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Hemodialysis and Oral Health

Swati Jain, Kirti Jain and Basavaraj Patthi

Abstract

Changing lifestyle and sedentary schedule have led to the substantial increase in major noncommunicable diseases (NCDs) such as cardiac problems, cancers, diabetes, psychiatric disorders, and chronic respiratory diseases. Recent times have shown increased trends in incidence as well as prevalence of renal diseases. Hemodialysis is the most opted treatment modality for the patients of chronic renal diseases. Hence, the aim of the current chapter is to address the effect of renal diseases and its treatment on oral health. An extensive literature search from the year 2000 till 2015 was conducted to assess the effect of hemodialysis and renal diseases on various clinical parameters associated with oral health like dental caries, periodontal diseases, prevalence of calculus, etc. The literature review revealed that the dental health is compromised in the patients undergoing hemodialysis therapy. The oral health-related parameters get worsened with increasing duration of hemodialysis as well. The primary reason behind the debilitated periodontal condition among the patients may be attributed to the neglect of proper oral hygiene practices by the patient as they are preoccupied by more time-consuming and life-threatening kidney disease. A strong relation between oral health and hemodialysis has been observed. There is a need for further interdisciplinary research with emphasis on preventive dental treatment for the patients undergoing hemodialysis ensuring optimum outcome.

Keywords: hemodialysis, dental health, duration of dialysis, kidney diseases

1. Introduction

Healthy life is the most significant virtue of one's existence. The physical, social, and economical productivity of an individual depends mostly on the quality of life led by an individual. Human beings have always strived to achieve an optimum milieu of internal and external environment [1]. The diseases affecting mankind can be broadly classified into two types—communicable and noncommunicable diseases. With improvement in health-care facilities, sanitation, litigation services, and treatment modalities, the reign of communicable diseases is on a decline. However, a contrary rise of noncommunicable diseases (NCDs) has been observed primarily due to changing lifestyles and diet [2].

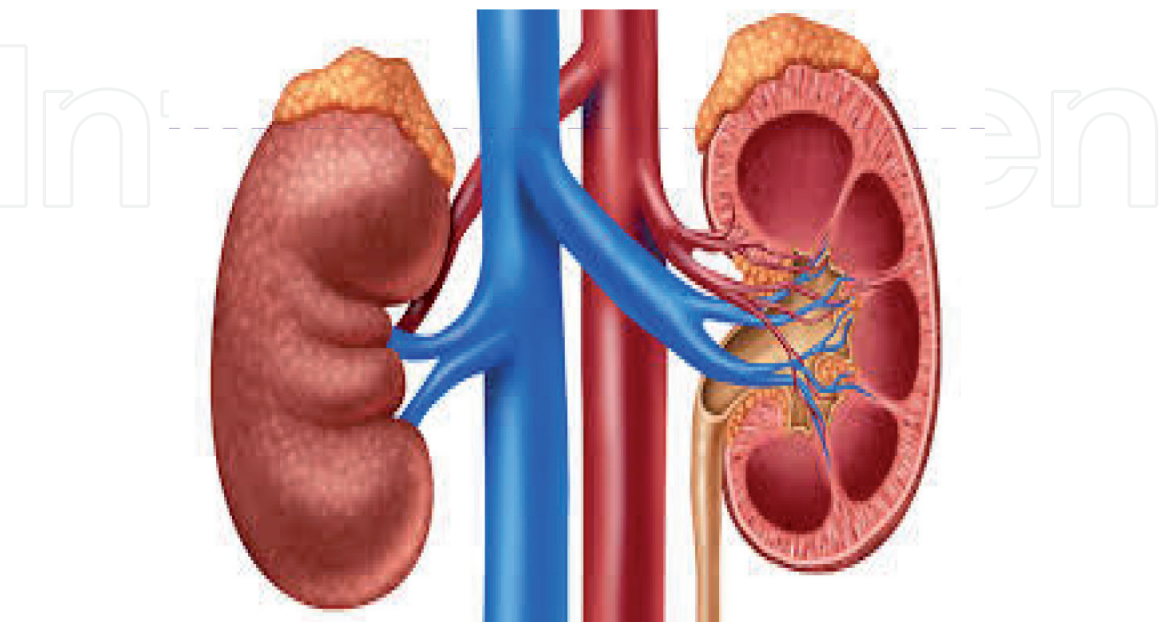
The changing scenario favoring NCDs can primarily be contributed to sedentary lifestyle and rapid population aging especially in developing countries like India. Diseases like cardiac problems, cancers, diabetes, psychiatric disorders, and chronic respiratory diseases have seen an exponential increase in recent times and have become the leading causes of death globally killing more people each year than all other causes combined [2, 3]. As per the Global Burden of Disease Study for 1990, noncommunicable diseases ranked first as the cause of death in developed countries as well as in many developing countries and the world as a whole. Hence, common

risk factor approach addressing the problems and issues connected with noncommunicable diseases can influence the major health gains worldwide [3, 4].



2. Kidney diseases

Kidneys play one of the vital roles in human beings as excretory organs. Their major functions include excretion of metabolic wastes, electrolyte regulation, and endocrine regulatory functions. Each human kidney is composed of about one million anatomical and functional units called nephron which is further composed of glomerule and tubule. Renal diseases pose a major health problem of modern world [5]. Compromised renal function might lead finally to renal failure which is characterized by the loss of functional capacity of nephrons associated with reduced glomerular functional rate [6]. The most frequent etiology of chronic renal failure includes diabetes mellitus, hypertension, glomerulonephritis, polycystic kidney disease, and pyelonephritis. Previously, glomerulonephritis was known to be the main cause of chronic renal failure; however, now diabetes mellitus and hypertension are the etiologic factors of the disease today which are considered to have genetic origin mostly [7, 8].



Transplantation is the ideal treatment for patients with end-stage renal disease. But, due to limited availability of matched donors for kidney transplantation, there has been an increased focus on alternative treatment modalities like hemodialysis

and peritoneal dialysis. In the last three to four decades, improvements in dialysis and transplantation have reduced morbidity and mortality among patients with end-stage renal disease.

3. Hemodialysis and oral health

Hemodialysis treatment modality is usually prescribed for prolonged duration with weekly frequency of once, twice, or more than twice a week, thus, creating a stressful environment for the patients [9]. This long-standing treatment modality has affected the survival rate among the patients positively. However, the chronic condition might influence the incidence of other systemic diseases in these patients primarily due to the lack of their ability to control water and electrolyte balance and filtrate waste products [10].

Further, oral health among these patients undergoing hemodialysis has been reported to be poor primarily due to their delicate state, neglect of oral hygiene, manifestations of systemic conditions, and immunosuppression [11, 12]. The specific effects of chronic renal disease and renal replacement therapy on periodontal tissues include gingival hyperplasia, increased level of plaque, calculus, and destructive periodontal disease. The findings have been reported by many studies [10, 13, 14]. It is interesting to note further that the dental diseases have coherent relation with the treatment duration of hemodialysis as well [8]. Very few studies have presented a cumulative data concerning the effect of duration of hemodialysis therapy on oral health of the patients undergoing hemodialysis. Hence the present chapter gives an insight of the oral health manifestations of hemodialysis and the underlying kidney disease correlating it with the duration of the treatment modality.



4. Influence of hemodialysis on oral health according to various studies

Hemodialysis has emerged as an optimum treatment modality for the patients with compromised renal function significantly reducing the mortality rate of these diseases. Researchers have provided with substantial evidence that chronic systemic diseases like renal failure and its treatment modalities have a significant effect on the oral environment resulting in an increased burden of oral diseases among these

S. No.	Oral findings in hemodialysis patients	Previous studies
1.	Debilitated periodontal status	1. Klassen and Krasko [7] 2. Bayraktar et al. [16] 3. Torkzaban et al. [10] 4. Joseph [13] 5. Dencheva [17] 6. Malekmakan [12] 7. Parkar et al. [11] 8. Bhatsange et al. [19] 9. Ziebolz et al. [20] 10. Jenabian et al. [8] 11. Kaushik et al. [21] 12. Jain et al. [23]
2.	Poor dental caries status	1. Dumitrescu et al. [18] 2. Ziebolz et al. [20]
3.	Poor oral hygiene behavior	1. Klassen and Krasko [7] 2. Dumitrescu et al. [18] 3. Xie et al. [22]
4.	Neglected oral health care seeking behavior among hemodialysis patients	1. Klassen and Krasko [7] 2. Dumitrescu et al. [18] 3. Xie et al. [22] 4. Jain et al. [23]
5.	Increased salivary buffer capacity	1. Ertugrul [14] 2. Kaushik et al. [21]

Table 1.
Oral health and hemodialysis: summary of literature review.

patients [2, 10, 11]. An insight into the various studies conducted worldwide would help us understand the topic (**Table 1**).

1. **Klassen and Krasko** [7] conducted a study to assess the dental health of dialysis patients. A questionnaire and a noninvasive oral examination were obtained from hemodialysis and peritoneal dialysis patients registered in the dialysis program at St. Paul’s Hospital in Saskatoon, Saskatchewan. A detailed medical history was obtained and recorded of a total of 373 dialysis patients in Central and Northern Saskatchewan. The clinical examination revealed that 64% of the patients who were dentate had been on dialysis for a mean of more than 2 years. Majority of the patients were diabetic, and almost all were hypertensive. Sixty (64%) of the dentate patients were candidates for kidney transplantation. The oral findings revealed an increased prevalence of tooth mobility, fractures, erosion, attrition, recession, gingivitis, and a high plaque index. Majority of the patients reported brushing once or more daily, but they flossed infrequently or never. Dental visits were infrequent, less than every 5 years in 59 (63%) of the dentate patients. Almost 81% of the treating dentists were aware about the medical condition of their patients. The author has concluded that the oral health of hemodialysis patients was compromised and required urgent attention and intervention.
2. **Ertugrul** [14] assessed the oral health status of children suffering from end-stage renal disease identifying the causes of low caries prevalence in this population in comparison with the control group. The study group consisted of 38 children, aged 4–17 years being treated in pediatric nephrology units at three different hospitals in Izmir, Turkey. The study and control groups had similar baseline oral hygiene habits with respect to daily tooth brushing

frequency and periodic dental checkup frequency. Oral examination findings indicated severe enamel hypoplasia in the study group with significant difference for DMFT and gingival and plaque indices when compared with the control group. It was further observed that study group showed high salivary buffer capacity in 89.5% of patients. Salivary levels of cariogenic streptococcus mutans and lactobacilli in the study group were significantly lower than in the control group. It was concluded that high salivary buffer capacity was observed due to increased concentrations of antibacterial chemicals such as urea in the saliva of children with ESRD. Also decreased levels of cariogenic microorganisms were detected. Thus, the authors suggested that all hemodialysis patients should receive dental health education, including oral hygiene instruction, in order to improve their overall oral health.

3. **Marakogolu et al.** [15] **carried out a study** to assess the microbial dental plaque load among the patients undergoing hemodialysis. For clinical parameters, gingival Index (GI), plaque index (PI) scores, and probing depths (PD) were recorded for hemodialysis patients and controls matched with the patient group. However, the results showed no statistically significant difference regarding clinical parameters between the two groups attributed mostly to the small sample size evaluated.
4. **Bayraktar et al.** [16] compared the periodontal and oral health status of hemodialysis patients and healthy controls. Seventy-six hemodialysis patients and 61 controls were examined for plaque deposits, gingivitis, periodontitis, calculus accumulation, and oral health status. The results showed no statistical difference in the probing pocket depths (PPD) but a highly significant difference for plaque index ($P < 0.001$), gingival index (GI) ($P = 0.007$), and calculus surface index ($P < 0.001$). There was a highly significant difference for GI ($P = 0.001$) and PPD scores ($P < 0.001$) between subgroups receiving hemodialysis 3 years or more. A positive correlation between time on dialysis and parameter of missing teeth, GI scores, and measurement of PPD was found in the patient group. The hemodialysis group showed less DMFT than the controls.
5. **Torkzaban et al.** [10] conducted a survey to assess the prevalence of periodontal disease and its related characteristics in 31 hemodialysis patients from the dialysis department of educational Ekbatan Hospital in Hamadan. Clinical parameters that were assessed were periodontal disease index (PDI), papillary bleeding index (PBI), and plaque control record index (PCRI), and medical history was recorded. Then, the recorded data were analyzed. It was observed that all hemodialysis patients had periodontal disease. Plaque control record index was higher than 50% in nearly all patients. Despite the high accumulation of plaque in the patients, the rate of gingival bleeding was low. Also, it was observed that more than half of the patients did not brush their teeth. Renal transplantation patients had a lower plaque accumulation than the others, and consequently periodontal disease was less observed. Periodontal condition debilitated with the duration of hemodialysis.
6. **Joseph** [13] carried out a study with an aim to assess the prevalence of periodontal disease among a group of patients with renal disease and healthy controls. A total of 77 renal disease patients and 77 healthy controls were examined for clinical parameters like oral hygiene status, gingival inflammation, probing pocket depth, and clinical attachment loss. Periodontal findings

were grouped into three as no/mild, moderate, and severe periodontitis. All periodontal parameters were significantly high in patients as compared to controls ($p < 0.001$). The prevalence and severity of periodontal disease was also significantly higher in the case group ($p < 0.001$). This study provides evidence for a greater prevalence and severity of periodontal disease among patients with renal disease. The periodontal health of all patients with renal disease needs to be carefully monitored.

7. **Dencheva** [17] conducted a study to estimate the periodontal conditions and treatment needs by CPITN of 150 patients out of which 45 (30%) were on hemodialysis, 45 (30%) were renal transplanted patients, and 60 (40%) were healthy controls, aged between 18 and 84 years. All patients were asked not to brush their teeth before the examination. Periodontal examination was done after dialysis. The results showed that CPI score 3 and CPI score 2 in the control group were more significant than those in hemodialysis groups and transplanted group. Sixty percent from transplanted group have gingival pockets of up to 3.5 mm and sub- and/or supragingival calculus. The percentage of patients with code CPI 3 is also high and shallow. Most patients in control group (71%) were with CPI 2. None of the three groups of patients with healthy periodontium in all sextants existed.
8. **Dumitrescu et al.** [18] assessed oral health status and behaviors among Romanian adult individuals on renal dialysis along with self-reported anxiety, stress, and depression level. A cross-sectional study was conducted on a total sample size of 61 adults (mean age 53.9 years; 44% women; 66% married). The questionnaire included information about sociodemographic factors, behavioral factors, self-reported oral health status, anxiety, stress, and depression. The clinical parameters revealed that 99.4% of the participants reported to have current non-treated caries, 94.4% were not satisfied by appearance of own teeth, 97.5% presented extracted teeth, and 64.6% of them reported to have gum bleeding. 34.5% of the individuals brushed once a day or less, 92.5% of them never used dental floss, and 78.3% never used mouth rinse. Regarding oral hygiene practices, only 13% of participants availed dental treatment services, and 89.4% had consulted the dentist only when treatment is needed or when in pain. The main reasons for non-consultation from a dentist were anxiety and financial roadblock. A high percentage of dialysis patients presented anxiety (85.1%), stress (60.9%), and depression in everyday life (61.5%). Duration of hemodialysis did not affect the clinical oral parameters examined. The results supported the view that there was an increased risk for anxiety, stress, depression, and impaired dental/gingival health and behaviors among individuals on renal dialysis. Early dental treatment and psychological interventions were recommended.
9. **Malekmakan** [12] aimed to assess the oral health status and related risk factors in Iranian hemodialysis patients. Sociodemographic information, medical history, and dental health findings were recorded for 72 patients (mean age and HD time of 53.4 ± 15.3 years and 36.9 ± 33.8 months, respectively). The results showed that 48.6% of the patients complained of dry mouth, 49.3% of taste change, and 31% of bad breath. A high 46.9% of the hemodialysis patients had dental calculus. The mean DMFT score was 18.6 ± 9.9 . The authors observed that DMFT score was significantly lower in patients with dental calculus than in patients without it ($P = 0.001$).

10. **Parkar et al.** [11] assessed the periodontal status of patients in hemodialysis patients in two super specialty renal institutes in Gujarat, India, through a cross-sectional study in 152 hemodialysis patients and 152 controls. Clinical parameters were evaluated through simplified oral hygiene index, community periodontal index (CPI), and loss of attachment (LOA) as per WHO methodology 1997. The findings of the study highlighted that the dialysis group had compromised oral hygiene than controls ($P < 0.001$). There was a high severity of periodontitis in the dialysis group as compared with the control group ($P < 0.001$). None of the subjects had healthy periodontium. There was a high severity of periodontitis (for both in terms of CPI and LOA) in the dialysis group as compared with control group that was found to be statistically highly significant ($P < 0.001$). For the intergroup comparison for CPI and LOA, there was no statistical significant difference regarding the periodontal findings. It was thus concluded that periodontal diseases are prevalent in chronic renal failure patients emphasizing the need for concurrent dental treatment among these patients.
11. **Bhatsange et al.** [19] conducted a study to gain an insight into whether duration of dialysis therapy influences the oral and periodontal health of hemodialysis patients. A total of 75 hemodialysis patients and 25 controls was assessed. Depending upon the duration of dialysis, the study groups were divided into three subgroups. Simplified oral hygiene index and periodontal disease index by Ramfjord were recorded. The results showed that the prevalence of periodontal disease was evident in the dialysis group. Oral hygiene status was poor in comparison with the control group. Clinical and biochemical parameters showed a statistically significant difference between the groups rather than within the groups.
12. **Ziebolz et al.** [20] evaluated oral hygiene behavior and oral health status of hemodialysis patients in Germany. Dental examination findings consisted of DMFT and the degree of gingival inflammation (PDI: periodontal disease index) among 129 patients. The findings revealed the average dialysis duration was 4.1 years. The underlying kidney diseases were glomerulonephritis in 30% of patients and diabetic nephropathy in 22% of patients. Only 63% of the patients ($n = 34$) visited a dentist when they had complaints. In 46 cases (85%), the dentist had been informed about the patient's requirement for dialysis, and in most cases (70%), the dental treatment took place on the day after dialysis. The clinical parameters showed that the mean DMFT of the patients was 22.1 ± 6.5 . The median degree of gingival inflammation (PDI) was 1. In addition to a high proportion of missing teeth, a good level of restoration of caries was found. The gingiva showed only a low level of inflammatory changes.
13. **Jenabian et al.** [8] assessed the periodontal status of hemodialysis patients in Babol, Northern Iran. A total of 115 patients were studied (63 males, 52 females). The clinical parameters which were assessed were plaque index (PI), gingival index (GI), clinical attachment level (CAL), and probing pocket depth (PPD). The data were collected and analyzed. The results showed that PI, GI, CAL, and PPD scores were 2.37 ± 0.55 , 2.36 ± 0.63 , 3.98 ± 1.61 , and 4.41 ± 1.4 , respectively. It was observed that the PI scores deteriorated with increasing age ($p < 0.024$). Also, CAL was significantly higher in males than in females (4.39 ± 1.57 vs. 3.53 ± 1.56 , $p < 0.02$). The results showed that longer duration of hemodialysis is associated with severe periodontal diseases, especially in males.

14. **Kaushik et al.** [21] assessed the changing oral and salivary environment in patients suffering from end-stage renal disease (ESRD) and undergoing hemodialysis. A cross-sectional study was conducted on 100 ESRD patients over a period of 15 months out of which 25 patients were randomly selected to assess the salivary changes and compared with 25 controls. The study showed that most common oral manifestations in these patients were oral malodor, dry mouth, taste change, increased caries incidence, calculus formation, and gingival bleeding. The salivary findings revealed that the rates of both unstimulated and stimulated whole saliva decreased in patients; however, pH and buffer capacity of unstimulated whole saliva increased. The authors have suggested that ESRD patients undergoing hemodialysis require special considerations during dental treatment as they have varied oral manifestations primarily due to their treatment modality.
15. **Xie et al.** [22] evaluated oral health status and oral hygiene behavior among hemodialysis patients in China. Caries status was examined and recorded along with the sociodemographic information of 306 patients, aged 24–88 (58.09 ± 14.06). It was interesting to note that that majority of the patients followed good oral hygiene practices and brushed their teeth twice daily. However, limited use of other oral hygiene aids like floss or mouth wash was reported. The oral health treatment seeking behavior was compromised since the commencement of hemodialysis therapy. The mean DMFT scores of the patient were 9.63 ± 7.54 . It was concluded that hemodialysis therapy seemed to prevent patients from visiting a dentist and there was a great need for dental treatment among these patients.
16. **Jain et al.** [23] conducted a study to assess the effect of duration of hemodialysis and the underlying kidney disease on the dental health status of patients undergoing hemodialysis and to compare their dental health status with that of healthy controls. A cross-sectional study was conducted on 400 patients and 400 controls selected through stratified random sampling method from five zones of Delhi. Based on the duration of hemodialysis, the patient group was divided into subgroups ranging from less than 3 months to more than 12 months. The complete oral health status was recorded using the WHO dentition status and treatment need, community periodontal index, oral hygiene index, and prosthetic status and prosthetic needs. It was observed that with increasing duration of hemodialysis, periodontal status worsened as per maximum CPI scores (p value = 0.018). Majority of patients (81.25%) reported the presence of calculus. It was interesting to observe that the severity of periodontal disease was higher among the patient group (p value 0.035). Oral hygiene status was also compromised among patients (mean OHI scores 5.15 ± 1.975). No significant difference was observed regarding caries status among patients and controls. Prosthetic needs were higher among patients. It was thus concluded that the duration of hemodialysis had a significant influence on oral hygiene status and prosthetic needs signifying the need of preventive dental treatment.

5. Discussion and summary

The present chapter highlights the fact that oral health status is debilitated and compromised among the hemodialysis patients and gets worsened with increasing

duration and hemodialysis and underlying kidney disease which might contribute significantly to morbidity and potential mortality among these patients. This further emphasizes the concept of common risk factor approach with multidisciplinary patient care approach.

The dental health is compromised in patients undergoing hemodialysis therapy, and with the increasing duration of hemodialysis, various clinical oral health-related parameters get worsened with increasing duration of hemodialysis. The chronic disease condition and time-taking treatment (hemodialysis) affect the oral health-care habits resulting in poor periodontal condition among the patients. The psychological effect of long-standing kidney diseases resulting in high stress level and depression in hemodialysis patients compromises the periodontal health further. Hence, oral health promotive and preventive intervention early in the hemodialysis patients can influence the oral health status positively.

This warrants the need for intensified preventive oral health-care modalities in these patients, so as to improve their dental health which can have a significant impact on their overall health. The dialysis team should be encouraged to make the dental referral as early as possible, if needed, and regular monthly dental checkups should be advocated. Further emphasis on the effective implementation of oral health promotion program for medically compromised patients is recommended. Oral health education and counseling regarding oral health-care-seeking behavior during the hemodialysis appointment can motivate and educate patients along with their family members. At the same time, dental fraternity should receive appropriate training for treatment of these medically compromised patients to cater to the needs of this special group.

Analysis of the effect of duration of dialysis on the periodontal tissues did not show confirmatory relationship. However the frequency of hemodialysis has a significant influence on the periodontal status of the patients with a deteriorated CPI scores with the increased frequency of hemodialysis from once to twice and more than twice a week.

Also, there is a significant existence of higher prosthetic needs concerning to mouth among the patients undergoing hemodialysis. Hence, oral health-care delivery system may be strengthened to cater to the prosthetic needs of these patients as well. Increased prosthetic needs of the patients with the duration of dialysis might be attributed to the dental care denial by the dental practitioners owing to their compromised medical status.

The hemodialysis patients usually report poor oral hygiene. These patients exhibit immunocompromised state although they are not completely immune deficient and are still able to deal with bacterial challenge. The patients with chronic kidney disease showed poor oral hygiene which could probably be due to long-standing disease duration leading to a debilitated oral hygiene. Further there is high deposit of calculus on teeth due to uremic salivary pH in hemodialysis patients.

Majority of the hemodialysis patients suffer from diabetic nephropathy and have strict dietary pattern. Further, increased alkalinity of the oral cavity is reported in the uremic patients as a result of high urea level in saliva inhibiting bacterial growth and increasing salivary buffer capacity [23].

Further studies are required to correlate the dental findings with the biochemical serum markers over a duration of time so as to validate the influence of duration of dialysis therapy on dental health.

The current chapter highlights the relation between oral health and hemodialysis. This further necessitates more interdisciplinary research on this topic. Medical and dental health-care professionals need to join hands and work together ensuring optimum patient care.

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