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Factors affecting CPAP compliance in patients with obstructive sleep apnea

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Abstract

Background/Aim: Continuous positive airway pressure (CPAP) is the most effective treatment for obstructive sleep apnea (OSA), but adequate patient compliance is required for treatment to achieve clinical success. This study aimed to determine factors affecting compliance with CPAP therapy in patients with OSA.

Methods: In this retrospective cohort study, the records of patients that started CPAP treatment due to OSA between January 1, 2018 and August 30, 2020 were reviewed. The patients were divided into two groups based on their CPAP compliance: Group 1 included those who used CPAP regularly, and Group 2 included irregular users. Parameters such as age, gender, body mass index, apnea-hypopnea index, and educational status were compared between the groups.

Results: Baseline apnea-hypopnea index (AHI) and oxygen desaturation index (ODI) of patients using CPAP regularly were higher than irregular users ($P=0.003$, $P=0.045$, respectively). There was no significant difference between the groups in terms of age, gender, and body mass index ($P=0.542$, $P=0.120$ and $P=0.796$, respectively). In multivariate logistic regression analysis, low AHI, low ODI and low educational level were independent risk factors affecting CPAP compliance ($P=0.010$, $P=0.016$ and $P=0.047$, respectively).

Conclusion: According to the results of this study, low AHI and ODI levels and low education status were risk factors for non-compliance with CPAP treatment. Therefore, patients with these features may require closer follow-up for early identification of CPAP treatment failure due to non-compliance.

Keywords: Continuous positive airway pressure, Obstructive sleep apnea, Compliance, Apnea-hypopnea index

Introduction

Obstructive sleep apnea (OSA) is a common disease characterized by partial or complete obstruction of the upper airway during sleep. The prevalence of OSA has been gradually increasing, and various studies on adults have shown it to vary between 15-45% [1, 2]. It is known that OSA is associated with many systemic diseases such as hypertension, cardiovascular problems, cerebrovascular events, pulmonary hypertension, and depression [3]. In addition, by causing daytime sleepiness, OSA can lead to decreased work performance and traffic accidents [4].

Continuous positive airway pressure (CPAP) applied with a nasal mask during sleep is the most common treatment for OSA. The positive pressure provided by the CPAP machine allows the intraluminal pressure to exceed the pressure created by the surrounding tissues. Thus, upper airway collapse does not occur, and obstructive apnea-hypopnea events are prevented. It has been shown that CPAP improves day and night symptoms of OSA, normalizes sleep structure, reduces cardiovascular morbidity and mortality, improves cognitive functions, and increases quality of life [5-7].

Although CPAP is an extremely safe and effective method of treatment, its effectiveness is closely related to the rate of adherence to it [8]. The prevalence of CPAP non-compliance (using the CPAP machine for less than 4 hours per night), which is an important challenge in the management of OSA patients, ranges from 29-83% [9].

There are many studies in the literature examining the factors affecting CPAP compliance in OSA patients. The aim of this study was to examine the relationship between CPAP compliance and factors such as age, gender, apnea-hypopnea index (AHI), body mass index (BMI), oxygen desaturation index (ODI), and educational status.

Materials and methods

Records of patients who started CPAP treatment due to OSA in a sleep laboratory of a tertiary hospital between January 1, 2018 and August 30, 2020 were retrospectively reviewed. The study was approved by Yozgat Bozok University Clinical Research Ethics Committee (2017-KAEK-189_2021.02.10_21) and the Helsinki Declaration rules were followed throughout the study.

All patients were clinically evaluated in the sleep medicine department before and after polysomnography. Demographic data of the patients including age, gender, education level, and BMI were recorded. Polysomnographies were performed using a 31-channel ALICE 6 LDe (Respironics, PA, USA) device. The average number of apnea and hypopnea per hour (AHI) and the average number of episodes per hour with desaturation of >4% (ODI) were obtained from the PSG reports. Patients who were recommended to use CPAP had at least one overnight trial of CPAP using the auto-titration technique. Technicians in the sleep clinic trained patients on the basics of using CPAP.

Patients that were older than 18 years old, diagnosed with OSA, given a CPAP device, and accepted to fill out a questionnaire on CPAP compliance were included in the study.

Patients were called for follow-up and information about compliance was obtained.

The patients included in the study were divided into two groups. Regular CPAP users (using CPAP for at least 4 hours a night) were included in Group 1, while those who did not use it regularly were included in Group 2. Both groups were compared in terms of age, gender, BMI, AHI, and ODI values. The independent values of these factors in predicting CPAP compliance were also investigated.

Statistical analysis

SPSS software (version 20.0 for Windows, IBM Corp., Armonk, NY, USA) was used for all data analyses. Descriptive data were given as mean (SD). Kolmogorov-Smirnov/ Shapiro-Wilk's tests were used to determine whether continuous variables were normally distributed. Mann-Whitney U test and Student t-test were used for numerical data with and without normal distribution, respectively. A logistic regression analysis was performed to determine independent predictors of CPAP compliance. The receiver operating characteristic (ROC) test was applied to determine the cutoff value of the data in affecting CPAP compliance. A P-value of <0.05 was considered statistically significant.

Results

There was no significant difference between the groups in terms of age, gender, and BMI. The mean AHI, ODI values and education level of Group 1 were significantly higher than those of Group 2. The demographic data, BMI, AHI, ODI and education levels of the groups are shown in Table 1. In multivariate logistic regression analyses, low AHI, low educational level and low ODI were independent risk factors affecting CPAP compliance. There was no significant association between CPAP compliance and BMI. The correlation between CPAP compliance and age, gender, AHI, ODI, BMI, and educational level are shown in Table 2.

Table 1: Comparison of demographic and clinical parameters in patient groups

Parameters	CPAP non-compliers (n=30)	CPAP compliers (n=30)	P-value
Gender (F/M)	11 F / 19 M	14 F / 16 M	0.120
Age in years	53.27(10.14)	54.90 (10.47)	0.542
BMI, kg/m2	29.58 (2.94)	29.83 (3.48)	0.796
AHİ	31.78 (14.94)	55.69(32.53)	0.003
ODİ	36.64 (14.91)	49.23 (31.96)	0.045
Education level	8.40 (3.38)	10.50 (3.87)	0.031

Data presented as mean (SD). CPAP: continuous positive airway pressure, F: female, M: male, BMI: body mass index, AHI: Apnea-hypopnea index, ODI: oxygen desaturation index, SD: standard deviation

Table 2: Multivariate logistic regression model of potential factors affecting CPAP compliance

	B	P-value	OR	95% C.I. Lower	Upper
Age	-0.009	0.881	0.991	0.884	1.111
Gender	1.292	0.218	3.641	0.465	28.478
AHI	0.527	0.010	1.693	1.136	2.523
BMI	-0.242	0.205	0.785	0.539	1.142
ODI	-0.479	0.016	0.619	0.419	0.916
Education level	0.337	0.047	1.401	1.004	1.953

CPAP: continuous positive airway pressure, BMI: body mass index, AHI: Apnea-hypopnea index, ODI: oxygen desaturation index, SD: standard deviation OR: odds ratio, CI: confidence interval.

In patients with a definitive diagnosis of CPAP incompliance, statistically significant parameters (AHI, ODI, and education levels) were evaluated in ROC curve analysis, and sensitivity and specificity of each parameter were calculated. According to the ROC analysis, AUC values of AHI, ODI, and education levels were 0.724, 0.616 and, 0.655 respectively (Figure 1). The optimal AHI, ODI and educational level cutoff values for distinguishing the two groups were 27.2 (80% sensitivity and 65%

specificity), 29.7 (77% sensitivity and 50%), and 9.5 years (70% sensitivity and 60% specificity), respectively (Table 3).

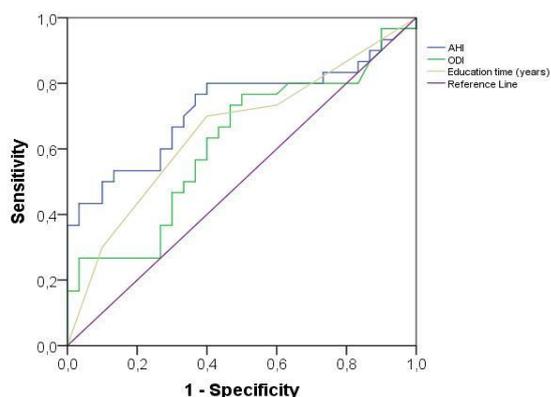Figure 1: ROC analysis for performance to predict CPAP compliance of AHI, ODI and education level

Table 3: ROC curve characteristics of the discriminative factors to detect CPAP compliance

	AUC	SD	P-value	95% Cl	Cutoff value	Sensitivity%	Specificity%
AHI	0.724	0.068	0.003	0.591-0.858	27.2	80	65
ODI	0.616	0.074	0.124	0.471-0.760	29.7	77	50
Education level	0.655	0.072	0.039	0.515-0.795	9.5	70	60

Values that are statistically significant are indicated in bold. ROC: receiver operating characteristic, AUC: area under curve, AHI: Apnea-hypopnea index, ODI: oxygen desaturation index.

Discussion

There are various options for the treatment of OSA, including behavioral methods such as weight loss, cessation of smoking and alcohol use, sleep position training, as well as other methods such as CPAP, intraoral appliance therapy and surgical intervention in the upper airway. However, the American Academy of Sleep Medicine recommends that CPAP be considered as both the first line and gold standard treatment for OSA [10].

CPAP is a very effective treatment for OSA; however, low patient compliance remains a significant problem. Although there is no globally accepted definition of good CPAP compliance, studies have shown that the patient should use CPAP for at least 4 hours a day to benefit from treatment. Therefore, to achieve an effective and successful CPAP treatment, it is necessary to identify factors affecting patient compliance and eliminate issues that have negative impact. These factors are diverse and can include disease and patient characteristics, treatment titration procedures, device factors, as well as psychological and social factors [11, 12]. The severity of OSA, daytime sleepiness, age, gender, and patient comorbidities can increase or decrease the use of CPAP [13].

Studies examining the relationship between OSA severity and CPAP compliance have revealed conflicting results. In some studies, no relationship was found between AHI and CPAP compliance [14, 15]. On the other hand, there are studies showing that CPAP compliance is better in severe OSA patients with high AHI [13, 16]. In our study, patients with good CPAP compliance had higher mean AHI values than patients with poor compliance. AHI value was an independent factor affecting CPAP compliance. In ROC analysis, AHI above 27.2 predicted CPAP compliance with 80% specificity and 65% sensitivity.

Kohler et al. [17] reported a positive correlation between CPAP compliance and high ODI value, which is another parameter that shows the severity of OSA. In another study,

Riachy et al. [18] showed that mean ODI was significantly higher in the CPAP-compliant patient group, and that higher ODI was an independent predictor for CPAP compliance. In the multivariate logistic regression analysis performed in our study, there was a strong positive relationship between high ODI value and CPAP compliance. Our results therefore confirm the findings of previous studies showing that OSA severity is a predictor of CPAP compliance.

In many studies, income level, region of residence, and years of education have been associated with CPAP compliance [19, 20]. This may be since people with high income can access services easier and individuals with higher education status are more aware of the risks of the disease. In our study, we also observed that higher education level was associated with better CPAP compliance.

Although there are conflicting results in the literature regarding the relationship between age, gender, BMI, and CPAP compliance, in large patient series, Kohler [17] and McArdle [21] stated that age, gender and BMI were not associated with CPAP compliance. In this study, we could not find a significant relationship between CPAP compliance and these factors. Therefore, we think that these factors should not affect decisions about CPAP treatment recommendations.

Limitations

Our study has some limitations. First, the CPAP usage times were self-reported, and not obtained from an objective data such as a compliance meter. The low number of patients is another limitation. In addition, the retrospective design of the study prevented us from obtaining data on the extent of the training of patients before beginning CPAP therapy. Future prospective studies, where the same investigator informs all participants to ensure that everyone is adequately and homogeneously informed, are needed to better understand the factors involved in CPAP compliance.

Conclusion

According to the results of this study, low AHI levels and low education status were risk factors for non-compliance with CPAP treatment. Therefore, patients with low AHI levels and low educational status may require closer follow-up for early identification of CPAP treatment failure due to non-compliance.

References

1. Peppard PE, Young T, Barnet JH, Palta M, Hagen EW, Hla KM. Increased prevalence of sleep-disordered breathing in adults. Am J Epidemiol. 2013;177:1006–14.
2. Heinzer R, Vat S, Marques-Vidal P, Marti-Soler H, Andries D, Tobback N, et al. Prevalence of sleep-disordered breathing in the general population: the HypnoLaus study. Lancet Respir Med. 2015;3:310–8.
3. Jennum P, Hein HO, Suadicani P, Gyntelberg F. Cardiovascular risk factors in snorers. A cross-sectional study of 3,323 men aged 54 to 74 years: the Copenhagen male study. Chest. 1992;102:1371–6.
4. Garbarino S. Excessive daytime sleepiness in obstructive sleep apnea: implications for driving licenses. Sleep Breath. 2020;24:37-47.
5. Nick AA, Catcheside P, Buchan C, Hensley M, Naughton TM, Rowland S, et al. The effect of CPAP in normalizing daytime sleepiness, quality of life, and neurocognitive function in patients with moderate to severe OSA. Sleep. 2011;34:111-9.
6. Marin JM, Carrizo SJ, Vicente E, Agusti AG. Long-term cardiovascular outcomes in men with obstructive sleep apnoea-hypopnoea with or without treatment with continuous positive airway pressure: an observational study. Lancet. 2005;365:1046-53.
7. Giles TL, Lasserson TJ, Smith BH, White J, Wright J, Cates CJ. Continuous positive airways pressure for obstructive sleep apnoea in adults. Cochrane Database Syst Rev. 2006;3:CD001106.
8. Weaver TE, Maislin G, Dinges DF, Bloxham T, George CF, Greenberg H, et al. Relationship between hours of CPAP use and achieving normal levels of sleepiness and daily functioning. Sleep. 2007;30:711-9.
9. Weaver TE, Grunstein RR. Adherence to continuous positive airway pressure therapy: the challenge to effective treatment. Proc Am Thorac Soc. 2008;5:173–8.
10. Morgenthaler TI, Aurora RN, Brown T, Zak R, Cathy Alessi C, Brian Boehlecke B, et al. Practice parameters for the use of autotitrating continuous positive airway pressure devices for titrating pressures and treating adult patients with obstructive sleep apnea syndrome: an update for 2007. An American Academy of Sleep Medicine report. Sleep. 2008;31:141–7.

11. Weaver TE, Grunstein RR. Adherence to continuous positive airway pressure therapy: the challenge to effective treatment. Proc Am Thorac Soc. 2008;5:173–8.
12. Lee CHK, Leow LC, Song PR, Li H, Ong TH. Acceptance and adherence to continuous positive airway pressure therapy in patients with Obstructive Sleep Apnea (OSA) in a Southeast Asian privately funded healthcare system. Sleep Sci Jun. 2017;10:57–63.
13. Al-Abri MA, Al-Harmeli A, Al-Habsi M, Jaju D. Acceptance and Compliance of Continuous Positive Airway Pressure in Patients with Obstructive Sleep Apnea: Local Population Survey. Oman Medical Journal. 2020;35:198.
14. Engleman HM, Martin SE, Douglas NJ. Compliance with CPAP therapy in patients with the sleep apnoea/hypopnoea syndrome. Thorax. 1994;49:263–6.
15. Joo MJ, Herdegen JJ. Sleep apnea in an urban public hospital: assessment of severity and treatment adherence. J Clin Sleep Med. 2007;3:285–8.
16. Yetkin O, Kunter E, Gunen H. CPAP compliance in patients with obstructive sleep apnea syndrome. Sleep Breath. 2008;12:365–7.
17. Kohler M, Smith D, Tippett V, Stradling JR. Predictors of long-term compliance with continuous positive airway pressure. Thorax. 2010;65:829-32.
18. Riachy M, Najem S, Iskandar M, Choucair J, Ibrahim I, Juvelikian G. Factors predicting CPAP adherence in obstructive sleep apnea syndrome. Sleep Breath. 2017;21:295-302.
19. Simon TT, Reuveni H, Greenberg DS, Oksenberg A, Tal A, Tarasiuk A. Low socioeconomic status is a risk factor for CPAP acceptance among adult OSAS patients requiring treatment. Sleep. 2009;32:545–52.
20. Tarasiuk A, Reznor G, Greenberg-Dotan S, Reuveni H. Financial incentive increases CPAP acceptance in patients from low socioeconomic background. PLoS One. 2012;7:e33178.
21. McArdle N, Devereux G, Heidarnejad H, et al. Long-term use of CPAP therapy for sleep apnea/hypopnea syndrome. Am J Respir Crit Care Med. 1999;159:1108e14.