Assessment of oral health status and inflammatory markers in end stage chronic kidney disease patients: A cross-sectional study

Lokesh Sharma¹, Devina Pradhan², Rahul Srivastava³, Manas Shukla⁴, Omveer Singh⁵, Pratik⁶

¹Dental Surgeon and Consultant- Kanpur, Uttar Pradesh, ²Department of Public Health Dentistry, ³Oral Medicine and Radiology, ⁴Periodontology, Rama Dental College Hospital and Research Centre, Kanpur, Uttar Pradesh, ⁵Department of Public Health Dentistry, Career Dental College, Lucknow, Uttar Pradesh, ⁶Department of Orthodontics and Dentofacial Orthopaedics, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand, India

ABSTRACT

Aim: To assess the oral health status and inflammatory markers in end stage chronic kidney disease (CKD) patients. Objectives: To study and compare oral health status of end stage CKD patients with the control group (matched health individuals) and to study and compare inflammatory biomarkers in study and control groups. Materials and Methods: A cross-sectional study was conducted among 50 patients of end stage CKD and 50 matched healthy individual, who were taken as control in the study. Convenience sampling technique was used. Oral health status was recorded by using WHO proforma (2013). Erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) were also measured in the both groups. These are inflammatory markers which show systemic inflammation. Statistical analysis was done by using IBM SPSS Statistics-version 21 (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.) Results: The study revealed that patients on dialysis going for transplantation have evidence of increased inflammation as indicated by raised CRP values. Conclusion: The present study concludes that the oral hygiene of the patients is deteriorated who are having chronic kidney disease. Good oral and dental care in CKD patients can improve the transplant outcomes.

Keywords: Chronic renal failure, dialysis, oral health, oral manifestations, transplantation

Introduction

World Health Organization (WHO) defines oral health as a stage of being free from mouth and facial pain, oral and throat cancer, oral infection and sores, periodontal disease tooth decay, tooth loss and other disease, and disorder that limit an individual's capacity in biting, chewing, smiling, speaking, and psycho social wellbeing. Oral health and general health are interlinked. The mouth acts as a window to the general health of the body. Bacterial from mouth can cause infection in the other part of the body when the immunity of the host is impaired by disease or medical treatment. Systemic inflammation and treatment also affect the oral health as xerostomia, altered balance of oral microorganisms.

Chronic kidney disease (CKD) is defined as kidney damage for 3 or more months associated with structural or functional

Address for correspondence: Dr. Devina Pradhan, Senior Lecturer, Department of Public Health Dentistry, Rama Dental College Hospital and Research Centre, Kanpur - 208 024, Uttar Pradesh, India. E-mail: meetdrdevina@gmail.com

Received: 16-01-2020 Revised: 12-03-2020 Accepted: 26-03-2020 Published: 31-05-2020

Access this article online

Quick Response Code:

Website: www.jfmpc.com

DOI: 10.4103/jfmpc.jfmpc_101_20

How to cite this article: Sharma L, Pradhan D, Srivastava R, Shukla M, Singh O, Pratik. Assessment of oral health status and inflammatory markers in end stage chronic kidney disease patients: A cross-sectional study. J Family Med Prim Care 2020;9:2264-8.
abnormalities of the kidney with or without decreased glomerular filtration rate (GFR). CKD is a public health problem with high impact on the quality of life. Modi and Jha carried out a population-based study and found the incidence of end stage kidney disease as 229 per million of population in India.[1]

CKD is a worldwide health problem, with adverse outcome of cardiovascular disease and premature death. It has become evident that inflammation plays an important role in the pathogenesis of atherosclerosis complication. CKD patient also has an increased risk of atherosclerosis complication. In line with this, dental problems can be important source of systemic inflammation.

C-reactive protein (CRP) may not be merely a marker of inflammation, but may in fact mediate several key processes in the development of atherosclerosis including plaque initiation, formation, and rupture.

Study by Menon et al. suggested an early involvement of inflammatory process in the development of cardiovascular disease patient with CKD.

CKD patients have associated oral problem arising from the disease process or the effect of therapy or both. Untreated oral lesion may deteriorate the clinical presentation and prognosis.[3] There are clinical and radiological changes in the mouth in CKD patient.[4] Some studies have reported higher incidence of oral lesion in dialysis patient with oral symptom of xerostomia, taste disturbance, uremic odour, tongue coating, mucosal inflammation, enamel hypoplasia.[5–7]

Undiagnosed and untreated oral lesion in CKD may result in high graft rejection rate and increase in systemic inflammatory burden.[8] The role of oral infection in worsening the systemic disease is not well established, however, significant improvement in underlying systemic diseases have been observed after treatment of associated oral lesion.[9] Oral health care is important in the management of CKD. In the developed countries, oral health care in CKD patient while in developing countries oral health care is neglected in CKD patients. There is poor dental awareness among the patients and health delivery personnel.

Gingivitis and periodontitis are common manifestation of poor oral health. Poor oral health in CKD patients is an important contributory factor in atherosclerosis, protein energy wasting, systemic infection, and inflammation.

Primary healthcare physician can play a very vital role in early diagnosis of oral health related conditions like dental caries, periodontitis etc., by diagnosing their clinical features like bleeding gums, redness, inflammation, etc., in the patients suffering from chronic kidney disease. Hence, the role of primary healthcare physician, being the first point of contact for general population becomes paramount.

Inflammation play an important role in causing various complications in CKD patient and inflammatory markers such as C-reactive protein, pro and anti-inflammatory cytokines are sensitive and independent predictors of outcomes in CKD patient. Poor oral health could result in stimulation of inflammation and cytokine stimulation. This could result in production of donor specific anti HLA antibodies which could cause rejection. At present oral health evaluation of a prospective kidney transplant recipient before transplantation is not routinely done. There is need to evaluate the benefit of good oral hygiene and its effect on renal transplant outcome.

Material and Methods

The present cross-sectional study was conducted on dialysis patients attending the department of Nephrology at SGPGI hospital, Lucknow. A sample of 50 patients of end stage CKD in the study group and 50 matched individuals in the control group were taken.

Sample size was estimated by using software ‘Power Analysis and Sample size’ (PASS), version-16 [NCSS, LLC. Kaysville, Utah, USA]. To detect the 30% difference in oral health status between groups, where minimum difference in oral health status (in %) between two groups was assumed to be 70% and 40%, respectively. At minimum two-sided 95% confidence interval and 85% power of the study, the estimated sample size was 48 for each group which was rounded off to a sample of 55 patients. After excluding dropouts, final sample size was 50 patients in each group.

The study protocol was reviewed and approved by the Institutional Ethical Committee (Dated: 22-02-2018) of Sardar Patel Post Graduate Institute of Dental and Medical Sciences and Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow. The purpose of the study was explained to the participants and written informed consent was obtained in both the languages (English and Hindi).

CKD patients going for renal transplantation were included in the study whereas, CKD patients using artificial denture and patients having infection anywhere in the body were excluded from the study.

The data were collected through a comprehensive WHO Oral Health Assessment Proforma for adults (2013). In addition, ESR and CRP were also measured by the Western green method, latex particle immunoturbidimetric method. A type III clinical examination was carried out as per American Dental Association specification (1970). Patients were examined on ordinary chair under natural day light by a single calibrated examiner using a plain mouth-mirror and CPI probe.

Data were analyzed using IBM SPSS Statistics-version 21 (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.) Descriptive statistics included calculation of means and standard deviation. Data
distribution was assessed for Normality using Shapiro–Wilk test. Categorical data were compared using chi-square test. All values were considered statistically significant for a value of $P < 0.05$.

## Results

Distribution of the demographic and clinical values among the study and control groups are shown. The mean age of the patients was $36.18 \pm 11.15$ and $35.9 \pm 6.64$ in group 1 and 2, respectively. The number of decayed teeth were higher in the CKD group and the result were found to be statistically significant ($P = 0.029$). In addition, the bleeding on probing ($P = 0.011$), and pockets with depth of $4–5$ mm ($P = 0.035$) were also statistically significant [Table 1].

Distribution of the characteristics among the study and control groups are shown. The gender distribution among the groups was found to be statistically significant ($P < 0.001$). In addition, the fluorosis and erosion scores were also significant among the groups ($P < 0.001$) respectively [Table 2].

The mean categorical comparison between CKD and control group is shown. The mean value in CKD group was higher amongst the study group (9.94) than the control group (2.07) [Graph 1].

### Table 1: Distribution of the demographic and clinical values among the study and control groups

|                  | CKD ($n=50$) | Control ($n=50$) | $P^{**}$ |
|------------------|--------------|-----------------|---------|
| *Age             | FT:          | FT:             |         |
|                  | 36.18±11.15  | 35.90±6.64      | 0.879   |
| D (Decayed)     | 0.0 (0.0-2.0)| 2.0 (0.0-3.0)   | 0.029*  |
| M (Missing)     | 0.0 (0.0-1.0)| 0.0 (0.0-1.0)   | 0.047*  |
| F (Filled)      | 0.0 (0.0-1.3)| 0.0 (0.0-0.3)   | 0.781   |
| DMF             | 2.0 (0.0-3.0)| 3.0 (2.0-4.0)   | 0.015*  |
| Bleeding        | 0.0 (0.0-0.5)| 0.0 (0.0-0.0)   | 0.011*  |
| Pocket: 4-5 mm  | 0.0 (0.0-4.25)| 0.0 (0.0-0.0)   | 0.035   |
| Pocket: ≥6 mm   | 0.0 (0.0-0.0)| 0.0 (0.0-0.0)   | 0.042*  |
| Loss of Attachment: 0-3 mm | 6.0 (5.0-6.0)| 6.0 (6.0-6.0)| 0.010*|
| Loss of Attachment: 4-5 mm | 0.0 (0.0-1.0)| 0.0 (0.0-0.0)| 0.018*|
| Loss of Attachment: ≥6 mm | 0.0 (0.0-0.0)| 0.0 (0.0-0.0)| 0.080 |

* $P<0.05$ significant, ** Chi-Square test

### Table 2: Distribution of the characteristics among the study and control groups

| Variable’s  | Cases ($n=50$) | Control ($n=50$) | Total ($n=150$) | $**P$ |
|-------------|----------------|-----------------|----------------|------|
| Gender      |                |                 |                |      |
| Males       | 47 (90.4)       | 5 (9.6)         | 52 (52.0)      | 0.001*|
| Females     | 3 (6.3)         | 45 (93.8)       | 48 (48.0)      |      |
| Urban       | 30 (54.5)       | 25 (45.5)       | 55 (55.0)      |      |
| Peri Urban  | 6 (30.0)        | 14 (70.0)       | 20 (20.0)      | 0.134 |
| Rural       | 14 (56.0)       | 11 (44.0)       | 25 (25.0)      |      |
| Fluorosis   |                |                 |                |      |
| Absent      | 31 (46.3)       | 36 (53.7)       | 67 (67.0)      | 0.001*|
| Present     | 19 (57.6)       | 14 (42.4)       | 33 (33.0)      |      |
| Erosion     |                |                 |                |      |
| Absent      | 30 (44.1)       | 38 (55.9)       | 68 (68.0)      | 0.001*|
| Present     | 20 (62.5)       | 12 (37.5)       | 32 (32.0)      |      |
| Oral Mucosal Lesions | 48 (99.0) | 50 (91.0) | 98 (98.0) | 0.495 |
| >0          | 2 (100.0)       | 0 (0.0)         | 2 (2.0)        |      |

* $P<0.05$ significant, ** Chi-Square test

## Discussion

The present study was done to assess the oral health status and inflammatory markers in end stage CKD patients. A total of 100 participants were included in the study and were assigned to two groups of 50 patients each. The mean age of patients was $36.18 \pm 11.15$ and $35.9 \pm 6.64$ (in years) in group 1 and 2 respectively. However, a similar study conducted by Brito, et al. in 2011 had a mean age of 50 years and there was no significant difference found, which is a good indicator as there is no cofounding effect of the age on the true difference when observed in the clinical variable between the groups.$^{[10]}$

In the present study conducted, the number of teeth involved was observed in different clinical variable and compared between CKD group and control group. The number of decayed teeth were higher in the CKD group and the result were found to be statistically significant ($P = 0.029$). Similar results were found in the study conducted by Brito et al., 2011. In addition, the present study conducted and study done by Brito et al., 2011 revealed that bleeding on probing and the percentage sites with clinical attachment loss of $0–3$ mm and $4–5$ mm, pocket depth of $4–5$ mm were found to be significantly higher ($P = 0.009$, $P = 0.001$, $P = 0.035$ respectively) amongst chronic kidney disease group.
As it is clearly evident that chronic renal failure (CRF) is a progressive impairment of the kidney function that is associated with the deterioration of nephrons occurring as a consequence of diabetes, chronic glomerulonephritis and hypertension. In addition, if CRF is not treated, it predisposes to an irreversible stage of disease known as end stage renal disease. It further necessitates to dialysis or kidney transplantation.[11]

Patients having end stage renal disease or CKD are prone to develop pathologic conditions in the oral cavity. A variety of oral signs and symptoms like xerostomia, dental caries, periodontal disease, pockets, dental fluorosis, erosion, and oral mucosal lesions can be seen.[12]

The present study conducted revealed that patients having CKD had significantly higher levels of decayed teeth ($P = 0.029$), bleeding on probing ($P = 0.011$), pockets with depth of 4–5 mm ($P = 0.035$), clinical attachment loss of 0–3 mm, 4–5 mm ($P = 0.010$ and $P = 0.18$, respectively). A similar study conducted by Nylund, et al. in 2015 revealed that the prevalence of periodontal disease (pocket depth ≥4 mm) was found higher in CKD patients (88%).[13] Other studies conducted were in accordance with the present study conducted.[1415]

In the present study, results indicated that there was significant difference in the dental fluorosis and erosion scores ($P = 0.001$) whereas, no significance was found in location and oral mucosal lesion scores ($P = 0.134$, and $P = 0.495$, respectively) among CKD patients group. These results are in accordance with a similar study conducted by Dagirdas et al.[16]

As per the literature available, it is clearly evident that in chronic kidney disease patients, the oral health is altered. A similar study was conducted by Bots, et al. in 2006 which revealed that patients had significantly more teeth covered with calculus than the control group patients ($P < 0.05$). In addition, the percentage of supra and sub gingival calculus was also found to be slightly higher amongst chronic kidney disease patients (34.4%) than in control group (24.6%).[1617]

Periodontal disease is believed to be associated with cardiovascular disease which can further lead to systemic atherosclerosis.[18] Intervention studies have shown that the treatment of periodontal disease improves serum inflammatory markers and flow mediated arterial dilation, a marker of endothelial function that becomes dysfunctional early in the cause of atherosclerosis.[1922]

On reviewing the literature available, it is being found that there is a greater deterioration of oral health and especially periodontal health in patients with chronic kidney disease which needs, quick and immediate attention.[2324] Our data show that patients on dialysis going for transplantation have evidence of increased inflammation as indicated by raised CRP values. This was accompanied by other objective improvement in oral health indices.

Our study shows that oral disease is quite prevalent in patients with advanced chronic kidney disease going for kidney transplantation. Intervention by a regime of aggressive dental and mouth hygiene would reduce the already existing inflammation and this could have a favorable effect.

**Conclusion**

The present study concludes that the oral hygiene of the patients is deteriorated who are having chronic kidney disease. Good oral and dental care in CKD patients can improve the transplant outcomes.

It is recommended that all patients on dialysis especially those going for transplantation should undergo dental check-up routinely. They should also be educated to undertake good oral and dental care while on dialysis and follow it up after transplantation.

**Declaration of patient consent**

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

**Financial support and sponsorship**

Nil.

**Conflicts of interest**

There are no conflicts of interest.

**References**

1. Sanders AE, Slade GD, Lim S, Reisine ST. Impact of oral disease on quality of life in the US and Australian populations. Community Dent Oral Epidemiol 2009;37:171-81.
2. Parkar S, Ajithkrishnan C. Periodontal status in patients undergoing hemodialysis. Indian J Nephrol 2012;22:246-50.
3. Davidovich E, Schwarz Z, Davidovich M, Eidelman E, Bimstein E. Oral findings and periodontal status in children, adolescents and young adults suffering from renal failure. J Clin Periodontol 2005;32:1076-82.
4. Klassen J, Krasko B. The dental health status of dialysis patients. J Can Dent Assoc 2002;68:34-8.
5. Craig R. Interactions between chronic renal disease and periodontal disease. Oral Diseases 2007;14:1-7.
6. Naugle K, Darby M, Bauman D, Lineberger L, Powers R. The oral health status of individuals on renal dialysis. Ann Periodontol 1998;3:197-05.
7. El Nahas A, Bello A. Chronic kidney disease: The global challenge. Lancet 2005;365:331-40.
8. Atassi F, Almas K. Oral hygiene profile of subjects on renal dialysis. Indian J Dent Res 2001;12:71-6.
9. Murthy A, Hiremath S. Assessment of oral health status of
patients undergoing renal dialysis in a hospital at Bangalore City. J Indian Assoc Public Health Dent 2005;5:35-8.

10. Brito F, Almeida S, Figueredo C, Bregman R, Suassuna J, Fischer R. Extent and severity of chronic periodontitis in end stage chronic kidney disease patients. J Periodontol Res 2012;47:426-30.

11. Anuradha BR, Katta S, Kode VS, Praveena C, Sathe N, Sandeep N, et al. Oral and salivary changes in patients with chronic kidney disease: A clinical and biochemical study. J Indian Soc Periodontol 2015;19:297-03.

12. Nylund K, Meurman J, Heikkinen A, Furuholm J, Ortiz F, Ruokonen H. Oral health in patients with renal disease: A longitudinal study from predialysis to kidney transplantation. Clin Oral Investig 2017;1:1-7.

13. Nylund K, Meurman J, Heikkinen A, Honkanen E, Vesterinen M, Ruokonen H. Oral health in predialysis patients with emphasis on periodontal disease. Quintessence Int 2015;46:899-907.

14. Sobrado-Marinho JS, Tomás-Carmona I, Loureiro A, Limeres-Posse J, García-Caballero L, Díz-Dios P. Oral health status in patients with Oral health status in patients with moderate-severe and terminal renal failure. Med Oral Patol Oral Cir Bucal 2007;12:E305-10.

15. Daugirdas JT. Proposed controlled trials of phosphate reduction in CKD: Which way should we go? Kidney Int 77:929-30.

16. Bots C, Poorterman J, Brand H, Kalsbeek H, Amerongen B, Veerman E, et al. The oral health status of dentate patients with chronic renal failure undergoing dialysis therapy. Oral Dis 2006;12:176-80.

17. Poduval RD, Wolgemuth C, Ferrell J, Hammes MS. Hyperphosphatemia in dialysis patients: Is there a role for focused counseling? J Ren Nutr 2003;13:219-23.

18. Bayraktar G, Kurtulus I, Kazancioglu R, Bayramguler I, Cintan S, Bural C, et al. Oral health and inflammation in patients with end-stage renal failure. Perit Dial Int 2009;29:472-79.

19. Bhatson A, Patil SR. Assessment of periodontal health status in patients undergoing renal dialysis: A descriptive, cross-sectional study. J Indian Soc Periodontol 2012;16:37-42.

20. Gautam N, Gautam N, Koganti R, Rao T, Agarwal R, Alamanda M. Effect of end-stage renal disease on oral health in patients undergoing renal dialysis: A cross-sectional study. J Int Soc Prev Community Dent 2014;4:164-69.

21. Andrade M, Salazar S, de Sá L, Portela M, Ferreira-Pereira A, Soares R, et al. Role of saliva in the caries experience and calculus formation of young patients undergoing hemodialysis. Clin Oral Investig 2015;19:1973-80.

22. Nylund, K, Meurman J, Heikkinen A, Honkanen E, Vesterinen M, Ruokonen H. Oral health in predialysis patients with emphasis on periodontal disease. Quintessence Int 2015;46:899-907.

23. Ruokonen H, Nylund K, Meurman J, Heikkinen A, Vesterinen M, Ruokonen H. Oral health in predialysis patients with emphasis on periodontal disease. Quintessence Int 2015;46:899-907.

24. Dännewitz B, Sommerer C, Stölzel P, Baid-Agraval S, Nadal J, Bärthlein B, et al. Status of periodontal health in German patients suffering from chronic kidney disease—Data from the GCKD study. J Clin Periodontol 2020;47:19-29.