ORIGINAL RESEARCH

Prevalence of Dental Caries and Periodontal Disease in Chronic Renal Failure Patients and its Relationship with Salivary pH

Jabeena Gowher[1], Uzma Taj[2], Mohammed Eajaz Ahmed Shariff[3]

Abstract

Introduction: In patients with chronic renal failure (CRF), dental caries and periodontitis are two common oral health issues. These patients have weakened immune systems and often experience reduced salivary flow. When the immune system is compromised, normally harmless oral bacteria can become harmful, leading to infection and damage in the mouth. The aim was to measure the prevalence of dental caries and periodontal disease in chronic renal failure patients and its relationship with salivary pH.

Material and Methods: This study was conducted in Department of oral pathology, Vydehi Institute of Dental Sciences, Bangalore. 60 patients of chronic renal failure (CRF) were divided into 3 groups, Group A (n=17) patients of who had clinically healthy gingiva, Group B (n=23) patients who had generalized chronic gingivitis and Group C (n=28) patients who had generalized chronic periodontitis. Periodontal parameters; decayed, missed and filled teeth (DMFT) index, gingival index, plaque index and salivary pH were recorded. Unstimulated whole saliva was collected according to Navazesh's method. The pH of saliva was measured by single electrode digital pH meter.

Results: The prevalence of DMFT, Plaque Index and Gingival index was high in chronic generalized periodontitis in comparison with chronic generalized gingivitis and clinically healthy gingiva. The pH in cases of generalized chronic gingivitis was more alkaline in comparison with generalized chronic periodontitis. The periodontal depth pocket and clinical attachment loss, there was statistically difference seen in chronic generalized periodontitis and chronic generalized gingivitis ($p<0.05$).

Conclusion: The higher prevalence of caries and periodontitis seen in CRF patients is attributed to the low pH of the saliva, which could be due to the interspecies interaction in the microbial biofilm. Thus salivary pH may significant diagnostic biomarker in periodontal disease.

Keywords: Dental caries, periodontitis, chronic renal failure, plaque index, gingival index, Salivary pH.

Introduction

Dental caries and periodontitis are two different oral health conditions. Dental caries, also known as tooth decay, occurs on the visible surfaces of the teeth, while periodontal infections happen in the gum tissue surrounding the teeth. Caries is the result of bacterial fermentation of dietary carbohydrates leading to the destruction of dental hard tissue due to acidic by-products. It is a slow-progressing chronic condition. On the other hand, periodontal disease refers to any disorder of the tissues supporting the teeth. It is influenced by various factors such as poor oral hygiene, specific plaque bacteria, smoking, diabetes, aging, and a person's susceptibility to the disease.[1,2] Patients with chronic renal failure are more susceptible to oral infections due to weakened immune systems and reduced saliva flow. This can lead to the transformation of normal oral bacteria into harmful pathogens, resulting in infections and damage to the oral cavity. Some common oral issues seen in these patients include periodontitis, caries, mucositis, gingivitis, burning

[1]Department of Oral Pathology, KGF College of Dental Sciences and Hospital, K.G.F, Karnataka, India; [2]Department of Prosthodontics, Bangalore Institute of Dental Sciences, Bangalore, Karnataka, India. [3]Department of Bio Medical Dental Sciences, Faculty of Dentistry, Al Baha University, Saudi Arabia

Corresponding Author: Jabeena Gowher, Department of Oral Pathology, KGF College of Dental sciences, Karnataka. India. Email: drjgowher@gmail.com

How to cite the article: Gowher J, Taj U, Shariff MEA. Prevalence of dental caries and periodontal disease in chronic renal failure patients and its relationship with salivary pH.Oral MaxillofacPathol J 2024; 15(2);297-301.

Source of Support: Nil

Conflict of Interest: None

Acknowledgement: We sincerely thank participants, staff members of departments of oral pathology and Nephrology, Vydehi institute of medical and dental sciences for their immense help during the study.

sensation, abnormal salivary flow rates, pigmentation, and oral candidiasis[3,4].

There is limited information about the prevalence of cavities and tooth loss in individuals with early-onset periodontitis. It's not clear whether tooth loss in these patients is primarily due to the loss of periodontal support or dental cavities. Some studies have found that acidic pH is associated with dental cavities and periodontitis, but the opposite is true for periodontal diseases. Therefore, further research is needed to understand the prevalence of dental cavities and periodontal disease in chronic renal failure patients and its relationship with salivary pH.

Material and Methods

This cross sectional study was conducted at Department of Oral Pathology, Vydehi Institute of Dental sciences and Research Centre, Bangalore. Patients who were clinically diagnosed cases of chronic renal failure reported to the department of Nephrology at Vydehi medical college hospital, Bangalore were considered for the study. Ethical clearance was obtained from the institutional ethical committee (VIDS/IEC/2013/21) as per standard guidelines and informed consent was obtained from all the individuals.

60 patients of CRF were divided into 3 groups. Group A had 17 subjects who had clinically healthy gingiva, Group B had 23 patients who had generalized chronic gingivitis and Group C had 28 subjects who had generalized chronic periodontitis. Patients with generalized chronic gingivitis as evidenced with inflammation of the gingiva without loss of attachment. Patients of the 20-65 years age group with gingivitis, periodontitis, presence of at least 20 healthy natural teeth (excluding third molars) and patients of chronic renal failure were included in the study. Patients with edentulous teeth, malocclusion, mouth breathing and local pathologic factors conducive to induction of periodontal disease. History of cancer, fungal or respiratory infections, current or past habit of tobacco smoking or chewing were excluded from the study.

National institute of Dental research guidelines[5,6] for gingival inflammation index were considered for the study. 0= No bleeding, 1= Bleeding after the probe placement in the gingival sulcus up to 2 mm and along the inner surface of the gingival sulcus. Findings of Gingiva and periodontium were recorded for each patient. Patients with clinically healthy gingiva with a probing up to 3mm crevice were labeled as control group. The basis for periodontitis for the loss of attachment with pocket depth of ≥ 5 mm in at least 30% sites. The following parameters were recorded: Decayed missing and filled teeth (DMFT) score, Plaque index, gingival index, probing pocket depth (PD), Clinical attachment loss (CAL) and salivary pH. PD and CAL were measured by using a William's periodontal probe.

Table 1: Distribution of cases in the different groups (A, B, C)

CRF Groups	Number of cases	
	n=60	%
Group A	17	28.33
Group B	20	33.33
Group C	23	38.33

Group A-Clinically healthy gingiva, **Group B-** Generalized chronic gingivitis **Group C-** Generalized chronic periodontitis

Saliva sample collection

Navazesh's method

Unstimulated whole saliva specimens were collected in the morning, and it was asked from all selected subjects that brush their teeth and do not use any oral stimulation (eating and drinking) for 90 min prior to collection. The subjects spit into the collection tube about 1 minute for up to 10 min. The pH of the saliva was immediately measured with the help of a single electrode digital pH meter. The pH meter was then standardized using freshly prepared buffers of pH 7 and pH 4. The electrode was kept inserted in double distilled water. The electrode was gently dried completely using fresh sterile filter papers each time and then inserted in the sample. After observing the pH, the electrode tip was washed with a gentle stream of distilled water and then inserted in the double distilled water[3,9].

Salivary sample analysis

The pH of the saliva was immediately measured, with the help of a single electrode digital pH meter (Electronics India. Model 111E). The pH meter was standardized every day. The electrode was inserted in hydrochloric acid of 0.1 N overnight. The pH meter was then adjusted using freshly prepared buffers of pH 7 and pH 4, and the electrode was kept inserted in double distilled water. The electrode was gently dried completely using fresh sterile filter papers each time and then inserted in the sample. After observing the pH, the electrode tip was washed with a gentle stream of distilled water and then inserted in the double distilled water. Freshly prepared solutions and chemicals were used.

Statistical Analysis

Data obtained were computed on Microsoft excel sheet.

Table 2: Mean and standard deviation values of Decayed missed and filled tooth (DMFT), Plaque Index (PI), Gingival Index (GI) and salivary pH

Parameters	Group A	Group B	Group C	p value*
	Mean ±SD	Mean ±SD	Mean ±SD	
Decayed, missed and filled tooth (DMFT)Index	2.71±1.99	2.59±1.7	3.19±1.54	<0.001
Plaque Index (PI)	0.35±0.13	1.56±0.32	1.94±0.32	<0.001
Gingival Index (GI)	0.44±0.1	1.49±0.38	2.46±0.49	<0.001
Salivary pH	7.06±0.04	7.26±0.10	6.89±0.13	<0.001

Group A vs B, Group A vs C, Group B vs C

**p value <0.001- Significant*

Statistical package for social sciences (SPSS version 17.0, Chicago, USA) and Graph pad prism version 5.0 were used for analysis. Descriptive statistics analysis using student t test and Analysis of variance (ANOVA) test were used to compare groups. Data expressed as mean ± SD. The level of significance of study parameters between the groups were studied. P value: <0.05 was considered statistically significant.

Results

Total 60 patients participated in this study of which 46(76.6%) were males and 14(23.3%) were females [Fig 1]. The mean age group of the male and female patients were 62.1±8.8 and 54.6 ±5.3 respectively. The patients were divided into 3 groups Group A (Clinically healthy gingiva), Group B (Generalized chronic gingivitis) and Group C (Generalized chronic periodontitis) comprising of 17(28.33%), 20 (33.33%) and 23(38.33%) respectively [Table 1].

The Mean values of DMFT index in group A (clinically healthy gingiva), group B (chronic generalized gingivitis), group C (chronic generalized periodontitis) were 2.71±1.99, 2.59±1.7, 3.19±1.54. There was statistically significant difference (p<0.001) when compared in different groups. The Plaque index (PI) and Gingival index (GI) in Group A were 0.35±0.13, 0.44±0.1, Group B 1.56±0.32, 1.49±0.38 and Group C 1.94±0.32, 2.46±0.49 respectively [Fig 2, Table 2]. There was a statistical difference (p<0.001) found in Plaque index and Gingival index when compared in the different groups. The prevalence of DMFT, Plaque Index and Gingival index was high in chronic generalized periodontitis in comparison with chronic generalized gingivitis and clinically healthy gingiva.

The average salivary pH in group A (clinically healthy gingiva), group B (chronic generalized gingivitis) and group C (chronic generalized periodontitis) were 7.06±0.04, 7.26±0.10, and 6.89±0.13 respectively [Fig 3]. The pH in cases of generalized chronic gingivitis was more alkaline in comparison with generalized chronic periodontitis [Fig 2, 3, & Table 2]. The periodontal depth pocket and clinical attachment loss in group A (clinically healthy gingiva) were 0.02±0.01, 0.10±0.01, group B (chronic generalized gingivitis) 4.10±0.12, 4.65±0.14 and group C (chronic generalized periodontitis) 6.89±0.15, 7.12±0.19 respectively. There was a statistical difference seen in Group B

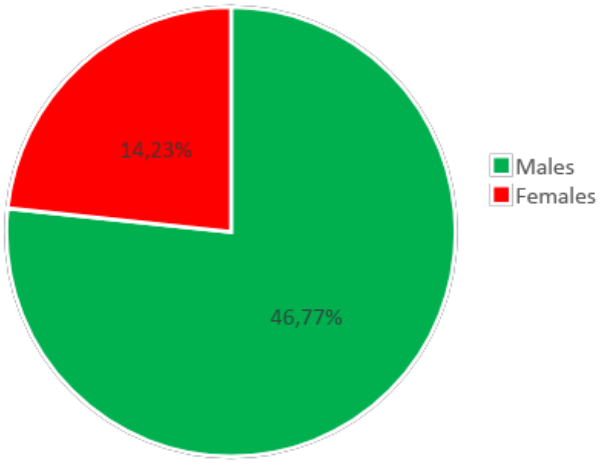

Fig 1: Gender distribution of subjects

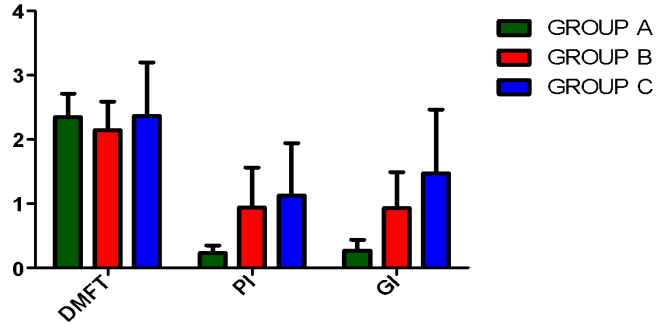

Fig2 :Mean Values of Decayed missed and filled tooth(DMFT)index, Plaque index(PI),Gingival index(GI)

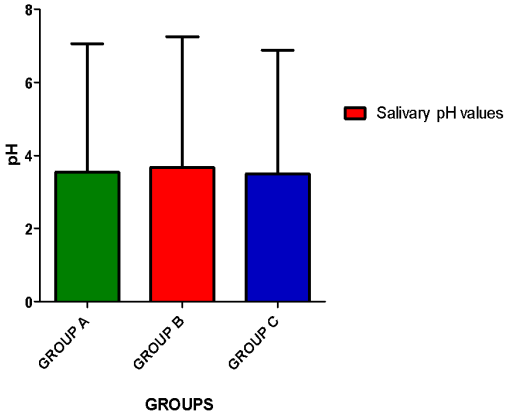

Fig 3:Comparison of Average values of salivary pH in different groups

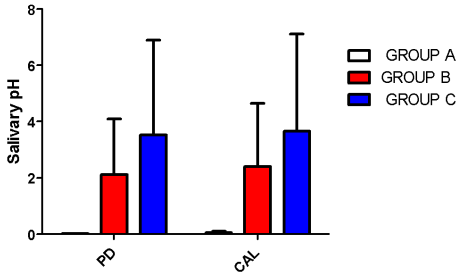

Fig4:Periodontal pocket depth(PD) and clinical attachment loss(CAL) in groups(B,C)

and C [Fig4]. Higher prevalence of caries was seen in group C (chronic generalized periodontitis).

The prevalence DMFT, Plaque index, gingival index were increased in chronic generalized gingivitis and their salivary pH was more alkaline and flow was affected. The salivary pH was low in chronic generalized periodontitis. All these factors contributed in CRF patients. There was higher the prevalence of caries and periodontitis seen in CRF patients is attributed to the low pH of the saliva.

Discussion

Oral and dental lesions representing CRF are 97% worldwide. In some reports[3], prevalence of oral and dental lesions in CRF patients was 100%. Oral lesions are usually due to constrained diets, malnutrition, immunosuppression and the effects of nephrotoxic drugs, uremic toxins on the oral tissues. These patients exhibit oral lesions such as dental caries and periodontitis. Saliva is an exceptional fluid and its significance as a diagnostic marker has advanced exponentially in the past decade. The present study attempts to evaluate the prevalence of dental caries and periodontal disease in chronic renal failure patients and its relationship with salivary pH. The patients were divided into 3 groups Group A (Clinically healthy gingiva), Group B (Generalized chronic gingivitis) and Group C (Generalized chronic periodontitis) comprising of 17 (28.33%), 20 (33.33%) and 23 (38.33%) respectively. Our findings were in concordance with findings of Joshi A et al[7].

We revealed mean values of DMFT in group A (clinically healthy gingiva), group B (chronic generalized gingivitis), group C (chronic generalized periodontitis) were 2.71±1.99, 2.59±1.7, 3.19±1.54. There was statistically significant difference ($p<0.001$) when compared in different groups. The findings were in agreement with Joshi A et al and Xi and colleagues[7,15,16,19] showed significantly increased DMFT scores when compared to healthy and chronic generalized gingivitis.

Our findings showed the average mean values salivary pH in group A (clinically healthy gingiva), group B (chronic generalized gingivitis) and group C (chronic generalized periodontitis) were 7.06±0.04, 7.26±0.10, and 6.89±0.13 respectively. The pH in cases of generalized chronic gingivitis was more alkaline in comparison with generalized chronic periodontitis. The periodontal depth pocket and clinical attachment loss in in group A (clinically healthy gingiva) were 0.02±0.01, 0.10±0.01, group B (chronic generalized gingivitis) 4.10±0.12, 4.65±0.14 and group C (chronic generalized periodontitis) 6.89±0.15, 7.12±0.19 respectively. There was a statistical difference seen in Group B and C. Similar findings were noted by Menezes et al[18]. The pH values in healthy gingiva and chronic generalized gingivitis were alkaline in nature in contrast to chronic generalized periodontitis were acidic in nature. However, the negative association may be related to the demineralization process, occurring at an acidic pH of 5.5 and below, seen in development of caries as opposed to the mineralization process seen in calculus formation, occurring at an alkaline pH of 6.5 and above[8,16,17]. Our findings showed that there was higher the prevalence of caries and periodontitis seen in CRF patients is attributed to the low pH of the saliva, which could be due to the interspecies interaction in the microbial biofilm. Thus salivary pH may be a significant diagnostic biomarker in periodontal disease. Our findings were in concordance with findings of menezes et al[18]. The present study showed increased caries prevalence in chronic periodontitis patients. Streptococcus gordini and Streptococcus sanguins (being one of the key stone pathogens for dental caries) generate H_2O_2 in the biofilm during initial colonization.[10] Also, Streptococcus gordini is able to recruit Porphyomonas gingivalis; the key stone pathogen for chronic periodontitis, into the biofilm via cell signaling through AI-2[11]. Other possible causes could be due to the friendly relation between Streptococcus mutans and Veilonella spp, where Veilonella uses the lactic acid produced by Streptococcus for its growth within the biofilm[12]. It has been demonstrated that large numbers of S. cristatus are able to adhere to F. nucleatum, resulting in formations known as corncobs[13].

The host response also has a role to play in the above interaction. It was established that after invasion into several oral epithelial cell lines, F. nucleatum elicits an instantaneous host response with increased interleukin-8 (IL-8) expression. Association with S. cristatus attenuates the induction[14,17]. Also, F. nucleatum is able to increase the synthesis of the cytokines IL-6 and IL-8, based on the same, it can be concluded that increased cytokine levels can lead to a greater periodontal destruction. The low caries prevalence seen in the AgP group in spite of having an acidic pH could be attributed to the inter-species interaction in the microbial biofilm. This co-culture enhances the expression of the complement resistance protein ApiA in A. actinomycetemcomitans, significantly enhancing its resistance toward host-innate immunity.

Conclusion

The higher prevalence of caries and periodontitis is seen in CRF patients is attributed to the low pH of the saliva, which could be due to the interspecies interaction in the microbial biofilm. Thus salivary pH may significant diagnostic biomarker in periodontal disease. In view of the debilitated systemic condition of chronic renal failure patients on hemodialysis, the implementation of programs for the prevention and treatment of oral problems as well as regular follow-up at the beginning of dialysis are necessary to increase the patient's awareness regarding his condition.

References

1. Albandar J M. Epidemiology and risk factors of periodontal diseases. Dent Clin North Am. 2005; 49 (3):517-32. DOI: 10.1016/j.cden.2005.03.003
2. Walter Loesche. Dental Caries and Periodontitis: Contrasting Two Infections That Have Medical Implications. Infectious diseases clinics of North America. 2007; 21(2):471-502. DOI: 10.1016/j.idc.2007.03.006
3. Patil S, Khandelwal S, Doni B, Rahman F, Kaswan S. Oral manifestations in chronic renal failure patients attending two hospitals in North Karnataka, India. OHDM. 2012; 11:100–6.
4. Wahid A, Chaudhry S, Ehsan A, Butt S, Ali Khan A. Bidirectional relationship between chronic kidney disease & periodontal

disease. Pak J Med Sci. 2013; 29: 211–5. doi:10.12669/pjms.291.2926

5. Caravajal P, Gomez s, Cosat R, Toledo A. Prevalence, severity and risk indicators of gingival inflammation in a multi-center study on South American adults: a cross sectional study. J Appl Oral Sci. 2016 ; 24 (5):524-34. doi: 10.1590/1678-775720160178
6. National Institute of Dental Research. Oral Health of United States Adults-the National Survey of Oral Health in U.S. National Findings; 167–8.NIH Publication No. 87-2868. DOI: 10.1111/j.1752-7325.1987.tb02005.x
7. Joshi A, Gupta A, Lihala R, Vaid P. Association of salivary pH in patients with dental caries and periodontal disease. Int J Res Med Sci 2022; 10:240-4. https://doi.org/10.18203/2320-6012.ijrms20215060
8. Sioson PB, Furgang D, Steinberg LM, Fine DH. Proximal caries in juvenile periodontitis patients. J Periodontol. 2000; 71:710-6. OI: 10.1902/jop.2000.71.5.710.
9. Navazesh M. Methods for collecting saliva. Ann N Y Acad Sci. 1993; 694:72-7. Doi: 10.1111/j.1749-6632.1993.tb18343.x.
10. Kuboniwa M, Tribble GD, James CE, Kilic AO, Tao . Streptococcus gordonii utilizes several distinct gene functions to recruit Porphyromonas gingivalis into a mixed community. Mol Microbiol. 2006; 60:121-39. DOI: 10.1111/j.1365-2958.2006.05099.x
11. Edwards AM, Grossman TJ, Rudney JD. Fusobacterium nucleatum transports noninvasive Streptococcus cristatus into human epithelial cells. Infect Immun. 2006; 74:654-62. DOI: 10.1128/IAI.74.1.654-662.2006
12. Zhang G, Chen R, Rudney JD. Streptococcus cristatus attenuates Fusobacterium nucleatum-induced interleukin-8 expression in oral epithelial cells. J Periodontal Res. 2008; 43:408-16. DOI: 10.1111/j.1600-0765.2007.01057.x
13. Hasegawa Y, Mans JJ, Mao S, Lopez MC, Baker HV, Handfield M. Gingival epithelial cell transcriptional responses to commensal and opportunistic oral microbial species. Infect Immun. 2007; 75:2540-7. DOI: 10.1128/IAI.01957-06
14. Ramsey MM, Whiteley M. Polymicrobial interactions stimulate resistance to host innate immunity through metabolite perception. Proc Natl Acad Sci USA. 2009; 106:1578-83. DOI: 10.1073/pnas.0809533106
15. Al-Nowaiser A, Roberts G, Trompeter R, Wilson M, Lucas V. Oral health in children with chronic renal failure. Pediatr Nephrol. 2003; 18:39–45. DOI: 10.1007/s00467-002-0999-7
16. Xi W, Bo H, Haiyang P, Chang L, Jinlin S, Ming T. Oral health status of patients undergoing hemodialysis: a meta-analysis. Hua Xi Kou Qiang Yi Journal. 2017;35: 155–61. DOI: 10.7518/hxkq.2017.02.009
17. Ertugul F, Elbek C, Sabah E, Mir S. The oral health status of children undergoing hemodialysis treatment. Turk J Pediatr. 2003; 45:108–13.
18. Menezes CRSD, Pereira ALA, Ribeiro CCC, Chaves CO, Guerra RNM, Thomaz EBAF. Is there association between chronic kidney disease and dental caries? A case-controlled study. Med Oral Patol Oral Cir Bucal. 2019; 24 (2):e211-6. doi: 10.4317/medoral.22737
19. Sekiguchi RT, Pannuti CM, Silva HT Jr, Medina-Pestana JO, Romito GA. Decrease in oral health may be associated with length of time since beginning dialysis. Spec Care Dentist. 2012 32(1):6-10. doi: 10.1111/j.1754-4505.2011.00223.