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Original Research

Evaluation of Different Methods for Removing Oral Biofilm in Patients Admitted to the Intensive Care Unit

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Abstract:

Background: The present study aimed to evaluate the different methods for removing oral biofilm in combination with 0.12% chlorhexidine, in patients admitted to the intensive care unit (ICU) of the General University Hospital.

Materials and Methods: Initially, the patients were included in the study and underwent periodontal evaluation by means of the visible plaque index (VPI) and gingival bleeding index (GBI). The removal of visible biofilm, by a professional, was carried out using a toothbrush and dental floss, followed by the application of a 0.12% chlorhexidine solution. The patients were included in this randomized and controlled study into four groups (total n = 48), as follows: Chlorhexidine and gauze 12/12 h; chlorhexidine and gauze 24/24 h; chlorhexidine and brushing 12/12 h; chlorhexidine and brushing 24/24 h. The patients underwent the biofilm removal protocol for 7 days and then were subjected to a new clinical evaluation as to VPI and GBI. Data analysis was performed through stratification and arrangement of the records, in order to carry out the associations with health indicators used in the study, and the statistical tests used were Kappa and t-test for independent and paired samples.

Results: A decrease in the VPI and GBI values when comparing baseline to the final evaluation for all groups was observed.

Conclusion: Based on the methodology, it was possible to concluded that chlorhexidine associated with the mechanical action of the toothbrush or gauze in the times 12 h and 24 h in the ICU environment presented the same results as regards amount of visible biofilm.

Key Words: Chlorhexidine, dental plaque, intensive care, oral hygiene

Introduction

Periodontics has evolved and been focused on comprehensive studies of the periodontal disease, in order to dimension the influence and interaction of oral bacteria with systemic health imbalances and disorders, given that the oral cavity is a diverse ecosystem with up to 700 different colonizing microbial species. There is a strong association between periodontal pathogens and long-distance infectious conditions related to coronary heart disease, stroke, bacterial endocarditis, diabetes mellitus and respiratory diseases, particularly pneumonia.[1]

There is a difficulty in performing oral hygiene of patients admitted to the intensive care unit (ICU) due to the presence of adhesive plasters, tubes and bite blocks. This fact associated with oral hygiene negligence make the oral biofilm and oropharynx suitable reservoirs for microorganisms, including those which do not belong to the oral microbiota, thus causing or worsening remote infections.[2,3] In addition to this, the severity of the systemic disease, individual' decreased immune responses, antibiotic use, poor nutrition and naso- and endo-tracheal intubation increase the risk for infection by pneumonia, which can lead to death.[4,5]

Cotton swabs and gauze are commonly used for cleaning patients' teeth, gum, and tongue. Nurses prefer to use cotton swabs and gauze because they are convenient, require little set-up, and clean faster than tooth brushing, but they are ineffective for removing plaque in between the teeth.[6]

Segers *et al.* (2006)[7] evaluated the efficacy of decontamination of the naso- and oro-pharynx with 0.12% chlorhexidine gluconate. The incidence of nosocomial infections in the experimental and placebo groups was 19.8% and 26.2%, respectively. The lower respiratory tract infections were less common in the experimental group than were in the placebo group. The length of hospital stay for patients treated with chlorhexidine was 9.5 days compared with 10.3 days in the control group. Rello *et al.* (2007)[8] undertook a study aiming to explore the type and frequency of oral hygiene practices in European ICUs. The findings showed that oral care in ICU patients was a responsibility of the nursing staff in the majority of the centers participating in the survey. Nevertheless, only a minority of respondents had received training and education regarding oral health when they attended the nursing school. According to Sona *et al.* (2009),[9] among all hospital-acquired infections, nosocomial pneumonia accounts for 10% to 15%; and a total of 20% to 50% of all patients affected by infections

progress to death. The risk of nosocomial pneumonia is 10-20 times greater in the ICU, and its development in patients under mechanical ventilation and/or humidifier ranges from 7% to 40%.

Scannapieco *et al.* (2009)[10] conducted a study to determine the minimum frequency of application of 0.12% chlorhexidine required to reduce oral pathogens colonization in 175 intubated ICU patients. The subjects were recruited from March 1, 2004 to November 30, 2007. The authors concluded that chlorhexidine reduced the number of *Staphylococcus aureus,* but it did not reduce the number of enteric microorganisms such as *Pseudomonas* or Actinobacter in the dental plaque of the study subjects. A non-significant reduction in the rate of pneumonia was observed in groups treated with chlorhexidine compared to the placebo group. Munro *et al.* (2009)[11] verified the effects of mechanical (brushing) and pharmacological (topical chlorhexidine) action and combination of both methods on the development of acquired pneumonia ventilation (PAV). The study sample was divided into four groups: oral swab with 0.12% chlorhexidine 2 times/day; tooth brushing 3 times/day; combination of chlorhexidine and brushing, and control group. The results showed that chlorhexidine statistically reduced the incidence of PAV on the 3rd hospital day and brushing had no significant effect and did not increase the effect of chlorhexidine when combined.

Based on the fact of the integral promotion of individual health and the importance of the integrated care between dentistry, nursing and medicine, targeting health recovery and comprehensive treatment, there was an interest to evaluate supragingival periodontal status of patients admitted to an adult ICU of the General University Hospital (GUH) after performing different forms of oral biofilm removal associated with 0.12% chlorhexidine.

Materials and Methods

This study project was conducted after submission to and approval by the Research Ethics Committee of the University of Cuiabá, linked to National Council for Ethics in Research under number 2011-68.

From a total of 190 patients admitted to the adult ICU of the aforementioned GUH between January 2012 and January 2013, 142 were excluded by the study eligibility criteria. Then, 50 patients were periodontally examined, of which 48 remained hospitalized and were selected and randomized into four distinct groups (n = 12).

The study sample consisted of 48 patients from the GUH, University of Cuiabá, Brazil, which is a reference hospital for secondary and tertiary care procedures (medium and high complexity, respectively) in various specialties. Once the patient stayed in the ICU for 24 h, he/she was included in the study and underwent professional removal of visible biofilm with toothbrush and floss, followed by the use of a 0.12% chlorhexidine solution (Periogard®, São Paulo, Brazil). In cases when it was necessary, a supragingival scaling was initially performed. The patients were selected and randomized into four groups, as described below:

1. Group chlorhexidine and gauze 12 (CG12) - patients using CG 12/12 h (12)
2. Group chlorhexidine and gauze 24 (CG 24) - patients using CG 24/24 h (12)
3. Group CB 12 - patients using chlorhexidine and brush 12/12 h (12)
4. Group CB 24 - patients using chlorhexidine and brush 24/24 h (12).

Due to ethical issues, the present study was initiated after patient's legal guardians signed an informed consent, in cases when patients were sedated. As inclusion criteria, patients should remain hospitalized for at least 8 days in the ICU of the GUH, be medically available to participate of the study, over 18 years old, not pregnant and with 12 teeth at least. Edentulous patients with limited mouth-opening, making use of any type of oral restraint or immunosuppressed (HIV or transplanted) were excluded.

Periodontal health status was assessed using a clinical mirror (Duflex®, São Paulo, Brazil) and a calibrated Williams's periodontal probe (Hu-Friedy®, Chicago, IL). The oral biofilm removal protocol was carried out by master's student nurse. The patients were laid down with their heads at an angle of 45°; biofilm removal for the group CG 12 and CG 24 h was performed with the aid of a gauze soaked in 0.12% chlorhexidine (Periogard®, São Paulo, Brazil), rolled around a spatula. This gauze was then scrubbed on the buccal surfaces in an anterior-posterior movement, and for the lingual faces of the teeth and tongue, it was wrapped to the operator's fingers and soaked in chlorhexidine to remove biofilm. For the chlorhexidine and brush group, soft brushes n. 30 (Oral B®, São Paulo, Brazil) were used, which were soaked in 0.12% chlorhexidine. The Bass brushing technique was used in this study. The evaluation of the supragingival examinations regarding visible plaque index (VPI) and gingival bleeding index (GBI) of all patients was performed after 24 h of patient staying in the ICU and 7 days after inclusion in the study.

There was training of the examiner (Kappa-value: 0.74) with regard to the VPI and GBI measurements, in order to improve data collection reliability. The VPI and GBI were used to assess the tooth faces: Buccal, mesial, lingual, and distal of all teeth excluding third molars.[11] The VPI was measured first in all teeth (aforementioned surfaces) concerning the presence of visible or non-visible biofilm. The GBI was observed for the same faces of VPI with a periodontal probe at a 45° angle, about 0.5 mm from the gingival sulcus, going across the gingival margin

thoroughly. There was a wait of 30 s to verify the presence or absence of bleeding on the marginal gingival.[12] Examination of patients was performed by a PhD professor, specialized in periodontics, blinded to the groups included in this study.

Data were stratified and organized for analysis in order to allow their crossing with health indicators used in the study. The statistical tests Kappa, ANOVA, and Turkey *post-hoc* for independent paired samples were applied, with a significance level of 5% and 95% confidence interval.

Results

In total, 50 patients were examined from which two were excluded for not having stayed in the ICU for an 8-day minimum period. Of the patients evaluated in the ICU, 30 (63.8%) were male and 18 (36.2%) female. Age range 23-62 years participated in the study.

Of the patients evaluated, 14 were white, and 34 were non-white. The underlying diseases were distributed into five groups (Table 1). Chronic diseases were found in 19 patients (38%); polytraumatism, in 14 patients (30.5%); cerebral vascular and oncological diseases were found in nine patients (19.5%) and six patients (11.1%), respectively. In terms of social class, the adult basic education program's socioeconomic questionnaire was applied and eight patients (16.6%) were from the Class B and 40 patients (83.4%) were from the Class C.

In relation to visible plaque (Table 2), the findings of the comparisons of different protocols at baseline and post-treatment demonstrated statistically significant reductions in the amount of biofilm ($P < 0.05$). In the comparison of the distinct protocols for use of chlorhexidine, no significant statistical differences were found between the strategies evaluated ($P > 0.05$).

As to the GBI data (Table 3) at baseline and post-treatment, the groups with distinct protocols were found to show significant differences in the comparisons ($P < 0.05$), while the protocols for use of chlorhexidine showed no statistically significant differences ($P > 0.05$).

Table 1: The underlying diseases were distributed into five groups.

Disease	*N*	%
Oncological diseases	5	10.4
Polytraumatism	14	29.1
Cerebral vascular diseases	10	20.8
Chronic diseases	19	39.5
Total	48	100

Table 2: Dental plaque at baseline and post-treatment.

	Groups	*N*	Mean	±Standard deviation
VPI	CG12 baseline	12	Aa 98.70	3.90
	CG12 post-treatment		Bb 22.44	24.38
	CG 24 baseline	12	Aa 100.0	0.00
	CG 24 post-treatment		Bb 35.41	38.54
	CB 12 baseline	12	Aa 100.0	0.00
	CB 12 post-treatment		Bb 21.33	31.89
	CB 24 baseline	12	Aa 93.22	3.68
	CB 24 post-treatment		Bb 23.86	24.33

CG 12: Chlorhexidine and gauze 12/12 h; CG 24: Chlorhexidine and gauze 24 h; CB 12: Chlorhexidine and brush 12/12 h; CB 24: Chlorhexidine and brush 24 h. Different letters within the same column indicate statistically significant differences between the groups ($P<0.05$)

Table 3: Gingival bleeding index at baseline and post-treatment.

	Groups	*N*	Mean	±Standard deviation
GBI	CG12 baseline	12	Aa 68.33	26.96
	CG12 post-treatment		Bb 4.17	4.20
	CG 24 baseline	12	Aa 77.91	40.26
	CG 24 post-treatment		Bb 17.66	32.02
	CB 12 baseline	12	Aa 50.33	40.87
	CB 12 post-treatment		Bb 2.91	4.12
	CB 24 baseline	12	Aa 52.78	40.41
	CB 24 post-treatment		Bb 5.76	6.76

CG 12: Chlorhexidine and gauze 12/12 h; CG 24: Chlorhexidine and gauze 24 h; CB 12: Chlorhexidine and brush 12/12 h; CB 24: Chlorhexidine and brush 24 h. Different letters within the same column indicate statistically significant differences between the groups ($P<0.05$)

Discussion

A number of studies have correlated oral health with different hygiene protocols considering the outcome of a decrease in the occurrence of pneumonia or respiratory diseases.[13,14] Accordingly, just a few authors investigate therapies for maintaining oral health.[9] Another complicating factor is the diversity of rinses, as well as the combination with mechanical brushing or use of gauze.[6,11]

This study demonstrated that different methods for removing oral biofilm were effective in controlling biofilm dental. Similar studies with mechanical protocol and 0.12% or 0.2% liquid/gel chlorhexidine have shown that such a therapy is effective at reducing visible biofilm.[10,15] Nevertheless, it has not been demonstrated that there is a reduction in gingivitis levels, even in the presence of visible biofilm, which is likely to be less virulent and pathogenic than the referential biofilm. The findings of this study in both experimental times (12 and 24 h) are similar to those of other authors.[16,17] In this sense, it seems that oral hygiene performed once a day associated with chlorhexidine to mechanically disrupt biofilm can maintain a stability pattern for at least 8 days without problems. However, there must be at least a dentist performing the initial diagnosis, as well as assessing the clinical conditions of the patients in an 8-day minimum period.

Although the object of study is not related with pneumonia, it is clear that the results can help reduce the contamination risk for bacterial, upper and lower respiratory tract diseases. It is worth noting that the findings of several studies have not shown a direct relationship between biofilm control and decreased death rates.[10] However, there was difficulty to find a clinical study demonstrating decreased levels of inflammatory markers

in addition to decreased visible biofilm. Such scarcity of data is likely to be a result of the difficulties found in the assessment of this sort of patients. Moreover, despite the excellent design of the studies on these topics, there has been lack of periodontal disease markers. Perhaps, this fact occurs because many research conducted in this area of knowledge are hold by non-dentists, whom would assist in the clinical diagnosis and even would be calibrated to examine visible biofilm.[16]

Conclusions

Based on the methodology, it can be concluded that the use of chlorhexidine associated with the mechanical action of brush and gauze (12 and 24 h) in the ICU environment did not differ as regards visible biofilm control and health of gingival tissues.

Acknowledgments

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