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QUALITY OF SLEEP IN HEMODIALYSIS PATIENTS: THE ROLE OF DEMOGRAPHIC AND CLINICAL CHARACTERISTICS

KVALITET SNA KOD BOLESNIKA NA HEMODIJALIZI: ZNAČAJ DEMOGRAFSKIH I KLINIČKIH KARAKTERISTIKA

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Abstract

Introduction: Sleep disorders are common among patients treated with chronic dialysis. Still, these conditions are seldom diagnosed and often undertreated, because they are attributed to the renal disease itself and/or considered a reaction to dialysis treatment.
Aim: The aim of this study was to assess the prevalence of poor sleep quality and its relations with demographic and clinical characteristics of patients undergoing chronic hemodialysis (HD).
Material and Methods: A cross-sectional observational study was performed on 82 patients (49 men, mean age 64.77 ± 10.00 years, range 30-85) on HD maintenance in a University Hospital Center in Belgrade. Sleep quality was assessed with the Pittsburgh Sleep Quality Index (PSQI). Other relevant data were collected by general questionnaire and from patients' medical histories. Data were analyzed with Chi-square, Fisher and T test, using the SPSS (version 21.0).
Results: The mean PSQI was 6.74 ± 3.99. Poor quality of sleep (PSQI>5) was present in 47 (57.3%) patients. Patients treated with hemodiafiltration statistically more often had significantly better quality of sleep (p=0.047), whereas patients receiving dialysis treatment in the afternoon shift more frequently had poor quality of sleep (p=0.017). Age, sex, employment status, comorbidities, dialysis vintage and adequacy were not related to the quality of sleep significantly.
Conclusion: The type of dialysis treatment and dialysis shift are closely interrelated with the quality of sleep in patients on chronic HD treatment.

Keywords:
Quality of sleep,
Dialysis,
Hemodialysis

The authors declare no conflicts of interest.

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Sažetak

Uvod: Poremećaji spavanja često se javljaju kod bolesnika lečenih dijalizom. Ipak, ova stanja se retko dijagnostikuju i nedovoljno leče, jer se simptomi često pripisuju bubrežnoj bolesti i/ili reakciji na dijalizno lečenje.
Cilj: Cilj istraživanja bio je da se proceni prevalenca lošeg kvaliteta sna i povezanost lošeg kvaliteta sna sa demografskim i kliničkim karakteristikama bolesnika na hroničnom programu hemodijalize (HD).
Materijal i Metode: U opservacionoj studiji preseka uključena su 82 bolesnika (49 muškaraca, prosečne starosti 64,77 ± 10,00godina, opseg 30-85) lečeni hroničnim hemodijalizama u KBC „Dr Dragiša Mišović" u Beogradu. Za procenu kvaliteta sna korišćen je Pittsburgh Sleep Quality Index (PSQI). Drugi relevantni podaci prikupljeni su iz opšteg upitnika i iz medicinskih istorija pacijenata. Dobijeni podaci analizirani su $\chi 2$, Fišerovim i T testom, koriteći SPSS (verzija 21,0).
Rezultati: Prosečni PSQI bio je 6,74 ± 3,99. Loš kvalitet sna (PSQI > 5) bio je prisutan kod 47 (57,3%) bolesnika. Bolesnici lečeni hemodijafitracijom statistički značajno češće su imali bolji kvalitet sna, (p = 0,047), dok su pacijenti dijalizirani u popodnevnoj smeni imali znatno češće loš kvalitet sna (p = 0,017). Nasuprot tome, starost, pol, status zaposlenja, komorbiditeti, vreme lečenja dijalizom i adekvatnost dijalize nisu značajno uticali na kvalitet sna.
Zaključak: Vrsta dijaliznog tretmana kao i smena dijaliziranja su blisko povezani sa kvalitetom sna kod pacijenata na hroničnom tretmanu dijaliziranja.

Ključne reči:
kvalitet sna,
dijaliza,
hemodijaliza

Introduction

Chronic kidney disease (CKD) is becoming an increasing public health problem on a global level (1). Chronic renal disease represents damage of the structure or function of the kidneys that lasts longer than three months and/or reduction in glomerular filtration rate (GFR) below 60ml/min/1,73m2 (2). In a large number of cases, CKD remains unrecognized and untreated for a long time, progressing gradually and irreversibly to the terminal phase, when, in order to keep the patient alive, it is necessary to introduce hemodialysis (HD), peritoneal dialysis (PD) or kidney transplantation (3,4). The incidence of end-stage renal failure (ESRF) has grown exponentially in the last two decades. Around 2 million patients are currently treated with renal replacement methods worldwide (5). According to the latest available data, there were 5858 patients with ESRF in Serbia in 2014, treated mainly with HD (88.3%) and PD (10.7%) (6).

Clinical syndrome of ESRF is a result of the loss of complex ability of the kidneys to remove metabolic waste products and excess fluid, to regulate the acid-base balance, secrete erythropoietin and metabolize vitamin D. Therefore, it is manifested with a variety of symptoms, including cardiovascular, gastrointestinal, hematological, skin, hormonal and neurological.

Hemodialysis is a method of treatment of ESRF which compensates some of the kidney functions. It removes harmful products of metabolism, nitrogen compounds and excess fluid from the body, partially correcting electrolyte and acid-base composition of body fluids (4).

Adequate sleep is essential for good health. Sleep is a regenerative process necessary for normal functioning of all systems in the body. Studies have shown that the prevalence of insomnia, in the general population, varies widely from 4 to 64%, but when it comes to dialysis it is present in 45–69 % of patients (7, 8). Acute and chronic lack of sleep in the general population is related to hypertension and elevated parameters of inflammation, so they represent risk factors for cardiovascular morbidity (9).

The aim of this study was to assess the prevalence of poor sleep quality and its relationship with demographic and clinical characteristics of patients undergoing chronic HD.

Material and Methods

A cross-sectional observational study was performed, which involved all patients treated with chronic HD in a University Hospital Center in Belgrade. All subjects voluntarily gave their informed consent to participate in the study. The exclusion criteria were: HD less than 3 months and/or less than 3 sessions per week; hospitalization due to cardiac decompensation or complications related to dialysis, in the last 30 days prior to this study; a known diagnosis of neuropsychiatric disease; a stressful event (death or illness of a family member or a close friend, changing socio-economic status, divorce or break up, wedding, moving); and cognitive deficits.

Patients self-completed the general and Pittsburgh Sleep Quality Index (PSQI). PSQI is consisted out of 19 questions that generate data for 7 specific components of sleep: individual subjective assessment of sleep quality, latency, duration, efficiency and interruptions of sleep, use of sleeping medication, and daytime dysfunction in the last 30 days. Sleep latency is the time needed to fall asleep (normal value < 20 minutes). The duration of sleep is the exact number of hours spent sleeping (recommended >

7 hours), and sleep efficiency represents the ratio of the number of hours spent sleeping, as well as the total number of hours spent in bed during the night (the normal range is 80 to 95% and it decreases with age). Each of the components is evaluated on a scale from 0 to 3. The total sum of the components represents PSQI value for the patient and can vary from 0 to 21, where a higher value indicates poorer quality of sleep. The reference PSQI value for defining poor quality of sleep is > 5 (10). The original English version of PSQI was translated by a licensed professional translator for English language.

Other clinically relevant data were obtained from the medical records and electronic health records of patients.

Venous blood samples were taken for laboratory analyses before, and immediately after, the first week of HD treatment and analyzed at the Department of Laboratory Diagnostics of the University Hospital Center in Belgrade. Hemoglobin was determined on the hematology counter Sismex XS-1000i (Sysmex Corporation, Japan) using sodium lauryl sulfate cytometry.

The reference value for patients on HD is 110-112 g / dl (11). Hematocrit (HCT) was calculated by the following formula:

HCT = (MCV x erythrocyte count) / 10

Biochemical parameters were determined on an integrated biochemical analyzer - Dimension RKL Max (Siemens Healthcare GmbH, Germany). Index saturation of transferrin (Transferrin SaturationTSAT) was calculated by the following formula:

TSAT = (Fe + / TIBC) × 100% (normal range 20-40%)

The recommended value for ferritin in patients on HD is up to 200 ng / ml, (11) and for intact parathyroid hormone (iPTH) 2-9 times the reference values for the applied method (12).

All patients were dialyzed three times per week on machines, with controlled ultrafiltration, using the bicarbonate diylasate and polysulfonic dialyzers with high and low flux. The HD adequacy was assessed by the Kt/V index, according to Daugirdas's formula:

$$Kt/V = -\log\left[{}^{Upost}\!/_{Upre} - 0{,}008t\right] + \left[4 - 3{,}5\,{}^{Upost}\!/_{Upre}\right] \times {}^{(Wpre - Wpost)}\!/_{Wpost},$$

where : Upost - urea values after dialysis, Upre - values of urea before dialysis, Wpost - body weight after dialysis, Wpre - body weight before dialysis and t – dialysis time in minutes. The lowest acceptable Kt/V value for an adequate dialysis is 1.20.

Continuous variables are presented as mean and standard deviation, and categorical as numbers and percentages. The Student t test for independent samples was used to test the difference of means of continuous numerical data. The significance of the difference in frequency gradation characteristics were evaluated with Pearson $\chi 2$ test. In situations where, due to numerical limitations, it was not possible to apply $\chi 2$ test, we used Fisher's exact probability test. Statistical analysis was performed using the appropriate module within the software package SPSS 21.0, Microsoft. p value less than 0.05 was considered as statistically significant.

Results

From a total of 90 patients dialyzed at the Department of hemodialysis in a University Hospital Center in Belgrade at the time of the research, 7 did not meet the criteria for inclusion in the study (2 were dialyzed 2 times a week; 2 had cardiac decompensation or complications related to dialysis in the last 30 days prior to this study; 2 had experienced a stressful event and one had a cognitive deficit). Out of 83 filled in questionnaires, only one was subsequently rejected as inadequately completed. The final number of participants was 82 (49; 59.8% men). The demographic characteristics of the examined population and the incidence of underlying renal disease are presented in **Table 1**. Only 5 patients (6.1%) were employed. Twenty patients (24.4%) identified themselves as current smokers, while 46 (56.1%) confirmed being former smokers. In addition to diabetes and hypertension, which were present in 17 (20.7%) and 30 (36.6%) patients, 5 patients (6.1%) had angina pectoris, left ventricular hypertrophy, absolute arrhythmia and chronic heart failure.

Table 1. Demographic characteristics and the incidence of underlying renal disease in the examined population

Variable		Value
Age (years)		64.7 ± 10.0
Sex (Male/Female N°)		(49/ 33)
Underlying renal disease (N°/%)	Hypertension	(36/ 43.9%)
	Diabetes	(17/ 20.7%)
	Polycystic kidney disease	(9/ 11%)
	Glomerulonephritis	(6/ 7.3%)
	Chronic pyelonephritis	(2/ 2.4%)
	Other kidney diseases	(11/ 13.4%)

Almost half of the patients included in the study (47.56 %) were dialyzed in the morning shift, and the rest in the afternoon. The majority of patients (66; 80.50 %) had an adequate dialysis dose, i.e. Kt/V≥ 1.20. Patients had a satisfactory regulated anemia, adequate reserves of iron, well-regulated electrolyte levels and parameters of bone metabolism, while the average body mass index was above the upper reference value for normal nutritional status (**Table 2**).

Quantitative characteristics of sleep for the examined population are shown in **Table 3**. The average sleep latency was 25.30 ± 17.78 minutes, average length of sleep 7.01 ± 1.45 hours per night, and average sleep efficiency was 84 ± 16%. The average subjective sleep quality score was 0.99 ± 0.87. The mean PSQI was 6.74 ± 3.99, and poor quality of sleep, i.e. PSQI > 5 was present in 47 (57.3%) patients.

Table 2. Average values of laboratory parameters in examined population

Variable	Mean ± SD
Hemoglobin (g/l)	101.7 ± 13.63
Hematocrit (%)	0.31 ± 0.04
Urea (mmol/l)	25.69 ± 5.81
Creatinin (umol/l)	926.39 ± 182.27
Sodium (mmol/l)	138.72 ± 3.01
Potassium (mmol/l)	5.39 ± 0.81
Calcium (mmol/l)	2.22 ± 0.21
Phosphorus (mmol/l)	1.56 ± 0.53
iPTH (pg/ml)	182.50*
Iron (umol/l)	12.64 ± 6.43
TSAT (%)	39.69 ± 18.53
Ferritin (ng/ml)	825.67 ± 437.64
TIBC (umol/l)	33.85 ± 7.57
Albumins (g/l)	35.83 ± 6.02
BMI (kg/m²)	25.32 ± 5.38

Women had poor quality of sleep more often than men, but the difference was not statistically significant (p=0.160), (**Table 4**). Furthermore, no significant difference was found statistically in the prevalence of poor quality of sleep related to age (p = 0.632), (**Table 4**). More frequently, unemployed patients complained of poor sleep, but the difference was not statistically significant (p = 0.158). Patients with diabetes or hypertension did not have significantly more often poor quality of sleep.

Table 3. Characteristics of sleep and sleep quality index in the examined population

Sleep variables	Mean ± SD
Subjective assessment	0.99 ± 0.87
Sleep duration (h)	7.01 ± 1.45
Sleep latency (min)	25.30 ± 17.78
Sleep efficiency (%)	84 ± 16
PSQI	6.94 ± 3.99

Legend: PSQI - Pittsburgh Sleep Quality Index, SD - standard deviation

Table 4. Demographic and clinical characteristics and quality of sleep

Variable		Good sleep (PSQI ≤ 5)	Poor sleep (PSQI > 5)	P
Sex	Male	24 (49.0%)	25 (51.0%)	0.160
Age	> 65 years	19 (45.2%)	23 (54.8%)	0.632
Employment	Yes	4 (80.0%)	1 (20.0%)	0.158
Smoking	No	4 (25.0%)	12 (75.0%)	0.211
	Yes (active)	8 (40.0%)	12 (60.0%)	
	Ex-smoker	23 (50.0%)	23 (50.0%)	
Diabetes	Yes	7 (41.2%)	10 (58.8%)	0.888
Hypertension	Yes	13 (36.1%)	23 (63.9%)	0.287

Legend: PSQI - Pittsburgh Sleep Quality Index

The median dialysis vintage was 36 months. No significant difference was found in the distribution of good and bad sleepers, in relation to dialysis vintage (p=0.823), (**Table 5**). Patients treated with HDF more frequently had better quality of sleep (p=0.047), while those receiving dialysis treatment in the afternoon shift more often had poor quality of sleep, significantly (p=0.017). The adequacy of dialysis was not significantly related to the quality of sleep (p=0.510), (**Table 5**).

Discussion

Patients on dialysis often have sleep disorders that may go unnoticed. Previous studies have shown that these disorders are more common in patients on dialysis than in the general population (13). Besides, the consequences of poor sleep are more pronounced in patients on dialysis than in the general population, i.e. poor sleep quality is related to worse quality of life and increased morbidity and mortality in these patients (14-16). A wide variability of the incidence of certain sleep disorders in patients on dialysis, ranging from 30 - 80%, indicates inadequately defined criteria for their diagnosis and previous lack of valid instruments for identifying specific disorders (15).

In order to investigate sleep disorders in patients with ESRD treated with HD, this study has assessed the prevalence of poor sleep quality and examined the relationships between demographic, clin-

Table 5. Dialysis-related characteristics and quality of sleep

Variable		Good sleep (PSQI ≤ 5)	Poor sleep (PSQI > 5)	p
Type of dialysis	HD	18 (40.9%)	26 (59.1%)	0.047*
	HDF	10 (71.4%)	4 (28.6%)	
Dialysis vintage	≥36 months	17 (41.5%)	24 (58.5%)	0.823
Dialysis adequacy	Good	27 (40.9%)	39 (59.1%)	0.510
Shift	Morning	22 (56.4%)	17 (43.6%)	0.017*
	Afternoon	13 (30.2%)	30 (69.8%)	

ical and dialysis-related characteristics and quality of sleep. The poor quality of sleep was present in 57.3% of the respondents in our study, which is within the range of values reported in the previous studies (8, 14, 17).

In the general population, insomnia is more common in women than in men, as was the case among the patients in this study, but without statistical significance (18). Previous investigations have reported controversial information on the relationship between poor sleep quality and the age of patients on HD (17-19). In our study, patients younger than 65 years more often had poorer quality of sleep than older patients, but the difference was not statistically significant. Other studies showed positive correlation between the employment and better quality of sleep in patients on HD, which was not the case in our study, probably due to the extremely small number of working patients (20). Also, no significant correlation has been noticed between the smoking habit and comorbidities and sleep quality, which was shown in earlier researches as well (8, 14, 19, 21).

In addition to general factors, there are a number of considerations specific for kidney disease or dialysis treatment itself, which may influence the onset of sleep disorders in these patients. Longer dialysis treatment, inadequate dialysis and dialysis in the morning shift have been associated with worse quality of sleep in earlier studies (18, 22, 23). Contrary to these results, in our study, poor quality of sleep was more commonly found in patients who were dialyzed in the afternoon shift. Possible reasons for this are afternoon nap during dialysis, which makes it difficult to fall asleep later in the evening, and energizing effect of dialysis on the cardiovascular system in the afternoon. Besides, in the afternoon shift in our population of patients there were several women who were more likely to have poor sleep quality. Furthermore, in our study, patients on HDF had significantly better quality of sleep (p=0.047) than patients treated with standard bicarbonate dialysis. Similar results have been demonstrated by other authors, who explained them by better removal of toxic molecules with this method of dialysis (24).

Restriction imposed in interpreting the results of this study is a relatively small number of subjects considering the prevalence of dialysis treatment. In addition, it must be mentioned that the gold standard for assessing the quality of sleep is polysomnography a method, which, however, is not suitable for routine use. Thus, in this study, as in many earlier, sleep quality was evaluated with generally accepted and validated questionnaire.

Conclusion

Our research has shown that the type of dialysis treatment and dialysis shift are factors closely associated with the quality of sleep, in patients undergoing chronic hemodialysis treatment. Assessment of the quality of sleep with a simple questionnaire could be included in routine periodical evaluations of hemodialysis patients.

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