BOAS) from oral health assessment for oncology cases. BOAS instrument has proven to be valid and reliable as assessment tools for the oral health status of intubated patients in the ICU.[31] The BOAS instrument was validated by experts in dentistry, surgical medical in nursing, and critical care nursing. The interrater reliability of the BOAS instrument was 0.92 with a correlation coefficient of 0.84.[27] BOAS in the Indonesian version has also been validated with a reliability value of 0.704. BOAS consist of five subscales of assessment included the lips, gingiva and mucous membranes, tongue, teeth, and saliva.[32] The rating each subscale has a score range of 1–4. The minimum total score is 5, while the highest score is 20. The higher score indicates the worsen oral health status. The BOAS instrument categorizes the oral health status into four classifications, i.e., no dysfunction (score 5), mild dysfunction (6–10), moderate dysfunction (11–15), and severe dysfunction (16–20).[31]

Intervention

Patients in this study were divided into two groups, i.e., the control group, and the intervention group with a simple randomization technique. Oral care was performed twice a day for three days of intervention. A previous study stated that

the implementation of oral care for three days was sufficient to provide a significant difference in oral health status in patients.[33] In addition, the average length of stay of a patient in this hospital is three days.

The control group was given oral care with only 20 ml of chlorhexidine gluconate 0.2%, while the intervention group was given 20 ml additional honey topically on the oral mucosa, covering the buccal, palate, labial, tongue, and lip areas. The honey used in this study is Indonesian local honey of the floral honey. The study stated that local Indonesian honey has antibacterial activity against Pseudomonas aeruginosa, Staphylococcus aureus, and Methylcillin-resistant Staphylococcus Aureus (MRSA) which is comparable to manuka honey.[34]

Oral care was performed using a combination of tooth brushing and swabbing techniques. Toothbrushing was done by using a pediatrics toothbrush while swabbing used sterile gauze. Nicolosi et al.[17] stated that chlorhexidine gluconate 0.2% is a gold standard solution of antibacterial, antiviral, and antifungal activity. The direction of the toothbrush started from the upper left of the teeth (gingiva) to the right, then from the lower right teeth to the lower left part of the gingiva. After that, the tooth brushed in the lingual part. Tooth brushing was done for at least 2 min. The tongue was also brushed from the back to the front carefully to avoid shifting the ETT. Furthermore, the swab on the buccal and ETT tube used sterile gauze with chlorhexidine gluconate. Oral care was done every 12 h for three days. Oral care procedures began and end with a suction procedure. Assessment of oral health status was evaluated before and after the intervention of both groups.

Statistical analysis

Univariate analysis was used to determine the respondent characteristics. Data were assessed for normality using Shapiro–Wilk and homogeneity test using Levene test. The results of the normality and homogeneity test showed a p-value > 0.05, this indicates that the data of this study is normally distributed and homogeneous. Besides this, the data type of oral health status is numeric data, therefore, paired parametric tests and independent t-tests can be used. Statistical significance was accepted at $p < 0.05$. Data were analyzed using SPSS version 23.

Ethical consideration

The authors had obtained ethical clearance from Central Hospital in West Java, Indonesia on April 2, 2018 with approval number LB.04.01/A05/3C/100/IV/2018. The authors have ensured that all respondents have received appropriate informed consent. For conscious respondents, informed consent to participate in this study was carried out by patients with family assistance, while for patients who were unconscious or under sedation, informed consent was given by next kin. Agreement to participate could be withdrawn at any time.

Table 1 Characteristics of intubated patients.

Characteristics	Control group *n* (%)	Intervention group *n* (%)
Sex		
Male	7 (38.9%)	9 (50%)
Female	11 (61.1%)	9 (50%)
Age		
18–40 years old	5 (27.8%)	3 (16.7%)
41–60 years old	3 (16.7%)	4 (22.2%)
61–70 years old	10 (55.6%)	11 (61.1%)
Disease severity (APACHE II score)		
Mild	3(16.7%)	1 (5.6%)
Moderate	13(72.2%)	13 (72.2%)
Severe	2 (11.2%)	4 (22.2%)
Extremely severe	0	0
Using drugs causing xerostomia		
Yes	18 (100%)	18 (100%)
No	0	0
Oral dysfunction (admission)		
No dysfunction	1 (5.6%)	0
Mild dysfunction	4 (22.2%)	8 (44.1%)
Moderate dysfunction	11 (61.1%)	8 (44.1%)
Severe dysfunction	2 (11.1%)	2 (11.1%)

Results

Based on the characteristic of respondent, the data showed that the majority of respondent were women (61.1%) in the control group, while in the intervention group the sexes were the same between men and women (50%). The majority of respondents were 61–70 years old in the control group (55.6%) and the intervention group (61.1%). These results indicate that respondents from both groups belong to the elderly. The severity of disease in both groups was dominated by the category of moderate disease severity (72.2%). Drugs that trigger xerostomia such as anti-hypertensives, diuretics, and antihistamines were used by all respondents in the control and intervention groups (100%). The majority of oral dysfunction at admission in ICU of both control and intervention groups were mild until moderate dysfunction (Table 1).

The results showed that the mean score comparison of the oral health status of control and intervention groups obtained p-value < 0.001. The mean score of oral health in the control group was 13.28, while in the intervention group that was 8.33. These results mean that oral health status in the intervention group is better than the control group because the lower the score, the better the oral health status.

Based on the results of the different dependent t-test in Table 2, the control group obtained *p-value = 0.004* ($p < 0.05$). This showed that there was a significant difference between oral health scores before and after oral care in the control group. The difference in the mean before and after oral care showed a value of −1.34. This negative value (−) indicates an increase in oral health scores after

Table 2 The comparison of oral health status (pre & post) groups.

Groups	Oral health status		Differences (mean)	*p value*
	Before intervention	After intervention		
Control				
Mean ± SD	11.94 ± 2.92	13.28 ± 2.02	−1.34	0.004*
Intervention				
Mean ± SD	11.89 ± 3.01	8.33 ± 1.53	3.56	<0.001*

* Dependent *t*-test, the significance value was $\alpha < 0.05$.

Table 3 BOAS subscale between groups.

BOAS Subscale	Mean ± SD		*p-Value*
	Control group*n* = 18	Intervention group*n* = 18	
Lips	−1.06 ± 0.998	1.50 ± 0.924	<0.001*
Gingiva & mucous	−0.67 ± 0.686	0.78 ± 0.732	<0.001*
Tongue	−0.06 ± 0.639	0.56 ± 0.616	0.009*
Teeth	1.00 ± 0.594	1.00 ± 0.686	1.000
Saliva	−0.56 ± 0.616	−0.28 ± 0.575	0.214

* Independent *t*-test, the significance value was $\alpha < 0.05$.

the intervention. This means that the oral health status in the control group deteriorated because the higher score, the worse the oral health status. In contrast, *p*-value of intervention group < 0.001. It showed that it was a significant difference in oral health status before and after oral care of the intervention group. The mean difference of 3.56. A positive score indicates a decrease score after *oral care*. It means that the status of oral health in the intervention group improved (Table 2).

Based on the results of the different independent *t*-test (Table 3), the subscale of the lips, gums, mucosa, and tongue obtained a *p*-value < 0.05. This means that there were significant differences before and after oral care between the control and intervention groups on the three subscales. In contrast to those subscales, the teeth and saliva subscale showed there was no significant difference in both groups.

Based on the different dependent *t*-test (Table 4), the subscale of the lips, gums & mucosa, tongue, and teeth showed a *p*-value < 0.05. This shows that there were significant differences in those subscales before and after the intervention. The mean difference before and after the intervention on the four subscales has a positive (+) value, which means that there was an improvement in the moisture of the lips, gums, mucosa, and tongue as well as improved teeth hygiene.

Discussion

The results showed that there were significant differences in oral health status between the control group and the intervention group after treatment. The results of this study support the study conducted by Ames et al.[17] which shows that implementing comprehensive oral care can improve oral health status. Comprehensive oral care which includes toothbrushing with chlorhexidine gluconate and additional topical application for lip and mucosal care can improve oral health status gradually from the first day of intubation to the fifth day. The study suggests that maintaining mucosal integrity is an important component of oral care for patients in the ICU.[13] Prendergast et al.[35] stated that the implementation of oral care coupled with oral and lip mucosal care in patients in the ICU, is not only effective in improving oral health status while the patient is intubated, but also up to 48 hours after the patient is extubated. This is because oral health includes various conditions of the oral cavity and all of its supporting components that influence each other. Thus, comprehensive interventions are important to maintain it.[35,36]

Furthermore, this study presents that there were significant differences in the BOAS subscale on the assessment of the lips, gums, and mucosa, as well as the tongue between the group that was not given additional topical agents and the group that was given additional topical agents of honey. These findings support the study conducted by Motallebnejad et al.[37] which showed that administration of additional topical agents with pure honey could improve ulceration of the oral mucosa and lips in cancer patients with radiotherapy with $p < 0.001$. Although the population of this study and Mottalebnejad et al.[37] are different, patients with tracheal intubation and patients receiving radiotherapy are both at high risk of developing oral health problems due to external and internal factors.[6,38] Samani et al.[39] added that topical application of pure honey during three days was also proven to be effective in improving the healing index from 3.02(±0.65) on day 1 to 3.62(±0.42) on day three with $p = 0.001$. Moreover, there was a significant difference in the healing index on seven days of intervention with $p < 0.001$. This is because honey has various biological and chemical compositions that act as therapeutic agents. Some studies

Table 4 BOAS subscale of Intervention group.

BOAS subscale	Mean ± SD		Mean difference	*p-Value*
	Before intervention	After intervention		
Lips	2.89 ± 1.132	1.39 ± 0.502	1.5	<0.001*
Gingiva & mucous	2.06 ± 0.802	1.28 ± 0.461	0.78	0.002*
Tongue	2.44 ± 0.784	1.89 ± 0.758	0.55	0.004*
Teeth	2.33 ± 0.907	1.33 ± 0.485	1	0.001*
Saliva	2.17 ± 0.786	2.44 ± 0.784	−0.27	0.59

* Dependent *t*-test, the significance value was $\alpha < 0.05$.

mentioned that topical application of honey can help the healing process of oral mucosal tissue at every stage.[25,39,40] The role of honey in the inflammatory stage is as an antioxidant to protect cells from oxidative stress. Furthermore, the antimicrobial in honey has an important role in this stage, namely to accelerate the healing process.[41]

In the next stage, honey plays a role in stimulating fibroblast proliferation in forming the basic substance of new tissue growth at the fibroblastic stage. The final stage of the wound healing process is the remodeling stage. At this stage, honey is topically proven to play an effective role in the process of wound contraction and food epithelialization.[42] Gethin and Cowman[26] added that the high osmotic nature of honey can create autolytic debridement and create a moist environment. Thus, the granulation process and tissue epithelialization can occur more quickly.

In contrast to the group that was given honey as an additional topical agent, the tissue healing process in the control group took longer due to the absence of an agent that protects mucosal cells in the inflammatory stage in the vascular and cellular phases.[40] Furthermore, the process of mucosal ulceration at the fibroblastic stage in the control group may experience disturbances in the tissue granulation process due to the unfavorable environment around the wound for the granulation process and tissue epithelialization.[26,42] Therefore, the results of this study showed an improvement in the subscales of the lips, gums, and mucosa, and tongue in the intervention group. These results corroborate previous studies that oral care with honey added topical agents can improve oral health status, especially on the subscales of the lips, gums, and mucosa as well as on the tongue. Ramsay et al.[40] added that honey is an effective antimicrobial in oral activity.[43]

In contrast to the three previous BOAS subscales, the dental and salivary subscales showed no significant difference in the mean difference in oral health scores before and after treatment between the control and intervention groups (*pvalue > 0.05*). The results showed that the dental subscale assessment in the control and intervention groups both improved. This may be because, in the dental intervention, both groups received the same oral cate procedures, toothbrushing, swabbing, and suctioning. Furthermore, the researchers also determined the volume of the chlorhexidine gluconate antiseptic solution, the tools, and the same implementation technique in both groups. The duration of the toothbrushing implementation is at least two minutes and the direction of brushing teeth is systematic, effective in removing plaque on the teeth.[31,35] This study confirms the study conducted by Samani et al.[39] which stated that topical application of honey to the oral mucosa was not able to repair plaque on the teeth, even though on the seventh day of observation.

The results of the assessment of the saliva subscale showed no significant difference between the control and intervention groups. The difference in the mean before and after obtained a negative value (−) indicates that there was a worsening of the salivary subscale in both groups. This study supports the findings of Munro et al.[44] The study showed that saliva volume in patients with ETT experienced a significant decrease from the first day of intubation to the seventh day with *p = 0.003*. Salivary immunoglobulin A levels also showed a decrease on the fourth day of the ETT patient. Furthermore, all samples in this study experienced a decrease in consciousness. Barbara[45] mentioned that patients with decreased consciousness were more susceptible to decreased salivary secretion in the mucosa due to the inability to eat and drink. Thus, the stimulation of saliva production decreased.

Furthermore, de Almeida et al.[46] stated that increasing age is associated with a decrease in saliva production due to a decrease in *acinar* cells in the salivary glands. In this study, indeed most of the respondents in the two groups aged 61–70 years were included in the elderly age category. Moreover, all respondents in the control and intervention groups in this study received xerostomia-triggering drugs such as antihistamines, diuretics, and antihypertensives that might affect salivary secretion.

The limitation of this study is that salivary studies were only carried out on the mucous membrane area of the inner lip. This is because an examination of the lower tongue area cannot be carried out. After all, it is blocked by the ETT tube which can risk causing a change in the position of the ETT tube. Therefore, it is necessary to conduct further study on salivary assessment techniques in intubated patients. Since this study was only carried out in a single setting, small sample size, and a short period of intervention. Further study is needed in a large sample size and a longer period of intervention (7 days intervention). In addition, we recommend further study on the possible side effects of honey as an additional topical agent in the oral care of intubated patients on the incidence of dental plaque and the Clinical Pulmonary Infection Score to detect the incidence of pneumonia in patients.

Conclusion

The implementation of oral care with honey as an additional topical agent affects improving the oral health status of intubated patients in the ICU. Honey as an additional topical agent can increase the moisture of the lips, gums, and mucosa as well as the tongue. Thus, the health of the oral mucosa of intubated patients will be better with honey as an additional topical agent. A good mucosal condition will help prevent infection and colonization of microorganisms. Prevention of VAP is one of the responsibilities of nurses in the intensive care unit as part of VAP bundle care.

Conflict of interest

The authors declare that they have no conflict of interest.

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