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SLEEP

Are symptoms of obstructive sleep apnoea related to good continuous positive airway pressure compliance?

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ABSTRACT Obstructive sleep apnoea (OSA) is a common disease that can be treated with continuous positive airway pressure (CPAP). CPAP tolerance may be associated with its compliance. Even though there are several predictors for good CPAP compliance, there are limited data available on the correlation between CPAP compliance and OSA symptoms. This study aimed to evaluate this correlation. We conducted a cross-sectional study and enrolled adult patients diagnosed with OSA through polysomnography who had experience using a CPAP machine. A self-report questionnaire was used to evaluate CPAP compliance and study variables. Predictors of CPAP compliance were analysed using stepwise multivariate logistic regression analysis. There were 68 patients with OSA who completed the questionnaire during the study period. Of those, 14 (20.59%) exhibited good CPAP compliance. Only fatigue as a symptom was an independent factor associated with good CPAP compliance, with an adjusted odds ratio of 5.380 (95% CI 1.274–22.719). In conclusion, fatigue was the only symptom associated with good CPAP compliance in patients with OSA.

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Introduction

Obstructive sleep apnoea (OSA) is a common condition. Its prevalence in the general population in North America may be up to 30% in men and 15% in women [1, 2]. Patients with untreated OSA are at increased risk for metabolic dysfunction, pulmonary hypertension, arrhythmias, fatal myocardial infarction, and ischaemic stroke [3–6]. The first-line treatment for OSA is continuous positive airway pressure (CPAP), good compliance with which can lead to better outcomes in areas such as quality of life and cardiovascular health [7]. However, only approximately 50% of patients with OSA comply with CPAP treatment [8].

There have been several studies conducted to evaluate predictors for CPAP use [9, 10]. One study from France, for example, found that insomnia was related to good daily CPAP use [3]. Another study found that CPAP compliance was not associated with socioeconomic status, education, or personality type [10]. Patients with OSA and depression or who are unemployed may require more attention in order to increase their CPAP compliance. Even though there are several predictors for good CPAP tolerance and compliance, there are limited data available on the correlation between CPAP compliance and OSA symptoms. This study aimed to evaluate this correlation.

Methods

This was a cross-sectional study conducted at Khon Kaen University's Srinagarind Hospital in Thailand between September and December 2018. The inclusion criteria were age over 18 years, diagnosis with OSA through polysomnography, and that the patient should be familiar with the use of a CPAP machine for at least 3 months. Diagnosis of OSA is made by evidence of an apnoea-hypopnoea index (AHI) of 5 times·h^{-1} or more. CPAP therapy is indicated for those with an AHI of 5 times·h^{-1} or more with any symptoms or complications of OSA. It is also indicated for an AHI of 15 times·h^{-1} or more without any symptoms or complications of OSA.

A self-report questionnaire was used that consisted of questions regarding baseline characteristics, OSA symptoms, comorbid diseases, and experience of CPAP compliance. Good CPAP compliance was defined as more than 6 h of nightly CPAP use in the past 3 months. The study protocol was approved by the Khon Kaen University Ethics Committee in Human Research (Thailand; HE611351).

Baseline characteristics included sex, age, body mass index (BMI), satisfaction, education, occupation, insurance status, and income. OSA symptoms included gastroesophageal reflux disease, headache, dizziness, fatigue, daytime somnolence, and unrefreshing sleep. Comorbid diseases included hypertension, diabetes mellitus, heart failure, arrhythmia, coronary artery disease, and stroke.

All eligible patients were categorised as having either good or poor CPAP compliance. Descriptive statistics were used to compare factors between patients with good and those with poor CPAP compliance. Factors associated with CPAP compliance were computed using logistic regression analysis. Univariate logistic regression analysis was applied to calculate the crude odds ratio (OR) of individual variables for good CPAP compliance. Factors with a p-value <0.20 by univariate logistic regression analysis or that were clinically significant were included in subsequent stepwise multivariate logistic regression analysis. Analytical results were presented as ORs and 95% confidence intervals. The goodness of fit of the multivariate logistic regression model was tested using the Hosmer–Lemeshow method. All data analysis was performed using STATA software (StataCorp LP, College Station, TX, USA).

Results

There were 68 patients with OSA who completed the questionnaire. Of those, 14 (20.59%) had good CPAP compliance and 54 (79.41%) had poor compliance. Age and BMI were comparable between the two groups (52.81 *versus* 52.21 years, p=0.710; 49.34 *versus* 49.26 kg·m^{-2}, p=0.820).

Baseline characteristics, OSA symptoms, and comorbidities in both groups are shown in table 1. There was no significant difference in the proportion of patients with OSA symptoms or comorbid diseases between the two groups. A higher proportion of patients with good CPAP compliance experienced fatigue (71.43% *versus* 44.44%, p=0.132), daytime somnolence (85.71% *versus* 62.96%, p=0.124), and unrefreshing sleep (78.57% *versus* 61.11%, p=0.348). However, fatigue was the only independent factors associated with good CPAP compliance, with an adjusted OR of 5.380 (95% CI 1.274–22.719).

Discussion

CPAP treatment has been shown to decrease the risk of both fatal and nonfatal cardiovascular diseases [11]. The adjusted hazard ratio for CPAP treatment was 0.64 (95% CI 0.5–0.8) after adjusting for age, sex, AHI, BMI, comorbid diseases, diabetes mellitus, hypertension, previous history of cerebrovascular disease, and chronic obstructive pulmonary disease. The mean duration of CPAP use per night was 6.4 h, indicating that good CPAP compliance (at least 6 h·night^{-1}) is crucial. The rate of good CPAP compliance

TABLE 1 Baseline characteristics of obstructive sleep apnoea patients categorised by continuous positive airway pressure machine compliance

Factor	Poor compliance	Good compliance	p-value
Patients n	54	14	
Male sex	33 (61.11)	9 (64.29)	0.999
Age years	52.81±19.18	52.21±13.67	0.710
Body mass index kg·m^{-2}	49.34±10.99	49.26±8.18	0.820
Education			
Elementary school	7 (12.96)	2 (14.29)	0.906
High school	12 (22.22)	2 (14.29)	
Graduated	35 (64.81)	10 (71.43)	
Occupation			
Government	28 (51.85)	5 (35.71)	0.372
Insurance			
Government	33 (61.11)	8 (57.14)	0.999
Income			
<5000 baht	8 (14.18)	2 (14.29)	0.999
Symptoms			
Headache	20 (37.04)	4 (28.57)	0.755
Dizziness	21 (38.89)	6 (42.86)	0.999
Fatigue	24 (44.44)	10 (71.43)	0.132
Daytime somnolence	34 (62.96)	12 (85.71)	0.124
Unrefreshing sleep	33 (61.11)	11 (78.57)	0.348
Comorbidities			
Hypertension	33 (62.26)	7 (50.00)	0.542
Diabetes mellitus	12 (22.22)	2 (14.29)	0.717
Gastro-oesophageal reflux disease	17 (31.48)	4 (28.57)	0.999
Heart failure	3 (5.56)	0	0.999
Arrhythmia	9 (16.67)	3 (21.43)	0.701
Coronary artery disease	1 (1.85)	0	0.999
Stroke	4 (7.41)	0	0.574

Data are presented as n (%) or mean±SD, unless otherwise stated.

in this study was quite low. It was comparable to that found in African-American patients with OSA (20.59% *versus* 21%) and lower than those found in White (45%) or Latino (56.3%) patients [12, 13]. Possible explanations for the low CPAP compliance in these populations include low socioeconomic status, poor understanding of the consequences of OSA, cultural factors, short sleep duration, and insomnia [12, 14, 15]. Another factor that may have affected CPAP compliance was age. A study from Taiwan showed that patients with OSA over 65 years old had a CPAP acceptance rate that was significantly lower than younger patients (31.5% *versus* 60%; p=0.01) [16]. The mean age of this study population was also quite high at 52 years (table 1), which may have resulted in the low CPAP compliance rate.

A study from Spain found that there were four predictors for CPAP compliance, including headache, psychological symptoms, hypertension, and quality of life [17]. In our study, only fatigue was an independent predictor for good CPAP compliance. A previous study from Belgium showed that fatigue was also a predictor for CPAP purchase with a coefficient of 0.538 (p=0.008) [18]. Additionally, fatigue is a common symptom of OSA, resulting in the limitation of physical activity and/or poor quality of life [19]. Regular CPAP use may increase the amount of physical activity in which a patient engages by 1431 steps·day^{-1} over 7 months and may improve sleep quality (p<0.001) [20]. Therefore, patients with OSA who had fatigue tended to have good CPAP compliance. Additionally, CPAP significantly improved vitality or fatigue score if use 4 h·night^{-1} or more compared with those used CPAP less than 4 h·night^{-1} (14.2 *versus* 12.2, p=0.0281) after using CPAP for 2 to 9 months [21]. The effect size for the group with good compliance with CPAP was large for vitality (effect size 0.96) and may result in significant improvement of total score of general well-being (effect size 0.75).

In this study, good CPAP compliance is defined by using CPAP of at least 6 h·night^{-1}. Even though it is recommended to use CPAP at least 4 h·night^{-1} by the American Academy of Sleep Medicine [22], a previous study found that using CPAP for 3.3 h·night^{-1} did not reduce deaths from cardiovascular diseases compared with usual care (17.0% *versus* 15.4%, p=0.34) [23]. Additionally, a review found that using CPAP nightly more than 6 h improves sleepiness both subjectively and objectively, visual memory

task, and daily function [24]. In this study, the good compliance of CPAP increased by 50% of recommended hours or 6 h·night^{-1}.

There were some limitations to this study. First, it was conducted in a single study site, meaning that the results may not be applicable to other populations. Second, the study population did not include all patients with OSA. Those patients who did not purchase CPAP were not included. Other aspects of CPAP were not studied, such as quality of life or other aspects [25, 26]. Third, some data were missing, such as severity of OSA at the time of diagnosis due to the focus of CPAP compliance in this study.

Conclusion

Fatigue was the only symptom associated with good CPAP compliance in patients with OSA.

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Conflict of interest: None declared.

References

1 Young T, Palta M, Dempsey J, *et al.* Burden of sleep apnea: rationale, design, and major findings of the Wisconsin Sleep Cohort study. *WMJ* 2009; 108: 246–249.
2 Peppard PE, Young T, Barnet JH, *et al.* Increased prevalence of sleep-disordered breathing in adults. *Am J Epidemiol* 2013; 177: 1006–1014.
3 Salord N, Gasa M, Mayos M, *et al.* Impact of OSA on biological markers in morbid obesity and metabolic syndrome. *J Clin Sleep Med* 2014; 10: 263–270.
4 Krieger J, Sforza E, Apprill M, *et al.* Pulmonary hypertension, hypoxemia, and hypercapnia in obstructive sleep apnea patients. *Chest* 1989; 96: 729–737.
5 Filgueiras-Rama D, Arias MA, Iniesta A, *et al.* Atrial arrhythmias in obstructive sleep apnea: underlying mechanisms and implications in the clinical setting. *Pulm Med* 2013; 2013: 426758.
6 Ifergane G, Ovanyan A, Toledano R, *et al.* Obstructive sleep apnea in acute stroke: a role for systemic inflammation. *Stroke* 2016; 47: 1207–1212.
7 Marin JM, Carrizo SJ, Vicente E, *et al.* 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: 1046–1053.
8 Campos-Rodriguez F, Martinez-Garcia MA, de la Cruz-Moron I, *et al.* Cardiovascular mortality in women with obstructive sleep apnea with or without continuous positive airway pressure treatment: a cohort study. *Ann Intern Med* 2012; 156: 115–122.
9 Weaver TE, Maislin G, Dinges DF, *et al.* Relationship between hours of CPAP use and achieving normal levels of sleepiness and daily functioning. *Sleep* 2007; 30: 711–719.
10 Filtness AJ, Reyner LA, Horne JA. One night's CPAP withdrawal in otherwise compliant OSA patients: marked driving impairment but good awareness of increased sleepiness. *Sleep Breath* 2012; 16: 865–871.
11 Myllylä M, Hammais A, Stepanov M, *et al.* Nonfatal and fatal cardiovascular disease events in CPAP compliant obstructive sleep apnea patients. *Sleep Breath* 2019; 23: 1209–1217.
12 Quintos A, Naranjo M, Kelly C, *et al.* Recognition and treatment of sleep-disordered breathing in obese African American hospitalized patients may improve outcome. *J Natl Med Assoc* 2019; 111: 176–184.
13 Nogueira JF, Simonelli G, Giovini V, *et al.* Access to CPAP treatment in patients with moderate to severe sleep apnea in a Latin American city. *Sleep Sci* 2018; 11: 174–182.
14 Billings ME, Auckley D, Benca R, *et al.* Race and residential socioeconomics as predictors of CPAP adherence. *Sleep* 2011; 34: 1653–1658.
15 Dudley KA, Patel SR. Disparities and genetic risk factors in obstructive sleep apnea. *Sleep Med* 2016; 18: 96–102.
16 Yang MC, Lin CY, Lan CC, *et al.* Factors affecting CPAP acceptance in elderly patients with obstructive sleep apnea in Taiwan. *Respir Care* 2013; 58: 1504–1513.
17 Rafael-Palou X, Turino C, Steblin A, *et al.* Comparative analysis of predictive methods for early assessment of compliance with continuous positive airway pressure therapy. *BMC Med Inform Decis Mak* 2018; 18: 81.
18 Leemans J, Rodenstein D, Bousata J, *et al.* Impact of purchasing the CPAP device on acceptance and long-term adherence: a Belgian model. *Acta Clin Belg* 2018; 73: 34–39.
19 Diamanti C, Manali E, Ginieri-Coccossis M, *et al.* Depression, physical activity, energy consumption, and quality of life in OSA patients before and after CPAP treatment. *Sleep Breath* 2013; 17: 1159–1168.
20 Jean RE, Duttuluri M, Gibson CD, *et al.* Improvement in physical activity in persons with obstructive sleep apnea treated with continuous positive airway pressure. *J Phys Act Health* 2017; 14: 176–182.
21 Lo Bue A, Salvaggio A, Iacono Isidoro S, *et al.* OSA and CPAP therapy: effect of gender, somnolence, and treatment adherence on health-related quality of life. *Sleep Breath* 2019; In press [https://10.1007/s11325-019-01895-3].
22 Patil SP, Ayappa IA, Caples SM, *et al.* Treatment of adult obstructive sleep apnea with positive airway pressure: an American Academy of Sleep Medicine systematic review, meta-analysis, and GRADE assessment. *J Clin Sleep Med* 2019; 15: 301–334.
23 McEvoy RD, Antic NA, Heeley E, *et al.* CPAP for prevention of cardiovascular events in obstructive sleep apnea. *N Engl J Med* 2016; 375: 919–931.
24 Weaver TE, Grunstein RR. Adherence to continuous positive airway pressure therapy: the challenge to effective treatment. *Proc Am Thorac Soc* 2008; 5: 173–178.
25 Sawunyavisuth B. What are predictors for a continuous positive airway pressure machine purchasing in obstructive sleep apnea patients? *Asia Pac J Sci Technol* 2018; 23: APST-23-03-10.
26 Phitsanuwong C, Ariyanuchitkul S, Chumjan S, *et al.* Does hypertensive crisis worsen the quality of life of hypertensive patients with OSA? A pilot study. *Asia Pac J Sci Technol* 2017; 22: APST-22-02-01.