

Oral Manifestations in Diabetic and Nondiabetic Chronic Renal Failure Patients on Hemodialysis

V Asha, S Latha, Anuradha Pai, K Srinivas, KS Ganapathy

ABSTRACT

Introduction: Oral cavity reflects the general health status of an individual. Diagnosing and treating oral manifestations of systemic disease pose a greater challenge to oral physician. Chronic renal failure (CRF) is one such disease that demonstrates a complex set of oral findings due to disease itself and also due to treatment like hemodialysis. Diabetes, the most common cause of CRF also affects oral health. An attempt is made in this study to evaluate and compare oral health status of diabetic and nondiabetic CRF patients who were on maintenance hemodialysis.

Materials and methods: Study was done on 106 CRF patients who were on hemodialysis. Patients were divided into diabetic (55 patients) and nondiabetic (51 patients) group based on their blood sugar level. Patients of both groups were examined for predialytic salivary pH, decayed, missing, filled teeth, periodontal condition and mucosal lesions.

Results: Salivary pH in diabetic group was less when compared to nondiabetic group ($p < 0.001$). Diabetic group had higher caries prevalence ($p < 0.001$) and periodontal disease compared to nondiabetics.

Conclusion: Study revealed decrease in salivary pH and increased prevalence of caries and periodontal disease in diabetic group. Differences in oral manifestations were also noticed between diabetic and nondiabetic uremic patients.

Keywords: Diabetes, Chronic renal failure, Hemodialysis, Salivary pH, Oral manifestations.

How to cite this article: Asha V, Latha S, Pai A, Srinivas K, Ganapathy KS. Oral Manifestations in Diabetic and Nondiabetic Chronic Renal Failure Patients on Hemodialysis. J Indian Aca Oral Med Radiol 2012;24(4):274-279.

Source of support: Nil

Conflict of interest: None

INTRODUCTION

Chronic renal failure (CRF) implies structural renal damage that reduces glomerular filtration capacity of the kidneys leading to an increased serum creatinine and blood urea nitrogen (BUN) levels.¹ Diseases causing CRF are diverse, however diabetes mellitus (DM) is considered to be the most important and common cause.²⁻⁴ It is important to ascertain if an underlying disease is present, since such a disease in itself may influence oral manifestations.⁵

With widespread availability of dialysis the lives of CRF patients have been prolonged, and thus the number of patients reporting to dentists with the resulting oral manifestations have also increased. Frerichs first described

oral manifestations of uremia more than 150 years ago.⁶ Researchers estimate that up to 90% of renal patients will show oral symptoms.⁵ Typical uremic oral manifestations include, dry mouth, taste change and uremic odor. Other uremic oral manifestations reported in literature include tongue coating, mucosal inflammation, mucosal petechiae and ecchymosis, oral ulceration and enamel hypoplasia. High incidence of gingivitis and periodontitis and low incidence of caries has been reported.⁷⁻⁹

Although the oral and dental changes of the individual diseased condition, i.e. DM and CRF have been examined, investigations for diabetic CRF patients on hemodialysis are limited. Since, the influence of coexisting medical condition that is DM and CRF on oral and dental health requires an updated approach, a need was felt to assess oral and dental health status of diabetic uremic patients receiving hemodialysis.

MATERIALS AND METHODS

Source of data: CRF patients under maintenance hemodialysis therapy in NU trust, Padmanabhanagar, Bengaluru, were included in this study with written permission of respective authorities of the trust, institution ethical committee and with the consent of the patients participated. The study consisted of 106 uremic patients, 69 male and 37 females under age group of 25 to 70 years. The patients were divided into diabetic and nondiabetic groups based on their fasting and postprandial blood sugar level.

Methodology

Method of collection of data: Type 2 diabetic CRF patients with history of 6 months of diabetes who are on maintenance hemodialysis for more than a month and nondiabetic CRF patients who are on maintenance dialysis for more than a month were included in the study. Patients who received irradiation therapy for head and neck cancer; patients on medications like, tricyclic antidepressants, anticholinergics and antihistamines and patients with diabetic history of less than 6 months were excluded.

Method

Salivary pH assessment: Predialytic unstimulated whole salivary pH was recorded using pH-measuring strips

(Indikrom papers, Qualigens fine chemicals, Glaxosmith-kline pharmaceuticals). Patients were instructed to rinse the mouth with water and then to pool the saliva on the tongue. The pH strip was placed to wet it and the color change was immediately matched with the scale provided with the strip and the pH value was recorded.

Oral manifestations: The specific oral manifestations were classified into subjective and objective findings.

Subjective findings that were included are dry mouth, taste change, tongue or mucosa pain. To assess the subjective findings each patients were asked questions regarding the symptoms and were recorded as present or absent.

Objective findings that were included are uremic odor, tongue coating, mucosal petechiae or ecchymosis and ulceration. Uremic odor was recorded by smelling the odor when the patient was talking. Tongue coating, mucosal petechiae or ecchymosis and ulceration were recorded under torch light illumination. They were recorded as present or absent.

Dental Manifestations

DMFT index was recorded for the incidence of caries, using mouth mirror and probe. The decayed tooth was recorded as (D) missing teeth as (M), filled teeth as (F) according to WHO criteria. Temporary restorations are considered as 'D', the initial lesions like chalky spots, stained fissures are not considered as 'D'.¹⁰

All 28 teeth are examined, teeth not included are, third molars, unerupted teeth, congenitally missing and supernumerary teeth, teeth removed for other reasons than dental caries such as trauma, cosmetic purpose or for use as a bridge abutment. The overall DMFT value was obtained as a sum of the decayed, missing and filled teeth for each patient. The DMFT index is generally expressed as the average number of DMF teeth per person in the population being studied.

Coding Criteria

- E—Excluded tooth or tooth space
- 1—Sound permanent tooth
- 2—Filled permanent tooth
- 3—Decayed permanent tooth
- 0—Missing tooth, unerupted, impacted, congenitally missing
- X—Extracted permanent tooth

CPI was done for assessment of periodontal status, using mouth mirror and CPI (Manipal) probe which is specifically designed periodontal probe, with a 0.5 mm ball tip and black band between 3.5 and 5.5 mm and rings at 8.5 and 11.5 mm

from the ball tip. According to WHO protocol, the dentition is divided into six sextants defined by tooth numbers: 18-14, 13-23, 24-28, 38-34, 33-43 and 44-48, and was coded as follow:¹¹

- Code 0—Healthy periodontium
- Code 1—Bleeding on gentle probing
- Code 2—Calculus deposition
- Code 3—Pocket 4 to 5 mm (black band on the probe partially visible)
- Code 4—Pocket 6 mm or more (black band on probe not visible)
- Code X—Excluded (less than two teeth present)

The index teeth to be examined are 17, 16, 11, 26, 27, 37, 36, 31, 46 and 47. If no index teeth are present all the remaining teeth in that sextant are examined and the highest score is recorded as the score for the sextant.

Statistical methods: Chi-square test and Fisher exact test have been used to find the significance of frequency distribution of study parameters between diabetic and nondiabetic groups. Student 't' test and Mann-Whitney test have been used to find the significance of mean values of study parameters between the two groups. Odds ratio has been used to find the strength of oral manifestations between the two groups.

Statistical software: The statistical software namely SPSS 15.0, Stata 8.0, MedCalc 9.0.1 and Systat 11.0 were used for the analysis of the data and Microsoft Word and Excel have been used to generate graphs and tables, etc.

RESULTS

In this study, 106 CRF patients who were on hemodialysis were included. Out of 106 patients, 55 patients (51.9%) were known diabetics and 51 (48.1%) were nondiabetics.

Age group and duration of hemodialysis has no statistically significant difference between diabetic and nondiabetic patients. Sex distribution analysis reveals more male patients in diabetic group.

As shown in Table 1 and Graph 1, 50 nondiabetic patients (98%), 54 diabetic patients had dry mouth (98.2%) with p-value of 0.957, which was not statistically significant. Thirty-seven nondiabetic patients (72.5%) and 38 diabetic patients (69%) had taste change with p-value of 0.693, which was not statistically significant. Eight nondiabetics (15.7%) and 12 diabetics (21.8%) had tongue or mucosa pain with p-value of 0.420. Fifteen nondiabetics (29.4%) and 26 diabetic (47.3%) had uremic odor with p-value of 0.059. Six nondiabetics (11.8%) and eight diabetics (14.5%) had tongue coating with p-value of 0.778. Twenty-seven nondiabetics (52.9%) 28 diabetics (50.9%) had mucosal petechiae with p-value of 0.834. Six nondiabetics (11.8%)

and five diabetics (9.1%) had ecchymosis with p-value of 0.652. One nondiabetic (1.9%) and one diabetic (1.8%) had mucosal ulceration with p-value 0.957.

Average DMFT-total in nondiabetic group was 4.59 ± 0.92 and in diabetic group it was 10.38 ± 1.14 , the difference is statistically significant (high in diabetic) with $p < 0.001$, as shown in Table 2 and Graph 2.

Diabetic group had lesser number of codes 0, 1 and 2 and greater number of codes 4 and X. Diabetic group had severe periodontal disease than compared to nondiabetic group as seen in Table 3 and Graph 3.

Salivary pH is significantly decreased in diabetic group when compared to nondiabetic group with $p < 0.001$ as seen in Table 4 and Graph 4.

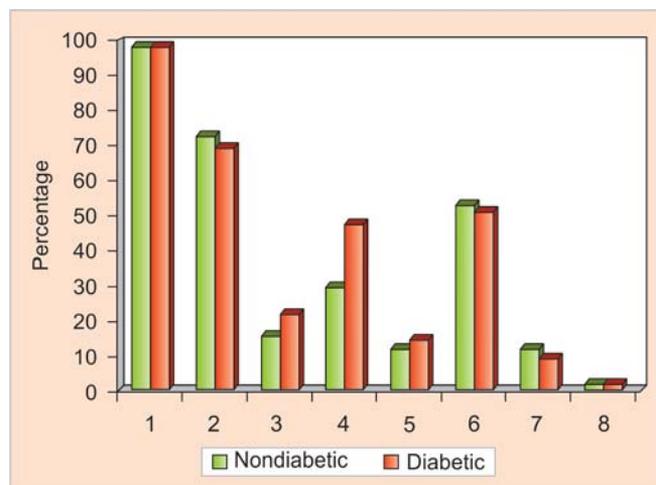
DISCUSSION

Recognizing the oral manifestations of the underlying systemic disease is a challenge. It becomes even more challenging if there are any coexisting medical conditions. In this study comorbid condition of CRF and DM is assessed.

Dry mouth was seen both in diabetic and nondiabetic patients with no significant statistical difference which is contrary to the previous study showing dry mouth to be severe in the diabetic group than the nondiabetic group.⁹ There are several reasons for the prevalence of dry mouth. The decreased salivary flow may be due to direct uremic involvement of salivary glands, chemical inflammation,

dehydration, mouth breathing and also from the restricted fluid intake, irrespective of whether the patient is diabetic or not.^{9,12} The other conditions that may cause dry mouth in uremic patients are retrograde parotitis, metabolic abnormalities and use of diuretics.

In the present study, taste change was analyzed to be slightly more in nondiabetic than diabetic patients though the number was not statistically significant. Previous study reported that the taste change is more in diabetic uremic patients.⁹ The cause of metallic taste in uremic patients has



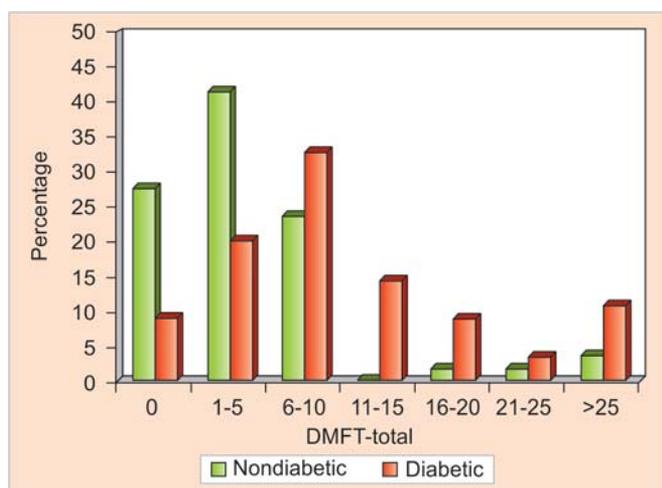
Graph 1: Oral manifestations (1) dry mouth, (2) taste change, (3) tongue/mucosal pain, (4) uremic odor, (5) tongue coating, (6) mucosal petechiae, (7) ecchymosis, (8) mucosal ulcerations

Table 1: Oral manifestations

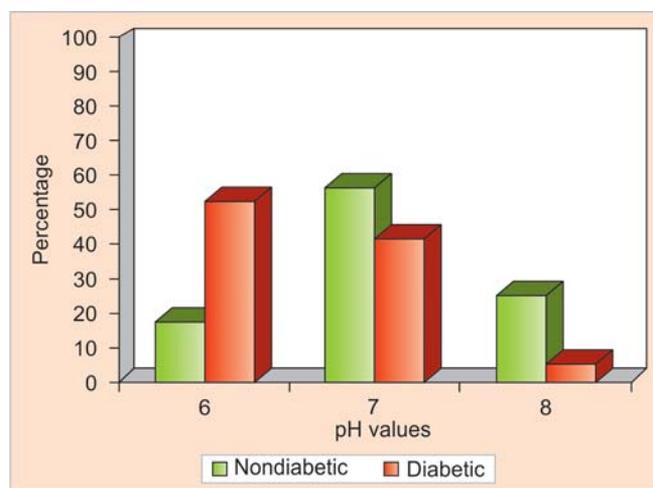
Oral manifestations	Nondiabetic (n = 51)		Diabetic (n = 55)		Univariate analysis	
	No.	%	No.	%	p-value	OR
<i>Subjective symptoms</i>						
Dry mouth	50	98.0	54	98.2	0.957	1.08
Taste change	37	72.5	38	69.1	0.693	0.72
Tongue/mucosal pain	8	15.7	12	21.8	0.420	1.50
<i>Objective symptoms</i>						
Uremic odor	15	29.4	26	47.3	0.059	2.16
Tongue coating	6	11.8	8	14.5	0.778	1.27
Mucosal petechiae	27	52.9	28	50.9	0.834	0.92
Ecchymosis	6	11.8	5	9.1	0.652	0.75
Mucosal ulcerations	1	1.9	1	1.8	0.957	0.92

Table 2: Distribution of DMFT-total

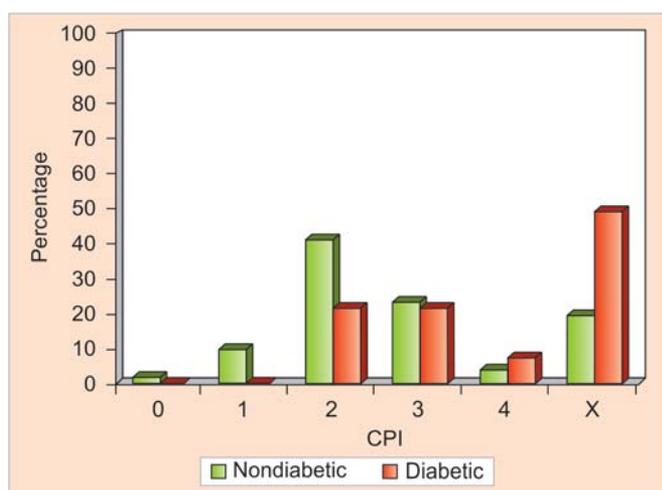
DMFT-total	Total (n = 106)		Nondiabetic (n = 51)		Diabetic (n = 55)	
	No.	%	No.	%	No.	%
0	19	17.9	14	27.5	5	9.1
1-5	32	30.2	21	41.2	11	20.0
6-10	30	28.3	12	23.5	18	32.7
11-15	8	7.5	-	-	8	14.5
16-20	6	5.7	1	1.9	5	9.1
21-25	3	2.8	1	1.9	2	3.6
>25	8	7.5	2	3.9	6	10.9
Mean ± SE	7.55 ± 0.77		4.59 ± 0.92		10.38 ± 1.14	



Graph 2: Distribution of DMFT-total



Graph 4: pH distribution



Graph 3: CPI code

infection, due to the underlying metabolic disorder and also due to denture use. A study supports higher incidence of stomatitis in diabetic patients than nondiabetic patients.¹² Accumulation of ammonia, which is the breakdown product of urea, might irritate the oral mucosa resulting in glossitis and stomatitis.

Uremic odor is typical of uremic patients caused by high concentration of urea in the saliva, and its breakdown to ammonia. In the present study, uremic odor was found to be higher in diabetic group than the nondiabetic group though not in statistically significant numbers. This result is not in accordance with the previous study, which reported greater incidence in nondiabetic group, and they correlate it to higher urea level in saliva of CRF patients.⁹ But the measurement of salivary urea was neither done in their study nor in the present study to support their assumption. Therefore, further investigation is required in this regard.

There was no significant difference in the incidence of tongue coating between the two groups. This result is

been reported to be due to urea content in the saliva and its subsequent breakdown to ammonia and carbon dioxide by bacterial urease.^{5,12} The change in taste can also be due to metabolic disturbance, the use of medication, diminished number of taste buds and changes in the salivary flow and composition.¹³ Another study reports that high levels of urea, dimethyl and trimethyl amines and low levels of zinc might be associated with decreased taste perception in uremic patients.¹²

Mucosal pain was slightly higher in diabetic uremic patients than nondiabetic group, though not statistically significant. This result was inconsistent with the previous study.⁹ Diabetic patients are at higher risk of fungal

Table 3: CPI code

Periodontal condition	Nondiabetic (n = 51)	Diabetic (n = 55)	p-value
0, n (%)	1 (1.9%)	–	0.481
1, n (%)	5 (9.8%)	–	0.023
2, n (%)	21 (41.2%)	12 (21.8%)	0.032
3, n (%)	12 (23.5%)	12 (21.8%)	0.999
4, n (%)	2 (3.9%)	4 (7.3%)	0.680
X, n (%)	10 (19.6%)	27 (49.1%)	0.001

Table 4: pH distribution

pH distribution	Total (n = 106)		Nondiabetic (n = 51)		Diabetic (n = 55)	
	No.	%	No.	%	No.	%
6	38	36.8	9	17.6	29	52.7
7	52	49.1	29	56.9	23	41.8
8	16	15.1	13	25.5	3	5.5
Mean ± SE	6.79 ± 0.07		7.08 ± 0.09		6.53 ± 0.08	

consistent with the previous study. Poor oral hygiene associated with precipitation of salivary urea on the tongue may be the cause.

The incidence of mucosal petechiae and ecchymosis between the two groups was found to be statistically similar. This manifestation may be due to bleeding tendency because of abnormal thrombocyte function and a decrease in platelet factor III. It may also relate to the anticoagulants used during hemodialysis.⁹ The association between the prevalence of petechiae and ecchymosis and serum anticoagulant level require further studies

The incidence of mucosal ulceration was rare in both the groups. Uremic stomatitis represents relatively uncommon intraoral complication; the incidence has decreased due to advent of dialysis. The exact etiology remains unknown, but suspected to be due to chemical burn of mucosa by ammonia or ammonia compounds formed by the hydrolysis of urea or loss of tissues resistance to normal and/or traumatic influences.¹⁴

The number of decayed ($p < 0.001$) and missing teeth ($p < 0.001$) were more in diabetic group than nondiabetic group. The number of filled teeth ($p < 0.006$) were less in diabetic group than nondiabetic group in the present study. The resulting DMFT index was significantly high in the diabetic group than in nondiabetics ($p < 0.001$). Since, uremic patients are often on high carbohydrate diet and low protein diets to minimize the nitrogen products produced by the metabolism of protein, severe caries can be expected, however, caries index is noticeably lower in uremic patients. This low caries rate is attributed to inhibition of plaque and bacteria by higher levels of salivary urea.⁵ The low caries incidence might be due to higher salivary pH and buffering capacity associated with increased salivary urea. High salivary urea level produces an anticariogenic effect by inhibiting growth of *Lactobacillus* and neutralizing acid formed in plaque. Increased calculus deposits may also contribute to low caries rate by preventing acid coming in contact with teeth. Diabetic patients exhibit higher tendency for caries owing to decreased salivary flow rates. In other studies there was no difference in the incidence of DMFT between the controls and uremic patients.^{13,15,16}

On assessing the CPI index, both study groups had a low incidence of code 0 (healthy periodontium) and code 1 (bleeding on gentle probing). Code X (excluded) was found to be greater in diabetic group, having statistically significant difference that indicated greater tooth loss in diabetic group, the results being consistent with the previous study.⁹ Changes in the salivary pH and low flow rate of saliva results in increased calculus deposits and high incidence of gingivitis and periodontitis in uremic patients.^{2,9} DM is a known systemic factor for periodontitis

and tooth loss. In contrast a study revealed that periodontal attachment did not differ from a matched control group.¹⁵ Increased bleeding on probing does not directly reflect the level of inflammation in CRF patients because bleeding could be because of various reasons. Three key factors that predispose to this bleeding are: Anticoagulant used during hemodialysis, thrombocytopenia and abnormal platelet function, leading to faulty platelet aggregation.

In this study, salivary pH was found to be greater in the nondiabetic than diabetic group. This is in accordance with the previous study.⁹ Salivary pH of end-stage renal disease (ESRD) patients is alkaline, because of high concentration of ammonia as a result of urea hydrolysis.¹²

The overall observation of the study reveals that although there were statistically significant changes in the caries prevalence, periodontal disease and salivary pH between the diabetic and nondiabetic uremic patients, there were no statistically significant changes in the oral manifestations like dry mouth, taste change, uremic odor, petechiae and ulcers.

CONCLUSION

This study has not only explored the association between general health and oral health but also provided information regarding the consequences of the association between two health conditions and their effects on oral cavity. The results of this study emphasize the need for collaboration between the dental and medical fraternity to provide optimal health to this special population.

ACKNOWLEDGMENTS

The authors would like to acknowledge Dr Sujatha D, Dr Bharati A Patil, Dr Sushmini Hegde (Staff: Department of Oral Medicine and Radiology, The Oxford Dental College, Bengaluru), Dr Venkatesh Krishnamoorthy (Medical Director, Head, Urology), Dr Diliprangarajan (NU Trust) and KP Suresh (Biostatistician).

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