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Evaluation Of Salivary Parameters And Oral Health Status In Adult Hemodialysis Patients.

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ABSTRACT

Chronic kidney disease leads to varied alterations systemically and orally, which includes oral manifestations including changes in the flow rate and composition of the saliva. The present study aimed to evaluate the salivary pH, buffering capacity and the flow rate of saliva to the oral health status in adult hemodialysis. Twenty healthy individuals and sixty patients undergoing hemodialysis were divided into four groups based on the following criteria: Group 1: Control group; healthy individuals, Group 2: Patients undergoing dialysis<1 year, Group 3: Patients undergoing dialysis since 1 year - 3 years, Group 4: Patients undergoing dialysis>3 years. The OHI-S, PI and DMFT Index evaluation was conducted to examine the oral health status. Saliva was collected after pre-stimulation to measure the flow rate, buffering capacity and pH. The results exhibited a reduction in the salivary flow rate and buffering capacity with the increase in the time interval of hemodialysis, but the salivary pH was found to be increasing with time. A direct relationship was seen between the DMFT scores and the scores of OHI-S and PI with the increasing time interval. There was a significant correlation between DMFT index, OHI-S and PI with stimulated salivary flow rate, and buffering capacity in the patients. In infection prone hemodialysis patients, impairment of the oral health status can lead to exigent consequences. Therefore, regular dental examinations and treatment should be made mandatory in all patients undergoing hemodialysis. This is fundamental to ensure optimal oral health in patients with chronic kidney disease.

Keywords: Hemodialysis, Oral health status, Dental caries, Saliva

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INTRODUCTION

Saliva, a known biofluid is a clear, slightly acidic mucoserous exocrine secretion produced in the oral cavity by the three major salivary glands; parotid, submandibular, sublingual and around 450- 750 minor salivary glands which are situated on the tongue, buccal mucosa and palate [1]. As a diagnostic fluid, saliva offers distinctive advantages due to the non-invasive collection and also, does not warrant use of specialized equipment for collection and storage, small sample aliquots, easier patient co-operation, cost effectiveness, convenience when repeated samples are needed for monitoring over time and greater sensitivity. Besides, saliva does not clot in contrary to blood [2].

The prevalence and incidence of patients with end stage renal disease has been increasing over the last few decades [3]. Also, due to advent of newer technologies in medical care leading to prolonged life expectancy, patients with renal disorders are increasingly encountered in routine dental practice [4].

Kidneys play the most important role in the removal of metabolic waste products, electrolytes and water from the human body. A condition is identified as end stage renal disease when the functioning of the kidneys is impaired to almost 5-10% compared to the original capacity, hence requiring either hemodialysis or renal transplantation. The procedure of hemodialysis involves an artificial simulation of the renal system by detoxification of nitrogen and other metabolic products from the blood by using a hemodyalizing system [6]. The oral manifestations in patients undergoing hemodialysis can be due to numerous potential factors, such as the relative state of immunosuppression, osteodystrophy of the renal system, multiple medications, restriction of oral fluid intake and bone loss [7, 8]. A vast array of oral manifestations have been reported inpatients of end stage renal disease namely; gingivitis, xerostomia, halitosis, mucosal pallor, oral lesions, teeth mobility, malocclusion and an increased risk of dental erosion due to frequent regurgitation [5, 6]. Also, the systemic and salivary changes caused due to chronic renal failure and almost diminished oral self care may probably affect status of oral health in these patients [9-11].

The recognition of these oral manifestations in patients undergoing hemodialysis is important, as they can be potential indicators of the presence or extent of the disease. This can help the clinician to diagnose the disorder, determine the treatment requirement, assess the prognosis of the disease and formulate the treatment plans accordingly. Therefore, the aim of the present study was to evaluate the salivary pH, buffering capacity and the flow rate of saliva to the oral health status of the dentition as recorded DMFT Index (Decayed, Missing and Filled Teeth), PI(Periodontal Index) and OHI-S (Oral Hygiene Index - Simplified) in adult hemodialysis patients.

MATERIAL AND METHODS

The present study was conducted on a total of 80 individuals; 20 healthy individuals and 60 patients undergoing hemodialysis treatment in the Department of Nephrology at K.S Hegde Hospital. Ethical clearance was acquired from the Institution Ethics Committee. Patients under the age of 18 years and complete edentulous patients were excluded from the study.

The patients were divided into four groups based on the following criteria:

Group I: Control group [20patients] – healthy individuals,
Group II: Patients undergoing dialysis < 1 year [20 patients].
Group III: Patients undergoing dialysis from 1 year – 3 years[20 patients] and
Group IV: Patients undergoing dialysis >3 years [20 patients].

After obtaining the patient`s informed consent, oral health status was determined by conducting dental examinations namely; DMFT index, OHI-S and PI. The teeth were isolated with cotton rolls & examined using a mouth mirror & probe under good illumination for DMFT Index evaluation. OHI-S and PI evaluation was done with William's probe under good illumination. All the individuals taking part in the study were asked to abstain from smoking, drinking, eating and performing oral hygiene procedures, 2 hours before the collection of saliva samples [12]. The sample collection was done for nearly 5 min, between 9:00 a.m. and 11:00 a.m. The analysis of the saliva samples was conducted by using the saliva-check kit (GC Asia Dental Pvt. Ltd., Singapore, 508724). All samples were collected post the hemodialysis procedure, at the nephrology department.

Flow rate

The saliva was collected into a collection cup after pre-stimulation. Whole saliva was stimulated with the aid of paraffin-wax chewing method. The saliva was collected from each subject for 5 min. For the measurement of flow rate, the collection of saliva into the collection cup was timed. It was expressed as ml/min. it was evaluated based on the following readings as per the saliva check kit: <3.5ml- very low, 3.5-5.0ml-low, >5.0ml-normal.

Buffering capacity

Sufficient saliva was drawn from the collection cup using a pipette, followed by a drop of saliva each being dispensed onto the three test pads. After 2 minutes, the test pads started to change color.Depending upon the final color on the test pad, the total number of points was calculated. The combined total buffering capacity of saliva was interpreted based on the saliva buffer capacity indicator available with the kit: green - 4, green/blue-3, blue-2, red/blue-1, and red-0. Depending upon the total points, the buffering ability of the saliva was deciphered based on the following scores; 0-5:very low, 6-9:low, 10-12: normal/high.

pH measurement

The saliva was pipetted onto a pH test strip for 10 seconds. The color obtained on the test strip was compared against the salivary pH indicator available in the package.

RESULTS

An inverse relationship was observed between the decreases in the flow rate of saliva in hemodialysis patients to the increasing time intervals. Patients under dialysis more than 3 years had the least mean (SD) salivary flow rate of 4.43 (2.24) followed by patients under dialysis for 1 - 3 years (4.93±2.48), under dialysis for less than 1year (6.02±3.04), and highest in control group (7.33±2.60). The median salivary flow rate in those subjects is 3.75, 4, 5.50 and 6.25 respectively. There was a significant difference in the distribution of the salivary volume among the study groups (p<0.001). On pair wise comparison between the study groups, the difference in the distribution of salivary volume was found to be statistically significant between control group and 1-3years and more than 3years (<0.05) All other comparisons were non significant. (Table1).

Table 1: Comparison of the variation of the flow rate of saliva in adult hemodialysis patients compared to healthy controls at different time intervals of treatment.

Group	N	Mean (SD)	Median	Kruskal Wallis test		Mann Whitney U test (p-value)	
				Chi Square Value	p-value	I Vs III	I Vs IV
I	20	7.33 (2.6)	6.25	14.686	0.002*	<0.001*	
II	20	6.02 (3.04)	5.5				
III	20	4.93 (2.48)	4				
IV!	20	4.43 (2.24)	3.75				

An inverse relationship was observed between the decreases in the buffering capacity of saliva in hemodialysis patients to the increasing time intervals. Patients under dialysis for more than 3 years had the least mean (SD) salivary buffering capacity of 4.65 (1.93) followed by patients under dialysis for 1 - 3 years (6.0±3.81), under dialysis for less than 1year (8.05±2.35), and highest in control group (10.90±1.52). The median buffering capacity in those subjects is 4.5, 5.5, 9 and 12 respectively. On pair wise comparison between the study groups, the difference in the distribution of DMFT score was found to be statistically significant between all the groups (<0.05) except when comparing patients under dialysis for 1 – 3 years and more than 3 years (Table 2)

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Table 2: Comparison of the variation in the buffering capacity of saliva in adult hemodialysis patients compared to healthy controls at different time intervals of treatment.

Group	N	Mean (SD)	Median	Kruskal Wallis test		Mann Whitney U test (p-value)				
				Chi Square Value	p-value	I vs II	I vs III	I vs IV	II vs IV	II vs III
I	20	10.9 (1.52)	12	40.328	<0.001*	<0.001*				0.04*
II	20	8.05 (2.35)	9							
III	20	6 (3.81)	5.5							
IV	20	4.65 (1.93)	4.5							

A direct relationship was observed between the increase in the pH of saliva in hemodialysis patients to the increasing time intervals. Patients under dialysis for more than 3 years had the highest mean (SD) salivary pH of 7.31 (0.36) followed by patients under dialysis for 1 - 3 years (6.84 ±0.50), under dialysis for less than 1 year (6.78±0.33), and lowest in control group (6.55±0.25). The median pH in those subjects is 7.4,6.8, 6.6 and 6.6 respectively. There was a significant difference in the distribution of the pH levels among the study groups (p<0.001). On pairwise comparison between the study groups, the difference in the distribution of pH levels was found to be statistically significant between all the groups (<0.05) (Table 3).

Table 3: Comparison of the variation in the pH of saliva in adult hemodialysis patients compared to healthy controls at different time intervals of treatment

Group	N	Mean (SD)	Median	Kruskal Wallis test		Mann Whitney U test (p-value)					
				Chi Square Value	p-value	I vs II	I vs III	I vs IV	II vs IV	III vs IV	II vs III
I	20	6.65 (0.27)	6.6	18.162	0.002*	<0.001*					0.04*
II	20	6.84 (0.45)	6.6								
III	20	6.99 (0.42)	6.8								
IV	20	7.21 (0.26)	7.4								

A direct relationship was observed between the Oral Hygiene Index – Simplified (OHI-S) scores obtained in patients on haemodialysis with increasing time intervals. A significant difference in the OHI-S score was observed between the study groups p<0.001 with subjects having disease of duration more than 3yrs having the highest score (3.20±1.20) followed by those with 1 - 3yrs (3.15±0.97), less than 1 yr(2.78±1.06) and least in control group (1.46±0.46) (p<0.001). On pair wise comparison, the difference in the score between control and less than 1yr, 1- 3 yrs and more than 3 yrs were statistically significant (p<0.05). All other comparisons were non-significant (p>0.05) (Table 4)

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Table 4: Comparison of the OHI-S values in adult hemodialysis patients compared to healthy controls at different time intervals of treatment.

Groups	N	Mean (SD)	ANOVA		Tukey Post Hoc test (p-value)		
			F	p-value	I Vs II	I Vs III	I vs IV
I	20	1.46 (0.46)	14.22	<0.001*	<0.001*		
II	20	2.78 (1.06)					
III	20	3.15 (0.97)					
IV	20	3.20 (1.20)					

A direct relationship was observed between the Periodontal Index (PI) scores obtained in patients on haemodialysis with increasing time intervals. A significant difference in the PI score was observed between the study groups p<0.001 with subjects having disease of duration 1- 3yrs having the highest score (3.57±1.48) followed by those with > 3yrs (3.51±1.32), <1 yrs (2.89±1.12) and least in control group (0.27±0.17) (p<0.001).The median values were 4, 3.75, 3 and 0.3 respectively. On pair wise comparison, the difference in the score between control and the three groups – less than 1yr, 1- 3 yrs and more than 3 yrs were statistically significant (p<0.05). All other comparisons were non-significant (p>0.05) (Table 5)

Table 5: Comparison of the PI values in adult hemodialysis patients compared to healthy controls at different time intervals of treatment.

Group	N	Mean (SD)	Median	Kruskal Wallis test		Mann Whitney U test (p-value)		
				Chi Square Value	p-value	I Vs II	I Vs III	I Vs IV
I	20	0.27 (0.17)	0.3	44.68	<0.001*	<0.001*		
II	20	2.89 (1.12)	3					
III	20	3.57 (1.48)	4					
IV	20	3.51 (1.32)	3.75					

A direct relationship was observed between the increases in the DMFT scores in hemodialysis patients to the increasing time intervals. Patients under dialysis for more than 3 years had the highest mean (SD) DMFT score of 12.45 (6.45) followed by patients under dialysis for 1-3 year (10.75±7.26), under dialysis for less than 3 years (950±6.06), and least in control group (3.05±2.31). The median DMFT score in those subjects 9.50, 9, 10 and 2.50 respectively. There was a significant difference in the distribution of the DMFT score among the study groups (*p*<0.001). On pair wise comparison between the study groups, the difference in the distribution of DMFT score was found to be statistically significant between all the groups (<0.05) when compared to the Control group (Table 6).

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Table 6: Comparison of the DMFT values in adult hemodialysis patients compared to healthy controls at different time intervals of treatment.

Group	N	Mean (SD)	Median	Kruskal Wallis test		Mann Whitney U test (p-value)		
				Chi Square Value	p-value	I Vs II	I Vs III	I Vs IV
I	20	3.05 (2.31)	2.5	29.94	<0.001*	<0.001*		
II	20	9.5 (6.06)	10					
III	20	10.75 (7.26)	9					
IV	20	12.45 (6.45)	9.5					

DISCUSSION

Majority of the patients suffering from chronic kidney disease are known to manifest oral symptoms and signs, amongst which approximately 90% of the patients have reported oral mucosal tissue changes [13, 14]. Besides changes in the oral mucosa, these patients are known to be prone to caries, which is considered to be a multifactorial disease with salivary flow rate, pH and volume as the most predominant risk factors. Several studies have reported the connection of the salivary flow with periodontal, dental and oral status in end stage renal disease patients [14, 15]. Saliva has important protective properties, participating in the maintenance of oral mucosa and hard tissues integrity, that is mandatory in maintenance of the physiological balance within normal conditions. Bots et al. advocated that any disorder influencing the instituted equilibrium between all the components in the oral cavity leads to decrease in the salivary flow rate, causes symptoms and signs of dryness of the mouth and atrophic changes in the oral mucosal tissue [8]. In chronic kidney disease patients, determination of a few established biomarkers in saliva can be an efficient alternative method for monitoring the efficacy of the treatment with dialysis [15].

In the present study, an inverse relationship was noted between salivary flow rate and increase in the time intervals of hemodialysis treatment. The reduction in the salivary flow rate in patients undergoing hemodialysis has been confirmed in earlier studies; also sometimes confirming to levels lower than the limits of hyposalivation [8, 16]. The potential cause of reduction in the salivary flow rate has been attributed to direct damage to the salivary glands and containment of fluid intake in patients undergoing hemodialysis treatment [7, 11]. Regardless, the results of the present study are contrary with the evaluation by Bots *et al.*, who proposed that the salivary flow in dialysis patients remained within the normal range [8].

In the present study, a direct relationship was noted between the increase in the salivary concentration of pH with increasing time intervals whereas an indirect relationship was noted between the decrease in buffering capacity of saliva with increasing time intervals. This is a consistent observation in all the studies which have evaluated these salivary parameters, both in adults and children [17-19]. The increase in the salivary pH could be by virtue of the increasing salivary urea levels [20-22]. Urea is known to act by two consequent mechanisms. Initially, the urea is metabolized by the bacterial urease to carbon dioxide and ammonium ion causing an alkalinizing effect and also, then the urea propagates a periphrastic reaction of plaque in metabolizing carbohydrates to acid catabolites. It has been calibrated in earlier studies that the production of hydrogen ions drops down by tenfold in patients undergoing hemodialysis [23]. This can be attributed as a potential factor leading to the lowering buffer capacity of saliva with increasing time intervals of hemodialysis. Hence, urea plays a cardinal role in the alkalization and buffering of saliva.

In the present study, an inverse relationship between DMFT scores and the increase in the time interval of hemodialysis treatment was noted. Decreased salivary flow among the individuals along with

decreased buffering capacity can be denoted as the ascribing factors [22, 8, 17]. Although the salivary pH was increased, the increase in the DMFT scores in the present study could be attributed to diminished oral hygiene and poor maintenance, food impaction due to periodontitis, hence providing an ideal environment for caries. The total DMFT score demonstrated a significant difference between the groups in our study (p <0.05).

A direct relationship was observed between the Periodontal Index (PI) scores and OHI-S scores with increasing time intervals in patients on hemodialysis. Again, this could also be ascribed to as poor oral hygiene, in turn leading to alteration in the calcium-phosphorous balance, increase in the urea concentration and changes in the salivary composition causing increased plaque and calculus deposition in these patients. In patients with end stage renal disease, increase in the plaque and calculus deposition has been reported in many studies, which can be attributed to poor oral hygiene [12, 7, 2, 24, 26-28]. Also, the altered calcium-phosphorous balance has also been analyzed as an element of the increase [11, 26]. In accession, calculus accumulation could ascribe to the high urea concentration, and should be considered as a potential determinant of monitoring between supportive periodontal therapy intervals [29].

Literature advocates that in patients with chronic kidney disease, implementation of oral health care at home tends to be less prevalent when they did seek oral health care from a dental surgeon on a regular basis [30]. In the present study, the salivary collection and analysis was done post hemodialysis. Hence, the limitations of this study may be that it has could be further broadened by increasing the number of cases evaluated and analyzing the salivary parameters pre and post hemodialysis at varying time intervals.

CONCLUSION

Oral manifestations may lead to austere measures in patients undergoing hemodialysis who are prone to infections. Hence, regular oral health examinations should be considered to be an indispensible protocol in patients with chronic kidney disease. Prospective research in vast cohorts of renal transplant and hemodialysis patients at varying intervals of time must be considered to evaluate the efficiency and expediency of salivary analysis for monitoring of patients with chronic kidney disease.

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