Effect of non-surgical periodontal treatment on chronic kidney disease patients

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Abstract: Chronic kidney disease (CKD) is a debilitating systemic condition. Our working hypothesis is that CKD predialysis patients with periodontitis would respond poorly to periodontal treatment owing to immunologic compromise. Twenty-one predialysis patients (group 1) and 19 individuals without clinical evidence of kidney disease (group 2) with chronic periodontitis were subjected to non-surgical periodontal treatment with no antibiotics. Clinical periodontal and systemic parameters were evaluated at baseline and 3 months after treatment. Both groups showed significant and similar post-treatment improvements in all periodontal parameters examined. Most interestingly, periodontal treatment had a statistically significant positive effect on the glomerular filtration rate of each individual (group 1, $p = 0.04$; group 2, $p = 0.002$). Our results indicate that chronic periodontitis in predialysis kidney disease patients improved similarly in patients with chronic periodontitis and no history of CKD after receiving non-surgical periodontal therapy. This study demonstrates that CKD predialysis patients show a good response to non-surgical periodontal treatment.

Descriptors: Chronic Periodontitis; Dental Scaling; Root Planing; Chronic Kidney Failure.

Introduction

The concept that systemic diseases can be affected by the progression and treatment of periodontitis has been the focus of sustained interest in the field of Periodontology. Evidence of a relationship between oral bacteria and systemic diseases such as bacterial endocarditis, other cardiovascular diseases, atherosclerosis, and lung disease is well-documented in the literature.[1-7]

Periodontal disease is an infection caused by Gram-negative bacteria leading to a chronic inflammatory state, which more recently has been associated with chronic kidney disease (CKD).[8-10] It is still not clear whether periodontitis has a role as a risk factor for CKD. However, in many cases, the etiology of kidney disease remains unknown and cannot be explained by the usual primary causes, such as diabetes mellitus, hypertension, pyelonephritis, glomerulonephritis, nephrosclerosis, polycystic kidney disease, and collagen vascular disease.[11,12]

CKD is a public health problem whose prevalence has been increasing worldwide. A clinical consequence of renal failure is the retention of

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excretory products and interference with endocrine and metabolic functions. This failure in kidney homeostasis is called uremia and it is associated with immune dysfunction, including defects in lymphocyte and monocyte function.[13,14]

The aim of this study was to investigate how predialysis CKD patients with periodontitis respond to non-surgical periodontal treatment.

Materials and Methods

The study population included 21 CKD predialysis patients (group 1) who were recruited from the Nephrology Division of Clementino Fraga Filho University Hospital (Federal University of Rio de Janeiro), and 19 individuals (group 2) who were recruited from the General Medicine of the same hospital during 2006. All of the subjects included in the study were informed about the aims of the study, risks and benefits, and signed an informed consent form. The Ethics Committee of Public Health Studies approved this study. The criteria for the population to take part in the study were as follows: 35–76 years of age; and at least 15 teeth. The exclusion criteria for the study were as follows: HIV-positivity; pregnancy; lupus erythematosus; rheumatoid arthritis; need for antibiotic prophylaxis; and the use of antibiotics in the last 6 months. To calculate the glomerular filtration rate (GFR) values, the Cockcroft and Gault equation was used to estimate the clearance of creatinine, as follows:

$$C_{Cr} = [(140 - \text{age}) \times \text{weight}] / (72 \times S_{Cr})$$

where C_{Cr} was expressed in milliliters per minute, age in years, weight in kilograms, and serum creatinine (S_{Cr}) in milligrams per deciliter.

In the case of females, the GFR value obtained was multiplied by 0.85.

This study used the GFR to define the groups, according to the renal function stage proposed by the National Kidney Foundation.[15] Group 1 consisted of patients with a clinical diagnosis of renal failure and a GRF between 89 and 15 ml/min who were receiving conservative treatment (predialysis). Group 2 consisted of patients seeking general medical care without signs and symptoms of renal disease and a GFR > 90 ml/min. A detailed medical history was obtained from all subjects at baseline, as well as information about age, gender, body mass index (BMI), ethnicity, and smoking profile. All volunteers received a full mouth periodontal clinical examination performed at six sites per tooth (excluding the third molars) by one trained examiner. The presence of supragingival biofilm was recorded as the visible plaque index (VP). The presence of marginal gingival bleeding was recorded as the gingival bleeding index (GB). The presence of suppuration (SUP), bleeding on probing (BOP), the number of teeth, probing depth (PD), attachment loss (AL), and calculus index[16] were also evaluated. The inclusion criteria for chronic periodontitis were at least four sites in three different teeth, with an AL ≥ 4 mm and bleeding on probing. Both groups received non-surgical periodontal treatment consisting of oral hygiene instructions, scaling and root planing (SCRP) with manual instruments (Gracey curettes; Hu-Friedy®, Chicago, IL, USA) under local anesthesia, by sextant for each dental visit completed over a 6-8 week period for the entire mouth. Clinical periodontal parameters, GFR, and serum creatinine[17] data were assessed at baseline (immediately before SCRP) and 3 months post-therapy.

The sample size calculation took into consideration an estimated alpha error of 5% and a beta error of 20% to detect a variation of 32% for a PD ≥ 7 mm in group 1 and 20% in group 2, assuming a 14% variation in both groups. Hence, for a two-sided test, 19 subjects were needed in each group. The 14% variation was obtained from our pilot study.

The mean numeric variables were calculated for each subject as well as for each group, and comparisons between the two groups were determined using the Mann–Whitney test. The categorical variables were compared using a χ^2 test. The Wilcoxon signed-rank test was used to compare the baseline values with the values after 3 months. The data were tested for normality before applying non-parametric tests. The results were considered statistically significant at a $p < 0.05$. Appropriate software was used for these analyses (SPSS for Windows, version 17.0, SPSS Inc., Chicago, IL, USA).

Results

Table 1 provides the demographic features, smoking status, and BMI of the population. There were no significant differences between the two groups with respect to smoking, BMI, and all demographic characteristics, except for age ($p = 0.02$).

With regard to comorbid health conditions, we found participants with hypertension and type 2 diabetes. In group 1, there were 9 subjects with hypertension and 4 with both hypertension and diabetes. In group 2, there were 11 subjects with hypertension and 1 subject with diabetes (type 2). The renal disorders in group 1 included pyelonephritis ($n = 1$), glomerulonephritis ($n = 1$), polycystic kidney disease ($n = 3$), collagen vascular disease ($n = 1$), nephrolithiasis ($n = 2$), and idiopathic ($n = 13$).

The results showed that both groups experienced a significant improvement in many of the periodontal clinical parameters measured. Moreover, the overall periodontal condition in both groups improved in a similar fashion, so that no clinical differences between the two groups could be established post-treatment. During the period of periodontal therapy there were a few occurrences of tooth loss, which could be attributed to two causes: cariogenic and prosthetic (Table 2).

Table 1 - Demographic characteristics, smoking status and body mass index (BMI) of the study population.

Demographic characteristics, smoking status and BMI		Group 1 (n = 21)	Group 2 (n = 19)	*p* value
Age in years (mean ± SD)		58.00 ± 10.78	52.57 ± 4.86	0.02*
Ethnicity (%)	white	52.4	57.9	0.94
	black	23.8	21.1	
	others	23.8	21.1	
Gender (%)	female	52.4	73.7	0.17
Smoking (%)	smoking	9.5	15.8	0.55
BMI (mean ± SD)		26.31 ± 4.42	26.56 ± 4.40	0.82

SD = standard deviation; *significant differences between groups by Mann-Whitney U test ($p < 0.05$); Mann-Whitney U test for BMI and χ^2 test for categorical variables.

Table 2 - Mean and standard deviation for periodontal clinical parameters pre- and post-SCRP.

Clinical parameters		Group 1 (*n* = 21)		*p* value	Group 2 (*n* = 19)		*p* value	Difference between groups
		pre-SCRP	post-SCRP		pre-SCRP	post-SCRP		*p* value
GB		29.7 ± 19.7	17.6 ±11.0	0.004**	20.1 ±16.4	12.2 ± 0.62	0.03*	0.34
VP		70.9 ± 16.0	48.9 ±18.8	< 0.001***	59.2 ±16.3	33.1 ±15.7	< 0.001***	0.62
SUP		0.9 ± 1.08	0.3 ± 0.61	0.02*	0.6 ± 1.19	0.03 ± 0.08	0.04*	0.43
BOP		60.4 ± 16.4	46.2 ±15.4	0.002**	58.3 ±14.9	38.5 ±11.6	< 0.001***	0.48
Number of teeth		20.0 ± 3.49	19.52 ± 3.92	0.04*	21.73 ± 4.45	20.89 ± 4.85	0.01**	0.28
PD	1 - 3 mm	56.3 ± 14.7	87.9 ±14.3	< 0.001***	64.3 ±18.2	91.8 ± 0.8	< 0.001***	0.52
	4 - 6 mm	13.8 ± 12.3	10.8 ±11.9	0.02*	12.4 ± 9.2	7.6 ± 7.6	0.001***	0.32
	≥ 7 mm	29.9 ± 12.6	1.3 ± 2.8	< 0.001***	23.3 ±15.8	0.6 ± 1.3	< 0.001***	0.23
AL	1 - 3 mm	47.5 ± 18.6	73.1 ±22.5	< 0.001***	56.0 ±22.6	78.5 ±17.6	< 0.001***	0.29
	4 - 6 mm	19.3 ± 12.2	22.7 ±13.9	0.99	18.6 ±11.1	19.9 ±15.4	0.47	0.71
	≥ 7 mm	33.2 ± 14.4	4.2 ± 9.1	< 0.001***	25.4 ±17.0	1.6 ± 2.9	< 0.001***	0.32
Calculus index		3.12 ± 2.77	0.80 ± 1.04	< 0.001***	2.47 ± 2.99	0.64 ± 0.97	0.001***	0.46

*($p \leq 0.05$); **($p \leq 0.01$); ***($p \leq 0.001$) significant within-group differences between pre- and post-SCRP values (Wilcoxon signed-rank test); no significant difference between groups (Mann-Whitney U test); SCRP, scaling and root planing; VP, visible plaque index (% of sites); GB, gingival bleeding index (% of sites); SUP, suppuration (% of sites); BOP, bleeding on probing (% of sites); PD, probing depth (% of sites); AL, attachment loss (% of sites).

Table 3 - Mean and standard deviation for GFR and creatinine pre- and post-SCRP.

Laboratory parameters	Group 1 (n = 21)		p value	Group 2 (n = 19)		p value	Difference between groups
	pre-SCRP	post-SCRP		pre-SCRP	post-SCRP		p value
GFR (mean ± SD)	46.5 ± 21.3	50.7 ± 26.8	0.04*	91.7 ± 24.7	105.3 ± 28.5	0.002**	0.11
Creatinine (mean ± SD)	2.0 ± 1.4	2.1 ± 1.8	0.53	0.9 ± 0.3	0.8 ± 0.3	0.08	0.91

*($p < 0.05$); **($p < 0.01$) significant within-group differences between pre- and post-treatment values (Wilcoxon signed-rank test); no significant difference between groups (Mann-Whitney U test); SCRP, scaling and root planing; GFR, glomerular filtration rate.

There was a significant impact on GFR post-SCRP in both groups, showing a statistically significant improvement in GFR in group 1 ($p = 0.04$) and group 2 ($p = 0.002$; Table 3).

Discussion

We detected a significant improvement in the measured periodontal parameters after SCRP in the predialysis CKD group and the control group lacking clinical evidence of CKD (Table 2). Despite the presence of CKD in patients with chronic periodontitis, conservative non-surgical periodontal treatment was effective in this group. Contrary to our original hypothesis (patients with CKD not yet in dialysis would respond poorly to periodontal treatment because of diminished immune function[13,14]), patients with predialysis CKD responded similarly to patients without CKD to non-surgical periodontal treatment. This may be a result of predialysis CKD patients not yet developing a severe uremic state, as observed in dialysis patients. Therefore, the immune dysfunction may not be as clinically diminished in the predialysis state for the purpose of dental therapy. Consequently, the treatment of chronic periodontitis with non-surgical strategies without adjunctive antibiotics was effective.

Some studies have demonstrated elevated dental calculus indices in CKD patients (adults and children) undergoing hemodialysis.[18-21] However, we did not observe a significant difference in the quantity of calculus between group 1 and 2 individuals at baseline. We also did not observe a significant difference in calculus reduction after periodontal treatment between the two groups ($p = 0.46$; Table 2). It is difficult to compare our results with the existing literature because there are no studies that have analyzed predialysis patients and periodontal treatment.

The existing literature on dental treatment for patients with CKD is based on the use of antibiotic prophylaxis for bacterial endocarditis prevention. These guidelines focus on patients undergoing hemodialysis. Bacteremia caused by dental procedures might predispose synthetic vascular access grafts to infection, although this form of infection has not been well-documented.[22] Our results show that patients with CKD in predialysis can benefit from traditional periodontal treatment without using antibiotics, achieving good clinical results. However, dentists must be aware of the relative inability to ingest, absorb, metabolize, and excrete medications by CKD predialysis patients.[23]

Several studies indicate that chronic renal patients in predialysis have a high prevalence of inflammation.[24,25] In our results, the impact of periodontal treatment on GFR suggests that periodontal treatment could have an important role in reducing inflammatory mediators, as several studies indicate that kidneys are important for the clearance of cytokines.[13,14,26,27,28] This favorable GRF response corroborates the findings of a recent investigation.[29] Within the limitations of this study, it is clear that additional studies with a larger sample size would be needed to draw any final conclusions regarding the effect of non-surgical periodontal therapy on GFR levels.

Conclusions

The present interventional study demonstrates that CKD predialysis patients show a good clinical periodontal response from non-surgical periodontal

treatment, similarly to patients without clinical evidence of CKD. The data also indicate that a longitudinal follow-up with a larger sample size study is needed to evaluate the effect of periodontal therapy on GFR levels.

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