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ORIGINAL ARTICLE

Evaluation of periodontal parameters in patients undergoing peritoneal dialysis or hemodialysis

G Bayraktar[1], I Kurtulus[2], R Kazancioglu[3], I Bayramgurler[1], S Cintan[2], C Bural[1], S Bozfakioglu[4], M Besler[5], S Trablus[5], H Issever[6], A Yildiz[4]

[1]Department of Removable Prosthodontics, Faculty of Dentistry, Istanbul University; [2]Department of Periodontology, Faculty of Dentistry, Istanbul University; [3]Department of Nephrology, Haseki Training and Research Hospital; [4]Department of Nephrology, Faculty of Medicine, Istanbul University; [5]Department of Nephrology, Istanbul Training and Research Hospital; [6]Department of Public Health, Faculty of Medicine, Istanbul University, Istanbul, Turkey

OBJECTIVE: To analyze and compare periodontal parameters in chronic renal failure (CRF) patients undergoing peritoneal dialysis (PD) therapy with a group of patients on hemodialysis (HD) treatment and healthy controls (C).

PARTICIPANTS: Seventy-five PD patients (mean age: 44 ± 12 years) were matched with 41 HD patients (mean age: 46 ± 15 years) and 61 C (mean age: 46 ± 18 years).

METHODS: Plaque (PI) and calculus (CSI) accumulation and gingival bleeding (GI) were recorded with the appropriate indices. Periodontal condition was assessed using the probing pocket depth (PPD). One-way ANOVA test, Pearson chi-squared test, Mann–Whitney U-test and Kruskal–Wallis test were performed to compare PD patients with HD patients and healthy C.

RESULTS: Plaque Index values were significantly higher ($P < 0.001$) in the PD and HD groups than the C group. GI values were significantly higher ($P < 0.01$) in the HD group than the PD group. Finally, CSI values in the PD and HD groups were also significantly higher ($P < 0.001$) than the C group.

CONCLUSIONS: Chronic renal failure patients on PD treatment are more susceptible to periodontal diseases like HD patients. Thus, it is very important to maintain an optimal oral hygiene level. Further studies on periodontal parameters of only PD patients are needed to get more information on the oral health status of this patient group.

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Correspondence: Dr Idil Kurtulus, Atakoy, 9/10, Kisim, A11B, Daire: 75, 34750 Bakirkoy, Istanbul, Turkey. Tel: +90 212 5601251, Fax: +90 212 6165218, E-mail: idil_kurtulus@yahoo.com

Introduction

Chronic renal failure (CRF) is the progressive and irreversible decline in the number of functioning nephrons. Once the damage is past the point of compensation, patients develop end-stage renal disease. Dialysis treatment and kidney transplantation are thus life-saving medical procedures in these patients (Sowell, 1982; Clark, 1987; Kerr, 2001).

Blood is cleared from toxins by means of a semi-permeable membrane in dialysis treatment. In peritoneal dialysis (PD), the patient's own peritoneal membrane is used for this purpose, whereas a semi-permeable synthetic membrane is used in hemodialysis (HD). There are usually three different types of dialysis programs in the PD treatment [continuous cycling PD (CCPD), continuous ambulatory PD (CAPD) and nightly intermittent PD (NIPD)], whereas there are two types in the HD treatment (home HD and center HD) (Berkow et al, 1982). HD is the treatment of choice whenever the peritoneal surface is reduced or there exist hyperkalemia, hypercalcemia, pulmonary edema, congestive heart failure, and uremic syndrome. However, when factors like patient preference, residual renal function, comorbidity, survival, and quality of life are taken into consideration, PD is preferred (Berkow et al, 1982; Jameson and Wiegmann, 1990). The most important reason that the patients prefer PD therapy over HD therapy is they are free of the dialysis machine, which eliminates the need for arterio-venous shunt (Fay and O'Neal, 1984).

Improvement in dialysis and modalities for treating patients with CRF are extending the life expectancy of the affected patient population (Rapaport and Converse, 1977; Fay and O'Neal, 1984). Oral and dental examinations of patients, who are candidates for receiving a renal transplant, are required to eliminate potential infections (Fay and O'Neal, 1984). Patients under dialysis are more susceptible to infection, because of general debilitation and depression of the immunologic response. Furthermore, in patients using immunosupressants for receiving

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a renal transplant, persisting oral infections can have a severe course. They can even be the cause of rejection of the transplanted kidney (Eigner *et al*, 1986). Thus, it is of utmost importance to determine and treat also periodontal diseases except for other oral and dental illnesses (Eigner *et al*, 1986).

Several studies report that gingivitis and periodontitis are common findings in HD patients (Tollefsen and Johansen, 1985; Wolff *et al*, 1985; Locsey *et al*, 1986; Naugle *et al*, 1998; Al Wahadni and Al Omari, 2003). Additionally, Periodontal Index values of HD patients were reported to be equal (Gavalda *et al*, 1999; Bots *et al*, 2006) or lower than (Epstein *et al*, 1980; Jaffe *et al*, 1986; Nunn *et al*, 2000; Atassi, 2002; Proctor *et al*, 2005) those of healthy controls (C).

Previous studies analyzing and comparing periodontal parameters of C were performed either in CRF patients comprising only HD patients (Tollefsen and Johansen, 1985; Jaffe *et al*, 1986; Gavalda *et al*, 1999; Nunn *et al*, 2000; Ertugrul *et al*, 2003; Davidovich *et al*, 2005) or in both PD and HD patients (Wolff *et al*, 1985; Klassen and Krasko, 2002; Duran and Erdemir, 2004; Bots *et al*, 2006). Thus, the aim of this study was to analyze and compare periodontal parameters in a group of CRF patients undergoing PD to a group of patients receiving HD as well as healthy C.

Material and methods

Participants
Seventy-five PD patients (PD group-test group, 32 male, 43 female; mean age, 44 ± 12 years); 41 HD patients (HD group-test group, 23 male, 18 female; mean age, 46 ± 15 years) constituting the dialysis group with a total of 117 patients and 61 healthy controls (C group, 22 male, 39 female; mean age, 46 ± 18 years) were included in our study. The C group was age and gender matched to both the PD and HD groups (Table 1). They had neither any medical intervention nor took any medications during the past 15 days. Moreover, no change in the medication of dialysis patients was made prior to the study for at least 3 months. All participants gave informed consent to take part in this study.

The etiology of CRF in the PD group was diabetic nephropathy in 8 (11%), chronic rejection in 4 (6%), amiloidosis in 1 (1%), polycystic kidney disease in 9 (12%), hypertensive nephrosclerosis in 11 (14%), chronic

glomerular diseases in 14 (18%), chronic pyelonephritis in 9 (12%), and unknown in 20 (26%) patients.

The HD group consisted of 6 (15%) patients with diabetic nephropathy, 8 (20%) patients with chronic glomerulonephritis, 6 (15%) patients with chronic pyelonephritis, 12 (29%) patients with hypertensive nephrosclerosis, 5 (11%) patients with amyloidosis, and 4 (10%) patients without any known etiologies.

In this group, all patients (100%) received HD therapy three times a week for approximately 4 h in the dialysis centers.

Clinical examination and indices
Prior to clinical examination, a detailed medical history was recorded for all the participants. Periodontal indices were performed at 10:00–11:00 hours before a midweek HD session in the HD group and in the same time period in the PD and C groups using a dental mirror, explorer, and a periodontal probe with Williams markings.

The thickness of microbial dental plaque on the tooth surface near the marginal gingiva was assessed using Silness and Löe Plaque Index (PI). After the teeth were dried, the microbial dental plaque was scraped by a periodontal probe and evaluated by unaided eye (Silness and Loe, 1964).

Gingival condition was evaluated using Löe and Silness Gingival Index (GI). A blunt instrument, such as a periodontal probe, is used to assess the bleeding potential of the tissues in this index (Loe and Silness, 1963).

The amount of calculus accumulation was evaluated by the Calculus Surface Index (CSI). The presence or absence of supra- and/or subgingival calculus was determined by visual or tactile examination using a mouth mirror and dental explorer (Ennever *et al*, 1961).

Periodontal condition was examined using the probing pocket depth (PPD) to measure and calculate the means of the distance between the bottom of the pocket and the margin of the gingiva from six sites of each tooth (mesiovestibule, midvestibule, distovestibule, distolingual, midlingual, and mesiolingual) (Novak, 2002).

Statistical analyses
Statistical analyses were performed using a software (spss for Windows Software Package, Version 11.5.0; SPSS Inc., Chicago, IL, USA). One-way ANOVA test was used to calculate the means and to assess the differences between the ages of PD, HD, and C (patients) groups. The difference between the distribution of the gender of the PD, HD, and C patients was analyzed with Pearson chi-squared test. Differences between time on dialysis of PD and HD groups were analyzed using Mann–Whitney *U*-test. The means and statistical difference of the PI, GI, and CSI indices and measurement of PPD were assessed using Kruskal–Wallis test. The level of significance was set at $P < 0.05$.

Table 1 The distribution and statistical comparison of age and gender among PD, HD and C groups and time on dialysis among PD and HD groups

	PD group	HD group	C group	P-value
n	75	41	61	
Age (years; ± s.d.)	44 ± 12	46 ± 15	46 ± 18	NS
Gender (male/female)	33/43	23/18	22/39	NS
Time on dialysis (months)	35 ± 23	39 ± 25	–	NS

n, number of persons in the groups; PD group, patients on peritoneal dialysis; HD group, patients on hemodialyis; C group, healthy controls; s.d., standard deviation; NS, not significant ($P > 0.05$).

Results

No statistically significant differences were found between the distribution of age and gender among PD,

Table 2 Descriptive values (mean $\pm$ s.d. and median values) and statistical analyses of PI, GI, CSI indices and measurement of PPD in the PD, HD and C groups

Periodontal indices	PD group, n = 75		HD group, n = 41		C group, n = 61		P-value
	Mean $\pm$ s.d.	Median (min.–max.)	Mean $\pm$ s.d.	Median (min.–max.)	Mean $\pm$ s.d.	Median (min.–max.)	
PI	1.63 $\pm$ 0.87[a]	1.43 (0.08–3.00)	1.94 $\pm$ 0.97[b]	2.00 (0.00–3.00)	1.06 $\pm$ 0.83[a,b]	1.00 (0.00–3.00)	< 0.001[a,b]
GI	0.19 $\pm$ 0.29[c]	0.10 (0.00–1.92)	0.37 $\pm$ 0.52[c]	0.21 (0.00–1.94)	0.24 $\pm$ 0.27	0.19 (0.00–1.39)	< 0.01[c]
CSI	0.81 $\pm$ 0.28[d]	1.00 (0.00–1.00)	0.73 $\pm$ 0.32[e]	0.75 (0.00–1.00)	0.44 $\pm$ 0.41[d,e]	0.38 (0.00–1.00)	< 0.001[d,e]
PPD	1.89 $\pm$ 0.52	1.67 (1.00–3.17)	1.88 $\pm$ 0.40	1.67 (1.34–3.10)	1.94 $\pm$ 0.62	1.72 (0.52–3.92)	NS

n, number of persons in the groups; PD group, patients on peritoneal dialysis; HD group, patients on hemodialyis; C group, healthy controls; PI, Plaque Index; GI, Gingival Index; CSI, Calculus Surface Index; PPD, probing pocket depth; s.d., standard deviation; NS, not significant ($P > 0.05$).
[a]Statistical comparison of PI values between PD and C groups.
[b]Statistical comparison of PI values between HD and C groups.
[c]Statistical comparison of GI values between PD and HD groups.
[d]Statistical comparison of CSI values between PD and C groups.
[e]Statistical comparison of CSI values between HD and C groups.
$P < 0.01$, statistically high significance; $P < 0.001$, statistically very high significance.

HD, and C groups. There was also no significant difference between the means of time on dialysis of PD and HD groups (Table 1).

Median values and statistical comparisons for PI, GI, CSI indices, and measurement of PPD are given in Table 2. PI values were found significantly higher ($P < 0.001$) in both the PD and HD groups than the C group. GI values were found significantly higher in the HD group than the PD group ($P < 0.01$). Finally, the CSI values in the PD and HD groups were also significantly higher ($P < 0.001$) than the C group.

Discussion

In the present study, plaque accumulation on the tooth surfaces of the PD and HD patients did not reach a pathological level; however, it was still higher than those of the C group. Several studies (Galili *et al*, 1983; Tollefsen and Johansen, 1985; Wolff *et al*, 1985; Kitsou *et al*, 2000; Al Nowaiser *et al*, 2003; Al Wahadni and Al Omari, 2003; Davidovich *et al*, 2005) also report higher plaque levels in CRF patients receiving HD therapy. Furthermore, although not statistically significant, plaque accumulation was also higher in the HD group than the PD group in our study. Patients undergoing HD therapy are more dependent on health centers than PD patients, as they receive dialysis therapy bound to a machine for approximately 4 h several times a week. Al Wahadni and Al Omari (2003) reported that individuals on HD therapy may ignore oral hygiene and other potential problems due to spending much time in the dialysis center. Likewise Galili *et al* (1983) stated that patients on HD therapy would be depressed due to their more severe systemic condition and thus would show insufficient compliance during dental treatments and neglect oral health care. Furthermore, PD patients are usually capable of continuing dialysis therapy at home. One can expect that they should be more aware of their oral health than HD patients. But the higher plaque levels in the PD group in the present study indicate that PD patients also neglect oral self-care, although not as

much as HD patients do. As there is no available study focused on only periodontal parameters in PD patients, it was not possible to compare and evaluate present findings.

Another concern is about the influence of some drugs these patients have to take, on their periodontal health status. However, this study aimed to observe the current periodontal health status together with the clinical outcomes of the medications that the dialysis patients have to take and to compare these clinical findings with those from healthy C. Thus, it would be interesting to categorize the dialysis patients regarding their medication in their treatment protocol and to analyze the effects of medications on periodontal health status in further studies.

Gingival Index values of the PD, HD, and C groups were not also pathologically higher like the PI values in the present study. However, gingival inflammation of the HD group was significantly higher than that of the PD group. This finding suggests that higher plaque levels in the HD group as well as the increased Bleeding Index might be the result of the anticoagulant medication they have to take. On the other hand, GI values of the PD and HD group were found comparable with those of the C group in the present study. In the literature, there are several studies reporting higher (Davidovich *et al*, 2005), lower (Tollefsen and Johansen, 1985; Jaffe *et al*, 1986; Gavalda *et al*, 1999; Ertugrul *et al*, 2003) or equal (Bots *et al*, 2006) GI values of the HD group compared with C patients. It has been suggested that the uremic state in the HD patients may suppress inflammatory reactions in the tissues, which would result in infrequent detection of gingival inflammation in these patients than healthy controls (Tollefsen and Johansen, 1985; Kerr, 2001). An experimental gingivitis study on a group of HD patients and healthy controls (Kitsou *et al*, 2000) showed no differences in the evolution of experimental gingivitis in both groups, indicating that uremia would not retard gingival inflammation in HD patients. Therefore, gingivitis would progress in the same way as in healthy controls and

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would develop only because of insufficient oral hygiene. In spite of the high plaque accumulation in the PD and HD groups in the present study, we found comparable GI values with the C group. This finding suggests that high urea levels in both the PD and HD groups caused lower GI values (Shannon *et al*, 1977; Epstein *et al*, 1980; Eigner *et al*, 1986; Ertugrul *et al*, 2003). However, there is also no available study about GI values only in PD patients; thus, it was not possible to compare present findings.

In this study, calculus accumulation in the PD and HD groups were significantly higher than that of the C group. Epstein *et al* (1980) also reported higher calculus levels in CRF patients receiving HD therapy. They suggested that this finding could have been the result of alterations in serum phosphorus–calcium levels in CRF patients and higher salivary urea levels that creates an appropriate environment for calculus formation (Westbrook, 1978; Epstein *et al*, 1980; Eigner *et al*, 1986). On the basis of the higher plaque and calculus levels in the PD and HD groups in the present study, we can also suggest that these patient groups should pay more attention to their oral hygiene and should more often brush their teeth in order to prevent calculus formation.

Present PPD findings were found comparable in the PD and HD groups with the C group. As plaque accumulation and gingival inflammation did not reach pathological levels in the PD and HD groups, PPD measurements were expectedly low.

In conclusion, although not pathologically high, we also found higher plaque and calculus accumulations in the HD group than those in the C group, as we found in the PD group in the present study.

Conclusions

Present findings showed that CRF patients receiving PD therapy are more susceptible to periodontal diseases like HD patients. Therefore, it is very important to maintain an optimal oral hygiene level. In order to achieve this:

- patients should be kept under regular control in order to instruct them on regular and appropriate tooth brushing, to remotivate them and recommend alcohol-free mouth rinses in cases when necessary;
- scaling and root planing should be performed in cases when necessary.

Additionally, CRF patients should be regularly sent to dental examinations by the dialysis center to improve systemic health and quality of life. It is therefore important and necessary for nephrologists to work in cooperation with dentists to consult the systemic condition of this patient group.

The authors suggest that further studies on periodontal parameters only in the PD patients are needed. In order to get more reliable data based on large patient materials, multicenter approaches should be planned in future studies. There is also a need to include a control group of chronic hospital patients in future studies, in order to establish more direct associations.

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