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Evaluation of Sleep Quality and Quantity of Patients with Benign Prostatic Hyperplasia Using the Medical Outcomes Study-sleep Scale

Benign Prostat Hiperplazisi Olan Hastalarda Uyku Kalitesi ve Niteliğinin "Medical Outcomes Study-sleep Scale" ile Değerlendirilmesi

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What's known on the subject? and What does the study add?

Nocturia is one of the main symptoms associated with benign prostatic hyperplasia (BPH). Sleep disturbance, awaken short of breath or headache, sleep quantity, sleep adequacy, and somnolence are adversely affected in BPH patients. In this study, we aimed to evaluate the sleep quality and quantity of patients with BPH using the Medical Outcomes Study-sleep scale. To the best of our knowledge, this is the first study to evaluate the usability of this scale in urology practice. According to our findings, it is important to evaluate the subdomains of sleep quality and quantity, especially in patients with increased post-voiding residual urine volume and decreased Qmaximum, Qaverage, and voiding volume.

Abstract

Objective: This study aimed to evaluate the sleep quality and quantity of patients with benign prostate hyperplasia (BPH) and compare them with that of a control group using the Medical Outcomes Study-sleep scale (MOS-SS).

Materials and Methods: The study included 114 consecutive men who were recruited between 2014 and 2018. Voiding patterns of patients with BPH were evaluated by free uroflowmetry, and symptom scores were evaluated using the International Prostate Symptom score (IPSS). Sleep quality and quantity of all patients were evaluated using the MOS-SS questionnaire. The participants were divided into two groups: 57 BPH patients (group 1) and 57 healthy individuals (group 2). They were compared statistically in terms of MOS-SS subdomains. The relationship between MOS-SS subdomains and IPSS, free uroflowmetry parameters, and post-voiding residual urine volume (PVR) was evaluated in BPH patients. Factors affecting the MOS-SS subdomains were also investigated.

Results: The mean age of group 1 was higher than that of group 2 (67±9 vs 52±11 years, $p<0.001$). All MOS-SS subdomain scores except for snoring were adversely affected in group 1, and there was a statistically significant difference between the groups ($p<0.001$). A mild to moderate significant correlation was found between the MOS-SS subdomain scores and IPSS, free uroflowmetry parameters, and PVR. In multivariate analysis, free uroflowmetry parameters and PVR were found to be independent risk factors for predicting deterioration in the MOS-SS subdomains.

Conclusion: It was observed that sleep quality and quantity were negatively affected in group 1. We recommend that sleep quality and quantity should be investigated especially in BPH patients with increased PVR levels and decreased free uroflowmetry parameters.

Keywords: Benign prostatic hyperplasia, Lower urinary tract symptoms, Medical Outcomes Study-sleep scale (MOS-SS), Sleep disorders

Öz

Amaç: Benign prostat hiperplazisi (BPH) olan hastalarda uyku kalitesini ve niteliğini Medical Outcomes Study-sleep scale (MOS-SS) anketini kullanarak değerlendirmeyi ve kontrol grubu ile karşılaştırmayı amaçladık.

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Gereç ve Yöntem: Çalışmaya 2014-2018 yılları arasında toplam 114 erkek dahil edildi. BPH hastalarının işeme paternleri üroflovmetriyle, semptom skorları Uluslararası Prostat Semptom skoru (IPSS) kullanılarak değerlendirildi. Tüm hastaların uyku kalitesi ve niteliği MOS-SS anketi ile değerlendirildi. Hastalar iki gruba ayrıldı: 57 BPH hastası (grup 1) ve 57 sağlıklı birey (grup 2) MOS-SS anketi alt skorları açısından istatistiksel olarak karşılaştırıldı. BPH hastalarında IPSS, üroflovmetri parametreleri, işeme sonrası rezidüel idrar hacmi (PVR) değerlendirildi. MOS-SS alt skorlarını etkileyen faktörler araştırıldı.
Bulgular: Grup 1'de yaş ortalaması daha yüksek bulundu (67±9 vs. 52±11, p<0,001, p<0,001). Gruplar MOS-SS alt skorları açısından karşılaştırıldığında, horlama hariç tüm diğer skorların grup 1'de anlamlı olarak daha olumsuz etkilendiği gözlendi (p<0,001). MOS-SS alt skorları ile IPSS, üroflovmetri parametreleri ve PVR arasında anlamlı bir korelasyon bulundu. Çok değişkenli analizde ise, MOS-SS alt skorlarındaki bozulmayı öngörmede üroflovmetri parametreleri ve PVR'nin bağımsız risk faktörleri olduğu bulundu.
Sonuç: Çalışmamızda grup 1'deki BPH hastalarında uyku kalitesi ve niteliğinin olumsuz etkilendiği gözlendi. Özellikle artmış PVR düzeyleri olan ve üroflovmetri parametrelerinde azalma saptanan BPH hastalarında uyku kalitesi ve niteliğinin sorgulanması gerektiğini düşünüyoruz. MOS-SS anketi, bu anlamda üroloji pratiğinde kolayca kullanılabilecek bir sorgulama aracı olarak gözükmektedir.
Anahtar Kelimeler: Benign prostat hiperplazisi, Alt üriner sistem semptomları, Medical Outcomes Study-sleep scale (MOS-SS), Uyku bozuklukları

Introduction

Benign prostatic hyperplasia (BPH) is a clinical entity that refers to a prostatic adenoma causing bladder outlet obstruction with or without lower urinary tract symptoms (LUTSs) (1). BPH is a common urological disease affecting mainly the older male population (2), and its prevalence increases with age (3). LUTSs secondary to BPH include voiding and storage symptoms (4). Although prostatic enlargement is frequently seen in BPH, a prostate size below 20 mL could also cause these symptoms (4). Storage symptoms consist of increased frequency, nocturia, and urgency, whereas voiding symptoms include feeling of incomplete bladder emptying, intermittent and weak urine stream, and straining (5).

LUTSs due to BPH also affect health-related quality of life (HRQoL) (6-8). Studies showed sleep quality and HRQoL impairments and higher insomnia prevalence (6). Nocturia is the main cause of impaired sleep quality, and the treatment of BPH must include improvement of sleep quality and HRQoL (9,10). Sleep is closely related to a person's well-being, functionality, and general health. Depression and anxiety predisposition, decreased social function, chronic health problems, and increased mortality have been shown in patients with sleep problems (11,12). Several studies have been conducted to assess the sleep quality of patients who had sleep disturbances due to nocturia using questionnaires or polysomnography results (13,14).

Although sleep quality and quantity in different patient populations have been evaluated using the Medical Outcomes Study-sleep scale (MOS-SS) (15,16), no studies have been conducted in BPH patients so far. In this study, we aimed to assess and compare sleep quality and quantity of BPH patients with nocturia with that of a control group. To the best of our knowledge, this is the first study to evaluate sleep quality and quantity using the MOS-SS in BPH patients.

Materials and Methods

Study Population

The study was approved by the local ethics committee (protocol number: 43278876-929-2011/3357, 3246, approved date: June 12, 2014) at Health Science University Ankara Kecioren Training and Research Hospital. All procedures performed in our study involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. A formal written informed consent was obtained from all individual participants included in the study. The data of patients who did not consent was not used. After that, we designed a prospective, descriptive, and observational study.

All volunteers were evaluated using a urine sample, routine biochemical blood test analysis, and transabdominal ultrasonography (USG) to exclude any other urological pathology. Patients with storage (frequency, nocturia, and urgency) and voiding symptoms (feeling of incomplete bladder emptying, intermittency, straining, and weak urine stream) were further investigated for BPH diagnosis. Transabdominal prostate volume and total prostate-specific antigen (PSA) values were evaluated, and digital rectal examination was performed. Free uroflowmetry was performed to evaluate voiding patterns, and post-voiding residual urine volume (PVR) was determined by transabdominal USG after free uroflowmetry. Free uroflowmetry parameters (Qmaximum, Qaverage, and voiding volume) were noted in detail. Participants were requested to answer the validated Turkish language version of the International Prostate Symptom score (IPSS) questionnaire, which consists of seven items to assess LUTSs in men. Each question is scored from 0 to 5. Total scores range between 0-7, 8-19, and 20-35, and they are classified as mild, moderate, and severe, respectively. Frequency volume chart was used to exclude patients with nocturnal frequency, nocturnal polyuria, global polyuria, or excessive fluid intake as these can also lead to poor sleep quality.

Group 1 was composed of patients with benign rectal examination signs, a <2.5 ng/mL PSA value, >25 mL prostate volume, and <13 mL/s Qmaximum. Meanwhile, group 2 (control group) included patients who applied for control examination (asymptomatic renal cyst, previous kidney stone, or tumor treatment, etc.) and had no LUTSs. Therefore, the abovementioned further BPH investigations were not performed in the control group.

Patients who had a history of urethral stricture, prostate cancer, bladder cancer, transurethral/urethral surgeries, diabetes mellitus, diabetes insipidus, neurological disease that may cause voiding disorders, chronic obstructive pulmonary disease, obstructive sleep apnea syndrome, insomnia, or other sleep disorders, congestive heart failure, and chronic renal failure and who refused to participate were excluded from the study. We also used medical records in the hospital registration system to exclude these aforementioned additional diseases. Patients who were diagnosed with overactive bladder, chronic prostatitis, or urinary tract infection during the examination and did not meet the abovementioned BPH criteria were also excluded. In addition, we excluded patients who underwent prostate biopsy because of increased PSA and those who were reported as prostate cancer after biopsy. Of 147 patients, 114 were included in our study following these exclusion criteria. They were divided into two groups: BPH patients (group 1, n=57, 50%) and the control group (group 2, n=57, 50%).

Age and body mass index of the entire study population were noted. As the Turkish validity and reliability study of the MOS-SS questionnaire has not been performed yet, two specialists with a high English language knowledge level translated the forms into Turkish. Previous similar national studies were also used (17). All individuals were asked to complete the Turkish version of the MOS-SS questionnaire, and the results were recorded. Scores were calculated according to the guidelines recommended by the developers of the MOS-SS questionnaire (18).

MOS-SS Questionnaire

MOS-SS is a 12-item self-report questionnaire form that is used to assess six dimensions of sleep quality and quantity [sleep disturbance (4 items), snoring (1 item), awaken short of breath or with headache (1 item), sleep quantity (1 item), sleep adequacy (2 items), and somnolence (1 item)] in patients and the general population for over the past 4 weeks (18). It examines subjective data using a Likert-type scale. With the exception of sleep quantity, scores of each index range from 0 to 100; higher scores indicate poor condition of the concept being measured. The answers given to the 4th and 12th questions were reversed before calculating. Sleep quantity is scored as the average sleep hours per night. Sleeping between 7 and 8 h is accepted as optimal sleep (18).

Statistical Analysis

All statistical analysis was performed using the Statistical Package for the Social Sciences version 22.0 software (IBM Corp., Armonk, NY, USA). Descriptive data were expressed as mean and standard deviation, median and interquartile range, and number and frequency. The Kolmogorov-Smirnov test was used to check the normality of data for quantitative variables. The Student's t and Mann-Whitney U tests were used to compare the two groups of quantitative variables showing normal and abnormal distributions, respectively. The Pearson chi-square test was used to compare qualitative data. Spearman correlation analysis was performed to evaluate the relationship between the MOS-SS subdomains and IPSS, free uroflowmetry parameters, and PVR. A two-sided p-value of <0.05 was considered statistically significant for all statistical analyses.

Univariate and multivariate linear regression analyses were performed to determine the factors affecting the MOS-SS subdomains in group 1. Age, IPSS, free uroflowmetry parameters, and PVR were included in the univariate analysis. Variables with a p-value of <0.05 in the univariate analysis were included in the multivariate analysis. The number of predictors for creating a regression model was determined by 1:10 rule of thumb. The sample size for each group was calculated as 50. The correlation between the dependent and independent variables was described as regression coefficient (β) with a 95% confidence interval (95% CI).

Results

The mean ages of patients were 67±9 and 52±11 years in groups 1 and 2, respectively (p<0.001). There was no statistically significant difference between the groups in terms of BMI (p=0.517; Table 1). All patients with BPH had nocturia (at least two voids per night), and the control group had one or no void per night. Five (8.8%) patients had mild, 30 (52.6%) moderate, and 22 (38.6%) severe symptom scores according to IPSS.

All MOS-SS subdomain scores except for snoring were adversely affected in group 1, and there was a statistically significant difference between the groups (p<0.001 for each; Table 1). Prostate volumes, PSA levels, IPSS scores, free uroflowmetry parameters, and PVR of BPH patients are summarized in Table 2.

In addition, there was a negative correlation between the free uroflowmetry parameters and sleep disturbance, awaken short of breath or headache, sleep adequacy, and somnolence. There was also a moderate to strong correlation between sleep quantity and other parameters (Table 3). Correlation analysis results are summarized in Table 3.

The results of the univariate and multivariate analyses are summarized in Tables 4 and 5. Age and IPSS were independent

Table 1. Demographic characteristics and MOS-SS questionnaire subdomain scores of the study population

Variables		Group 1 (n=57, 50%)	Group 2 (n=57, 50%)	p-value
Age (mean ± SD), years		67±9	52±11	<0.001[a*]
Body mass index (mean ± SD), kg/m^2		28.5±3.6	28.0±4.0	0.517[a]
Average sleep time [median (IQR)], h		5.0 (3.0-6.0)	7.0 (6.0-8.0)	<0.001[c*]
Sleep disturbance (mean ± SD)		49.47±23.00	29.12±18.81	<0.001[a*]
Snoring, median (IQR)		60 (20.0-100.0)	40 (20.0-60.0)	0.052[c]
Awaken short of breath or with headache, median (IQR)		40 (20.0-60.0)	0 (0-20.0)	<0.001[c*]
Quantity of sleep (mean ± SD)		5.01±1.99	6.89±1.13	<0.001[a*]
Sleep adequacy, median (IQR)		60 (40.0-80.0)	30 (10.0-50.0)	<0.001[c*]
Somnolence, median (IQR)		60 (26.67-73.3)	26.67 (13.3-40.0)	<0.001[c*]
ΨOptimal sleep, n (%)	No	49 (86.0)	24 (42.1)	<0.001[b*]
	Yes	8 (14.0)	33 (57.9)	

[a]Student t-test.
[b]chi-square test.
[c]Mann-Whitney U test.
*p<0.05.
ΨOptimal sleep is defined as sleeping 7 or 8 h per night. All other sleeping time is defined as non-optimal sleep.
MOS-SS: Medical Outcomes Study-sleep scale, SD: Standard deviation, IQR: Interquartile range

Table 2. Free uroflowmetry parameters' results and symptom scores in BPH patients

Prostate volume [median (IQR)], mL	40.0 (31.0-60.0)
Total PSA [median (IQR)], ng/mL	2.80 (1.59-4.90)
IPSS, mean ± SD	17.93±8.03
$Q_{maximum}$ [median (IQR)], mL/s	7.9 (4.8-14.0)
$Q_{average}$ [median (IQR)], mL/s	3.5 (2.0-5.6)
VV [median (IQR)], mL	150.0 (120.0-200.0)
PVR urine [median (IQR)], mL	100.00 (70.0-156.0)

BPH: Benign prostate hyperplasia, PSA: Prostate-specific antigen, IPSS: International Prostate Symptom score, VV: Voiding volume, PVR: Post-voiding residual

risk factors for predicting the MOS-SS subdomains of "awaken short of breath or headache" (β=0.676, 95% CI: 0.015-1.337, p=0.045) and "sleep adequacy" (β=1.107, 95% CI: 0.421-1.793, p=0.002), respectively. Free uroflowmetry parameters and PVR were independent risk factors for predicting most of the worsening MOS-SS subdomain scores in multivariate logistic regression analysis (Table 5).

Discussion

In our study, we found that all MOS-SS subdomains except for snoring were negatively affected in BPH patients. A significant correlation was observed between the MOS-SS subdomains and free uroflowmetry parameters, and PVR. In addition, free uroflowmetry parameters and PVR were independent risk factors for predicting most of the worsening MOS-SS subdomain scores in multivariate analysis. In this context, sleep quality and quantity should be investigated in BPH patients with increased PVR and decreased free uroflowmetry parameters using multidimensional tools. It is possible to improve the HRQoL of patients by eliminating sleep problems.

BPH is a common health problem with bothersome symptoms, especially nocturia, among aging men (5). According to the International Continence Society, nocturia is defined as waking up one or more times to void at night (19). The prevalence is 3.4% in the male population younger than 20 years, and it increases to 32.4% for those older than 60 years (20). Sleep is a vital activity, and it is also crucial for mental functions (21). Bal et al. (14) indicated that nocturia mainly occurred during the rapid eye movement (REM) phase of sleep or superficial sleep phase. They found that there was no significant effect of timing (deep or superficial sleep) and frequency on sleep quality in patients with nocturia and benign prostatic obstruction. In contrast, nocturia was associated with increased daytime sleepiness (14). Bal et al. (14) evaluated sleep quality with "sleep efficacy" (the proportion of actual time spent in sleep to the total time spent in bed), "total sleep time," and "REM duration of sleep." In addition to these results, our study found that four of the five subdomains of sleep quality (sleep disturbance, awaken short of breath or headache, sleep adequacy, and somnolence) were worse in patients with BPH than those in the control group according to the MOS-SS questionnaire, which examined more subdomains of sleep quality.

Hernandez et al. (10) reported worse sleep quality for patients with nocturia compared with those who do not experience it. Similarly, Sakuma et al. (22) used the Pittsburgh Sleep Quality index (PSQI), and they found that LUTSs were associated with sleep disorders and the treatment with alpha-blockers had positive effects. Iwaki et al. (23) also used the PSQI to assess the effects of naftopidil, an alpha 1-adrenoreceptor antagonist, and found it to be effective in treating BPH symptoms and sleep quality (23). In our study, we found decreased sleep quality and quantity in patients with BPH than in the control group. Unfortunately, we did not evaluate the changes in the MOS-SS subdomains before and after BPH treatment. Nevertheless, based on the important results of the MOS-SS questionnaire in evaluating sleep quality and amount in BPH patients, our study may be a step toward future studies that can compare the

Table 3. Correlation analysis of the MOS-SS questionnaire subdomains and IPSS, uroflowmetry parameters, and post-voiding residual urine in BPH patients

Variables	Sleep disturbance		Snoring		Awaken short of breath or with headache		Quantity of sleep		Sleep adequacy		Somnolence	
	r	p	r	p	r	p	r	p	r	p	r	p
IPSS	0.322*	0.015	0.313*	0.018	0.181	0.178	-0.422**	0.001	0.396**	0.002	0.263*	0.048
$Q_{maximum}$ (mL/s)	-0.541**	<0.001	-0.160	0.233	-0.505**	<0.001	0.515**	<0.001	-0.494**	<0.001	-0.505**	<0.001
$Q_{average}$ (mL/s)	-0.540**	<0.001	-0.250	0.061	-0.506**	<0.001	0.548**	<0.001	-0.584**	<0.001	-0.527**	<0.001
VV (mL)	-0.486**	<0.001	-0.389**	0.003	-0.564**	<0.001	0.376**	0.004	-0.430**	0.001	-0.573**	<0.001
PVR Urine (mL)	0.442**	0.001	0.064	0.635	0.207	0.122	-0.490**	<0.001	0.327*	0.013	0.302*	0.220

Spearman correlation analysis: *Correlation is significant at the 0.05 level (two-tailed). **Correlation is significant at the 0.01 level (two-tailed). MOS-SS: Medical Outcomes Study-sleep scale, BPH: Benign prostate hyperplasia, PSA: Prostate-specific antigen, IPSS: International Prostate Symptom score, VV: Voiding volume, PVR: Post-voiding residual

Table 4. Univariate linear regression analysis results for predicting the factors affecting MOS-SS questionnaire subdomains in BPH patients

Variables	Average sleep time		Sleep disturbance		Awaken short of breath or with headache		Quantity of sleep		Sleep adequacy		Somnolence	
	β (95% CI)	p-value	β (95% CI)	p-value	β (95% CI)	p-value	β (95% CI)	p-value	β (95% CI)	p-value	β (95% CI)	p-value
Age (year)	-0.047 (-0.103 to 0.009)	0.100	0.401 (-0.246 to 1.048)	0.219	0.676 (0.015 to 1.337)	0.045*	-0.044 (-0.099 to 0.012)	0.119	0.574 (-0.147 to 1.296)	0.116	0.676 (-0.018 to 1.369)	0.056
IPSS	-0.067 (-0.132 to -0.002)	0.045*	0.739 (-0.008 to 1.486)	0.052	0.353 (-0.450 to 1.156)	0.382	-0.067 (-0.131 to -0.002)	0.043*	1.028 (0.204 to 1.852)	0.015*	0.517 (-0.316 to 1.350)	0.219
$Q_{maximum}$ (mL/s)	0.148 (0.063 to 0.234)	0.001*	-1.685 (-2.657 to -0.713)	0.001*	-1.942 (-2.933 to -0.950)	<0.001*	0.144 (0.059 to 0.228)	0.001*	-1.947 (-3.033 to -0.861)	0.001*	-1.931 (-2.981 to -0.882)	0.001*
$Q_{average}$ (mL/s)	0.326 (0.150 to 0.502)	<0.001*	-3.779 (-5.773 to -1.785)	<0.001*	-4.300 (-6.334 to -2.266)	<0.001*	0.317 (0.143 to 0.491)	0.001*	-4.689 (-6.867 to -2.511)	<0.001*	-4.445 (-6.577 to -2.313)	<0.001*
VV (mL)	0.005 (0.001 to 0.009)	0.018*	-0.070 (-0.117 to -0.024)	0.004*	-0.099 (-0.144 to -0.054)	<0.001*	0.005 (0.001 to 0.009)	0.019*	-0.085 (-0.137 to -0.033)	0.002*	-0.114 (-0.159 to -0.069)	<0.001*
PVR urine (mL)	-0.009 (-0.013 to -0.005)	<0.001*	0.099 (0.049 to 0.150)	<0.001*	0.063 (0.005 to 0.120)	0.033*	-0.009 (-0.013 to -0.005)	<0.001*	0.085 (0.025 to 0.145)	0.006*	0.078 (0.019 to 0.136)	0.011*

*p<0.005. MOS-SS: Medical Outcomes Study-sleep scale, BPH: Benign prostate hyperplasia, IPSS: International Prostate Symptom score, VV: Voiding volume, PVR: Post-voiding residual, 95% CI: 95% confidence interval

effects of medical and/or surgical treatments on sleep quality or evaluate the changes before and after these treatments.

Considering similar studies and our study, improving sleep quality and HRQoL as well as BPH and nocturia treatment is important. Chartier-Kastler et al. (24) reported higher insomnia rates in patients with BPH-related LUTSs. The severity of insomnia was also related to nocturia frequency (24). Vaughan and Bliwise (7) evaluated the effect of behavioral therapy on reducing the frequency of nocturia compared with that of medical therapy and found similar changes with both treatment modalities. Ohoka (25) indicated the importance of assessing nocturia in detail to have better therapeutic results. While treating nocturia as a component of BPH, nonurological factors such as obesity, sleep habits, blood glucose levels, cardiac problems, and fluid intake are crucial for evaluating detrusor contractility. In our study, we excluded most of the diseases that could cause polyuria and nocturia to minimize the number of confounding factors. On the other hand, since there is no statistically significant difference between the additional comorbidities of BPH patients and the control group, our study population can more accurately

Table 5. Multivariate linear regression analysis results for predicting the factors affecting MOS-SS questionnaire subdomains in BPH patients

Variables	Average sleep time		Sleep disturbance		Awaken short of breath or with headache		Quantity of sleep		Sleep adequacy		Somnolence	
	β (95% CI)	p-value	β (95% CI)	p-value	β (95% CI)	p-value	β (95% CI)	p-value	β (95% CI)	p-value	β (95% CI)	p-value
Age (year)	-	-	-	-	0.676 (0.015 to 1.337)	0.045*	-	-	-	-	-	-
IPSS	NS	NS	-	-	-	-	NS	NS	1.107 (0.421 to 1.793)	0.002*	-	-
$Q_{maximum}$ (mL/s)	0.112 (0.031 to 0.192)	0.007*	NS	NS	NS	NS	0.107 (0.027 to 0.186)	0.009*	NS	NS	NS	NS
$Q_{average}$ (mL/s)	NS	NS	-3.779 (-5.773 to -1.785)	<0.001*	-2.872 (-5.023 to -0.721)	0.010*	NS	NS	-3.547 (-5.774 to -1.320)	0.002*	NS	NS
VV (mL)	NS	NS	NS	NS	-0.070 (-0.118 to -0.021)	0.005*	NS	NS	-0.055 (-0.106 to -0.005)	0.031*	-0.107 (-0.151 ro -0.063)	<0.001*
PVR urine (mL)	-0.007 (-0.012 to -0.003)	0.001*	0.076 (0.026 to 0.126)	0.004*	NS	NS	-0.007 (-0.012 to -0.003)	0.001*	NS	NS	0.061 (0.011 to 0.111)	0.017*

*p<0.005.
MOS-SS: Medical Outcomes Study-sleep scale, BPH: Benign prostate hyperplasia, IPSS: International Prostate Symptom score, VV: Voiding volume, PVR: Post-voiding residual, 95% CI: 95% confidence interval

represent the effect of BPH on sleep quality and quantity. Finally, it is crucial to achieve better results for treating BPH and improving sleep quality and quantity and HRQoL.

Study Limitations

Nonetheless, our study has some limitations. First, as mentioned earlier, a Turkish version of the MOS-SS questionnaire was not validated so we had to translate it ourselves. Second, although we tried designing an observational study, PSA, prostate volume, IPSS, uroflowmetry parameters, and PVR could not be evaluated in group 2 because the patients had no LUTSs. Third, we did not compare the sleep quality and quantity scores of patients in the premedication and postmedication periods. In addition, we did not evaluate the HRQoL of patients using questionnaire forms, and an age-matched study could not be designed. Although BPH is more common in older men, BPH patients' being significantly older than the control group is another limitation. We tried excluding patients who have sleep disorders to prevent bias factors. However, there were patients who described snoring with different degrees, and 29.8% of all patients stated high degree of snoring in the questionnaire forms, even though they had no known sleep disorders. Patients with storage (frequency, nocturia, and urgency) and/or voiding symptoms (feeling of incomplete bladder emptying, intermittency, straining, and weak urine stream) were included in the study group. However, it would be more valuable to include and evaluate patients in the compensatory phase who may have no obstructive but irritative symptoms. Our aim was to determine the effect of BPH on sleep quality and quantity. However, following the strict exclusion criteria may have led to selection bias. Nevertheless, we showed that free uroflowmetry parameters and PVR were independent risk factors in predicting most of the worsening MOS-SS subdomain scores in multivariate logistic regression models. However, further prospective, randomized controlled studies with a larger sample size are required to validate our findings. We also think that the evaluation of the changes in MOS-SS scores before and after treatments may be a step for future studies.

Conclusion

Sleep quality and quantity may be negatively affected in BPH patients. In this patient group, especially in patients with increased PVR and decreased Qmaximum, Qaverage, and voiding volume, it is important to evaluate the subdomains of sleep quality and quantity with validated, reliable, and multidimensional tools such as the MOS-SS questionnaire. Although the MOS-SS questionnaire is an easy and practical tool, it can be used frequently similar to the IPSS form, which is also commonly used, for patients with these findings during urologist consultations. In this way, it may be possible to improve

the HRQoL of the patients with sleep disorders by performing neurology and/or psychiatry consultations.

Ethics

Ethics Committee Approval: The study was approved by the local ethics committee (protocol number: 43278876-929-2011/3357, 3246, approved date: June 12, 2014) at Health Science University Ankara Kecioren Training and Research Hospital.

Informed Consent: A formal written informed consent was obtained from all individual participants included in the study.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: S.S., F.G.S., Design: S.S., F.G.S., Data Collection or Processing: Ç.Ş., Ö.F.B., M.V., Analysis or Interpretation: N.K., İ.S., M.G., Literature Search: N.K., İ.S., Ç.Ş., Ö.F.B., M.V., F.E., Writing: S.S., F.G.S., M.G., F.E.

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