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Periodontitis and Periodontopathogens in Individuals Hospitalized in the Intensive Care Unit: A Case-Control Study

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The aim of the present study was to compare periodontal conditions between intensive care unit (ICU) in-patients and non-ICU patients through clinical and microbiological periodontal parameters. This case-control study included 88 individuals hospitalized in ICU and 176 non-hospitalized controls. All individuals underwent a complete periodontal examination and microbiological sampling. The total bacterial load and counts of *Porphyromonas gingivalis, Treponema denticola* and *Aggregatibacter actinomycetemcomitans* were evaluated using qPCR. Data were analyzed through the Chi-square, Fisher exact, and t-Student tests, and the Spearman correlation, as appropriate. The prevalence of periodontitis was 39.7% among controls and 59.0% among ICU in-patients (OR=2.18; p=0.002). ICU in-patients had a significantly higher occurrence of cardiovascular disease (p=0.002; OR=2.20) and history of periodontal disease (p=0.031; OR=1.92) than controls. Bacterial counts of *A. actinomycetemcomitans*, *T. denticola* and *P. gingivalis* were significantly higher in ICU in-patients with periodontitis than in controls. The correlation between periodontal parameters and microbiological findings among cases and controls showed a significant and positive correlation between: total bacteria load and % of sites with probing depth (PD) ≥ 4 mm (cases: r=0.22 and controls: r=0.13) and *P. gingivalis* and % sites with bleeding on probing (BOP) (cases: r=0.22 and controls: r=0.23). Thus, ICU in-patients presented a higher prevalence of periodontitis and worse periodontal condition (higher mean plaque index, BOP, clinical attachment level ≥3 mm, and sites with PD 4 to 6 mm).

Key Words: cardiovascular disease, diabetes mellitus, hospitalization, microbiology, periodontitis, respiratory disorder.

Introduction

Currently, periodontitis represents a serious public health problem. It can impair the quality of life of affected individuals due to the adverse effects on oral health, masticatory function, and aesthetics. Periodontitis accounts for a substantial proportion of tooth loss, which impacts on dental costs and general health (1).

Qualitative and quantitative assessments of subgingival microbial colonization have shown a positive correlation between the occurrence, the extension, and the severity of periodontitis and increased levels of colonization by specific Gram-negative bacteria (2). These periodontal pathogens have an infinite number of virulence factors, which induces cells to produce inflammatory mediators in the periodontal tissues. However, periodontal inflammation is not limited to periodontal tissues as bacteria and inflammatory mediators can enter the bloodstream and create systemic inflammation (3).

Studies showed that the oral health of individuals can deteriorate after short periods of hospitalization, as indicated by the increase in dental biofilm and gingival inflammation (4-6). Pathogens in the dental biofilm have also been implicated in inflammatory processes that can compromise the function of organs and systems, thereby contributing to increased morbidity and mortality and higher costs associated with health care (7).

Periodontitis can significantly increase the risk or alter the natural course of certain systemic chronic diseases (3,8). Current evidence supports an association between periodontitis and diabetes mellitus type II, (9) cardiovascular diseases (10,11) and respiratory diseases (3). However, controversial data have also been reported for these associations (8,9). Pre-existing periodontal conditions in hospitalized individuals has been associated with increased severity of other associated co-morbidities, especially respiratory and cardiovascular diseases (12).

In this sense, the potential impact of periodontal condition on the overall health of the individual emphasizes the importance of obtaining a greater understanding of this condition in hospitalized individuals, especially in the intensive care unit (ICU).

Notably, to date, few studies have been conducted on the periodontal condition from a clinical (4,6) or microbiological (13,14) perspective in ICU hospitalized individuals.

The hypothesis of the present study is that ICU in-patients present a worse periodontal condition when

compared to non-ICU patients, as well as they present higher counts of the periodontal pathogens *Porphyromonas gingivalis*, Treponema denticola and *Aggregatibacter actinomycetemcomitans* with a greater potential risk for systemic health.

The aim of the present study was to compare periodontal conditions between ICU in-patients and non-ICU patients through clinical periodontal parameters and also to quantify *P. gingivalis*, *T. denticola*, and *A. actinomycetemcomitans* in subgingival samples.

Material and Methods

Study Sample and Sampling Strategy

The sample for this case-control study was primarily composed of 615 individuals examined from January/2012 to March/2015. The case group initially comprised 284 individuals (convenience sample) under care in the ICU of the Hospital Universitário São Francisco de Assis, in Belo Horizonte, MG, Brazil. In this hospital, specific professional dental care during the ICU stay is not performed as a routine procedure. For the control group, 331 non-hospitalized individuals from two previous cross-sectional studies, that underwent the same data collection procedures in the hospital of the present study [databases from Lages et al. (15) and Cunha et al. (16)], were determined to be eligible. After applying rigorous selection criteria (Fig. 1) and randomization in the control group (for each two eligible participants, two envelopes with "included" or "not included" were drawn until reaching the proportion of 2 controls for each case), 196 and 155 individuals were excluded in the case and control groups, respectively. Thus, the final sample comprised 88 individuals in the case group and 176 in the control group. Sampling strategy and exclusion criteria is presented in Figure 1.

A sample size calculation was performed assuming an expected prevalence of severe periodontitis of 30% among ICU in-patients compared to 15% in not hospitalized control ones. Calculation was carried out using the Fleiss method

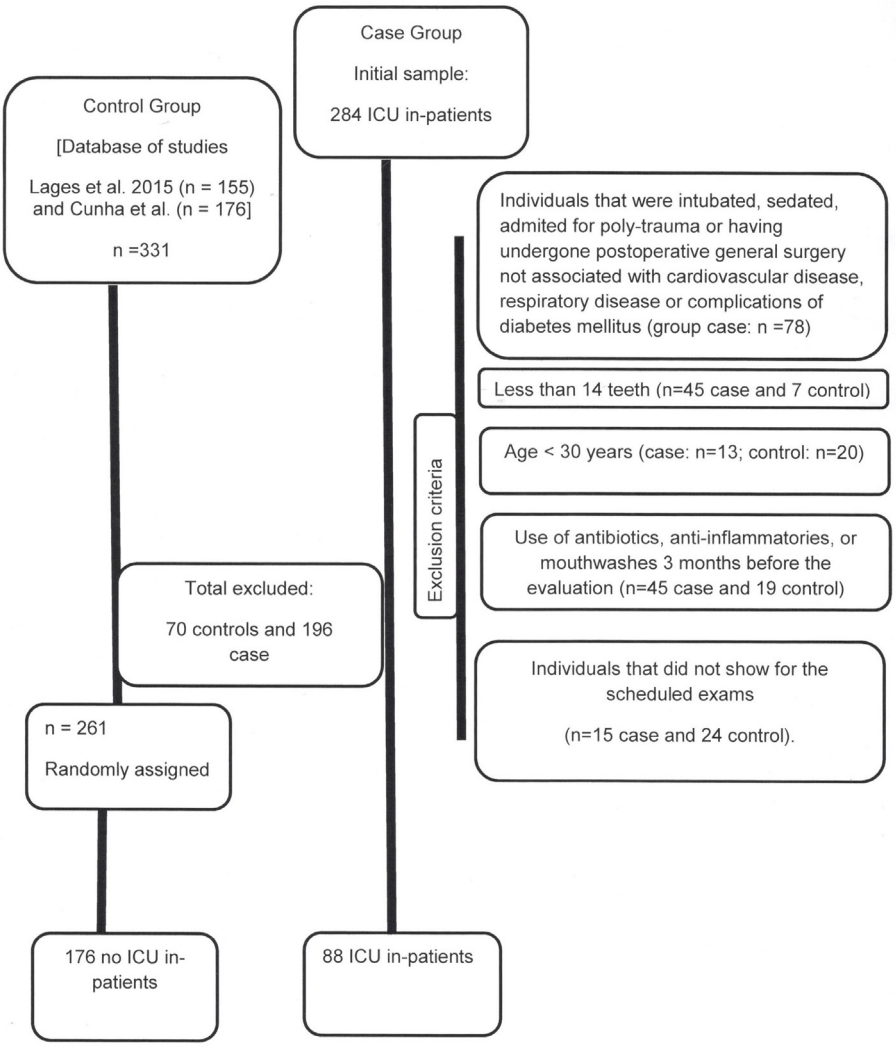

Figure 1. Sampling strategy and study sample.

through the OpenEpi software (**Open Source Epidemiologic Statistics for Public Health, version 3.01, Boston, USA).** Based on a significance level of 0.05, 80% power, and a case-control ratio of 1:2, a number of 88 cases and 175 controls were determined to be necessary.

After signing an informed consent, individuals or legal guardians were questioned by the examiner about their medical/dental history and given information about social, demographics, and behavioral risks regarding periodontal diseases. Then, individuals underwent a complete periodontal clinical examination and microbiological sampling. After the examination, participants or their legal guardians were informed about their periodontal condition. Individuals presenting any periodontal alterations were referred for dental care in public health care units or in the School of Dentistry, Federal University of Minas Gerais, according to the medical team consent. The study was approved by the Research Ethics Committee of the Federal University of Minas Gerais (protocol #CAAE 14943614.8.0000.5149).

The present observational study was designed and conducted according to the STROBE guidelines (www.strobe-statement.org/).

Sample Characterization

Data on the following characteristics were collected: sex, age, number of teeth present, completely decayed teeth or retained root tips, alcohol use, previous use of antibiotics or anti-inflammatory drugs in the last 3 months, continuous drug use, smoking (17), family history of periodontal disease (yes/no), presence of systemic diseases or conditions [(a) diabetes (9) (b) high blood pressure, (c) bacterial endocarditis, (d) cardiovascular diseases, (e) rheumatic fever, (f) respiratory diseases, (g) osteoporosis]. In the case group, the following data was also collected: reason for admission in the ICU, length of stay in the ICU, and hospital outcome (discharge/death). All the collected data was obtained in the medical records and confirmed by the specialist doctors responsible for the patients.

Case Definition, Severity and Extension of Periodontitis

Severity of periodontitis was defined as: a) moderate periodontitis - the presence of ≥2 interproximal sites with clinical attachment level (CAL) ≥4 mm or ≥2 interproximal sites with probing depth (PD) ≥ 5 mm (in different teeth) or 1 site with PD ≥ 5 mm (18); b) advanced periodontitis – the presence of ≥ 2 interproximal sites with CAL ≥ 6 mm (in different teeth) and ≥1 interproximal site with PD ≥5 mm (18). Extension of periodontitis was defined as: a) localized periodontitis – up to 30% of the affected sites; b) generalized periodontitis – more than 30% of the affected sites (1).

Periodontal Clinical Examination

A full-mouth periodontal clinical examination was performed by four trained examiners experts in periodontics (M.M.A, B.N.A., F.A.C, and E.J.P.L). Plaque index [PI (19)] PD, CAL, and bleeding on probing (BOP) were recorded in 6 periodontal sites per tooth with a manual periodontal probe (PCPUNC15BR and PQ2NBR, Hu-Friedy®, Chicago, USA) with circumferential probing, recording the highest values for each mesial, distal, buccal, and lingual sites. Inter and intra-examiner agreement values for PD and CAL revealed values greater than 0.89 (kappa test).

Microbiological Analyses

Subgingival samples were collected as previously described (20). Briefly, subgingival samples were collected from the sites of the five teeth showing the highest PD value, immediately after periodontal examination. Sterile paper points (#30) were inserted into the periodontal sulcus after the removal of supragingival plaque using sterile curettes.

Genomic DNA (gDNA) was extracted and purified from the pellet using PureLink® Genomic DNA Mini Kit (Life Technologies, Carlsbad, USA) according to manufacturer's specifications. Quantification of the total number of bacterial cells, *A. actinomycetemcomitans*, *P. gingivalis*, and *T. denticola* was carried out by quantitative real time polymerase chain reaction (qPCR) using TaqMan assay (Universal PCR Master Mix II, Life Technologies, Carlsbad, USA.) with a specific set of primers/probes: *A. actinomycetemcomitans* (forward: CAAGTCTGATTAGGTAGTTGGTGGG; reverse: TTCATTCACGCGGCATGGC; probe: ATCGCTAGCTGGTCTGAGAGGATGGCC); *P. gingivalis* (forward: ACC TTA CCC GGG ATT GAA ATG; reverse: CAA CCA TGC AGC ACC TAC ATA GAA; probe: VICATG ACT GAT GGT GAA AAC CGT CTT CCC TTC TAMRA); *T. denticola* (forward: CCG AAT GTG CTC ATT TAC ATA AAG GT; reverse: GAT ACC CAT CGT TGC CTT GGT; probe: 6FAMATG GGC CCG CGT CCC ATT AGC TAMRA) in an ABI 7500 Fast Real Time PCR System® (Life Technologies, Carlsbad, USA) following manufacturer's instructions in 20 uL reactions. The qPCR conditions were: 50 °C for 2 min, 95 °C for 10 min, 40 cycles of 95 °C for 15 s, and 60 °C for 1 min.

The absolute quantification of the target organism was determined by the plotting of the cycle threshold (Ct) value obtained from each clinical sample against a standard curve generated with a known concentration of gDNA of reference bacterial strains in 10-fold serial dilutions. Negative control (purified PCR-grade water instead of the DNA template) was included in all PCR reactions.

Statistical Analysis

Analyses were performed through the Chi-square, Fischer exact, and Student t tests, when adequate. In comparative

analysis between the occurrence of periodontitis in relation to the microbiological findings, the normality of data was tested through the Kolmogorov-Smirnov test. The normality hypothesis was rejected for all variables with p-values varying from 0.047 to <0.001. Since data distribution was too asymmetric and deviations from normal distribution were too high, non-parametric tests were used (Wilcoxon and Mann-Whitney test). Correlations between clinical periodontal parameters and bacterial quantification in case and control groups were evaluated through Spearman Correlation (r). All results were considered significant if p <0.05. All results were analyzed using the SPSS 17.0 statistical software (Statistical Package for Social Sciences for Windows Version, SPSS Inc., Chicago, IL).

Results

The final sample comprised 264 dentate individuals, 88 individuals admitted to the ICU (cases) and 176 non-hospitalized individuals (controls), with a mean age of 56.4 (±9.7) years, with mean number of teeth of 17.2 (±4.9). In the case group, the mean length of stay in the ICU was 13.1 (±8.0) days.

The case group presented the following reasons for admission in the ICU: (a) cardiovascular disorders (35.6%), (b) respiratory disorders (32.4%); (c) neurological disorders (20.4%); (d) sepsis (6.6%); (e) renal failure (4.0%); and (f) others (1.0%). There was no development of nosocomial pneumonia and 9.6% of the patients evolved to death (without significant correlation with periodontal and microbiological conditions).

Comparisons between ICU in-patients and controls in relation to variables of interest are reported in Table 1. The following variables were significantly different between cases and controls: presence of CVD (p=0.02; OR=2.20; 95%CI: 1.31 to 3.71), and presence of periodontal disease history (p=0.031; OR=1.92; 95%CI: 1.01 to 3.63).

The periodontal condition of cases and controls is presented in Table 2. The frequency of periodontitis was 49.3% in the total sample, 39.7% among controls, and 59.0% among ICU in-patients (OR=2.18, 95%CI: 1.29 to 3.68; p=0.002). Overall, ICU in-patients showed a worse periodontal condition when compared to controls. In the case group, a significantly higher occurrence and severity of periodontitis, lower number of teeth present, higher mean PI, BOP, CAL ≥3 mm, and sites with PD 4 to 6 mm were observed.

It should be noted that individuals in the case group had significantly greater tooth loss and / or retained root tips than individuals in the control group (p<0.001; Table 2).

Intra-group analysis revealed that cases and controls with periodontitis showed significantly higher total bacteria load, *P ginigivalis*, *A. actinomycetemcomitans* and *T. denticola* counts when compared to cases and controls without periodontitis. In the intergroup analysis, ICU in-patients presented a higher prevalence of periodontitis and worse periodontal condition than controls. Moreover, they also had a positive correlation with *P. gingivalis*, *T. denticola*, and *A. actinomycetemcomitans* counts. There were no significant differences between cases and controls without periodontitis (Table 3).

The correlation between periodontal parameters and microbiological findings among individuals the case and control groups showed a significant and positive correlation between: (1) total bacteria load and % of sites with PD ≥ 4 mm (cases: r=0.22; p=0.030 and controls: r=0.13; p=0.009); (2) *P. gingivalis* and % sites with BOP (cases: r=0.22; p=0.033 and controls: r=0.23, p=0.004); (3) *T. denticola* and % sites with BOP (cases: r=0.21; p=0.047) and % sites with PD ≥ 4mm (cases: r=0.32; p=0.002); (4) *A. actinomycetemcomitans* and % sites with BOP (cases: r=0.27; p=0.010). Thus, it is emphasized that

Table 1. Association between ICU in-patients and studied variables (bivariate analysis)

Variables	Cases (n = 88)	Controls (n = 176)	Crude OR (95% CI)	p*
Age				
35- 55	60 (52.8%)	97 (55.4%)		
>55	28 (47.2%)	79 (44.6%)	0.57 (0.33 to 0.98)	0.028
Sex				
Female	40 (45.4%)	98 (55.7%)		
Male	48 (54.6%)	78 (43.9%)	1.50 (0.90 to 2.52)	0.075
Smoking (Yes)	29 (33.0%)	56 (32.0%)	1.05 (0.61 to 1.81)	0.022
Alcohol use (Yes)	24 (27.2%)	33 (19.0%)	1.62 (0.88 to 2.96)	0.076
Diabetes (Yes)	26 (34.1%)	40 (22.8%)	1.42 (0.80 to 2.54)	0.142
Cardiovascular disease (Yes)	48 (54.5%)	62 (35.2%)	2.20 (1.31 to 3.71)	0.002
Respiratory disease (Yes)	14 (15.9%)	28 (18.9%)	1.0 (0.48 to 2.0)	0.429
Family income				
Up to 2 BMW	54 (61.4%)	93 (52.8%)		
>2 to 4 BMW	34 (38.6%)	83 (47.2%)	1.41 (0.84 to 2.38)	0.119
Family history of periodontal disease (Yes)	22 (25.0%)	26 (14.7%)	1.92 (1.01 to 3.63)	0.031

*Chi-square test; BMW=Brazilian minimum wage (equivalent to 320 U$). Significant ORs and p-values are shown in bold.

T. denticola and *A. actinomycetemcomitans* presented positive correlation only in the case group (Table 4).

Discussion

In the present study, ICU in-patients were significantly associated with an elevated risk for periodontitis. Additionally, ICU in-patients with periodontitis presented a higher frequency of all evaluated periodontopathogens, as well as a higher total bacterial load when compared to controls with and without periodontitis.

Few studies have been conducted on the oral health status of hospitalized individuals. Some studies have investigated the impact of hospitalization and the influence of dental biofilm accumulation during the hospitalization period (4-7). Several studies have reported an association between periodontal condition and systemic diseases (3,9-11).

Currently, a large body of scientific evidence supports the association between periodontitis and diabetes mellitus type II, (3,9) cardiovascular diseases (10,11) and respiratory diseases (3,8,14), with moderate to strong evidence (12). However, controversial results were also widely reported (3). In the present study, an absence of association between periodontitis and RD and DM were reported.

Concurrently with several studies (10-12), a positive association between periodontitis and CVD was reported in the present study (OR=2.20). In a recent review, Holmstrup et al. (12) reported that a considerable amount of knowledge has been accumulated about the link between periodontitis and CVD, with growing evidence for

Table 2. Association between ICU in-patients and periodontal condition

Variables	Cases (n = 88)	Controls (n = 176)	Crude OR (95%CI)	p
Periodontitis	n = 52 (59.0%)	n = 70 (39.7%)	2.18 (1.29 to 3.68)	0.002*
Number of teeth n (%)				
8 to 14	30 (34.0%)	31 (17.6%)	3.299 (1.65 to 6.58	<0.001‡
>14 to 20	36 (40.9%)	70 (39.9%)	1.88 (0.98 to 3.58)	
>20	22 (25.1%)	75 (42.5%)	1.0	
Completely decayed teeth and retained root tips ±SD	1.8 ±0.8	1.3 ±0.5	-	<0.001‡
Plaque Index Mean ±SD	2.65 ± 0.62	1.57 ± 0.78	-	<0.001‡
BOP mean ±SD	28.7 ±33.1	49.5 ± 33.9	-	<0.001‡
PD mean ±SD	3.3 ±0.6	2.5 ±1.3	-	<0.001‡
CAL mean ±SD	4.9 ± 1.4	4.3 ±1.7	-	0.060‡
Sites with BOP	24.7 ± 16.9	19.91 ± 18.1	-	<0.001‡
Sites with PD < 4 mm	83.7 ± 18.0	83.0 ± 17.0	-	0.762‡
Sites with PD 4 to 6 mm	12.0 ± 5.8	10.3 ± 5.9	-	<0.001‡
Sites with PD >6 mm	4.2 ±14.4	2.3 ± 1.3	-	0.150‡
Sites with CAL <3 mm	30.7 ± 21.0	29.78 ± 6.9	-	0.420‡
Sites with CAL ≥3 mm	69.3 ± 21.0	64.9 ± 33.8	-	<0.001‡
Sites with CAL ≥5 mm	16.5 ± 20.5	18.9 ± 20.7	-	0.120‡

Chi-square*, Student Test‡. Significant p-values are shown in bold.

Table 3. Comparative analysis between the occurrence of periodontitis in relation to the microbiological findings (bacterial count x 10^3)

Variables	**Cases (n = 88)**		**Controls (n = 176)**	
Periodontitis	Yes (n = 52)	No (n = 36)	Yes (n = 70)	No (n = 106)
Total Bacterial Load	199.1(183.7) [209.7^{Aa} ± 169.3]	56.2 (42.2) [58.6 ± 432.9 ^{Bb}]	124.3 (2311.3) [132.3^{Ab} ± 247216.7]	41.94 (35.2) [45.6 ^{Bb} ± 37.4]
P. gingivalis	78.9 (232.39) [99.7^{Aa} ± 273.4]	10.6 (2.9) [11.3^{Ba}± 3.1]	27.9 (132.8) [31.0 ^{Ab} ± 147.6]	10.8 (0.19) [12.1 ^{Ba} ± 0.22]
T. denticola	87.3 (926.6) [91.9^{Aa} ± 1053]	0.97 (4.8) [1.0^{4Ba} ± 5.1]	69.1 (178.6) [76.7 ^{Ab} ± 198.4]	0.92 (0.0) [1.0^{Ba} ± 0.0]
A. actinomycetemcomitans	23.0 (72.5) [25.1^{Aa} ± 74.2]	17.8 (45.2) [18.9^{Ba} ± 48.6]	63.8 (26851.5) [66.9 ^{Ab} ± 29974]	16.4 (0.19) [17.6 ^{Ba} ± 0.22]

Median (Q3-Q1), [Mean ± s.d.]; Intra-groups comparisons (cases with periodontitis versus cases without periodontitis, and Controls with periodontitis versus Controls without periodontitis) followed by distinct capital letters are significantly different (p<0.001; Wilcoxon test for independent samples). Inter-groups comparisons (cases with periodontitis versus controls with periodontitis, and cases without periodontitis versus controls without periodontitis) followed by distinct lower cases letters are significantly different (p<0.001; Mann-Whitney test for independent samples).

a causal relationship. There are plausible mechanistic data (including experimental results), and it appears that periodontal treatment may reduce the risk of atherosclerotic disease.

A high prevalence of periodontitis was observed in the present study sample: 39.7% among controls, and 59.0% among ICU in-patients. However, periodontitis was predominantly a moderate and localized form. Analysis of the periodontal clinical parameters revealed a mean % sites with PD 4 to 6 mm of 12.0% in the case group and 10.3% in the control group, as well as CAL ≥ 3mm in 69.3% of cases and in 64.9% of controls. This indicates that a higher attachment loss was responsible for the inclusion of individuals as periodontitis cases. Thus, despite the high prevalence, these results are consistent with an epidemiological survey among adults in Latin America showing a high prevalence of periodontitis, but with low severity and extension (21). Additionally, it was decided to exclude individuals <35 years old in a attempt to reduce the resulting variation of a young age group and the age-confounding effect on underestimating the occurrence of periodontitis (22).

Moreover, a high prevalence of periodontitis may be related to characteristics such as low socioeconomic and educational level, limited access to oral health services, and heterogeneous distribution of other risk factors for periodontitis in the Latin American population, as well as differences in the criteria adopted in categorizing patients (22).

Thus, specific pathogens in dental biofilms are reported to be involved in inflammatory processes that can compromise the function of organs and systems and, therefore, contribute to increased morbidity and mortality and the costs associated with health care (7,23). Linden et al. (3) reported that a pre-existing periodontal inflammation in hospitalized individuals might deteriorate or initiate new conditions, such as lung infections caused by oral cavity pathogens. These findings also reinforce the need for specific preventive primary care by oral health professionals in the intensive care unit. Thus, a routine oral hygiene practice in hospitals during the hospitalization period and a properly executed protocol can help to maintain or improve patient's oral health, with positive impacts on their quality of life (6)

Not all bacterial species present in the mouth are pathogenic. Four microbial complexes (blue, purple, yellow, and green) comprise several species considered to be compatible with the host (2,24), including Actinomyces, Streptococcus, and Capnocytophaga spp. These microbial species have been strongly associated with healthy individuals and are the first to colonize the tooth surface (25). Their growth usually precedes the multiplication of predominantly gram-negative species of the orange and red complexes, with a significant decrease observed in the proportions of Actinomyces spp. in the transition between health and disease (24). Pathogens of the orange and red complexes have shown associations with the form and the severity of periodontitis (2,25).

In the present study, bacterial counts of *T. denticola* and *P. gingivalis* (both red complex pathogens), as well as *A. actinomycetemcomitans*, were significantly higher in ICU in-patients with periodontitis. These findings are corroborated by studies reporting the detection of red complex pathogens in higher proportions in diseased sites and the strong association with higher PD and BOP in individuals with chronic periodontitis (2,24,25). Thus, a synergistic risk effect of the presence of infection and inflammation may be present in vulnerable individuals such as the ICU in-patients. However, it should be emphasized that since the mean number of days of ICU stay was short (13 days), the clinical and microbiological periodontal conditions may reflect a previous condition of the individuals (except for PI and BOP).

There are great challenges in the interpretation of studies on subgingival biofilm in a multifactorial manner. Nevertheless, it is important to note that any change in the

Table 4. Correlations between clinical periodontal parameters and bacterial quantification in case and control groups

Case group	Periodontal parameters		
Bacteria (Ct measures)	% sites with BOP** (p*)	% sites with PD ≥ 4 mm** (p*)	% sites with CAL ≥ 3 mm** (p*)
Total count (Universal)	0.15 (0.146)	0.22 (0.030)	0.01 (0.983)
P. gingivalis	0.22 (0.033)	0.35 (0.001)	0.14 (0.174)
T. denticola	0.21 (0.047)	0.32 (0.002)	0.01 (0.965)
A. actinomycetemcomitans	0.27 (0.010)	0.09 (0.411)	0.06 (0.573)
Control group	**Periodontal parameters**		
Bacteria (Ct measures)	% sites with BOP** (p*)	% sites with PD ≥ 4 mm** (p*)	% sites with CAL ≥ 3 mm** (p*)
Total Count (Universal)	0.12 (0.456)	0.11 (0.09)	0.01 (0.675)
P. gingivalis	0.23 (0.004)	0.13 (0.068)	0.11 (0.213)
T. denticola	0.17 (0.075)	0.27 (0.067)	0.07 (0.312)
A actinomycetemcomitans	0.19 (0.076)	0.11 (0.654)	0.03 (0.413)

*Spearman correlation. **Mean values of percentage of sites with bleeding on probing (BOP), probing depth (PD) and CAL (clinical attachment level).

environment can have an impact on the microbiota, which in turn is capable of inducing changes in the host response, generating an amplification loop of the periodontal disease process (25). In this sense, ICU in-patients could be subject to negative impacts on the subgingival microbiota.

In the present study, individuals in the case group had significantly greater tooth loss and/or retained root tips than individuals in the control group. In this sense, an interesting issue was reported by Scannapieco and Cantos (8) regarding the significance of poor oral health in the progression of systemic diseases, especially individuals in long-term care, called the dental experience "benign neglect", that is, in the absence of symptoms such as pain and swelling, dental pathology would ordinarily be resolved untreated. For example, it is not uncommon to be asymptomatic retained root tips in patients in long-term care.

Thus, root tips are a potential cause of chronic infection and present extra challenges in the maintenance of oral hygiene. The effect of retained root tips on systemic infections or other chronic diseases remains unexplored. There is a need for strong scientific evidence to provide guidance regarding the risks and rewards associated with treatment vs. 'benign neglect' (8).

Some limitations must be attributed to the present study though. Ideally the control group should be patients of the hospital not admitted to ICU, which was not possible due to logistics issues related to the exams and sample size. However, in order to minimize biases, the controls belonged to a sample of companions and / or relatives of individuals hospitalized in the University Hospital similar to those in the case group. Additionally, the convenience sample (despite the strict exclusion criteria) may have some impacts on the external validity of the results, and the case-control design does not detect any temporal influence among ICU-patients, periodontal conditions, and microbiological findings. Thus, the present study may be considered an important starting point for investigations on periodontal condition of ICU in-patients. In this sense, further studies with different populations and designs should be conducted in order to provide additional information on the clinical and microbiological periodontal condition of ICU in-patients.

In conclusion, ICU in-patients presented a higher prevalence of periodontitis and a worse periodontal condition (higher mean PI, BOP, CAL ≥3 mm, and sites with PD 4 to 6 mm) when compared to control individuals. Periodontitis was positively associated with CVD. Additionally, bacterial counts of *A. actinomycetemcomitans*, *T. denticola* and *P. gingivalis* were significantly higher in ICU in-patients with periodontitis.

Resumo

O objetivo deste estudo foi comparar as condição periodontais entre pacientes internados em Unidade de terapia intensiva (UTI) e indivíduos não hospitalizados através de parâmetros periodontais clínicos e microbiológicos. Este estudo caso-controle incluiu 88 indivíduos hospitalizados em UTI e 176 controles não hospitalizados. Todos os indivíduos foram submetidos a um exame periodontal completo e amostragem microbiológica. A carga bacteriana total e as contagens de Porphyromonas gingivalis, Treponema denticola e Aggregatibacter actinomycetemcomitans foram avaliadas utilizando qPCR. Os dados foram analisados, conforme apropriado, por meio dos testes de Qui-quadrado, Fisher exato, t-Student, Mann-Whitney e correlação de Spearman. A prevalência de periodontite foi de 39,7% entre os controles e de 59,0% entre pacientes internados em UTI (OR=2,18, IC 95%: 1,29-3,68; p=0,002). Pacientes admitidos na UTI apresentram significativamente uma maior ocorrência de doença cardiovascular (p=0,002, OR=2,20) e história de doença periodontal (p=0,031; OR=1,92) do que os controles. As contagens bacterianas de *A. actinomycetemcomitans*, *T. denticola* e *P. gingivalis* foram significativamente maiores nos pacientes em UTI com periodontite do que nos controles. A correlação entre os parâmetros clínicos periodontais e os achados microbiológicos entre casos e controles mostrou correlação significativa e positiva entre: carga bacteriana total e % de sítios com profundidade de sondagem (PS) ≥4 mm (casos: r=0,22 e controles: r=0,13) e *P. gingivalis* e % de sítios com sangramento à sondagem (SS) (casos: r=0,22 e controles: r=0,23). Pacientes internados na UTI apresentaram maior prevalência de periodontite e pior condição periodontal (maior média de índice de placa, SS, de sítios com nível de inserção clínica ≥ 3mm e PS de 4 a 6 mm) do que os controles.

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