SHORT COMMUNICATION

Changes in Oral and Salivary Contents in Patients with Chronic Kidney Disease

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ABSTRACT

Objective: To analyze oral manifestations and changes in salivary contents in patients with chronic kidney disease (CKD).

Study Design: A comparative study.

Place and Duration of Study: This study was conducted at the Nephrology Department of Ibne-Sina Hospital Multan, Pakistan from January 2021 to the Nephrology January 2023.

Methods: Patients diagnosed with chronic kidney disease were included in the study after giving informed consent. The study was conducted on 100 subjects: 50 were chronic kidney disease (patients (study group), and 50 were period on tally and systematically healthy participants (control group). Saliva samples of all participants were collected and sent to a laboratory for detailed analysis.

Results: The chronic kidney disease (CKD) patients had significantly reduced salivary flow compared to the healthy controls (P<0.001). The major oral manifestation in the study group was the the study group was the paleness of mucosa followed by calculus formation and bleeding of gums. The salivary sodium level in healthy controls was 13.4 ± 8.6, while in dialysis patients, it was 34.1 ± 19.3; this difference was statistically significant (P<0.001). Potassium level in control group was 19.2 ± 3.8 and in the study group was 22.5 ± 3.1 (P<0.001). The calcium level in the control group was 6.6 ± 2.1, and in the study group was 4.32 ± 4.55 (P<0.001). The Phosphorus level in control group was 5.5 ± 3.8 and study in study group was 27 ± 4.45 (P<0.001).

Conclusion: Salivary calcium, phosphorus, urea, sodium, and potassium levels in chronic kidney disease are significantly higher than those in normal individuals. These increased levels are correlated with the severity of renal disease. Decreased salivary flow rate and calculus deposition reflect increased salivary urea and renal disorder.

Keywords: *Chronic Kidney Disease, Oral Health, Periodontal Diseases, Saliva.*

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Introduction

Periodontitis also known as oral disease is a common condition occurring in 30-90% of the patients with chronic kidney disease.[1] Patients with advanced chronic kidney disease (CKD).are at higher risk of developing periodontitis as they have higher probing pocket depth and clinical attachment level. This eventually progresses to teeth loss which further affects the quality of life of patients.

William Hunter proposed focal infection theory, which was initially discarded, but eventually gained significant support as various evidence suggested mutual relationship between

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systemic and oral health.[2,3] Periodontal medicine brought this major paradigm shift.[4] However, there is limited literature in periodontal medicine on oral manifestation and salivary composition in patients with chronic kidney disease (CKD).

Kidney-related diseases are the major cause of morbidity and mortality. Glomerulonephritis accounts for 54.6%, and pyelonephritis accounts for 12.4% of all kidney diseases.[5] Patients end-stage kidney disease demonstrates varying clinical signs and symptoms, including hyperkalemia, hypocalcemia, and hyperphosphatemia, and hormonal disorders such as low level of $25(OH)_2$ Vitamin D and secondary hyperparathyroidism.[6]

CKD and its treatment have a major impact on body organs and systems, which leads to nervous, respiratory, cardiovascular, endocrine, urological, hemopoietic, and gastrointestinal complications. It also affects the composition, concentration, and flow of saliva. Tartar deposits, xerostomia, and high salivary pH, are common conditions in CKD patients due to lack of vitamins, dietary restrictions, uremic gastropathy, metabolic acidosis, leuko-glycemic index, and protein-energy wasting synd-rome.[7] However, these complications can be relatively minimized by hemodialysis.[8] However, no local study has been conducted to evaluate the oral health of renal patients. In this study, we will analyze oral manifestations and changes in salivary contents in patients with CKD.

Methods

The retrospective study was conducted at Department of Nephrology, Ibne-Sina Hospital Multan, Pakistan from January 2021 to January 2023. Patients diagnosed with CKD were included in the study after giving informed consent. Those with any other system illness were excluded. The hospital's ethical board approved the study.

The study was conducted on a total of 100 subjects; 50 were CKD patients (study group), and 50 were period on tally and systematically healthy participants (control group). The sample size was calculated by keeping 50% population size, 95% confidence interval and; 50rror rate. All participants underwent complete intraoral and general examination, and detailed data was recorded. Saliva samples of all participants were collected by spitting method; in the study group, samples were collected before hemodialysis (before 8 am), and patients were advised not to eat food before sample collection. Samples were collected in a glass tube and stored at -4°C, and color was visually estimated and categorized as transparent to opaque white or red. Paper strips were used for testing the pH of saliva. The flow rate of the samples was calculated. Levels of salivary sodium & potassium (flame photometry), calcium & phosphorus (Colorimetry), bicarbonate (titration), and urea (Berthelot method) in all samples were recorded.

SPSS version 23.0 was used for data analysis. Continuous data was represented as mean and standard deviation and was compared using *a t*-test. Categorical data was represented as frequency and percentage and compared using the *Mann-Whitney* test. *P* value < 0.05 was considered statistically significant.

Results

Salivary flow in both groups is shown in table-1. CKD patients had significantly reduced salivary flow compared to the healthy controls ($P<0.001$). The major oral manifestation in the study group was the the study group was the paleness of mucosa followed by calculus formation and bleeding of gums. The control group had normal oral mucosa. (Table-2).

The salivary sodium level in healthy controls was 13.4 ± 8.6, while in dialysis patients, it was 34.1 ± 19.3; this difference was statistically significant ($P<.001$). The potassium level in the control group was 19.2 ± 3.8, and in the study group was 22.5 ± 3.1 ($P<.001$). The calcium level in the control group was 6.6 ± 2.1, and in the study group was 4.32 ± 4.55 ($P<.001$). The phosphorus level in the control group was 5.5 ± 3.8, and the study in the study group was 27 ± 4.45 ($P<.001$). (Table-3).

Discussion

CKD has oral manifestations which should be recomposed as these indicate the extent of the disease.[9] These manifestations may be helpful in diagnosis and treatment planning. Recent

Table-1: Salivary flow in study groups

	Mean flow rate	Salivary flow (mL/min (%)		*P* Value
	-	0.1-0.4	0.5-1.0	
Study group	0.42	21 (42%)	24 (48%)	< 0.001
Control group	0.67	-	50 (100%)	

Table- 2: Oral and salivary changes in study groups

Lesions	Study group
Pale mucosa	31 (62%)
Calculus	18 (36%)
Bleeding gums	5 (10%)
Metallic taste	5 (10%)
Dental hypoplasia	3 (6%)
Fissured tongue	1 (2%)
None	-

Table-3: Comparison of salivary content between groups

	Control group	Study group	*Mann Whitney-U* test	*P*-value
Sodium	13.4 ± 8.6	34.1 ± 19.3	6.93	<0.001
Potassium	19.2 ± 3.8	22.5 ± 3.1	4.76	<0.001
Calcium	6.6 ± 2.1	4.32 ± 4.55	3.22	<0.001
Phosphorus	5.5 ± 3.8	27 ± 4.45	25.98	<0.001
Bicarbonate	50.2 ± 22	53.1 ± 27.8	0.58	<0.81
Urea	32.9 ± 15.9	138.5 ± 64.3	11.27	<0.001

technological advances have influenced the significance of saliva as a diagnostic tool. Using a saliva sample for diagnosis is simple and cost-effective.[10] In this study, we analyzed oral manifestations and changes in salivary contents in patients with CKD. The results showed that CKD patients had significantly reduced salivary flow compared to the healthy controls. These results are consistent with the findings of a previous study, in which the flow rate in the controls of the above-mentioned study was higher than that in the control group of our study.[11] Reduced flow rate among CKD patients could be due to drugs, dehydration, chemical inflammation, or Kussmaul breathing. The oral manifestations in the study group included calculus, bleeding gums, pale mucosa, fissured tongue, odor, dental hypoplasia, and petechiae. These findings were also reported in a previous study.[12] Previous studies reported that paleness of mucosa in CKD patients is due to bone marrow depression, anemia, and accelerated death of red cells.[8,13]

In the current study, caries in the control group was higher than in the study group. A previous study reported that CKD patients had high levels of salivary urea, which increased neutralizing capacity, thus inhibiting the release of free amino acids after plaque saturation with urea. Salivary urea restricts caries because of the inhibitory action of plaque accumulation.[14] In the current study, the mean salivary sodium level in healthy controls was 13.4 ± 8.6 mM/l, while in dialysis patients, it was 34.1 ± 19.3 mM/l. A previous study reported that controls had sodium levels of 27 ± 18 mM/l, while the study group had 16 ± 12 mM/l. This difference

can be explained by the collection of saliva samples on dialysis days and from major salivary glands.[6] In the present study, the mean potassium level in the control group was 19.2 ± 3.8, and in the study group was 22.5 ± 3.1. A previous study reported a potassium level of 19.8 ± 4.5 mM/l in the thecontrol group and 27.2 ± 6.1 mM/l.[15] This difference can be due to saliva being collected from the parotid gland as opposed to whole saliva in our study. The salivary calcium level in the control group was 6.6 ± 2.1, and in the study group, it was 4.32 ± 4.55, which is comparable to a previous study that reported a level of 5.3 ± 1.4 in the control group and 4.0 ± 3.55 in the study group.[16] The phosphorous level of the study group was 27 ± 4.45, which was significantly higher than 5.5 ± 3.8 in the control group, which is an indication of low flow rate as phosphorous levels and flow rate are negatively related. The results are like Samie et al. Our study group had significantly higher levels of urea in the saliva sample.[17] Urea was mainly present as ammonia. A previous study implied that this could be the reason of heavy calculus formation in dialysis patients.[18]

Our study has some limitations. The sample size was limited and the study was single-centered, so definite results could not be drawn. Large multi-center studies are needed for better analysis.

Conclusion

Salivary calcium, phosphorus, urea, sodium, and potassium levels in CKD are significantly higher than those in normal individuals. These increased levels are correlated with the severity of renal disease. Decreased salivary flow rate and calculus deposition reflect increased salivary urea and renal disorder.

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Authors Contribution

BF: Study designing, data analysis, results and interpretation

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ZHQ: Study designing, manuscript writing and proofreading

NY: Data collection, data analysis, results and interpretation

RR: Idea conception, data collection