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Original Article

Comparing the Effects of Matrica and Chlorhexidine on the Prevention of Ventilator-Associated Pneumonia

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Abstract

Background and Aim: Ventilator-associated pneumonia (VAP) is the second most common infection within intensive care units (ICUs). Happening in patients requiring mechanical ventilation for more than 48 hours, the disease is associated with high morbidity and mortality. This study aims to compare the effects of Matrica and chlorhexidine mouthwashes on the prevention of VAP among patients hospitalized in ICUs of selected hospitals in Qom in 2013.

Methods: This random clinical trial was conducted on 60 patients admitted to the ICUs of selected hospitals in Qom. The patients receiving mechanical ventilation had no record of pneumonia and were randomly assigned to experimental and control groups. The experimental group received the Matrica mouthwash and the control group received 0.2% chlorhexidine twice a day. On the eighth day, the VAP was determined using the clinical pulmonary infection score (CPIS). The results were analyzed in SPSS 16.0 using chi-square, independent and paired *t* tests. The significant level was set at 0.05

Results: Incidence of VAP was respectively 10 (33.3%) and 13 (43.3%) in Matrica and chlorhexidine groups ($P=0.42$). Moreover, the clinical pulmonary infection mean score for both groups showed no significant difference before the intervention ($P=0.31$) and after it ($P=0.79$).

Conclusion: As regards the prevention of VAP, there was no difference between the application of Matrica and chlorhexidine mouthwashes for oral care.

Keywords: Matrica, Ventilator-associated pneumonia, Mouthwash, 0.2% Chlorhexidine, Intensive Care Unit.

Introduction

As a profoundly common infection in intensive care units (ICUs), pneumonia accounts for 31% of hospital infections (1). It has been estimated that around 9% to 10% of patients hospitalized in ICUs are supported by mechanical ventilation (2). In addition, ventilator-associated pneumonia (VAP) is said to have comprised about 86% of hospital-acquired pneumonia (3). The incidence rate of VPA is 1%-3% for each day of hospitalization in ICU (4). The mortality rate for these patients clearly overrides those who do not experience VAP such that the mortality resulting from it in ICUs allots 24% to 50% to itself (3). From the economic dimension, VAP costs about €12 000 for each patient (5).

The risk factors that lead to the increased incidence of VAP include decreased level of consciousness, dry and open mouth, micro-aspiration of secretions, bacterial colonization in different areas of mouth like oropharynx, sinuses, and dental plaques. It is also possible for bacterial colonization to develop out of endotracheal tube (6). Patients' oral floras are different from those of healthy ones since there are some microorganisms in the flora of the patients that prompt pneumonia in them. Forty-eight hours following the hospitalization of the patient in the ICU, the oral flora moves towards gram-positive streptococcus. These pathogens, in turn, form into gram-negative pathogens that lead to the incidence of VAP in patients (3). Endotracheal tube leads to constant opening of the trachea that can encourage the bacterial contamination of the lungs by resulting in VAP. Therefore, oral health can prevent VAP incidence through the formation of dental plaques and its high effectiveness on bacterial accumulation (2).

Chlorhexidine is an antiseptic and bisbiguanide disinfectant that affects a wide range of bacteria, a limited number offungi and viruses. Until now, no antimicrobial resistance and carcinogenic effect has been reported for chlorhexidine (6). This mouthwash might be associated

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with adverse effects such as tooth staining, altered sense of taste, and mucosal irritation (7).

Recently, there has been a rising tendency towards herbal mouthwashes for their minimal side effects (8). Among the medicinal plants, chamomile extract has an antibacterial, antiviral and antifungal effect. Moreover, the alpha-bisabolol and chamazulene present in it demonstrate high antimicrobial properties (9). Compounds present within chamomile extract are anti-inflammatory and antioxidant as well. Due to its anti-flatulence and antispasmodic properties, the extract of this plant is also used in digestive disorders and stomach ulcers (10). Abdel Rahman et al showed that compared to chlorhexidine, Matrica mouthwash was more effective in treating inflammation and oral pathogens (11). Furthermore, according to Pourabbas et al, German chamomile mouthwash reduces the dental plaques without any side effects (12). Shabanlouei et al have also indicated that chamomile mouthwash is effective in reducing stomatitis intensity, pain intensity and stomatitis maintenance (13). In their study, Tiemann et al revealed that chamomile plant is highly effective on the oral side effects of cancer chemotherapy (14). In another research by Atai et al, it was shown that Matrica mouthwash possesses more antibacterial effects compared with other types of mouthwashes (15).

The results of these studies indicate that there is a general propensity to replace chemical medicines with herbal antiseptic ones. Based on this, intensive studies have been carried out on various plants including chamomile. Such studies have not directly explored the impacts of the therapeutic herb of chamomile on the prevention of VAP. In other words, the focus of these studies has been on other related areas of oral health. Upon an overview of the related literature, there seems to be no study regarding the effects of Matrica mouthwash on the incidence of VAP. On account of this and as regards the availability of the Matrica mouthwash in Iran, the current study aimed to compare the effects of Matrica and chlorhexidine in preventing VAP.

Methods

A random clinical trial with a control group, the present investigation was carried out in Nekooyi and Shahid Beheshti hospitals' ICUs in Qom during the first 6 months of 2013. Drawing on a study by Kusahara et al (7), the sample size was calculated at the significance level 0.05 with the power 95% using the following formula:

$$n = \frac{(z_{1-\frac{\alpha}{2}} + z_{1-\beta})(p1(1-p1)) + (p2(1-p2))}{(p_1 - p_2)^2}$$

$$n = \frac{(1.96+1.28)^2(0.25\times0.75)+(0.67\times0.33)}{(0.75-0.33)^2} = 24.3$$

With a 20% attrition rate, the sample size was considered 30 for each group.

The inclusion criteria were as follows: being orally intubated, having an age between 18 to 65, receiving mechanical ventilation within 48 hours of admission, having no history of immune deficiency disease, no oral mucositis, no known pulmonary disease, no history of food or drug allergy, or allergy to chamomile extracts as well as scoring below 6 on Clinical pulmonary infection score (CPIS). On the contrary, the exclusion criteria of the study comprised of transference from the ICU, death of the patient before completion of the study, and lack of consent to continue the study on the part of the legal guardian of the patient.

Data was collected using a questionnaire consisting of three parts including the demographic characteristics form; APACHI II system to measure the severity of the disease, and CPIS to evaluate the pulmonary infection. The questionnaire was completed in cooperation with the specialist colleague of the researcher. CPIS utilized here had six unique components including 1) the ratio of the arterial oxygen pressure (PaO_2) to the fraction of inspired oxygen (FIO_2), 2) chest radiograph, 3) tracheal secretions, 4) blood leukocytes, 5) temperature, and 6) culture of the tracheal aspirate (16). A CPIS of less than 6 indicated an absence of pneumonia, while CPIS above 6 referred to the incidence of pneumonia in a patient (17,18) (Table 1).

As regards the sampling method and culture of aspirate, first the inner part of the endotracheal tube of the patient was suctioned by Nelaton catheter and the secretions were removed; then, the tip of the catheter was cut using the sterile bistoury blade and put in the sample container. The samples were sent to the laboratory after some normal saline added to them. A score between 0-2 was assigned to each part.

After obtaining informed consent from the eligible patients' parents or legal guardians, they were assigned to experimental and control groups based on block randomization. Oral care protocol for the experimental group included primary oral as well as pharyngeal suction of the patient. Using a soft Oral-B kid toothbrush, the teeth, tongue and the oral cavity of the patient were brushed twice a day for three minutes. Then, the patient's oral cavity was completely washed with cotton swab and 50 drops of Matrica mouth rinse for 30 seconds in 30 cc normal saline (which was made from German chamomile extract, standardized for the presence of 0.09 to 0.17 mg kamazulene in each ml of the product in addition to containing the effective components of kamazulene and alpha-bisabolol). At the end, the patient's mouth was suctioned again, and his lips were moistened by hydroderm cream. This procedure was carried out for one week for the experimental group. In the control group, oral care was administered based on the oral care routine followed in the ward using 0.2 chlorhexidine mouthwash. After ten days, the scores of CPIS were examined regarding the presence or absence of pneumonia. The data were

analyzed in SPSS 16 using chi-square, independent and paired *t* tests. The significance level was set at 0.05.

Results

Based on the results of this study, the two groups were homogeneous in terms of gender, age, marital status, cause of hospitalization, smoking history, diabetes history, and finally the APACHI II score (Table 2). Moreover, no patient was excluded from the study during the research.

The incidence rates of pneumonia were respectively 13 (43.3%) and 10 (33.3%) for control and experimental groups ($P=0.42$). The paired *t* test revealed that in both control and experimental groups, the mean score of CPIS was significantly high following the intervention ($P<0.001$) rather than before it. Additionally, the independent *t* test showed that there was no significant difference between the mean CPIS in the control and experimental groups before ($P=0.31$) and after ($P=0.79$) the intervention (Table 3).

Discussion

The results of this study demonstrated that there was no significant difference between Matrica and chlorhexidine groups regarding the incidence of VAP. The average CPIS for both groups had no significant difference.

To conduct the study, an analysis of the Persian and English databases was initially carried out using the English keywords "Matrica", "ventilator-associated pneumonia",

Table 1. Parameters of CPIS

Variable	Clinical Criteria for Diagnosing Pneumonia (CPIS)
Fraction of Pao_2 to Fio_2	More than 240 (score 0) Less than or equal to 240 (score 2)
Pulmonary radiography	No infiltrate (score 0) Diffuse (or patchy) infiltrate (score 1) Localized infiltrate (score 2)
Body temperature	Between 36.1 to 38.4°C (score 0) Between 38.5 to 38.9°C (score 1) More than 39 and less than 36°C (score 2)
White blood cell count	4000 to 11 000 numbers (score 0) Less than 4000 or more than 11 000 (score 1)
Pulmonary secretions	Non (score 0) Non-purulent (score 1) Purulent (score 2)
Culture of tracheal aspirate	Negative culture or scant (score 0) Positive high quantity culture (score 1) Gram-negative bacteria seen in pulmonary secretions with positive culture (score 2)

Abbreviation: CPIS, clinical pulmonary infection score.

Table 2. Comparison of the Demographic Characteristics of the Members of Control and Experimental Groups

Variable		Matrica Group No. (%)	Chlorhexidine Group No. (%)	*P* Value
Gender	Male	14 (46.7)	30 (50)	0.79
	Female	16 (53.3)	30 (50)	
Marital status	Single	7 (23.3)	4 (13.3)	4.0
	Married	10 (33.3)	16 (53.3)	
	Widow	9 (30)	8 (26.7)	
	Divorced	4 (13.3)	2 (6.7)	
Cause of hospitalization	Difficulty breathing	6 (20)	3 (10)	0.22
	Heart trouble	6 (20)	5 (7.16)	
	Trauma	12 (40)	14 (7.46)	
	Neurological	6 (20)	4 (3.13)	
	Problems sepsis	0 (0)	4 (13.3)	
Smoking history	Yes	16 (53.3)	12 (40)	0.30
	No	14 (46.7)	18 (60)	
History of diabetes	Yes	7 (23.3)	5 (16.7)	0.51
	No	23 (76.6)	25 (83.3)	
Age (mean ± SD)		45.93±14.11	51.63 ± 12.18	0.09
APACHE II (Mean ± SD)		17.7 ± 3.37	17.63 ±5.79	0.95

Table 3. Comparison of the Average CPIS Before and After the Intervention in Both Experimental and Control Groups

Group	Stage		*P* Value (Paired *T* Test)
	Before Intervention (Mean±SD)	After Intervention (Mean±SD)	
Intervention	1.66 ± 1.06	5.56 ± 1.30	<0.000
Control	1.90 ± 0.66	5.46 ± 1.65	<0.000
The significant level of the Independent *t* test	*P*=0.31	*P*=0.31	-

Abbreviation: CPIS, clinical pulmonary infection score.

"mouthwash" and "intensive care unit" and their Persian counterparts. In the Internet search conducted, no study was found to have focused on the specific effects of Matrica mouthwash on VAP. The majority of the studies available focused on the effectiveness of Matrica on, for example, oral and dental health. For example, Darvishi Khezri et al (19) explored the significant antibacterial effect of Matrica, perisca, and chlorhexidine on the streptococcus pneumoniae and staphylococcus aureus of oropharynx area in mechanically ventilated patients. His study demonstrated the impacts of Matrica mouthwash on the accumulation of micro-organisms in patients' oropharynx area in comparison with perisca and chlorhexidine. In line with the above research, the effects of both Matrica and chlorhexidine mouthwashes were similar in the present investigation; nonetheless, the previous study did not aim at determining impacts of the given solutions on the prevention of VAP.

Alijani et al (8) showed the significant decrease of chemotherapy-induced ostomatitis incidence in children using mouthwash containing chamomile. The impact of Matrica mouthwash on the prevention of head and neck radiotherapy induced-stomatitis was probed by Bassampour et al (20). Both of these studies have revealed the effectiveness of Matrica on stomatitis, but neither has compared the findings with chlorhexidine. Paknejad et al (21) unveiled the efficacy of Matrica and 0.2% chlorhexidine mouthwashes in patients with chronic periodontitis. Contrary to the findings of the present study, the results of their study demonstrated a higher effect for Matrica over chlorhexidine. As indicated by Sadeghi's study (22), Matrica and perisca herbal mouthwashes are less effective on the prevention of oral bacterial growth than chlorhexidine (22). Compared with the findings of the previous research, the results of his research also demonstrate less effectiveness of Matrica. Such a result also contradicts the findings of our study.

In line with the above studies, a couple of researches have explored the impacts of chlorhexidine mouthwash alone or in comparison with other mouthwashes. For instance, Ranjbar et al (3) came to the conclusion that there was no difference between chlorhexidine and normal saline in preventing VAP. In the same way, Seyedalshohadaei et al (2) demonstrated that there is no difference between the application of 0.12 chlorhexidine compared with normal saline in patients with VAPs. According to Panchabhai et al (6), there was no distinction between potassium permanganate in contrast with chlorhexidine mouthwash concerning VAP incidence. Their study does not demonstrate the priority of chlorhexidine over other mouthwashes in terms of VAP prevention. This finding is in line with the results of the present research. However, Nicolosi et al (1) demonstrated the impacts of 0.12% chlorhexidine on reduced incidence of VAP in patients undergoing heart surgery (1). This study has also exclusively reported the effect of chlorhexidine on VAP prevention with no comparison of it with other mouthwashes.

Comparing the above findings, it can be concluded that using alternative techniques as Matrica herbal solution or routine methods such as mouthwash and normal saline in mechanically ventilated patients' oral care can be assigned a high priority.

Conclusion

Although Matrica reduced the incidence of VAP in this study, the difference was not significant. However, in light of the lower risk of herbal mouthwash in comparison with the chemical one, it can be recommended for use in ICUs.

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Ethical Considerations

This article is extracted from the author's MA thesis on intensive care registered with the number IRCT201303058288N3 in the database of clinical trials (http://www.irct.ir/) and holds a license from the Medical Ethics Committee of Shahed University numbered 41.168154.

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