

# Comparison of Systemic Oral Malodor in Patients Undergoing Hemodialysis and Peritoneal Dialysis\*

Taner Arabacı<sup>1</sup>, Gülnihal Emrem Doğan<sup>1</sup>, Mustafa Keleş<sup>2</sup>, Alper Kızıldağ<sup>1</sup>

## ABSTRACT

Chronic renal failure is one of the major cause of systemic oral malodor depending on uremia. Hemodialysis(HD) and peritoneal dialysis (PD) are the important procedures in the management of patients with end-stage renal disease(ESRD). In this study it was aimed to compare the systemic oral malodor in patients undergoing HD and PD. 74 patients (40 HD and 34 PD) recently diagnosed with ESRD were selected. This study were not included the patients with poor oral hygiene and had oral malodor depending on any intraoral etiology such as caries, periodontal disease and impacted teeth. Oral hygiene index(OHI) scores of the patients were calculated in to order assess oral health. Systemic oral malodor of the patients were calculated in order assess oral health. Systemic oral malodor of the patients were evaluated using organoleptic method. All measurements were performed pre-dialysis and post-dialysis (3 months after therapy) procedures. There were no statistically significant difference between the groups according to OHI scores ( $p>0.05$ ). The Oral malodor scores were found lower at post dialysis measurement than the baseline measurements in both group( $p<0.05$ ). The results of the organoleptic measurements indicated that systemic oral malodor were higher in HD group ( $2.67\pm0.81$ ) compared to PD group ( $1.98\pm0.57$ ) ( $p<0.05$ ). This study revealed that PD was more effective than HD in decreasing of systemic oral malodor in ESRD patients.

**Key words:** Halitosis, hemodialysis, peritoneal dialysis.

## Hemodiyaliz ve Periton Diyalizi Hastalarında Halitozisinin Karşılaştırılması

### ÖZET

Kronik böbrek yetmezliği üremiye bağlı kötü ağız kokusu oluşturan sebeplerin başında gelir. Hemodiyaliz (HD) ve periton diyalizi (PD) son dönem böbrek yetmezliği (SDBY) hastalarının idamesinde önemli tedavi prosedürlerindedir. Bu çalışmada HD ve PD terapisindeki hastaların kötü ağız kokularının karşılaştırılması amaçlanmıştır. Çalışmamıza SDBY teşhisi konulan 74 hasta (40 HD ve 34 PD) dahil edildi. Ağız hijyeni zayıf ve intraoral sebeplerden dolayı kötü ağız kokusu oluşturabilecek, çürük, periodontal hastalık ve kalmış kökleri olan hastalar çalışmaya dahil edilmedi. Oral hijyen indeksi (OHI) hastaların oral sağlık durumlarının değerlendirilmesi için kaydedildi. Hastaların sistemik nedenli kötü ağız kokusu oral sağlığın değerlendirilmesi için kaydedildi. Hastalarda sistemik nedenli kötü ağız kokusu seviyesi organoleptik metodla ölçüldü. Bütün ölçümler hastalar diyaliz terapisi almaya başlamadan ve diyaliz terapisinden 3 ay sonra gerçekleştirildi. Hastaların OHI istatistiksel olarak anlamlı farklılık göstermemekteydi ( $p>0,05$ ). Her iki grubun kötü ağız kokusu skorları diyaliz terapisinden sonra diyaliz terapisinden önceki değerlerine göre anlamlı derecede azalma gösterdi ( $p<0,05$ ). Organoleptik metodla ölçtüğümüz sistemik nedenli kötü ağız kokusu skorlarının HD grubunda ( $2,67\pm0,81$ ) PD grubuna göre daha yüksek olduğu görüldü ( $1,98\pm0,57$ ) ( $p<0,05$ ). Bu çalışma SDBY hastalarında PD terapisinin sistemik nedenli kötü ağız kokusunu azaltmada HD'ye göre daha etkili olduğunu göstermektedir.

**Anahtar kelimeler:** Ağız kokusu, hemodiyaliz, periton diyalizi

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<sup>1</sup>Ataturk University, Faculty of Dentistry, Department of Periodontology, Erzurum,  
<sup>2</sup>Ataturk University, Faculty of Medicine, Department of Nephrology, Erzurum,  
Turkey

**Correspondence:** Mustafa Keles, MD  
Ataturk University, Medical Faculty, Department of Nephrology 25240 Erzurum,  
Turkey  
Telephone: +90-442-3447250 Fax: +90-442-2361301  
E-mail: keles.m@gmail.com

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## INTRODUCTION

In describe of unwanted breath halitosis, oral malodor or bad breath terms can be used. Halitosis is a widespread complaint among adults all over the world. Studies reported that prevalence of halitosis ranging from 22% to more than 50%. Halitosis has multifactorial etiology; extrinsic and intrinsic factors play a role in the etiology of halitosis (1,2). Extrinsic factors consist specific food, alcohol, tobacco and specific spices. Intrinsic factors consist both systemic and oral factors (1). Halitosis may derived from periodontal disease, peri-implant disease, pericoronitis, low salivary flow rate, oral mucosal ulcerations, defective dental restorations, necrotic tooth pulps, a tongue coating (3-12). In 90% of halitosis case intraoral factors are reason. A clinical evaluation of halitosis on Belgium, indicated that 76% of these patients had oral reasons; gingivitis/periodontitis (11%), a tongue coating (43%) or a combination of the two reasons (13). However 10% of cases derived from systemic factors (3,14,15). Systemic factors consist nonpathologic and pathologic factors (1). Systemic factors include diabetes mellitus, destruction of the liver and renal failure. Diabetic ketoacidosis causes to typical breath odor (16). Diabetic patients have sweet or fruity odor of acetone (17,18). However liver failure leads to mostly or rarely sulfurous odor (18). And one third of patients receiving hemodialysis have ammonia-like oral odor (19). This malodor in renal disease patients can be associated with low salivary flow rates and high blood urea nitrogen levels. Peritoneal dialysis (PD) can reduce this problem (20). However the effect of Hemodialysis (HD) on oral malodor is unknown. So we aimed to was investigate and compare the systemic oral malodor in patients undergoing HD and PD before and after the treatment.

## MATERIALS AND METHODS

A total of 74 patients (40 HD and 34 PD patients); recently diagnosed with ESRD were recruited from the Department of Nephrology, Faculty of Medicine, Atatürk University, Turkey. All patients in this study were recently diagnosed with ESRD and had recently initiated PD or HD. Before enrollment, each patient consented to a review protocol. All procedures followed the tenets of the Declaration of Helsinki and the study protocol was approved by the Local Ethics Committee of Atatürk University.

In this study, the twin-bag system was employed in all patients and different kinds of PD fluid (Baxter Healthcare and Fresenius Medical Care) were used. All patients were on continuous ambulatory PD. All of HD patients were on standard HD therapy as 4 hour 3 times a in a week. Patients that were taking medications including tricyclic antidepressants, anticholinergics, antihistamines, and beta-blockers, receiving radiation therapy, or using any tobacco or alcohol products were excluded from this study. Also, patients with sinusitis, nasal septal deviation, lower respiratory tract infection, gastric reflux, liver failure, or diabetes mellitus were excluded from this study. All patients received oral hygiene education 15 days before PD and HD therapy as a standard procedure. In the initial examination, we first eliminated possible oral factors causing halitosis, such as periodontal problems and dental decay. After this elimination, we evaluated dental health just before measuring halitosis levels. Assessment of dental health consisted of two parts: decayed, missing, and filled teeth (DMFT) index for the incidence of dental caries and the Oral hygiene index (OHI). One examiner, who had been trained for caries and periodontal assessment, performed all the examinations (G.E.D.). Both dental examinations were performed using a mouth mirror and a Williams periodontal probe, to determine the periodontal index. For the examination of DMFT caries index, the examiner recorded sum of the teeth as decayed (D), missing (M), and filled (F) according to the WHO criteria for each patient. OHI is the sum of Debris index and Calculus index. In the debris index, soft deposits were used (21). This is a well-validated index of dental plaque that has been used in dental research for more than 40 years. The categories are as follows: 0=No debris or stains present, 1=Soft debris covering not more than one-third of the tooth surface or presence of extrinsic stain, 2=Soft debris covering more than one-third but not more than two-thirds of the tooth surface, 3=Soft debris covering more than two-thirds of the tooth surface. In calculus index, 0= No calculus present, 1= Supragingival calculus covering less than third of the exposed tooth surface, 2= Supragingival calculus covering more than one third but not more than two thirds of the exposed tooth surface or the presence of subgingival calculus around the cervical portion of the tooth or both, 3= Supragingival calculus covering more than two third of the exposed tooth surface or a presence heavy band of subgingival calculus around the cervical portion of the tooth or

both. The DMFT index and OHI were calculated before and after PD and HD therapy. We used the organoleptic scale described by Rosenberg and colleagues to measure halitosis (22). The organoleptic scale ranges from 0 to 5, where 0 = no odor, 1 = barely noticeable odor, 2 = slight but clearly noticeable odor, 3 = moderate odor, 4 = strong odor, and 5 = extremely foul odor. All patients were required to refrain from eating and drinking 8 hours prior to the test and to avoid eating garlic and onions within 24 hours before the assessment. They were also asked to abstain from tooth brushing, using toothpaste, mouthwash, breath fresheners, scented cosmetics, or grooming aids on the morning of testing. All subjects were tested within a few consecutive days between 08:00 and 09:00 hours. The organoleptic evaluation panel consisted of 3 researchers that were professionals in oral health. The researchers were blinded to the status of PD and HD. Further, the organoleptic test was conducted using a screen that concealed the researchers from the individuals (to avoid the influence of individuals' appearance on judgment) and a sterile glass tube (10 cm in length and 2 cm in diameter), which was fitted into a hole in the screen. Each patient was requested to close his/her mouth for 1 to 2 minutes prior to sampling and place about 4 cm of the glass tube into his/her mouth, then slowly exhale his/her breath through the glass tube. This step was repeated during each test. Three researchers assessed halitosis levels individually and each was blinded to the other researchers' decisions. Organoleptic scores were recorded on an ordinal scale independently by each researcher. The average of scores was calculated.

### Statistical Analyses

Data are presented as frequencies, percentages, means, and standard deviations. Statistical analyses were carried out using SPSS 15 statistical software (SPSS Inc., Chicago, IL, USA). Halitosis, DMFT index, and OHI values

obtained before and after PD and HD therapy were compared by paired t-test. The halitosis scores measured by each researcher were compared by Friedman variance analysis. Pearson's correlation analysis was done to compare halitosis with OHI and DMFT. The level of significance was set to  $p < 0.05$ .

### RESULTS

A total of 74 (39 females, 35 males; age range: 22-55 years, mean age:  $41 \pm 9$  years) individuals were evaluated. The causes of renal failure included hypertension (37.2%), chronic interstitial nephritis (22.3%), glomerulonephritis (18.6%), amyloidosis (7.5%), polycystic kidney disease (4.8%), and unknown (9.5%). Mean levels of DMFT, OHI and patients' halitosis scores were  $15.5 \pm 4.2$ ,  $4 \pm 0.79$  and  $3.80 \pm 0.3$  respectively in patients of PD group. After 3 months of PD therapy, mean levels of DMFT, OHI and patients' halitosis scores were  $15.5 \pm 4.2$ ,  $2.4 \pm 0.68$  and  $1.98 \pm 0.57$  respectively. Compared with baseline levels, there were statistically significant decreases in patients' OHI and halitosis scores ( $p < 0.05$ ) (Table 1). There were no differences in DMFT index before and after PD therapy ( $p > 0.05$ ) (Table 1). Mean levels of DMFT, OHI and patients' halitosis scores were  $16.8 \pm 6.2$ ,  $4.4 \pm 0.8$  and  $4.1 \pm 0.5$  respectively in patients of HD group. After 3 months of HD therapy, mean levels of DMFT, OHI and patients' halitosis scores were  $16.8 \pm 6.2$ ,  $2.7 \pm 0.86$  and  $2.67 \pm 0.81$  respectively. Compared with baseline levels, there were statistically significant decreases in patients' OHI and halitosis scores ( $p < 0.05$ ) (Table 1). There were no differences in DMFT index before and after HD therapy ( $p > 0.05$ ) (Table 1). There were no statistically significant differences between researchers' halitosis scores before or after PD and HD ( $p > 0.05$ ). The reduction in halitosis level after receiving PD and HD was statistically significant ( $p < 0.05$ ). When we compared groups the re-

**Table 1.** Mean levels of DMFT, OHI and halitosis in Peritoneal dialysis and Hemodialysis patients.

	PD			HD		
	Before	After	p-value	Before	After	p-value
DMFT	$15.50 \pm 4.20$	$15.50 \pm 4.20$	$>0.05$	$16.80 \pm 6.20$	$16.80 \pm 6.20$	$>0.05$
OHI	$4.00 \pm 0.79$	$2.40 \pm 0.68$	$<0.05$	$4.40 \pm 0.80$	$2.70 \pm 0.86$	$<0.05$
Halitosis	$3.80 \pm 0.30$	$1.98 \pm 0.57$	$<0.05$	$4.10 \pm 0.50$	$2.67 \pm 0.81$	$<0.05$

DMFT: Decayed, missing, and filled teeth; HD: Hemodialysis; OHI: Oral hygiene index; PD: Peritoneal dialysis.

**Table 2.** Comparison of mean levels of DMFT, OHI and halitosis between Peritoneal dialysis and Hemodialysis patients.

	Before treatment			After treatment		
	PD	HD	p-value	PD	HD	p-value
DMFT	15.50±4.20	16.80±6.20	>0.05	15.50±4.20	16.80±6.20	>0.05
OHI	4.00±0.79	4.40±0.80	>0.05	2.40±0.68	2.70±0.86	>0.05
Halitosis	3.80±0.30	4.10±0.50	>0.05	1.98±0.57	2.67±0.81	<0.05

DMFT: Decayed, missing, and filled teeth; HD: Hemodialysis; OHI: Oral hygiene index; PD: Peritoneal dialysis.

duction in halitosis level after receiving PD and HD was statistically significant more in PD group than HD group ( $p < 0.05$ ) (Table 2). There is no significantly difference in DMFT index and OHI scores between the group, before and after the dialysis treatment ( $p > 0.05$ ) (table 2).

## DISCUSSION

Halitosis has a large social and economic impact. For the majority of patients suffering from bad breath is important. In general, intraoral conditions, like insufficient dental hygiene, periodontitis or tongue coating are considered to be the most important cause (85%) for halitosis (23). Non-oral causes of oral malodor have received attention in the dental literatures, particularly because of the clinical importance of early diagnosis. Chronic renal failure (CRF) is related a small but significant percentage of halitosis (1, 2). Renal impairment is normally a result of a chronic glomerulonephritis, which damage the glomerular function, leading to an increased urea level in the blood. Breathed air is described as ammonium-like breath and generally is accompanied by complaints of dysgeusia (salty taste) (24).

The primary reference standard for the detection of oral malodor is the human nose. Direct sniffing of expired air (organoleptic and hedonic assessment) is the simplest, inexpensive, no equipment needed and a wide range of odours detectable. Although the method presents several problems such as; the extreme subjectivity of the test, the lack of quantification, the saturation of the nose and the reproducibility (25). Although these disadvantages, still, organoleptic scoring is considered as the gold standard in the detection of oral bad breath and it is most common method to evaluate oral malodor. Before halitosis may be managed effectively, an accurate diagnosis must be achieved (26). Thus the treatment of this problem can resolve by physicians and/or dental clinicians (27, 28).

The first step in the treatment of oral malodor is to assess the patient for any oral diseases or conditions that may cause oral malodor (1). For disease-free people, current oral malodor treatment is based on the assumption that the malodor is the result of an overgrowth of oral microorganisms that produce offensive volatile compounds. If it is determined that the source of malodor is not in the oral cavity, the patient should be referred to a physician for treatment of any related systemic disease (1). In the present study, we first eliminated possible oral factors that can cause halitosis. After this elimination, we measured halitosis level related to ESRD.

We used OHI to evaluate dental hygiene. There were no statistically significant difference between the groups according to OHI scores. This can be because of both HD and PD patients perform resemble oral (self) care. The Oral malodor scores were found lower at post dialysis measurement than the baseline measurements in both group. Keleş et al. (20) observed that, as the BUN levels decreased, the severity of halitosis also decreased in a parallel manner. In dialysis patients a change in salivary composition regarding urea has also been reported (29, 30). Renal disease in the form of CRF is associated with high blood urea nitrogen levels and low salivary flow rates. PD can decrease this problem (20). Keles et al. (20) found, higher salivary urea values in the dialysis group than in the control group, thus supporting findings of Epstein et al. (30). Uremic odor could be associated with accumulation of urea in the saliva (19). Indeed, a higher incidence of uremic odor may correlate with higher urea in the saliva of CRF patients (29). The level of salivary urea, which may have supported this idea, was not included in this study and should be further investigated by other studies. Trimethylaminuria is a rare odor-producing metabolic disease with symptoms of dysgeusia (perversion of the sense of taste)/dysosmia (defect or impairment of the sense of smell) that are due to excess production of trimethylamine [(CH<sub>3</sub>)<sub>3</sub>N].

Uremia that is caused by kidney failure also produces (CH<sub>3</sub>)<sub>3</sub>N, along with dimethylamine (1). Dialysis involves the removal of urea and other toxic substances from the plasma as well as the correction of electrolyte imbalance. Of the two methods of dialysis, HD is the most commonly used method in which, blood is passed through an extra corporeal circuit and pumped across an artificial semi permeable membrane to bring the blood into contact with the dialysate. The second method is the intermittent and continuous ambulatory peritoneal dialysis (PD). This method utilizes the peritoneal membrane, as the semi permeable membrane, with capillaries on one side and high osmotic fluid infused into the peritoneal cavity on the other side. The peritoneal cavity is drained and the cycle is repeated after a suitable time to allow the equilibration of diffusible substances.

The results of the organoleptic measurements indicated that systemic oral malodor were higher in HD group compared to PD group. Both of the groups have sample OHI scores, so this can be because the effect of systemic urea on oral malodor. Both HD and PD treatment cause systemic changes, oral complications and alterations in salivary composition and output (30, 31). Keles et al. found that uremic patients had lower salivary flow rates, which were found to be related to halitosis. This may be the result of accumulation and putrefaction of oral epithelial debris, food, low oxygen concentration, reduced availability of carbohydrates as bacterial substrate, and high oral pH. Dysgeusia and uremic fetor, bad taste and odour are caused not only by xerostomia but also by the presence of urease-splitting oral organisms, which metabolize urea (present in high levels in these patients). This can be a factor in HD patients to have high malodor levels.

The prevention of oral malodor is very important in patients with CRF because it leads to discomfort and psychosocial embarrassment. Dentists, oral hygienists, and medical doctors can help uremic patients to reduce their level of halitosis. It may be achieved via PD and HD treatment by decreasing the BUN level. By this way, patients can feel better and more confident in their daily lives.

The present observations suggest that ESRD patients who takes dialysis therapy have high oral malodor levels before dialysis treatment. Also HD patients has high oral malodor scores than the PD patients. Because there were no significant differences between OHI, the ob-

served decrease in halitosis level may not be related to debris and oral situations, may be related urea level. Furthermore, PD and HD therapy may play an important role in decreasing the level of halitosis in such patients and PD is more effective in decrease of oral malodor levels than the HD.

#### Disclosures

The authors declare there is no conflict of interest in this manuscript.

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