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Comparison of the Effect of Continuous Positive Airway Pressure and Surgical Treatment of Obstructive Sleep Apnea Syndrome on Nocturia

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

Obstructive Sleep Apnea syndrome (OSAS) may be one of the aetiological factors of nocturia, and the prevalence of nocturia in patients diagnosed with OSAS ranges from 52% to 76.9%. Continuous positive airway pressure (CPAP) therapy and/or surgical treatment are recommended for the treatment of OSAS. Regardless of treatment modalities (CPAP therapy or surgical treatment), treating OSAS improves nocturia.

Abstract

Objective: This study aimed to compare the effects of continuous positive airway pressure (CPAP) and surgical treatment of Obstructive Sleep Apnoea syndrome (OSAS) on nocturia.

Materials and Methods: Forty-eight patients who received treatment for OSAS and had nocturia between January 2019 and December 2019 were included in the study. Questionnaires of the International Prostate Symptom score, Overactive Bladder Symptoms score, International Consultation on Incontinence Questionnaire-Male Lower Urinary Tract Symptoms and International Consultation on Incontinence Questionnaire-Female Lower Urinary Tract Symptoms were administered to all patients. The number of nocturia was evaluated by the mean number of nocturia episodes in the bladder diary.

Results: Thirty-two (66.6%) patients received CPAP therapy, and 16 (33.3%) patients underwent surgical treatment for OSAS. The mean number of nocturia episodes of all patients before and after treatment was 2.3±1.4 and 1.7±2.2, respectively, and the difference was significant (p=0.032). However, surgical treatment and CPAP therapy were not superior to each other in terms of improving nocturia (p=0.901).

Conclusion: Regardless of treatment modalities, i.e., CPAP therapy or surgical treatment, treating OSAS improves nocturia.

Keywords: Obstructive Sleep Apnoea syndrome, nocturia, continuous positive airway pressure

Introduction

Nocturia was defined according to the International Continence Society as the complaint that the individual has to wake at night one or more times to void (1). Nocturia occurs at any age, although it is more common in the older population (2). Although nocturia is generally considered a symptom of benign prostate disease and/or bladder dysfunction, nocturia also occurs as a result of nocturnal polyuria, which is often defined as excessive night-time urine production. The pathophysiology of nocturia is classified into four mechanisms: an overall increase of urine production (24-h polyuria), an increase in urine production only at night (nocturnal polyuria), a permanent or only nocturnal reduced bladder capacity or any primary or secondary sleep disorder (3).

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Obstructive Sleep Apnea syndrome (OSAS), which is a common chronic disorder, is defined as complete or partial obstruction of the upper respiratory tract during sleep, which results in airflow reduction or cessation (4,5). OSAS may be one of the aetiological factors of nocturia, and the prevalence of nocturia in patients with OSAS ranges from 52% to 76.9% (6). Improvement of OSAS is expected to reduce the severity of nocturia. Continuous positive airway pressure (CPAP) therapy is recommended as primary treatment of OSAS (7). Taking into account the results of polysomnography (PSG) and pathologic site, surgical procedures could be performed in some patients. Various surgical procedures are described for these patients, such as septoplasty, uvuloplasty, uvulopalatoplasty, anterior palatoplasty, radiofrequency applications, laser-assisted surgery and maxillary and mandibular advancement (8).

Studies have revealed that CPAP therapy for OSAS also decreases the frequency of nocturia and the associated urine volume (9,10). However, to the best of our knowledge, only one study reported that surgical treatment of OSAS improves nocturia (11). Thus, in this study, we aimed to evaluate the effect of treatment of OSAS on nocturia and the superiority of CPAP therapy and surgical treatment to each other in terms of improving nocturia.

Materials and Methods

Patients who presented to the outpatient clinic with complaints of snoring and apnea were evaluated retrospectively by PSG after routine otorhinolaryngologic examinations between January 2019 and December 2019. Anterior rhinoscopy, oral examination and laryngoscopic examinations were performed to all patients. Patients were examined with the fibre-optic laryngoscope, and a Muller manoeuvre was performed to all patients. All patients were evaluated by the multidisciplinary sleep disorder board. After the evaluation of patients with snoring and apnea complaints who presented to the chest disease and otolaryngology outpatient clinics, pulmonologists and otolaryngologists referred these patients to the urologists.

Patients diagnosed and treated with lower urinary tract disease (benign prostate disease, bladder dysfunction, urinary tract infection, etc.) and previous urogenital operations and neurological disorders patients who did not receive surgical treatment or CPAP therapy due to OSAS were excluded from the study.

PSG tests of patients were performed at the sleep laboratory of Çukurova University, Faculty of Medicine, Department of Chest. The severity of OSAS was determined by the apnea-hypopnea index (AHI; mean number of apnea + hypopnoea per hour of sleep). In this study, AHI was classified as mild (5-15), moderate (16-30) and severe (>30) (12). CPAP or surgical treatment was given to the patients according to their clinical condition, OSAS severity and upper airway pathologies.

All patients filled the three-day bladder diary and questionnaires of the International Prostate Symptom score (IPSS), Overactive Bladder Symptoms score (OABSS), International Consultation on Incontinence Questionnaire-Male Lower Urinary Tract Symptoms LUTS (ICIQ-MLUTS) and ICIQ-Female LUTS (ICIQ-FLUTS) before PSG was performed and 3 months after CPAP therapy and surgical treatment. The number of nocturia was evaluated by the mean number of nocturia episodes recorded in the bladder diaries.

Ethics

Ethics committee approval for the study was obtained from the ethics committee of the University of Çukurova (approval no: September 4, 2020; 103/5). The study was carried out in accordance with the principles of the Helsinki Declaration.

Statistical Analysis

All analyses were performed using IBM SPSS Statistics version 20.0 statistical software package. Categorical variables were expressed as numbers and percentages, whereas continuous variables were summarised as mean and standard deviation and as median and minimum-maximum, where appropriate. Chi-square test was used to compare categorical variables between the groups. For comparison of continuous variables between two groups, Mann-Whitney U test was used. For comparison of two related (paired) continuous variables, paired samples t-test was used. The level of significance for all tests was 0.05.

Results

Forty-eight patients who had nocturia and underwent CPAP therapy or surgical treatment for OSAS were included in the study. The mean patient age was 50.6±11.5 (range, 29-78) years. Of them, 37 (77.1%) were male and 11 (22.9%) were female. Moreover, 5 (10.4%) patients had mild, 13(27.1%) had moderate and 30 (62.5%) had severe OSAS. Furthermore, 32 (66.6%) patients received CPAP therapy, and 16 (33.3%) patients underwent surgical treatment for OSAS. A comparison of demographic and clinical characteristics according to treatment methods are presented in Table 1. The mean AHI of patients who received CPAP therapy was 48.5±27.5 and that of patients who underwent surgical treatment was 41.5±27.7 (p=0.437).

The mean number of nocturia episodes of all patients before and after treatment was 2.3±1.4 and 1.7±2.2, respectively, and the difference was significant (p=0.03). The OAB-SS scores of all patients significantly decreased from 11.6±8.4 to 9.1±8.8 (p=0.004). The total FLUTS scores of all patients significantly decreased from 12.7±7.8 to 10.2±8.4 (p=0.046). Although a significant increase was noted in the total daily urine volume after treatment, there was a significant decrease in the total

Table 1. Demographic data and bladder diary parameters of patients according to treatment methods

	CPAP therapy (n=32)	Surgical treatment (n=16)	p-value
Age (years)[a]	51.5±12.5 52.0 (30.0-78.0)	48.8±9.5 50.0 (29.0-70.0)	0.463
BMI kg/m^2 [a]	32.7±6.0 33.0 (22.0-47.0)	31.8±6.8 30.0 (22.0-47.0)	0.443
Gender[b]			0.999
Male	25 (78.1)	12 (75.0)	
Female	7 (21.9)	4 (25.0)	
AHI value[a]	48.5±27.5 46.0 (7.0-135.0)	41.5±27.7 31.0 (6.0-85.0)	0.437
AHI severity[b]			0.141
Mild	2 (6.2)	3 (18.8)	
Moderate	7 (21.9)	6 (37.5)	
Severe	23 (71.9)	7 (43.8)	
HT[b]	18 (56.2)	7 (43.8)	0.610
DM[b]	9 (28.1)	3 (18.8)	0.725
Smoking[b]	16 (50.0)	10 (62.5)	0.609
Total daily fluid intake (mL)[a]	2303.1±1043.0 2000.0 (1000.0-5000.0)	2393.7±1373.7 1900.0 (1000.0-6000.0)	0.824
Total daily urine volume (mL)[a]	1850.0±830.0 1700.0 (1000.0-5000.0)	1850±783.1 1650.0 (1000.0-3500.0)	0.956
Total night-time urine volume (mL)[a]	532.8±460.9 400.0 (100.0-2000.0)	375.0±179.8 400.0 (100.0-800.0)	0.439

AHI: Apnea-hypopnea index, HT: Hypertension, DM: Diabetes mellitus, BMI: Body mass index, CPAP: Continuous positive airway pressure
[a]Data are expressed as mean ± standard deviation, median (min-max).
[b]Data are expressed as n (%).
Note: Bold values indicate significance (p<0.05)

night-time urine volume (p=0.016 and p=0.024, respectively) (Table 2). No significant difference in terms of IPSS and MLUTS between before and after treatment (p=0.621 and 0.326, respectively). We thought that it was caused by low IPSS score because we excluded patients with benign prostate disease.

Surgical treatment and CPAP therapy were not superior to each other in terms of improving nocturia (p=0.901). Compared with surgical treatment, CPAP therapy was superior only in terms of improving the IPSS score (p=0.017). As regards other parameters, CPAP therapy and surgical treatment were not superior to each other (p>0.005) (Table 3).

Discussion

In this study, we investigated the superiority of CPAP and surgical procedures in nocturia improvement in patients with nocturia due to OSAS. To our knowledge, this topic had never been explored previously. We found that CPAP and surgical

Table 2. Comparison of questionnaire form and bladder diary parameters of patients with OSAS before and after OSAS treatment

	Before treatment (n=48)	After treatment (n=48)	p-value
Nocturia episodesa	2.3±1.4	1.7±2.2	0.032
OABSS[a]	11.6±8.4	9.1±8.8	**0.004**
IPSS[a]	8.1±7.9	7.7±8.3	0.621
MLUTS totala (n=37)	6.7±7.9	5.1±6.2	0.326
FLUTS totala (n=11)	12.7±7.8	10.2±8.4	**0.046**
Total daily urine volume (mL)[a]	1850.0±806.3	2016.2±803.2	**0.016**
Total night-time urine volume (mL)[a]	480.2±395.1	333.7±314.8	**0.024**

[a]Data are expressed as mean ± standard deviation
Note: Bold values indicate statistical significance (p<0.05).
IPSS: International Prostate Symptom score, OABSS: Overactive Bladder Symptoms score, MLUTS: Male lower urinary tract symptoms, FLUTS: Female lower urinary tract symptoms, OSAS: Obstructive Sleep Apnea syndrome

Table 3. Comparison of questionnaire form and bladder diary of patients with OSAS before and after treatment between CPAP therapy and surgical treatment

	CPAP therapy (n=32)	Surgical treatment (n=16)	p-value
Δ-Nocturia Episodes[a]	-0.6±1.9 -1.0 (-6.0 to 6.0)	-0.5±1.9 -0.5 (-3.0 to 5.0)	0.901
Δ-OAV-B8[a]	-2.2±4.2 -1.0 (-14.0 to 6.0)	-1.5±4.3 -1.0 (-10.0 to 5.0)	0.945
Δ-IPSS[a]	-2.2±6.6 -1.0 (-21.0 to 14.0)	3.5±6.7 0.0 (-1.0 to 18.0)	**0.017**
Δ-MLUTS[a]	-1.3±4.8 0.0 (-14 to 11.0)	0.4±3.5 0.0 (-4.0 to 9.0)	0.428
Δ-FLUTS[a]	-1.1±1.8 0.0 (-4.0 to 1.0)	-5.0±6.2 -3.5 (13.0-0.0)	0.412
Δ-Total daily urine volume (mL)[a]	274.2±554.3 200.0 (-1500.0 to 1500)	58.3±556.7 0.0 (-1300.0 to 1000.0)	0.302
Δ-Total night-time urine volume (mL)[a]	-183.5±372.9 -150.0 (-1500.0 to 800.0)	0.0±245.8 -50.0 (-400.0 to 450.0)	0.114

[a]Data are expressed as mean ± standard deviation; median (min-max).
Δ: After treatment-before treatment
Note: Bold values indicate statistical significance (p<0.05).
IPSS: International Prostate Symptom score, OABSS: Overactive Bladder Symptoms score, MLUTS: Male lower urinary tract symptoms, FLUTS: Female lower urinary tract symptoms, CPAP: Continuous positive airway pressure, OSAS: Obstructive Sleep Apnea syndrome

treatment both improved nocturia but were not superior to each other. Thus, it is important to correct the aetiopathogenesis.

OSAS may play a role in the aetiology of nocturia, and a high prevalence of nocturia was reported in patients with OSAS (6). This occurs because of two mechanisms. First, nocturia is a result of airway obstruction caused by OSAS. Airway obstruction causes an increase in the intrathoracic negative pressure and venous blood flow to the heart. This situation stimulated the secretion of atrial natriuretic peptide (ANP) by the cardiac ventricles and right atrium (13). Second, nocturia is related to hypoxia caused by airway obstruction. Hypoxia causes ANP secretion by increasing pulmonary vasoconstriction and right atrial transmural pressure (14). In patients with OSAS, ANP causes nocturia by excessively increasing the production of urine at night. Therefore, we hypothesised that when treating OSAS will improve nocturia. Our study shows that nocturia episodes and night-time overproduction of urine significantly decreased after the treatment of OSAS. However, surgical treatment and CPAP therapy were not superior to each other in terms of improvement of nocturia episodes and night-time overproduction of urine.

A study conducted on 1790 patients reported that nocturia episodes were significantly more common in patients with OSAS. Authors concluded that age, body mass index, hypertension, AHI and respiratory effort index were significantly associated with nocturia (6). In a meta-analysis of 13 studies, with a total of 406 patients and 9518 controls, a significant association was found between OSA and risk of nocturia [RR=1.41, 95% confidence interval (CI) 1.26-1.59] and that patients who had severe OSA were at high risk of nocturia. The authors found that OSA was associated with risk of nocturia in men (RR=1.487, 95% CI 1.087-2.034, p=0.013); however, no significant relationship was found between OSA and nocturia in women (RR=1.537, 95% CI 0.831-2.842, p>0.05) (15). In another study of 1757 men undergoing PSG, nocturia was significantly associated with age and AHI, but OSAS may not be a risk factor for nocturia in the older population (16).

A meta-analysis revealed that the mean number of nocturia episodes decreased by 2.28 and the mean night-time urine volume (mL) decreased by 183.12 mL in patients after CPAP for OSAS (17). Another study reported that CPAP reduced nocturnal urine frequency and improved IPSS, QOL index and OABSS in patients with OSAS. They found that nocturnal urine production was decreased; this might have improved the night-time frequency and hours of undisturbed sleep (18). In another study on 51 patients with OSAS, Miyauchi et al. (10) concluded that 1 month of CPAP therapy significantly improves night-time frequency as well as improves overall IPSS and QOL score.

To our knowledge, only one study investigated the effect of surgical treatment due to OSAS on nocturia and reported that surgical treatment significantly decreased the number of nocturia, IPSS, OABSS, and QOL (11). However, no study has investigated the superiority of CPAP therapy and surgical treatment to each other in terms of improving nocturia in patients with OSAS. Therefore, our study is valuable. In this study, surgical treatment and CPAP therapy were not superior to each other in terms of improving nocturia, OABSS, and FLUTS. Moreover, OSAS treatment did not improve IPSS, and we thought that it was due to the low IPSS score because we excluded patients with benign prostatic hyperplasia. Thus, hypoxia, which is important regardless of the method, should be treated.

Study Limitations

One of the limitations of this study is the low number of patients with OSAS receiving CPAP therapy and surgical treatment. Moreover, we could not perform subgroup analysis according to surgical methods performed.

Conclusion

Regardless of treatment modalities, i.e., CPAP therapy or surgical treatment, treating OSAS improves nocturia. Thus, one of the most important methods of treating nocturia is to eliminate the risk factor.

Ethics

Ethics Committee Approval: Ethics committee approval for the study was obtained from the Ethics Committee of the University of Çukurova (approval no: September 4, 2020; 103/5). The study was carried out in accordance with the principles of the Helsinki Declaration.

Informed Consent: Retrospective study.

Peer-review: Externally and internally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: M.D., O.S., I.T., Concept: M.D., S.K., I.A.A., Design: M.D., O.S., S.K., Data Collection or Processing: M.D., O.S., S.K., N.A., M.D., I.T., I.A.A., Analysis or Interpretation: M.D., V.I., N.A., M.D., I.T., Literature Search: M.D., S.K., V.I., N.A., M.D., I.T., I.A.A., Writing: M.D., S.K., V.I., I.T., İ.A.A.

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