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Original Article

Periodontal status of patients undergoing peritoneal dialysis or hemodialysis

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Abstract: Objective: This study aimed to investigate the periodontal parameters in Chinese patients on peritoneal dialysis (PD) or hemodialysis (HD). Methods: 87 Chinese patients and 40 controls were recruited into present study. Results: In total, 51% of HD patients, 57.8% of PD patients and 25% of controls brushed their teeth once daily, while 42.9% of HD patients, 31.6% of PD patients and 70% of controls brushed twice daily; < 10% of patients in three groups brushed their teeth thrice daily. The average Plaque Index was comparable among three groups. However, the average Calculus Surface Index was significantly higher in HD patients as compared to PD patients (2.21 and 2.55, $P < 0.05$) and controls (2.28 and 2.55, $P < 0.05$). The average gingival bleeding (GI) was significant higher in controls as compared to HD patients (2.85 and 1.85, $P < 0.05$) and PD patients (2.85 and 1.87, $P < 0.05$). There was no significant difference in the average GI between HD patients and PD patients. Probing pocket depth (PPD) at different sites was comparable between HD patients and PD patients. However, PPD at upper-left-posterior, upper-right-posterior and lower-right-posterior was significantly higher in controls as compared to HD patients ($P < 0.05$) and PD patients ($P < 0.05$). Conclusions: In summary, the periodontal status of patients receiving PD or HD was poorer than healthy controls in China, but they have no bleeding and pocket symptoms. Dentists should emphasize the detailed dental examination and pay attention to the periodontal disease in CRF patients.

Keywords: Periodontal status, hemodialysis, peritoneal dialysis, chronic renal failure

Introduction

Chronic renal failure (CRF) is defined as a progressive and irreversible decline in the number of functioning nephrons, which leads to a reduction in the glomerular filtration rate (GFR). Once the damage becomes severe enough, patients develop end-stage renal disease (ESRD), and dialysis treatment or kidney transplantation is required. Because transplantation is limited by organ availability, dialysis treatment is the preferred therapy for CRF patients. The improvement of dialysis technique significantly extends the life expectancy of CRF patients. There are two types of dialysis: peritoneal dialysis (PD) and hemodialysis (HD) [1]. Both types of dialysis filter the patient's blood using a membrane that is permeable to water and toxins, but not blood cells. In PD, the peritoneal membrane of a patient is used for this purpose, whereas a semi-permeable synthetic membrane is used in HD. The selection of dialysis type is complicated. When the area of peritoneal membrane is reduced or the patient suffers from hyperkalemia, hypercalcemia, pulmonary edema, congestive heart failure, or uremia, HD is a preferred type. However, when some factors including patient's preference, residual renal function, comorbidity, survival, and quality of life are considered, PD will be employed. Patients generally prefer PD therapy over HD therapy because there is no need for dialysis machine or arterio-venous shunts [2].

Several changes occur in the oral cavity in CRF patients. Researchers estimate that up to 90% patients with renal disease show oral symptoms [3] CRF can affect the oral tissues and lead to gingival enlargement, xerostomia, and alterations in salivary composition and flow rate [4, 5]. Dental health status was found to be debilitated among the hemodialysis patients and got worsened with the duration of hemodialysis and the type of underlying kidney disease

mainly due to oral health negligence contributing to morbidity and potential mortality [6]. In addition, Garneata et al also found impaired periodontal health was highly prevalent in HD patients and periodontal disease (PDD) was more frequent in elderly diabetic smokers and in those with longer HD vintage; smoking and HD duration seemed to be the most important determinants [7] Gautam et al also found the greater deterioration of periodontal health was also found among dialysis patients with chronic renal disease and awareness regarding dental care is very less among these people [7]. A recent Chinese study showed HD therapy seemed to prevent patients from visiting a dentist, and there was a great need for dental treatment for Chinese HD patients [8].

Patients undergoing dialysis are more susceptible to infection. Chronic oral inflammation has been found to be associated with the decreased renal function. Garneata et al found inflammation seemed to accompany PDD [9]. Previous studies have reported that periodontitis in dialysis patients is common, and potentially has an impact on the morbidity, mortality and overall quality of life of CRF patients receiving dialysis treatment [10]. A high prevalence of periodontitis has been reported in HD patients; however, the severity of periodontitis is unknown in PD patients. A study by Bayraktar et al. examined 75 patients on PD and 41 patients on HD, but the periodontal examination was only performed in one location and information related to tooth brushing, smoking and drugs used was not discussed [7, 11].

Periodontitis and CRF are multifactorial diseases which result from an aberrant immune response in a susceptible host and may also be influenced by environmental factors. To date, no studies have been performed to compare the severity of periodontitis in patients undergoing different types of dialysis. This study was to investigate the periodontal status in patients undergoing PD and HD.

Patients and methods

Patients

This study was conducted between April 2014 and August 2014 and approved by the Institutional Review Board of the China-Japan Friendship Hospital, and informed consent was obtained from all the patients before study. In this cross-sectional study, CRF patients referring to the Department of Nephrology in the China-Japan Friendship Hospital (Beijing, China) were enrolled, and the periodontal status was evaluated. The patients underwent dialysis treatment due to the ESRD. The age (Control group: 54.38±11.96; HD group: 54.45±15.34; PD group: 59.29±15.00), gender (male rate, Control group: 46.2%; HD group: 62.5%; PD group: 60.5%), dialysis duration, drug related information (drug name, daily dosage and time for medication) and the pre-existing disease (type and course of disease) were recorded.

The inclusion criteria were as follows: 1) Patients were diagnosed with ESRD; 2) Patients underwent dialysis for > 1 year; 3) Patients were no younger than 18 years; 4) The treatment team agreed to the patient's involvement; 5) Informed written consent was obtained before study; 6) Seizures or nervous disorders were not observed before study, and logistic impossibility of investigation; 7) Patients had no current infectious diseases (hepatitis A, B, C; human immunodeficiency virus or *Mycobacterium tuberculosis* infection); 8) The medication maintained for at least 6 months; 9) Systemic diseases affecting the periodontium status such as diabetes mellitus other than dialysis were excluded.

According to the dialysis type, patients were divided into PD group and HD group. Patients with alternate use of two dialysis types were excluded. Meanwhile, healthy volunteers without systemic diseases were recruited as control group. The age and gender in control group were comparable to those in both PD and HD groups. Controls had neither any medical intervention nor any medication in the prior 15 days. All participants gave informed consent before study.

Questionnaire

The questionnaire on the duration of dialysis, the oral-hygiene habits at home and smoking status was administered after admission.

Participant characteristics

A total of 136 patients were recruited into this study, and finally 127 Chinese adults were

Table 1. Periodontal characteristics of CRF patients and controls (mean ± SD)

Periodontal parameters	HD patients (n=49)	PD patients (n=38)	Controls (n=40)	*P* value		
				HD_PD	HD_C	PD_C
Plaque Index (PI)	2.67±0.75	2.87±0.81	2.55±0.55	0.25	0.25	0.26
Gingival Index (GI)	1.58±1.00	1.87±0.85	2.85±0.65	0.15	0.01	0.01
Calculus Surface Index (CSI)	2.55±0.71	2.21±0.88	2.28±0.34	0.04	0.01	0.26
Probing pocket depth (PPD)						
Upper-anterior (Ua)	2.29±0.68	2.53±1.13	2.60±0.58	0.19	0.31	0.06
Upper-left-posterior (Ulp)	2.91±1.03	2.85±1.21	3.53±0.67	0.78	0.04	0.04
Upper-right-posterior (Urp)	2.87±1.27	2.81±1.20	3.58±0.70	0.89	0.03	0.03
Lower-anterior (La)	2.38±0.65	2.21±1.66	2.60±0.7	0.32	0.34	0.35
Lower-left-posterior (Llp)	2.96±1.10	3.16±0.57	3.53±0.67	0.57	0.06	0.25
Lower-right-posterior (Lrp)	2.88±0.92	3.16±1.59	3.53±0.81	0.33	0.01	0.04

Notes: There is significant statistical difference when $P < 0.05$.

included for analysis. There were 49 HD patients, 38 PD patients and 40 controls with a mean age of 55.9±15.2 years. There were 30 males and 19 females in HD patients with a mean age of 54.4±15.3 years, 23 males and 15 females in PD patients with a mean age of 59.2±14.9 years and 20 males and 20 females in controls with a mean age of 54.4±16.5 years. There were no significant group differences in the age and gender among three groups. The average duration of dialysis therapy was 4.7±2.8 years and 3.1±2.3 years in HD group and PD group, respectively.

Dental examination

All subjects were examined by a well-trained dentist. Prior to the clinical examination, a detailed medical history was reviewed for all participants. Periodontal indices were obtained from patients at 10-11 h before their midweek HD or PD session. The thickness of microbial dental plaque was assessed on the tooth surface near the marginal gingiva with the Silness and Loe Plaque Index (PI). After the teeth were dried, the microbial dental plaque was collected with a periodontal probe and visually evaluated. The gingival condition was evaluated using the Loe and Silness Gingival Index (GI). A blunt instrument, such as a periodontal probe, was used to assess tissue bleeding for this index (Loe and Silness, 1963). The amount of calculus was evaluated according to the Calculus Surface Index (CSI). The supra- and/or sub-gingival calculus was determined by visual and tactile assessment using a mouth mirror and dental explorer. The periodontal condition was examined by measuring the probing pocket depth (PPD). PPD was determined at six sites of the mouth, including the upper-anterior (Ua), upper-left-posterior (Ulp), upper-right-posterior (Urp), lower-anterior (La), lower-left-posterior (Llp), and lower-right-posterior (Lrp). PPD was calculated as the average distance between the bottom of the pocket and the margin of the gingiva. The number of missing teeth was also recorded.

Statistical analysis

Statistical analysis was performed using the SPSS for Windows (ver. 11.5.0; SPSS Inc., Chicago, IL, USA). The one-way analysis of variance (ANOVA) was used for comparisons of the means of PI, GI, CSI and PPD measurements among three groups. The difference between the distribution of the PD, HD, and C patients was analyzed with Pearson chi-squared test. A value of $P < 0.05$ was considered statistically significant.

Results

Oral habits

In total, 51% of HD patients, 57.8% of PD patients and 25% of controls brushed their teeth once daily, while 42.9% of HD patients, 31.6% of PD patients and 70% of controls brushed their teeth twice daily; < 10% of all the subjects brushed their teeth thrice daily. In addition, 22.7% of HD patients, 18.4% of PD patients and 20% of controls were active smokers. All smokers were male.

Table 2. Prevalence and statistical analyses of PI, GI, CSI, PPD

Periodontal indices	HD patients (n=49)		PD patients (n=38)		Controls (n=40)		*P* value		
	%	n	%	n	%	n	HD_PD	HD_C	PD_C
Plaque Index (PI > 2)	65.31	32	57.89	22	60	24	0.48	0.61	0.85
Gingival Index (GI > 2)	16.33	8	26.32	10	70	28	0.25	0.01	0.01
Calculus Surface Index (CSI > 2)	91.84	45	76.32	29	78.3	31	0.04	0.07	0.83
Probing pocket depth (> 2 mm)		0		0		0			
Upper-anterior (Ua)	22.45	11	40	15	55	22	0.08	0.01	0.18
Upper-left-posterior (Ulp)	60.87	30	51.43	20	97.23	39	0.38	0.01	0.01
Upper-right-posterior (Urp)	44	22	50	19	88.02	35	0.58	0.01	0.01
Lower-anterior (La)	31.11	15	58.33	22	52.5	21	0.01	0.04	0.6
Lower-left-posterior (Llp)	56.52	28	57.14	22	97.5	39	0.94	0.01	0.01
Lower-right-posterior (Lrp)	59.09	29	51.35	20	98.5	39	0.48	0.01	0.01

Notes: There was significant difference when P < 0.05.

Periodontal status

The periodontal features in different groups are presented in **Table 1**. There was no significant difference in the average PI among three groups. However, the average CSI was significantly higher in HD patients as compared to PD patients (2.21 and 2.55, P < 0.05) and controls (2.28 and 2.55, P < 0.05). The average GI was significant higher in controls as compared to HD patients (2.85 and 1.85, P < 0.05) and PD patients (2.85 and 1.87, P < 0.05). There was no significant difference in the average GI between HD patients and PD patients.

The PPD measurements are shown in **Table 1**. At six sites, PPD measurements were comparable between HD group and PD group. However, PPD at Ulp, Urp and Lrp was significantly higher in controls than in HD patients (P < 0.05) and PD patients (P < 0.05).

As shown in **Table 2**, 65% of PD patients, 58% of HD patients and 60% of controls had poor oral hygiene (PI > 2), showing no significant difference among them. In addition, 16% of PD patients, 26% of HD patients and 70% of controls had severe gingival bleeding (GI > 2). More controls had severe gingival bleeding as compared to PD patients and HD patients (P < 0.05). Moreover, 92% of PD patients, 76% of HD patients and 78% of controls had severe calculus problem (CSI > 2), suggesting that more PD patients had severe calculus problem (P < 0.05). The PPD measurements are show in **Table 2**. The PPD deeper than 2 mm was considered pathologic. Over 50% of PPD measurements were deeper than 2 mm in HD patients and PD patients. Over 90% of PPD measurements were deeper than 2 mm in controls at four sites. Statistical analysis showed more controls had pathologic PPD as compared to HD patients and PD patients (P < 0.01).

Discussion

Poor oral health, unsatisfactory daily oral hygiene habits and insufficient awareness of the importance of oral health are common in dialysis patients [12, 13]. Patients from both HD and PD groups did not pay attention to their oral hygiene, in that 50% of CRF patients and 10% of controls brushed their teeth only once [2, 14]. Healthy controls pay more attention to the oral hygiene as compared to CRF patients. Thus, clinicians should take measures to educate patients about dental health such that they understand the complications associated with poor dental health [11, 15-17].

In the present study, plaque accumulation was evident in three groups without significant difference among three groups. Our results suggest that all CRF patients and controls ignored their oral hygiene, although a lesser degree was observed in CRF patients. Previous studies have reported that individuals on HD therapy ignore their oral hygiene because they spent amount of time in the dialysis center. There is evidence showing that patients on HD therapy are depressed due to their disease condition [18, 19] and thus ignore their oral hygiene. However, PD patients perform dialysis at home [20], and thus it may be expected that they

would be more aware of their oral hygiene as compared to HD patients. In China, many elderly individuals brush their teeth once daily and do not emphasize their oral health. However, in case of ESRD, both HD patients and PD patients become very depressed, focus on their systemic condition, but ignore their oral health [21].

In a study, results showed a higher calculus level in CRF patients receiving HD therapy [22]. Our findings showed severe calculus accumulation in both CRF patients and controls. The calculus level observed in this study was higher than that reported in a previous study, which may be ascribed to the ignoring of dental care in the participants of present study. HD group was little significantly higher compared to the PD group and C group. This may be related to the alteration in serum phosphorus-calcium in HD patients. We recommend that all CRF patients should concern their oral hygiene [11].

Although CRF patients and controls had poor oral hygiene, our results showed GI was higher in controls than in HD patients and PD patients. However, the gingival inflammation in controls was more obvious than in PD patients and HD patients. On the other hand, the GI in PD patients and HD patients was lower than grouping controls of the present study. Several studies have reported lower or equal GI in HD patients as compared to controls. It has been suggested that the uremic state in HD patients may suppress the inflammatory reaction in tissues [17]. On the other hand, lower GI in HD patients and PD patients might be as a result of the use of anticoagulants in them. However, periodontitis will progress in the same way as in controls and develop because of insufficient oral hygiene. The lower GI would result from infrequent detection of gingival inflammation in these patients than in healthy controls [13]. We also recommend that dentists should pay more attention to the periodontal condition in CRF patients without periodontal bleeding.

In this study, PPD measurements indicated that the periodontal pockets in both HD patients and PD patients were shallow. A significant deeper pocket was observed in controls as compared to CRF patients. Previous findings also report a lower PPD in patients receiving HD or PD therapy. Though plaque accumulation and calculus level were pathologic in PD patients and HD patients, PPD measurements were unexpectedly low in our study. It is possible that higher urea level and anticoagulant medication are related to a lower level of gingival inflammation in PD patients and HD patients [23]. Though there was no deep periodontal pocket in CRF patients, the dentists should recognize and pay attention to the severity of periodontal disease.

Conclusion

In summary, the periodontal status is poor and there is severe periodontal disease in both CRF patients and controls in China. However, the bleeding and pocket symptoms are not obvious in CRF patients as compared to controls. CRF patients should be monitored carefully to maintain their oral health. Awareness must be increased among dialysis patients and nursing staff about the need for primary dental prevention.

Disclosure of conflict of interest

None.

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