

Effect of the Duration of Hemodialysis Treatment on Halitosis in Patients with Chronic Kidney Disease

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Abstract

Introduction: Unpleasant mouth odor, known as halitosis, is an oral manifestation commonly observed in patients with chronic kidney disease (CKD) undergoing hemodialysis treatment.

Aim of the Study: The aim of the present study was to determine the effect of the hemodialysis duration on halitosis in CKD patients.

Material and Methods: The study was targeted at 70 end-stage CKD patients from the northeast of Bulgaria, aged 32-89 years, undergoing chronic dialysis treatment of different duration. Halitosis was measured objectively as well as subjectively. The degree of halitosis was objectively recorded with FitScan Breath Checker (HC-212SF, Tanita Corporation, USA). The device measured the content of volatile sulfur compounds (VSCs) and hydrocarbons from the mouth-exhaled breath, taking readings in 5 degrees: 0 - no odor; 1 - slight odor; 2 - moderate odor; 3 - heavy odor; 4 - strong odor; 5 - intense odor. The subjective method entailed data collection by means of a questionnaire, asking the participants: "Do you have any complaints about bad breath in the mouth?" The answering options needed to be either Yes or No.

Results: The subjects were divided into 2 groups depending on the duration of the hemodialysis treatment they had underwent: Group 1 (dialysis treatment > 5 years) and Group 2 (dialysis treatment < 5 years). The FitScan Breath Checker found halitosis in all patients, where nearly half of them (48.60%, 34 patients) exhibited halitosis of the 4th degree. Patients with 2nd degree halitosis in Group 1 were found to be significantly more than patients from Group 2 (5:1.5 ratio), whereas in patients with the 5th degree halitosis the ratio was 1:5. A statistically significant positive correlation was established between the duration of hemodialysis and halitosis ($r_s = 0.28$, $p = 0.019$). However, there was no evidence of correlation between halitosis obtained with the FitScan device and the participants' subjective perception of bad breath ($\chi^2 = 3.807$, $p = 0.433$). There was no statistically significant dependence between the duration of treatment and the patients' subjective responses ($t = 1.525$, $p = 0.132$).

Conclusion: The duration of hemodialysis treatment proved to have a statistically significant effect on the objectively detected halitosis. There was no statistically reliable dependence between the subjective sense of unpleasant mouth breath and the objectively present halitosis.

Keywords: CKD; Duration of Hemodialysis; Halitosis; Objective and Subjective Study of Halitosis

Introduction

Chronic Kidney Disease (CKD) is a clinical laboratory syndrome occurring as a result of the progressive loss of kidney function leading to an impairment that develops over a period of months or years. It is characterized by a reduced glomerular filtration rate (GFR) and increased serum urea and creatinine levels. It manifests gradually over a long period of time and leads to terminal renal failure. Despite the serious health consequences the mild decline in renal function may be clinically inconspicuous. In the case of renal function loss of over 75 - 80%, the end stage of CKD takes place, requiring renal replacement therapy - peritoneal dialysis, hemodialysis or renal transplantation.

Hemodialysis is the most commonly used method in the life-saving treatment of end-stage CKD patients. Dialysis achieves the extracorporeal removal of waste products such as urea, creatinine, water and potassium from the blood. The principle of hemodialysis is diffusion of solutes through a semipermeable membrane. The procedure is normally carried out 3 times a week, with a duration of 4 hours (12 hours of dialysis a week). The dialysis time varies depending on the preserved residual renal function, waste quantity, salt level and body weight [1].

A typical oral manifestation in CKD patients, undergoing hemodialysis, is the unpleasant, specific mouth odor known as "uremic breath". There are a number of studies in the medical literature focusing on the negative effects of long-term dialysis on oral health of CKD patients. Apart from the kidney disease, the long-term renal replacement therapy itself is now perceived as having a negative impact on oral health and proves to be a contributing factor for the exacerbation of oral pathology in end-stage CKD patients [2-4].

Aim of the Study

The aim of the present study was to determine the effects of the hemodialysis duration on halitosis in CKD patients.

Material and Methods

The target of the study were 70 end-stage CKD patients from the northeast of Bulgaria, aged 32 - 89 years, undergoing hemodialysis treatment of different duration. 32 patients were men (45.71%), while 38 patients were women (54.29%), with a mean age of 60.66 years (SD = 14.46). The youngest participant was 32 years old and the oldest - 89 years old. All patients were treated at the Dialysis Clinic of St. Marina University Hospital in the city of Varna.

Halitosis was measured using 2 methods: an objective method (using a device) and a subjective method. The objective method involved data collection obtained by an electronic device, testing the absence or presence of halitosis and its degree. The objective finding was recorded using a FitScan Breath Checker (HC-212SE, Tanita Corporation, USA). The Breath Checker electronically detects the content of volatile sulfur compounds (VSCs), hydrogen sulphide (H_2S), methyl mercaptan (CH_3SH), dimethyl sulphide (CH_3-S-CH_3) and hydrocarbons in the mouth-exhaled breath, taking readings in 5 degrees:

- 0 - No odor
- 1 - Slight odor
- 2 - Moderate odor,
- 3 - Heavy odor,
- 4 - Strong odor
- 5 - Intense odor.

Operation of the device: After switching on the breath checker, the clinician waited a countdown of 5 seconds to clean the sensor until the device was ready for use. The patient then breathed into the designated openings at 1 cm away from the mouth until it beeped (Figure 1).



Figure 1: FitScan Breath Checker: the device in operational mode, objectively determining the degree of bad breath.

Subjective information was gathered on the patients’ complaints about unpleasant breath in the oral cavity. The survey consisted of general questions regarding the patient’s name, age and gender as well as the following question: “Do you have any complaints about bad breath in the mouth?” The answering options needed to be either Yes or No.

The statistical analysis was performed using SPSS Statistics software package for epidemiological and clinical research as well as frequency and percentage distribution of data, graphical representation of data, Pearson Chi-Square Test, etc.

Results

Contingent of patients: The duration of hemodialysis treatment of the patients under study ranged from 1 - 18 years. For the entire sample, the median duration of hemodialysis was 5 years. For the purpose of precise analyses the patients were divided in 2 groups:

- Group 1: Patients who had undergone hemodialysis for > 5 years.
- Group 2: Patients who had undergone hemodialysis for < 5 years.

Group 1 consisted of 36 participants (51%) while Group 2 included 34 participants (49%). The distribution of patients by gender and the duration of hemodialysis was presented in table 1.

Gender	Duration of hemodialysis				Total	
	> 5 years		< 5 years		Number	%
	Number	%	Number	%		
Men	20	28.57	12	17.14	32	45.71
Female	16	22.86	22	31.43	38	54.29
Total	36	51.43	34	48.57	70	100

Table 1: Frequency and percentage distribution of patients by gender according to the duration of hemodialysis.

The data on halitosis obtained from the device readings were presented in table 2. The study demonstrated that the values for the different degrees of objectively detected halitosis (Md = 4.00 (1.00 - 5.00) and X (± SD) = 3.39 (± 1.03)) were normally distributed as per Kol-

mogorov-Smirnov test (0.297, $p = 0.000$). All patients proved to have certain extent of halitosis. The smallest proportion of patients had 1st degree halitosis (4.3%, 3 patients). Nearly half of the patients under study (48.60%, 34 persons) displayed a 4th degree halitosis. There was a statistically significant difference between the patients from both groups who had 2nd and 5th degree ($p < 0.05$). The ratio between patients with 2nd degree halitosis from Group 1 and Group 2 was 5:1.5 whereas the ratio between patients with 5th grade halitosis was 1:5.

Degrees of halitosis	Duration of hemodialysis					Total	
	> 5 years		< 5 years				
	Number	%	Number	%	Number	%	
1 st	Men	0	-	0	-	0	-
	Women	2	2.9	1	1.4	3	4.3
	Total	2	2.9	1	1.4	3	4.3
2 nd	Men	5	7.1	2	2.9	7	10.0
	Women	5	7.1	1	1.4	6	8.6
	Tota	10	14.3	3	4.3	13	18.6
3 rd	Men	5	7.1	1	1.4	6	8.6
	Women	2	2.9	6	8.6	8	11.4
	Total	7	10.0	7	10.0	14	20.0
4 th	Men	9	12.9	7	10.0	16	22.9
	Women	7	10.0	11	15.7	18	25.7
	Total	16	22.9	18	25.7	34	48.6
5 th	Men	1	1.4	2	2.9	3	4.3
	Women	0	-	3	4.3	3	4.3
	Total	1	1.4	5	7.1	6	8.6
Total	Men	20	28.6	12	17.1	32	45.7
	Women	16	22.9	22	31.4	38	54.3
	Total	36	51.4	34	48.6	70	100.0

Table 2: Distribution of patients according to the degree of objectively detected halitosis and the duration of hemodialysis.

Further data analysis revealed a statistically significant positive correlation between the duration of hemodialysis and the extent of halitosis ($r_s = 0.28, p = 0.019$). Patients with longer duration of treatment had a higher degree of objectively established halitosis (Table 3).

Duration of hemodialysis	N	M	SD	t	p
Group 1 (> 5 years)	36	3.11	1.04	-2.388	0.020
Group 2 (< 5 years)	34	3.68	0.94		

Table 3: Effects of the duration of hemodialysis on the degree of halitosis.

There was a significant discrepancy between the patient’s subjective perception of bad breath and the objectively recorded halitosis. While the objective study revealed halitosis in all 70 patients (100%), halitosis was subjectively reported by only half of the participants (Table 4). Pearson’s chi-square test of independence showed that there was no link between the objective data on halitosis obtained from

FitScan Checker and the subjective perception of unpleasant breath ($\chi^2 = 3.807, p = 0.433$). The ratio between patients with 1st degree of objectively established halitosis and those who had not reported any bad breath was 3:0. For patients with 2nd, 3rd and 4th degree halitosis this ratio was 1:1.17, 1:1 and 1.13:1, respectively, while for patients with 5th degree of objectively detected halitosis, the ratio changed to 1:2. The data revealed that only in the cases of low-degree objective halitosis, CKD patients confirmed the subjective sensation of bad breath. The more severe the halitosis, the more patients lost the subjective sense of unpleasant mouth breath. Despite the tendency observed, the analysis did not prove a statistically significant correlation between the duration of hemodialysis and patients' subjective responses ($t = 1.525, p = 0.132$).

Degree of halitosis	Subjective perception of bad mouth breath				Total	
	Yes		No			
	Number	%	Number	%	Number	%
1 st	3	4.3	0	-	3	4.3
2 nd	6	8.6	7	10.0	13	18.6
3 rd	7	10.0	7	10.0	14	20.0
4 th	18	25.7	16	22.9	34	48.6
5 th	2	2.9	4	5.7	6	8.6
Total	36	51.4	34	48.6	70	100.0

Table 4: Comparative data on the objectively measured degrees of halitosis and the subjective perception of bad breath.

Discussion

Parkar, *et al.* [5] assessed the periodontal status of patients among a group of patients receiving hemodialysis by dividing them into 4 subgroups: (1) those that had been on dialysis for less than 3 months, (2) those that had been on dialysis for 4 - 6 months, (3) those that had been on dialysis for 7-9 months, and (4) those that had been on dialysis for 10 - 12 months. The aim of their study was to determine the effect of the duration of hemodialysis on the clinical periodontal status. The analysis of the effect of the duration of dialysis on the periodontal tissues of CKD patients showed no difference among the subgroups, which matched the results of Naugle, *et al.* [6], Marakoglu, *et al* [7].

In a 2005 study Davidovich, *et al.* [2] reported that the duration of end-stage renal failure and the type of systemic treatment had a significant influence on the oral condition. The authors found out that the dialysis duration and end-stage renal failure significantly correlated with the patients' oral manifestations.

In 2012 Sekiguchi, *et al.* [3] evaluated how oral health was affected by the length of time a patient had been receiving hemodialysis (HD) treatment. For this purpose the subjects were divided into 2 groups: Group L (subjects who had been on HD for less than 36 months), and Group M (those who had been on HD for more than 37 months). The group of subjects who had been on HD for more than 37 months had more periodontal disease and higher DMFT index scores, suggesting that the length of time on HD could negatively impact oral health.

Despite the abundant research on halitosis as a social and health issue, there are not many studies available exploring the dependence between halitosis and the duration of dialysis treatment. The reasons for this may be the shortened duration of replacement renal therapies nowadays and the increasing number of kidney transplants in the shortest possible timeframe. In 2011 Keles, *et al.* [8] examined the halitosis levels in 42 end-stage CKD patients before and after peritoneal dialysis (PD) therapy. The conclusions were that PD played an important role in decreasing the level of halitosis in those patients.

Conclusion

The duration of hemodialysis has a statistically significant effect on objectively established halitosis. Patients undergoing hemodialysis for over 5 years exhibit a significantly higher level of halitosis as measured by FitScan Breath Checker. There was no statistically reliable correlation between the subjective perception of unpleasant mouth breath and the presence of objectively proven halitosis.

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