



Comparison of Green Tea and Chlorhexidine Mouthwash Effects on Bacterial Colonies of Throat Cultures of Patients in ICU

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ABSTRACT

Aims Throat of a healthy individual is an environment, which is suitable for the growth of various bacteria and viruses. In patients who are under artificial ventilation, leakage around the cuff of the trachea may be the cause of pneumonia. The aim of this study was to investigate the effect of herbal teas of 5% green tea and 0.2% chlorhexidine mouthwash on oral hygiene of patients with tracheal intubation.

Materials & Methods This clinical trial study was conducted on 46 intubated patients admitted to ICU of Shahid Mohammadi hospital of Bandar Abbas, Iran in 2015. These patients were selected by simple random sampling method. In the first 4 days, the first group was mouthwashed with chlorhexidine solution and the second 4 days with green tea solution. The second group was first washed with green tea solution and the other 4 days with chlorhexidine solution for the first 4 days. On the first day and the end of the fourth and eighth day, the pharynx was cultured using sterilized method. The data were analyzed by SPSS 22 software using Chi-square, chi-square for trend, or Fisher's exact test.

Findings Patients in both intervention groups demonstrated improved oral health with respect to decreased bacterial load in pharynx. However, no significant difference was observed between the two intervention groups with respect to improved oral bacterial load ($p > 0.05$).

Conclusion The use of green tea and chlorhexidine mouthwashes has a similar effect on bacterial colonies in the pharynx.

Keywords Chlorhexidine; Green Tea; Mouthwashes; Oral Hygiene; Bacterial Colony

CITATION LINKS

[1] Oral care of intubated patients [2] Oral care interventions in critical care: Frequency and documentation [3] Pursuing excellence: Development of an oral hygiene protocol for mechanically ventilated patients [4] Centers for Disease Control and Prevention. Nurses' implementation of guidelines for ventilator-associated pneumonia from the Centers for Disease Control and Prevention [5] Evidence to support tooth brushing in critically ill patients [6] Oral care in ICU patients: A review of research evidence [7] Beyond comfort: Oral hygiene as a critical nursing activity in the intensive care unit [8] Chlorhexidine, toothbrushing, and preventing ventilator-associated pneumonia in critically ill adults [9] Effectiveness of 0.12% chlorhexidine gluconate oral rinse in reducing prevalence of nosocomial pneumonia in patients undergoing heart surgery [10] Oral health and care in the intensive care unit: State of the science [11] Oral care practices for orally intubated critically ill adults [12] Antibacterial and antifungal activity of *Syzygium jambolanum* seeds [13] Oropharyngeal cleansing with 0.2% chlorhexidine for prevention of nosocomial pneumonia in critically ill patients: An open-label randomized trial with 0.01% potassium permanganate as control [14] Beneficial effects of green tea--a review [15] Anticarcinogenic antioxidants as inhibitors against intracellular oxidative stress [16] Relationship between intake of green tea and periodontal disease [17] Comparing the effect of Echinacea and chlorhexidine mouthwash on oral health in patients hospitalized in intensive care units [18] Pharmacokinetics of tea catechins after ingestion of green tea and (-)-epigallocatechin-3-gallate by humans: Formation of different metabolites and individual variability [19] Comparison of the endotracheal tube suctioning with and without normal saline solution on heart rate and oxygen saturation [20] The effect of *Camellia Sinensis* (green tea) mouthwash on plaque-induced gingivitis: A single-blinded randomized controlled clinical trial [21] Chemistry and applications of green tea [22] The comparison of the effects of chlorhexidine mouthwash alone and Chlorhexidine mouthwash followed by oral suctioning on oral hygiene of critically ill patients [23] Comparative evaluation of green tea-aloe vera mouthwash and chlorhexidine 0.2% on gingival indices (a randomized clinical trial)

Introduction

Among the most important hygiene tasks of nurses working in hospital wards is to provide oral health and care of the hospitalized individuals [1]. Studies show that the lack of oral care of intubated patients in special wards of hospitals causes dryness and loss of moisture of the oral cavity and, therefore, growth and overload of bacteria in the oral cavity [2]. Numerous investigations imply to the association of pneumonia and inadequate oral care in intense care units (ICUs) [1, 3]. It has been shown that the risk of developing pneumonia in patients undergoing mechanical ventilation is several times greater than other patients and the mortality rate of these patients has been high [4]. Implementing the oral hygiene causes decreased dental plaque, inflammatory gum disease, and pneumonia caused by mechanical ventilation [5]. On the other hand, the oral flora in healthy individuals is stable over time. However, the normal flora of oral cavity changes in favor of gram-negative organisms within 48 hours of hospitalization. Furthermore, opportunistic pathogens grow and cause local and general symptoms if conditions are suitable. In weak patients in ICUs, fibronectin, which is a protective agent and commonly found on the teeth surface, is decreased. This results in promoted potential of the bacteria to attach to the surface of the teeth and the epithelial cells of the oral cavity and the pharynx. Intensified binding and accumulation of bacteria to the teeth surface leads to the development of a dental plaque [6, 7].

Chlorhexidine solution is used as a mouthwashing solution for controlling and preventing dental plaque and treating gingivitis [8]. Chlorhexidine is a broad-spectrum antibacterial agent and effective on gram positive and negative bacteria [9]. While chlorhexidine mouthwash was shown to reduce oral infections in cardiac patients after surgery [9], but this mouthwash did not ameliorate ventilator-dependent pneumonia in other special wards of hospitals [10]. The usual utilization of chlorhexidine solution is not recommended in all patients in the special wards because of side effects and antibiotic resistance [11].

Nowadays, application of medicinal plants as herbal medications has been becoming further common in the therapy of several disorders particularly infectious diseases, due to less side effects than chemical drugs [12]. *Camellia sinensis*, commonly known as green tea, is the plant of Theaceae family, with leaves of green and leather with white and aromatic flowers [13]. The polyphenols present in green tea contain a large group of substances called catechins, and their presence in tea is the cause of beneficial and advantageous effects on oral health [14]. Due to containing such compounds, green tea has unique

properties such as antioxidants, anti-inflammatory, anticancer and antibacterial effects [15]. Tannins are biosynthetic compounds that have a major microbicidal effect. Recent evidence has reported that the use of green tea interrupts the bacteria from localization on teeth and forming dental plaques. Therefore, green tea limits the secretion or formation of human amylase, bacteria, glucosyl transferase inhibition, and ultimately inhibits the glucan biosynthesis adhered to the teeth [16].

With regard to the advantages of herbal compounds and their less complicated effects compared with the chemical compounds and also considering that the effect of this drug on patients with endotracheal tube has not been studied, the aim of this study was to investigate the effect of herbal teas of 5% green tea and 0.2% chlorhexidine mouthwash on oral hygiene of patients with tracheal intubation.

Materials and Methods

This study was a clinical trial (IRCT2016020626402N1) before and after study and was conducted on intubated patients admitted to ICU of Shahid Mohammadi hospital of Bandar Abbas, Iran in 2015. 46 anesthetized patients admitted to the ICU of Shahid Mohammadi Hospital, Bandar Abbas, Iran were chosen by simple random sampling method.

The inclusion criteria were as follows: The patient should have a tracheal tube through the mouth. The age of the patient is between the ages of 18 and 65 years. It should be passed less than 12 hours after the patient is admitted to the ICU. The patient should not be admitted to hospital before being admitted to the special ward. The patient should not use antibiotics before admission. The patient should not be pregnant and sensitive to plant compounds. Artificial teeth should not be used by the patient. The admitted patient should not have chronic disease and immune system disorders. Any specific damage by tracheal intubation or irritation should be absent. The patient should not have a specific lesion in the mouth and around the mouth.

The exclusion criteria were, transferring a patient from ICU or his death before completion of the study, patient with any specific damage by tracheal intubation or irritation or any other physical agent, if the patient was unwilling to continue from the study by the legal guardianship of the patient [17].

The study protocol was confirmed by the ethical committee of Kerman University of Medical Sciences (IR.KMU.REC.1394.651) and written informed consent forms was obtained by all the cases before being included in the study.

In the study, the sampling was performed as follows: the study started from the first day of

admission to the ICU and lasted for 8 days. The study was performed through crossover approach in two groups according to inclusion criteria. First, after preparing the culture of the pharynx with sterilized swabs and maintaining in the agar medium and sending them to the lab, the oral health check list (Oral Health Form) using two criteria of Beck oral assessment scale (BOAS) and mucosal plaque score (MPS) completed [5].

The total number of samples was 46 patients that was categorized into two groups of chlorhexidine and green tea treated cases. All intervention procedure was conducted through blind approach. In the first 4 days, the first group was mouthwashed with chlorhexidine solution and the second 4 days with green tea solution. The second group was first washed with green tea solution and the other 4 days with chlorhexidine solution.

The effect of chlorhexidine antimicrobial activity persists for up to 6 hours after ingestion [17], and the duration of exposure to green tea is less than 4 hours [18]. Given that the mouthwash was done twice a day (morning and evening), in order to perform the mouth cleaning period after mouthwashing on the fourth day, the next mouthwash was used after 12 hours to complete the cleaning period.

Mouthwashing procedure: At first, the oral cavity and tongue surface of the patient was cleaned using a chlorhexidine solution and a soft toothbrush, followed by 10cc of the chlorhexidine mouthwash solution in the oral cavity, and after a minute a suction of throat and mouth area was carried out [19].

This process lasted for 4 days, and at the end of day 4, the culture was done again through sterilized approach and was sent to the lab. Then, in the second step, the patient was mouthwashed with green tea for 4 days. The tongue and tooth surfaces were cleaned using mouthwash solution of green tea and a soft toothbrush, with forward and backward movements. At the end of day 8, the culture was taken from the patient's throat again.

Green tea mouthwash preparation: In order to prepare the green tea mouthwash, firstly the leaves of the plant were collected and confirmed by a pharmacist in Kerman Medical Science Laboratory. The leaves of this plant were then crushed into small pieces and each 100g of leaves was soaked for 48 hours in 500ml of methanol. Afterwards the solution was passed through a filter and the solution was placed on drying pages for 3-4 days at the laboratory temperature. After that, the crystalline powder was extracted from the pages, and finally a 5% green tea solution was prepared by adding 0.5g of green tea extract to 100ml of distilled water [20].

Bacterial culture procedure: The culture

samples were obtained from the pharyngeal secretions and sterilized in agar and methylene blue for 24 hours, and then the results were determined using sterile swabs delivered from the laboratory.

Pharyngeal specimens were cultured on day one and on the end of days 4 and 8 using sterilized applicators. Afterwards, the samples were sent to the lab at a maximum of 15minutes. Samples delivered to the laboratory were cultured in the Blood Agar medium (a supplemented culture medium for the growth of gram-positive and gram negative bacteria) and Eosin Methylene Blue (EMB) medium (a specific culture medium for the growth of gram-negative bacteria) at 37°C incubator for 24 hours. After 24 hours, the plates were examined for bacterial growth. The lam was taken directly from the colonies, and the gram positive or negative bacterial status was determined. The bacterial species was identified by conducting biochemical samples and galleries. In case of lack of bacterial growth, culture was determined as negative [19].

Statistical analysis: In order to analyze the obtained data, SPSS software version 22 (SPSS, Chicago, IL; USA) was used. Chi-square, chi-square for trend, or Fisher's exact test was used to compare nominal data between the studied groups. Qualitative variables were represented as number (N) and percent (%), respectively

Findings

Males comprised major part of the studied individuals and multiple trauma was prevalent (Table 1).

Table 1) Demographic data and clinical characteristics of the studied individuals (n=46)

Variables	Number	Percent
Sex		
Male	38	82.6
Female	8	17.4
Age		
Less than 30 years	17	37.0
Between 30-40 years	14	30.4
More than 40 years	15	32.6
Smoking		
Smoker	20	43.5
Non-smoker	26	56.5
Diagnosed diseases		
MT	25	54.3
SDH	3	6.5
EDH	3	6.5
ICH	6	13.0
DAI	4	8.7
Laparatomy	1	2.2
SAH	4	8.7

MT: Multiple trauma; SDH: Subdural hematoma; EDH: Epidural hematoma; ICH: Intracranial hemorrhage; DA: Diffuse axonal injury; SAH: Subarachnoid hemorrhage

Table 2) Comparison of oral health status criteria in the two groups of chlorhexidine- and green tea-treated (n=46) at the beginning of the study (the numbers in parentheses are percentage)

Characteristics	Group 1 (First chlorhexidine then green tea)	Group 2 (First green tea then chlorhexidine)	P. value
Lips			
Smooth and pinky	13 (60.9)	16 (69.6)	0.54
Dried and red	9 (39.1)	7 (30.4)	
Gum			
Smooth and wet	17 (73.9)	21 (91.3)	0.24
Dried and pale	6 (26.1)	2 (8.7)	
Tongue			
Smooth and pinky	18 (78.3)	15 (21.7)	0.51
Dry and outward papillary	5 (21.7)	8 (34.8)	
Teeth			
Without food leftover	6 (26.1)	0	0.02
Less food leftover among teeth	14 (60.9)	16 (69.6)	
More food leftover among teeth	3 (13.0)	7 (30.4)	
Saliva			
Much watery	16 (69.6)	15 (65.2)	0.99
Increased saliva volume	4 (17.4)	5 (21.7)	
Less and a little thick	3 (13.0)	3 (13.0)	
Mucus			
Normal	15 (65.2)	15 (65.2)	0.99
Mild inflammation	7 (30.4)	8 (34.8)	
Moderate inflammation	1 (4.3)	0	
Plaque			
Without plaque	1 (4.3)	1 (4.3)	0.99
Rare	10 (43.5)	9 (39.1)	
Mild	8 (34.8)	8 (34.8)	
Many	4 (17.4)	5 (21.7)	

Oral hygiene evaluation based on the manifestations of the patients at the beginning:

Both groups at the beginning of the study were similar in terms of health and hygiene status of lips, gum and tongue, saliva, mucus and plaque, but the two groups were not similar in terms of teeth health and hygiene, and the first group had a better health condition.

There was a statistically significant difference at the starting point of the study with regard to tooth criteria between two groups (Table 2).

Bacterial circumstance assessment before interventions: There was no significant difference between the two treated groups. In other words, the two groups at the beginning of the study were similar in terms of pharyngeal colony cultures results (Table 3).

Bacterial circumstance assessment after interventions: There was no statistically significant difference between the intervention groups with respect to bacterial load improvement. This means that chlorhexidine and green tea equally affect the bacterial colonies. Despite chlorhexidine demonstrated slightly better effects, the difference was not statistically significant (Table 4).

Table 3) Comparison of frequency distribution of pharyngeal colony cultures in two groups of chlorhexidine- and green tea-treated (n=46) at the beginning of the study (the numbers in parentheses are percentage)

Characteristics	Group 1 (First chlorhexidine then green tea)	Group 2 (First green tea then chlorhexidine)	P. value
No culture	1 (4.32)	1 (4.32)	0.76
Staphylococcus	10 (43.2)	13 (56.16)	
Streptococcus	12 (52.0)	9 (38.7)	

Table 4) Comparison of distribution and frequency of pharyngeal colonies of two groups of chlorhexidine- and green tea-treated individuals (n=46) at the end of the study (the numbers in parentheses are percentage)

Groups	Firs period better performance	Second period better performance	Similar performance	P. value
Group 1 (First chlorhexidine then green tea)	1 (4.3)	8 (34.8)	14 (60.9)	0.76
Group 2 (First green tea then chlorhexidine)	0	10 (43.5)	13 (56.5)	

Discussion

In this study, we aimed to evaluate the efficacy of 5% green tea mouthwash with 0.2% chlorhexidine mouthwash and compare their effects on the bacterial circumstance and load of pharynx of the individuals hospitalized in the ICU of Shahid Mohammadi Hospital, Bandar Abbas, in 2015.

A study was conducted by Janabian *et al.* in 2012 on female students with plaque associated with gingival inflammation. The students mouthwashed 5ml of 5% green tea or normal saline per day.

The researchers concluded that the green tea mouthwash can be a safe and convenient treatment for periodontal inflammatory diseases

[20]. In a clinical trial, Panchabhai *et al.* compared the effects of chlorhexidine mouthwash and potassium permanganate on improving the oral hygiene and reducing ventilator-induced pneumonia in patients hospitalized in ICU. The results indicated that oral hygiene and ventilator-dependent pneumonia had a significant difference in comparison to pre-intervention conditions. Moreover, oral care improved the oral hygiene and decreased ventilator-dependent infection in the studied subjects [13]. On the other hand, it was demonstrated that a 5% green tea solution was effective in reducing staphylococci load in the evaluated individuals in United States [21].

In this investigation, the bacterial colonies of the pharynx before and after use of 0.2% chlorhexidine solution in patients were evaluated. The results of this study indicated that there was no statistically significant difference and both groups have the same effect. This means that chlorhexidine and green tea had a similar effect on bacterial colonies, and the use of these two solutions decreases the growth of bacterial colonies in the pharynx of both groups on day 4 and 8. Although chlorhexidine demonstrated slightly better performance, it was not statistically significant. These results are in line with the results of Grap *et al.* [2], who evaluated the effect of chlorhexidine gel on the amount of pharyngeal bacteria in patients hospitalized in ICU. They administered the gel twice daily for 5 days and the culture sampling were taken from the patient's pharynx on the first and fifth days. The results indicated that at the end of the fifth day, chlorhexidine gel reduced the pharyngeal bacteria. Furthermore, our observations were consistent with the study of Turkish population [22]. The results of this study showed that bacterial colonies in the intervention group on the seventh day were significantly lower than the first day.

In this study we determined the bacterial colonies of the pharynx before and after use of 5% green tea solution in patients hospitalized in ICU. We observed that there was no statistically significant difference and both compounds had the same effect. This means that green tea and chlorhexidine had same effects on bacterial colonies, and the use of these two compounds simultaneously decreased the growth of pharyngeal bacterial colonies in both groups on days first and eighth. Studies reported that green tea-aloe vera mouthwash and chlorhexidine 0.2% had ameliorative effects on gum indices and improved periodontal condition [23].

We also compared the therapeutic effects of 5% green tea and 0.2% chlorhexidine on pharyngeal colonies in patients. The results of this study showed that the status of the pharyngeal colonies of patients in both groups after eight days of intervention was improved. We demonstrated that bacterial colonies of the pharynx of patients on the first and eighth days of study were significantly different and the bacterial colonies of the pharynx on the eighth day were less than the first day.

In the current study, it was intended to investigate the effect of individual characteristics of patients hospitalized in ICU of Shahid Mohammadi Hospital of Bandar Abbas on bacterial colonies in pharynx. We recognized that age and sex of the evaluated individuals did not have effect on the status of bacteria colonies of pharynx. These observations were in accord with previous reports [22], in which the effect of two common mouthwashing methods

in hospital wards with chlorhexidine solution 0.2% and this solution plus suction decreased bacterial load of pharynx in hospitalized patients in the ICU. Of the 46 patients evaluated in the present study, 38 cases (82.6%) were men and 8 cases (17.4%) were women. This implies that men constituted the highest percentage of the study population, which are consistent with studies conducted by Rafiei *et al.* [19]. The ICU of Shahid Mohammadi Hospital is the trauma ward, and since men constitute most trauma patients, this observation was not surprising. Moreover, 25 patients (54.3%) had multiple trauma, as this complication was observed in previous studies [19]. We noticed that the average percentage of healthy teeth in each patient was 88.1 ± 7.0 , which has not previously been evaluated in similar studies.

In daily dental and oral hygiene implementations, mouthwashes can be used as auxiliary compounds contributing to oral hygiene. The present study indicated that the use of green tea and chlorhexidine mouthwashes had a similar effect on bacterial colonies in the pharynx. Using 10cc of these mouthwashes in the oral cavity and suction after one minute significantly reduced the bacterial colonies in the pharynx of these patients and led to a reduction of pneumonia and infection. However, with respect to the herbal source of the mouthwash, green tea is recommended instead of chlorhexidine. Oral cavity is the first defense barrier against invasive pathogens. In the anesthetized patients admitted to the intensive care unit, since this barrier is eliminated and the patient cannot eat anything, and considering the human throat is a microbial environment, the upper gastrointestinal tract is susceptible to infection, and the necessity for developing novel mouthwashes is sensed. Usually in anesthetized patients, the tracheal and airway tubes and the bands around the trachea tract for tube fixation cause inflammation and wound in mouth and throat. In this case, using a chlorhexidine mouthwash, which is a chemical substance and may make inflammation worse, hence the green tea mouthwash, which is made from entirely natural ingredients, is recommended for its antimicrobial and anti-inflammatory properties.

It is worthy to mention that there were some limitations and caveats in this study. Displacement of the endotracheal tube and the risk of aspiration were the matter of worry. Therefore, complete training of the nurses implementing the interventions was carried out. Another issue was that the number of study subjects was low; hence, we prolonging the study period to resolve this problem. Some cases hospitalized in ICU recovered from their main diseases earlier than finishing the intervention period and we attempted to solve the issue by including new cases. Ultimately, death of

subjects or refusal of the family of patients from continuing the investigation could cease the study, which was resolved with including new subjects. Considering that the herbal products have less hazardous effects, it seems that further studies could be oriented toward evaluation of other herbal medicines with anti-bacterial properties in a large cohort studies to gain bigger insight into the benefits of such products in eliminating infection load in mouth and throat of patients hospitalized in ICU.

Conclusion

The use of green tea and chlorhexidine mouthwashes has a similar effect on bacterial colonies in the pharynx.

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Ethical Permissions: The study protocol was confirmed by the ethical committee of Kerman University of Medical Sciences (IR.KMU.REC.1394.651) and written informed consent forms was obtained by all the cases before being included in the study.

Conflicts of Interests: There is no conflict of interests.

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