Factors Associated With Noncompliance to Treatment With Positive Airway Pressure

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Objective: To identify risk factors that may predispose patients with a diagnosis of obstructive sleep apnea (OSA) to fail treatment with positive airway pressure (PAP) owing to noncompliance.

Design: Retrospective medical chart review.

Setting: Academic tertiary care center.


Main Outcome Measures: Of the 949 patients identified, only 131 patients had complete medical and follow-up records that were adequate for analysis of compliance. Compliance was defined as using PAP for at least 4 hours per night on 70% of the nights monitored. We used χ² and logistic regression analyses to assess correlations among PAP compliance and various patient variables as well as among sleep and titration study parameters.

Results: Of the 131 patients analyzed, 48 patients (37%) were noncompliant with PAP therapy. A statistically significant correlation was found between a low apnea-hypopnea index (AHI) and PAP noncompliance (P = .004).

Conclusions: In this study, a low AHI was identified as a risk factor for noncompliance with PAP treatment. Therefore, patients with OSA and with a low AHI may warrant closer follow-up to allow early identification of PAP treatment failure owing to noncompliance and to allow timely institution of other treatment modalities, such as surgery.

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O BSTRUCTIVE SLEEP APNEA (OSA) is a chronic disorder characterized by frequent reduction and/or cessation of inspiratory airflow during sleep, with resulting hypoxemia and hypercapnia that are terminated by arousals. This pattern of repetitive arousals and nocturnal hypoxemia leads to disruption of sleep architecture and daytime hypsomnolence as well as a multitude of neurobehavioral and cardiopulmonary derangements. An increased incidence of cardiovascular disease, including congestive heart failure, hypertension, and cerebrovascular accidents, has been associated with OSA. A recent study by Marin et al showed that patients with untreated severe OSA have a significantly increased risk of fatal (odds ratio [OR], 2.87) and nonfatal (OR, 3.17) cardiovascular events compared with healthy participants. Another study by He et al reported an 8-year mortality rate of 37% for patients with an apnea index higher than 20 who never received treatment. This is in contrast to the 8-year mortality rate of less than 4% in patients with an apnea index lower than 20.

The recognition of OSA as a prevalent and significant public health problem is a fairly recent phenomenon. According to a 1993 study, OSA affects 4% of middle-aged American men and 2% of women. The prevalence of OSA increases with age, and it is estimated that 24% to 42% of the geriatric population may have OSA. Overall, approximately 18 million Americans have OSA. To put the scope of this health problem into perspective, OSA is a disease that is more prevalent than asthma and equally as prevalent as diabetes mellitus.

All patients diagnosed with OSA should be instructed to undergo behavioral changes such as weight loss, avoidance of alcohol and sedatives, sleeping on the side, and improvement in sleep hygiene, such as keeping a regular sleep schedule and getting an adequate amount of sleep. In general, patients with an apnea-hypopnea index (AHI) higher than 15 require more definitive treatment beyond behavioral changes. For patients with an AHI lower than 15, definitive treatment may also be beneficial if they have documented symptoms of excessive daytime sleepiness, impaired cognition, or documented history of hypertension, ischemic heart disease, or stroke. Definitive approaches to the treatment of OSA include the use of an oral de-
vice, upper airway surgery, and, more commonly, the use of a positive airway pressure (PAP) device.

Positive airway pressure, delivered either via a nasal or face mask, is the most commonly used modality for the treatment of OSA. The PAP generated by the device acts to counter the negative pressure in the upper airway and prevents airway collapse. Although PAP is an extremely safe and effective treatment modality, a wide range of compliance rates (46%-80%) has been reported. Noncompliance may be the result of skin reactions and discomfort from the mask as well as symptoms of nasal congestion, dryness, aerophagia, and eye irritations resulting from the pressurized air. Furthermore, some patients may be noncompliant owing to psychosocial issues such as claustrophobia, noncompliant personality, alcohol or drug abuse, and psychiatric disorders.

A number of studies have examined factors affecting PAP compliance in patients with OSA. However, most of these studies are from Europe and Canada and their findings may not be applicable to a US urban academic setting because of differences in health coverage systems as well as other socioeconomic factors. We set out to identify factors that may influence patient compliance with PAP therapy in an urban academic setting.

**METHODS**

**GENERAL INCLUSION AND EXCLUSION CRITERIA**

Patients older than 18 years who had been diagnosed with OSA requiring PAP treatment were eligible for participation in this trial. The need for PAP treatment was based on both the AHI as well as the patient’s symptoms. In general, PAP treatment was recommended for the following 2 groups of patients: those with an AHI higher than 15 regardless of daytime symptoms and those with an AHI of 5 to 15 and with documented symptoms of excessive daytime sleepiness, impaired cognition, mood disorders or insomnia, or documented hypertension, ischemic heart disease, or medical history of stroke.

The following patients were excluded from this study:

1. Patients with incomplete or missing medical records (eg, polysomnogram [PSG], PAP titration, initial office note, or follow-up medical records)
2. Patients who had not received a PAP machine at the time of their last clinic visit
3. Patients with low PAP compliance owing to a clearly identifiable and fixable problem with the PAP machine (eg, a poorly fitting mask, a broken machine, or hose leakage)
4. Patients with low PAP compliance owing to self-limiting health issues (eg, upper respiratory tract infection)
5. Patients whose compliance could not be clearly determined from the follow-up notes
6. Patients who underwent upper airway surgery (eg, uvulopalatopharyngoplasty)
7. Patients who lost a significant amount of weight either through exercise and diet or bariatric surgery

**REVIEW OF MEDICAL RECORDS**

We conducted a retrospective medical chart review of patients who underwent PSG and PAP titration between 1999 and 2003 at the Sleep Disorders Center at Hutzel Hospital, Detroit, Mich. Owing to the large number of PSGs (approximately 2000) performed in this busy sleep center, 2 study periods (March 1999 to July 2001 and March 2003 to December 2003) were selected to provide a good representation of the entire period without exhaustive review of all the 2000 charts. Of the 949 patients evaluated during these 2 periods, only 131 patients had complete medical and follow-up records adequate for analysis of compliance and were included in this study. Compliance was defined as use of PAP for at least 4 hours per night on 70% of the nights monitored.

**ANALYSIS OF DATA**

Analysis of factors that may influence PAP compliance was performed using \( \chi^2 \) (if the independent variables were nominal) or logistic regression (if the independent variables were continuous) analysis using the JMPIN program (SAS Institute Inc, Cary, NC). Factors analyzed included sex, age, body mass index (BMI, calculated as weight in kilograms divided by height in meters squared), neck circumference, Epworth Sleepiness Scale score, AHI, lowest oxygen saturation, tobacco and alcohol use, and the level of airway pressure required during titration.

**PATIENT CONFIDENTIALITY**

To protect the confidentiality of the study patients, each participant was assigned a code number. This study was approved by the Wayne State University (Detroit) Human Investigation Committee (Study No. HIC 023705MP4E).

Of the 131 patients evaluated, 48 patients (37%) were noncompliant with PAP therapy. The compliance rate of 63% was well within the range reported by other investigators (46%-80%). There were 60 men and 71 women. The mean age of the group was 53 years (range, 18-78 years); the mean BMI, 42.6 (range, 19.8-77.2); the mean neck circumference, 43.9 cm (range, 33.0-63.5 cm); the mean AHI, 78 (range, 3-451); and the mean PAP titration pressure, 13.6 cm H2O (range, 5-30 cm H2O). The PAP delivered was bilevel (36 patients), continuous (87 patients), or unknown (8 patients).

Using logistic regression analysis, a statistically significant positive correlation was found between a low AHI and PAP noncompliance (P = .004) (Figure). No correlations were found between compliance and other factors such as age, BMI, PAP titration pressure, lowest oxygen saturation, sex, tobacco and alcohol use, neck circumference, or Epworth Sleepiness Scale score.

Reasons for noncompliance included discomfort, facial rash, and a feeling of claustrophobia from the mask as well as symptoms of nasal congestion, dryness, and eye irritations resulting from the pressurized air.

**COMMENT**

Although PAP is an effective treatment for OSA, compliance remains a major issue. The rate of compliance varies widely (range, 46%-80%) as reported by different investigators from different locales. Previous studies on PAP compliance have demonstrated that a multitude of factors, such as sex, age, AHI, Epworth...
Sleepiness Scale score, BMI, titration pressure, and other psychological variables may influence compliance. In the present study, only the AHI was shown to be correlated with PAP compliance rates. Our finding that a lower AHI was associated with lower PAP compliance has also been reported by other investigators. We did not find any statistically significant correlation between PAP compliance and factors such as sex, BMI, age, neck circumference, tobacco use, Epworth Sleepiness Scale score, and titrated inspiratory pressure.

The finding of poor PAP compliance in patients with a less severe degree of OSA may not be surprising and can be attributed to a number of reasons. Some investigators felt that one of the most important determinant of PAP compliance is simply the patient’s perception of the cost-benefit ratio. In this schema, patients with mild OSA may not have a significant amount of daytime symptoms and therefore may not experience a significant benefit from the use of PAP. Given the lack of perceived benefit, these patients may be less likely to be compliant with the use of the PAP device and its associated inconvenience and discomfort (cost) on a daily basis. However, it is important to point out that despite the lack of perceived benefit by these patients, individuals with mild OSA do receive neurobehavioral benefits as well as cardiopulmonary benefits from proper OSA treatment. Peppard et al analyzed data from the Wisconsin Sleep Cohort Study and found a dose-response association between sleep-related breathing disorders at baseline and the presence of hypertension 4 years later. They found that patients with mild OSA (an AHI of 5-15) were twice as likely (OR, 2.03) to develop hypertension after 4 years of follow-up compared with patients with an AHI of 0. They even found an increased risk for development of hypertension (OR, 1.42) in patients with an AHI of 0.1 to 4.9. This finding underscored the importance of treating OSA, even the mild type.

This study has several limitations. First, the number of hours of PAP use was based on self-reporting by patients and not on objective data obtained from compliance meters. Some studies have demonstrated that self-reporting often overestimates the actual amount of PAP use. We were limited by the unavailability of compliance meters in our institution at the time of this study. This may be a common problem associated with urban sleep centers owing to reluctance of insurers to pay for the compliance meters. We began to dispense PAP devices with compliance meters, and in future studies we will measure compliance based on objective data.

Another limitation of this study was the small sample size. This was unfortunately the result of the large percentage of patients who were excluded from the study owing to incomplete or missing medical records (eg, PSG, PAP titration, initial office note, or follow-up medical records). There was also a large percentage of patients who were excluded because they were either lost to follow-up or did not have access to the PAP machine. The large percentage of patients lost to follow-up or who failed to have access to a PAP machine in our study population may be a unique problem in urban settings owing to socioeconomic factors. Although a large number of studies have evaluated PAP compliance, most of these studies focused on assessment of compliance in patients who have access to PAP devices (provided either...
because of the universal health coverage system or participation in a trial) and who actually returned to their physicians for follow-up. Furthermore, prospective studies evaluating PAP compliance introduced biases in the forms of selection (patients who agreed to participate in a study may be more likely to be compliant with treatment) as well as closer follow-ups (patients who are followed more closely are more likely to be compliant with treatment) as part of the study protocol. Thus, these studies failed to account for a large percentage of patients with OSA who either refused to receive PAP treatment or did not have access to PAP owing to a variety of socioeconomic reasons that may be more prevalent in an urban setting.

In this study, we identified a low AHI as a factor that was associated with increased risk for noncompliance with PAP treatment. Because treatment of OSA provides a beneficial effect even in patients with mild OSA, patients in the high-risk category may warrant closer follow-up to allow early identification of PAP treatment failure and to allow timely institution of other treatment modalities, such as surgery.

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Author Contributions: Dr Lin had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Lin. Acquisition of data: Lin, Prasad, and Pan. Analysis and interpretation of data: Lin, Pan, and Rowley. Drafting of the manuscript: Lin, Prasad, and Pan. Critical revision of the manuscript for important intellectual content: Lin and Rowley. Statistical analysis: Lin. Obtained funding: Lin. Administrative, technical, and material support: Lin, Prasad, Pan, and Rowley. Study supervision: Lin.

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REFERENCES


