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Oral Health Parameters of Diabetic and Non-Diabetic Patients Undergoing Heamodialysis- A Comparative Study

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Abstract

Objective of study: There is rising incidence of chronic kidney disease (CKD) worldwide. Although the oral health parameters have been examined and reported among CKD patients, investigations of diabetic heamodialytic patients are limited. Therefore, the aim of this study is to assess and compare dental and periodontal health parameters between diabetic and non diabetic heamodialysis patients in Karachi.

Materials & methods: A total of 100 heamodialysis patients were allocated as diabetic and non diabetic as per their HbA1c level and examined for dental caries and periodontal health using DMFT, PI, CPI and CAL indices with protocol given by WHO. Socio-demographics and medical history was recorded. All examinations were performed in pre-dialysis phase and by single-blinded examiner. Statistical tests of Chi square and student-tests were used for comparing percentages and mean differences between groups (p-value <0.05).

Findings: Among all socio-demographic variables, distribution of gender and duration of dialysis were not significantly different in between groups. There is a significant difference in all indices between both groups. DMFT mean was high among non diabetic patients and plaque scores were high among diabetics. Bleeding was more among diabetic patients and CAL showed more than 6mm attachment loss in same group.

Discussion: This study reveals that diabetic patients exhibit higher tendency for bleeding on probing, moderate level of attachment loss and abundance of plaque deposits as compared to non diabetic group. There is a need of further research to establish associations between diabetic nephropathy and oral health.

Abbreviations: PI: Plaque Index; CAL: Clinical Attachment Loss; CKD: Chronic Kidney Disease; DM: Diabetes Mellitus; ESRD: End-Stagerenal Disease; IRB: Institutional Review Board; CPI: Community Periodontal Index

Introduction

The burden of chronic kidney disease (CKD) has a progressive increase in south Asian countries including Pakistan. Delay in treatment resulting from lack of screening and risk identification which ultimately hinders implementation of preventive measures [1]. This often leads to more complicated condition, End-stage renal failure, which requires organ transplantation and dialysis therapy [2]. Periodontal diseases in association with other systemic diseases have increased drastically from past few decades and if considered with chronic kidney diseases (CKD) it is of no exception. In literature, there is an established relationship of systemic conditions like cardiovascular disease, pulmonary diseases, osteoporosis, anemia as chronic kidney disease (CKD) and especially diabetes mellitus (DM) with oral diseases [3]. Presence of one condition increases the chances of others. According to a survey, frequency of 40 years or older persons with reduced estimated glomerular filtration rate ranges from 15%to 20% [4]. Such a high burden is consistent with high prevalence of diabetes and hypertension, the leading causes of end-stage renal disease (ESRD). It is estimated that annual incidence of ESDR in Pakistan is about 150 patients per million of population. Therefore, each year, we shall have 16000 patients with ESRD [5].

A recent local survey results showed that, diabetes was the leading cause of CKD, confirming previous results from Pakistan [6]. These findings are consistent with those reported from Western countries. According to the United States Renal Data System (USRDS), the commonest cause of ESRD was diabetes (42.9%) [7]. Compared to Western countries, diabetes is more prevalent in subcontinent and it would likely to multiply over the next two decades [8]. A study from UK demonstrates the high prevalence of diabetes mellitus in the South Asian population in East London, with both a higher overall prevalence and earlier onset compared to both the Black and White populations [9]. Similar to ESRD, diabetes mellitus (DM) is also a contributor of oral pathological changes. Poorly controlled diabetes is also marked as systemic risk factor for many types of periodontitis. The findings of a comparative study revealed that diabetic hemodialysis patients presented an increased prevalence of caries and noticeable oral manifestations like dry mouth and oral mucosal inflammation, compared to nondiabetics [10]. Also, patients with poorly controlled diabetes with HbA1c level > 9% had a higher incidence of dry mouth and other oral symptoms than fairly or good controlled ones [10]. The association of periodontal disease with diabetes is well documented but its contribution in CKD is still debatable. Although the oral and dental changes of the individual diseased condition (i.e. DM or ESRD) have been examined, there is scarcity of data investigating periodontal health measures among diabetic hemodialyzed patients. Studies mostly reported oral condition associated to uremia in the general population of ESRD patients. The influence of coexisting medical conditions (i.e. DM and ESRD) on the dental health also needs inspection. The aim of this study was to assess and compare the oral health parameters between diabetic and non-diabetic patients on heamodialysis therapy.

Materials and Methods

This is a cross sectional analytical study conducted over a period of 3 months (April 2016 to June 2016) at heamodialysis units of Dow University of health sciences Ojha campus and Nephrology department of Jinnah Postgraduate Medical Centre. The study protocol was reviewed and approved by institutional review board (IRB) at Dow University of health sciences. All patients were informed before enrollment to a predefined protocol and written consent was taken. All the examinations of patients were in accord with the Declaration of Helsinki and its revisions. An inclusion criterion of the study was ESRD patients who were on maintenance hemodialysis therapy for not less than 3 months and were able to give informed consent. The exclusion criteria consisted of patients who had history of periodontal therapy or the use of antibiotics during the last three months prior to examination, pregnancy or lactation, diabetes diagnosed in less than 6 months, patients who were undergoing peritoneal dialysis, edentulous patients, patients who didn't agreed to participate in the study with inform consent, and patients who have index teeth extracted due to caries or mobility. Sample size was calculated using openepi version 3, 2-sample t-test for CPI mean with the power of 80% and confidence interval of 95% [11]. The mean difference was 0.31 for both the groups. Hence, the sample size for each group was maximum 55 subjects. As per inclusion criteria, there were 50 participants in the diabetic group and 50 in non diabetic group, respectively. Subjects were age and gender matched. Subsequently, the diabetic patients with ESRD were further classified into 2 subgroups according to their glycemic control:

HbA1C≤6.5% as good controlled and HbA1C>6.5% as poor controlled [12]. Data collection tool was a self-designed Performa consisting of three parts. The first portion recorded the socio-demographics details. The second portion recorded medical and dental history. Participant's Glomerular Filtration Rate was calculated from serum creatinine using Cockcroft-Gault equation [13]. While the third portion of the perform a included the clinical dental examination.

The indices used were DMFT index for dental caries and Plaque Index (PI) according to Silness and Loe and the WHO indices of Loss of Attachment (CAL) and community periodontal index (CPI) [14]. The oral examination was done by a single blinded examiner who had no knowledge of the patient's medical history and oral hygiene practices. For reliability (calibration), the examiner has been calibrated against gold standard periodontologist with percent agreement of 86%. The DMFT index was recorded as decayed (D), missing (M), and filled (F) teeth according to the criteria of WHO. The overall DMFT score was taken as the sum of all 3 components for each patient. The CPI and CAL indices were selected to minimize discomfort and lengthy periodontal assessment of these patients. The criteria for CPI was: Code 0 for healthy periodontium, code 1 for bleeding on gentle probing, code 2 for calculus deposition, code 3 for probing depth of 4 to 5 mm and code 4 for probing depth 6 mm or deeper and Code X for 3 or more teeth missing. The criteria of attachment loss was calculated as 0= 0-3mm, 1= 4-5mm (cementoenamel junction (CEJ) within black band), 2=6-8mm (CEJ between upper limits of black band an 8.5 mm long), 3= 9-11mm (CEJ between 8.5mm and 11.5mm rings), 4= 12mm or more (CEJ beyond 11.5 mm ring), X= excluded sextant, 9= not recorded. The periodontal condition for each sextant was identified with the highest recorded code. The teeth were isolated with cotton and examination was performed using standard cross infection control protocol. Probing on index teeth was recorded using examination instruments and CPITN Probe in the presence of artificial light (LED torch).

Statistical Analysis

The data was entered and analyzed in SPSS version 16 (Chicago IL, US). Descriptive analysis of socio-demographic data was performed with mean and standard deviation for quantitative variables and percentages for categorical variables. For the evaluation of significance of diabetes on dental and periodontal health, Chi square and fisher exact tests were used for CPI, CAL and PI, whereas student T-test used for comparing mean difference of DMFT. A value of $p < 0.05$ was considered statistically significant.

Results

Characteristics	Diabetic N=50	Non Diabetic N=50	P-value
Gender			
Male: female n (%)	31:19 (62%: 38%)	22:28 (44%:56%)	0.251
Mean Age(years, SD)	45.8 ±14.8	54.7 ±8.27	0.007
Education (n, %)			**0.003**
Illiterate	14 (28%)	3 (6%)	
literate	36 (72%)	47 (94%)	
Marital Status (n, %)			
Unmarried	7 (14%)	0	
Married	43 (86%)	50	
Monthly income (PKR)			**0.005**
None	5 (10%)	16 (32%)	
Less than 10, 000 PKR	11 (22%)	6 (12%)	
10 – 20, 000 PKR	22 (44%)	25 (50%)	
More than 20,000	12 (24%)	3 (6%)	
Brushing Frequency (n, %)			**<0.001**
None	8 (16%)	0	
Once a day	30 (60%)	20 (40%)	

Twice a day	12 (24%)	30(60%)	
Dental visit (n, %)			**0.005**
Never	30 (60%)	14 (28%)	
Less than 6 months	8 (16%)	12 (24%)	
More than 6 months	12 (24%)	24 (48%)	
Co-morbid (n, %)			**0.003**
none	22 (44%)	11 (22%)	
Hypertension	15 (30%)	33 (66%)	
Hepatitis C	8 (16%)	6 (12%)	
Cardiovascular disease	5 (10%)	0	
Mean duration of dialysis (years, SD)	2.43 ±0.718	2.19 ±0.785	**0.278**

Table 1: Socio-demographic characteristics of study population undergoing heamodialysis.

The characteristics of patients undergoing hemodialysis are presented in (Table 1). Among these 100 patients, 50 were diabetic and 50 were nondiabetic. The mean age was 45.8 years (±14.8) in the diabetic group and 54.7 years (±8.27) in the nondiabetic group. Ratio of male to female shows more men in diabetic group compared to women. Majority of patients were educated and married in both groups. Among all socio-demographic variables, distribution of gender and duration of dialysis were not significantly different in between groups.

	Diabetic N = 50	**Non Diabetic N = 50**	**P-value**
DMFT Index (Mean, SD)			
Decayed	1.6±1.85	3.0±2.69	**0.003**
Missed	2.22±2.46	2.78±2.83	0.330
filled	0.02±0.14	0.24±0.59	**< 0.001**
DMFT	3.84 ±3.43	6.02±5.08	**0.005**
CPI codes (n, %)			**0.025**
0	13 (26%)	9 (18%)	
1	9 (18%)	4 (8%)	
2	17 (34%)	23 (46%)	
3	11 (22%)	11 (22%)	
4	0	0	
X	0	3 (6%)	
LOA Index (n, %)			**0.015**
0	34 (68%)	35 (70%)	
1	13 (26%)	15 (30%)	
2	3 (6%)	0	
3	0	0	
4	0	0	
X	0	0	
Plaque Index (n, %)			**0.028**
0	5 (10%)	6 (12%)	
1	16 (32%)	19 (38%)	
2	21 (42%)	21 (42%)	
3	8 (16%)	4 (8%)	

Table 2: Prevalence of dental caries and periodontal condition in hemodialysis patients with and without DM.

Comparison of DMFT index between diabetics and non diabetics groups was analyzed by the Student t-test; D-decayed; M-missing; F- filled; T-total. Comparisons of CPI, CAL and PI were analyzed by chi-squared test.

The distributions of DMFT index, Plaque index (PI); clinical attachment loss (CAL) and CPI codes in both groups along with significance of association are presented in Table 2. Non Diabetic patients exhibit significantly higher decayed (D) component than those in the diabetic group (p-value= 0.003). The resulting DFMT index in non diabetic patients (6.02 ±5.08) also significantly higher than diabetic patients (3.84 ± 3.43) (p-value = 0.005). The statistics of CPI index depicted that both study groups had minimum incidence of Code 4. The non diabetic group showed greater percentage for calculus (46%), labelled as Code 2, compared to the diabetic group (34%). While codes 0 (healthy) and 1 (bleeding) were more frequent in diabetic group (26% & 18%). Another index of CAL showed that majority of patients had code 0 in both groups (68% in diabetics and 70% in nondiabetics). Code 2 was only exhibited by diabetic group in low frequency (6%). While assessing Plaque index, code 2 (mild accumulation) was most common in both groups (42%). Diabetic group had higher incidence (16%) of code 3 (abundance of plaque) compared to nondiabetics. Statistical analysis using the chi-square and student t-tests showed significantly differences for the CPI, CAL and PI assessments between the diabetic and nondiabetic group (p-value <0.05).

Discussion

This study was conducted among 100 heamodialysis patients- 50 were in diabetic group and 50 were non diabetic. The diabetic group was matched with nondiabetic group in age and gender. The aim of study was to assess and compare the oral health status of diabetic and nondiabetic patients who were undergoing heamodialysis therapy. Both of these conditions, diabetes and end-stage renal disease have major effects on oral health, but no comparative study has been reported to assess the combined effect of DM and ESDR on oral health in Karachi, Pakistan. Age is the well known risk factor for both chronic kidney disease [15,16] as well as periodontal diseases [17]. The mean age was 45.8 years (±14.8) in the diabetic group and 54.7 years (±8.27) in the non diabetic group. Both the groups have mean age lower than previous studies [9,16]. The mean age of the dialysis patients in this study was higher in this study than the subjects of an Indian and Turkish study of heamodialysis patients [10,18]. Participants of this study were more literate in both groups compared to a local study [19]. Mean duration of heamodialysis was less than 3 years in both groups which was lower than a similar study in Turkish population [15] while diabetic group has slightly higher duration compared to non diabetic group in both studies. There was significant difference between the diabetic and non diabetic groups in terms of brushing habit and visit to dentist and it is in agreement with previous studies [19-21]. Majority of patients in diabetic group (60%) had never visit a dentist in life. This difference might be showing their negligent behavior toward their oral health. Longer and tiring process of dialysis is itself a cause of lowered self-esteem among patients of ESDR. It would be more desirable to facilitate provision of dental health education within the dialysis centers and institutes. This will be much helpful for dialysis patients to awareness and instructions about the fate of poor dental health. There is a high rate of dental caries in patients with diabetes mellitus possibly due to alteration in oral microflora, oral Ph and their potential xerostomia [22]. In our study, there was a significant difference in DMFT scores of diabetic and non diabetic groups. DMFT mean score was almost double in non diabetic group than diabetic group which was in contrast with previous studies [9,10]. This might be reflecting the eating habits and oral health awareness in diabetic patients. Diet of diabetic patients is usually restricted to sugary and refined food and those also undergoing haemodialysis might be more cautious about their feeding pattern. This could be a possible reason of lowered DMFT score among diabetic group along with their optimum brushing practices in our study.

Diabetes is a well known risk factor for periodontitis and it has been reported by various investigators that extent and severity of periodontal disease might be increased in diabetic patients [22,23]. Assessment of plaque in our study revealed significant difference between both groups. Data from other countries reported a higher value of plaque index in heamodialysis patients as compared to controls [21,24]. Similar findings were established in our study which showed mild to moderate plaque deposits in both groups while abundant plaque scores were found among diabetic group. In terms of CPI and LOA index, diabetic group exhibited more bleeding and deeper pockets than non diabetic group. Also, there were significant statistical differences in both indices between diabetic and non diabetic heamodialysis patients. Bleeding on probing was also seen by researchers [20,21] among heamodialysis patients. It was suggested due to effect of certain medications, such as anti-coagulant therapy that could result in increased

bleeding on probing among heamodialysis patients. This finding also shows that the increased bleeding on probing may not be taken as reflection of the level of inflammation (gingivitis or periodontitis) in heamodialysis patients. Diabetes mellitus is a known systemic factor of periodontitis and tooth loss. Both of study groups showed loss of periodontal attachment but diabetic group had higher value of clinical attachment loss. Based on these findings, also reported by Chuang, et al. [8] there is an elevated risk for advanced periodontitis in diabetic patients undergoing heamodialysis and need more attention to their periodontal health. In another study with control group, that CPI values were significantly higher in peritoneal and heamodialysis groups [21]. A recent similar study with diabetic and non diabetic groups, demonstrated a borderline significant difference in investigation of CPI between those groups [10]. The limitations of this study include its performance in two dialysis centers and relatively small sample, but comparable with most of the previous studies. Also, bed side measurements of all indices were made and no radiological assessment was done for periodontal investigations. We also not made comparison of effect of biochemical indicators on oral health between both groups. There may be important differences in the host response to bacterial challenges. Also we did not have the oral health status prior to the heamodialysis for the estimation of the actual severity of caries and periodontitis during the heamodialysis.

Conclusion

In conclusion, this study is first to compare oral health findings between diabetic and non diabetic patients with heamodialysis therapy in Karachi. These findings within limitations of study, suggest that diabetic patients exhibit higher tendency for bleeding on probing, moderate level of attachment loss and abundance of plaque deposits as compared to non diabetic group. There were significant differences for socio-demographic variables as well as all dental indices between both groups. Maintenance of ideal oral hygiene could have positive effects in this high-risk group of patients. Prophylaxis and early dental care should be implemented in chronic renal disease patients; this would also be beneficial for their general health. There is need of longitudinal studies and larger samples in order to establish a causal relationship among diabetes, heamodialysis therapy and oral health status.

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