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Original Article

Use of Portable Monitors as a Cheap and Simple Method in Obstructive Sleep Apnea Diagnosis

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ABSTRACT

Objective: Obstructive sleep apnea (OSA) affects mortality and morbidity due to persistent hypoxemia attacks during the night. The use of portable sleep monitors (PMs) has been investigated in recent years because the use of polysomnography (PSG) in the OSA diagnosing is a rare and expensive method. In our study, we aimed to investigate the compliance of Turkish population to PMs and PSG.

Methods: Demographic records of 62 patients referred with OSA symptoms were collected from the database. An ear, nose, and throat (ENT) physician was examination was pweformed for all patients. Afterwards, sleep records were taken with PM, followed by PSG.

Results: There was no difference between the PM and PSG parameters in terms of the apnea–hypopnea index and the oxygen desaturation index. The sensitivity of the PMs was 89%, and the specificity was 100%.

Conclusion: This study showed that the PM and PSG parameters were compatible with each other. We concluded that portable monitors that are cheaper, simpler, and capable of shooting at home can be used in the diagnosis of OSA, where obesity and OSA are very common.

INTRODUCTION

Obstructive sleep apnea (OSA) is a condition in which the airflow is interrupted due to a partial collapse of the upper airway with recurrent episodes of sleep. Intermittent hypoxia during sleep decreases the sleep quality and reduces the quality of life.[1,2] In addition, OSA is a risk factor for arterial diseases, hypertension, stroke, and cognitive disorders affecting all the systems.[3–7]

Polysomnography (PSG) is one of the methods for diagnosing OSA, used in sleep laboratories in hospitals.

PSG is an expensive and inadequate tool to diagnose all patients with a low number of devices. Portable sleep monitors (PMs), which can also be used in the home environment, are being used more frequently because of their simplicity, costs, and effectiveness.[8,9]

In this study, we aimed to investigate the diagnostic efficacy of PMs in Turkish population by comparing them with the parameters of PSG, the apnea–hypopnea index (AHI), and the oxygen desaturation index (ODI) in the laboratory.

MATERIALS AND METHODS

This study was retrospective and cross sectional. An approval from the local ethics committee was obtained for the study, and the study was in accordance with the principles of the Helsinki Declaration.

Patient population

Between January 2015 and June 2015, a total of 70 patients who were admitted to a university hospital sleep outpatient clinic with the complaint of snoring, sleeping during daytime, tiredness; who were sleeping with a PM in the home environment; an AHI ≥15; and who were referred to our center for PSG were included in the study. Clinically and medically unstable cases who had a myocardial infarction or cerebrovascular events in the past 2 months were excluded. In addition, those with an active infection, cancer, and psychosis were excluded from the study. Three patients had cerebrovascular event, 1 patient had myocardial infarction, 1 patient had malignancy, 2 patients had active infections,

and 1 patient had psychosis. The study was completed by 62 patients.

Patients diagnosed with OSA who were sleeping with a PM in their homes were referred to our center for a PSG recording and PSG-guided titration studies in order to receive a CPAP device in accordance with the health practice notification (SUT) as the PSG registration could not be performed in a hospital. Patients were hospitalized in our sleep clinic for 15 days, and PSG was performed. A total of 62 patients were compared retrospectively with regard to the AHI and ODI criteria determined by a PM and PSG. The height and weight of all patients were measured, and their body mass index (BMI) was calculated.[10] The Epworth sleepiness questionnaire was applied. PSG was evaluated by two physicians who were blinded to the PM results.

Epworth Sleepiness Scale (ESS)

The subjective responses of the patients about daytime sleep conditions were evaluated and given 0–24 points. A score of 10 and above was considered to be positive.[11]

Portable sleep monitors

Sleep records of patients were taken using the ResMed brand Nox T3 device (USA) and the ApneaLink Ox device (Sweden).

NOXT3 Portable Monitor: The thoracic, abdominal, RIP respiratory effort and RIP flow, current (from the nasal cannula), snoring sound recording channel, and position records were obtained.

ApneaLink Ox Device (firmware version 04.08; software version 8.00): This device records the inverse square root of the current as a flow index using a nasal flow signal (a nasal cannula/pressure transducer system [sample rate] 100 Hz) and pulse oximeter (Nonin XPod 3012 with a Nonin 7000A finger probe [sample rate 1 Hz]; Hudiksvall, Sweden).

Patients were seen at the hospital at noon, and the time when they usually go to sleep in the evening was recorded. The device was set to start recording at the appropriate time. The patients were told how to use the device by the sleep technician. They were sent home with the device the following day.

Both devices with less than four hours were re-enrolled for sleep, and respiratory events were scored manually. When the air flow decreased to ≥90 and lasted for at least 10 seconds, the apnea was recorded as a hypopnea when the air flow decreased to ≥30 for at least 10 seconds.

The AHI was calculated as the average of the apnea–hypopnea values recorded for each hour.

Polysomnography

All participants underwent a standard diagnostic overnight PSG (Neurosoft, Neuron spectrum5, Ivanovia, Russia). A two-channel electrooculogram and three-channel electroencephalogram were used to determine the sleep stages during the PSG records; a nasal airflow catheter and thermistor were used for the intranasal pressure monitoring; and a submental electrode was used for sleep stages. Two tibia electromyography was used to record the leg movement; and an oxygen saturation measurement probe and chest and abdomen belts were used for the status of ventilatory effort during respiration. The scoring was based on the AASM 2013 criteria.[12] Apnea was defined as a 90% or greater decrease in the airflow for at least 10 seconds. Hypopnea was defined as a 3% or greater decrease in oxygen saturation and/or a 30% or greater decrease in the airflow for at least 10 second with arousal. The AHI was a number of the apnea–hypopnea episodes observed in each hour of sleep. If the AHI score was 5 or higher, the patient was deemed to have OSA, and the severity of OSA was categorized as the mild (AHI=5.0–14.9 events/hour), moderate (AHI=15.0–29.9 events/hour), or severe (AHI >30.0 events/hour) according to the AASM 2014 classification.[13]

Statistical analysis

The IBM SPSS Statistics for Windows 2012 (version 22.0, IBM Corp., Armonk, NY, USA) was used for the statistical analysis. A chi-squared (χ^2) test was used for the comparison of categorical data, while numerical data were analyzed using Student's t-test for variables with normal distribution, and the Mann–Whitney U test for variables without normal distribution. Data were expressed as the mean (standard deviation), median (25–75 percentile), and percentage (%), where appropriate. A p-value <0.05 was considered to be statistically significant.

Table 1. Patient demographics

	Patients numbers (n=62)
Gender, n (%)	
Male	44 (71)
Female	18 (29)
Age, mean (SD)	51 (10)
Body mass index (kg/m^2) (SD)	33 (7)

SD: Standard deviation.

Table 2. Comparison of portable monitor and polysomnography parameters

		n	Mean (SD)	p
AHI	Portable monitor	62	36 (26)	0.60
	Polysomnography	62	39 (27)	
ODI	Portable monitor	62	35 (27)	0.32
	Polysomnography	62	39 (27)	

AHI: Apnea–hypopnea index; ODI: Oxygen desaturation index; SD: Standard deviation.

RESULTS

General demographic characteristics of patients are presented in Table 1.

The AHI and ODI values in the PM and PSG are presented in Table 2. The sensitivity of the PM was 89%, and the specificity was 100% (Table 2).

Fifty patients were evaluated with the PM named NOXT3. The AHI was 37±3, and the ODI was 35±26 for this device. Twelve patients were evaluated with the ApneaLink OX device. The AHI was 35±27, and the ODI was 30±26 for this device. There was no statistical difference between the two devices when compared with each other or with PSG.

DISCUSSION

In our study, the AHI and ODI values in the PM records were consistent with the AHI and ODI values in the PSG records.

In previous studies, it was emphasized that PMs would be inadequate with the current status in diagnosing OSA. However, there is a need to standardize technology.[14,15]

In a different study, the device was used in the hospital instead of at home.[16] In our study, the device was used at home in accordance with its purpose. The devices had already been set to start at the appropriate time. The patients used them without the supervision of a medical professional.

In addition, the first night effect was eliminated, and the required PM recording repetition was minimized due to insufficient sleep time.

In other previous studies, it was observed that the PM data were not reviewed manually, and only the automatic scoring of the device was achieved.[17,18] In our study, all data were evaluated manually, and the error rate of the device in detecting respiratory events was minimized.

A randomized study was performed using a 2-channel PM, like in our study, with a sufficient number of patients, which were scored manually, and the sensitivity was 83%, whereas the specificity was 100%.[19] Another study using a NOX 3 device showed the sensitivity of 95% and specificity of 69%.[20] Devices used in the two above-mentioned studies were the same as the devices used in our study. The PM is a less expensive device than PSG. However, the EEG, EOG and chin activities cannot be recorded. The absence of these signals hinders the patient's sleep awakening period and complete detection of sleep stages. In this case, the PM can record respiratory events per hour during the recording time. However, the PSG shows respiratory events per hour during sleep. Therefore, PMs have a lower detection status than the AHI.

Although there were no statistical differences in our study, similar to previous studies, the AHI and ODI were found to be higher in patients with PSG.[19,20]

It is a known fact that PMs can skip mild OSA cases despite all the conditions required by the device.[16] In our study, while the AHI values in our patients ranged from 12–64/h, 30 cases (51.6%) were in the severe OSA group, and 20 cases (32.2%) were in the moderate OSA group. We think that the high AHI values of our patients were contributing to the high specificity and sensitivity results.

In the population, the presence of OSA without daytime sleepiness (AHI >5) is 24% in men and 9% in women.[21] Recently increased sleep apnea due to the increase in obesity. Just like in other parts of the world, obesity is increasing in our country. According to data from Turkey TURDEP, the obesity prevalence is 35%, 27% in men and 44% in women. In the past 12 years, obesity has increased in both women (34%) and men (10.7%) in Turkey.[22] According to the regulation on the health conditions and examinations to be sought for drivers published in the Official Gazette dated 29 December 2015, persons with a BMI >33 have been reported to be evaluated by PSG before obtaining a driver's license, whether they had sleep-related complaints or not.[23]

Since the PSG is expensive and rarely used, approximately 90% of the current potential patient group under investigation was deprived of the access to treatment. Considering the comorbid diseases caused by OSA,[24] its mortality and morbidity would be decreased with a fast diagnosis and immediate treatment. PMs provide the opportunity for patients to record in their home environment.

Due to the comfort of the home environment, patients do not experience problems such as lack of sleep due to the first-night effect they are exposed to in the laboratory.

The strength of our study is that a large number of patients can receive PM records and PSG recordings at very close intervals in a standard manner and that PM data can be obtained at home, in accordance with its purpose.

The weakness of our study is that we could not include any other PM parameters besides AHI and ODI because of its retrospective nature. The use of two different devices as a PM is one of the study limitations.

CONCLUSION

This study showed that the PM and PSG parameters were compatible with each other. PMs are cheaper, simple, and can be used at home.

Considering the limited resources in our country, we think that PMs could be used more widely.

Ethics Committee Approval

Approved by the local ethics committee.

Peer-review

Internally peer-reviewed.

Authorship Contributions

Concept: S.S., G.Ç.A.; Design: G.Ç.A., S.S.; Data collec-

tion: S.S., G.Ç.A.; Analysis: S.S.; Literature Search: G.Ç.A.; Writing: S.S.; Critical review: S.S., G.Ç.A.

Conflict of Interest

None declared.

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Obstrüktif Uyku Apnesi Teşhisinde Daha Ucuz ve Basit Bir Yöntem Olan Portable Monitörler Kullanılabilir mi?

Amaç: Obstrüktif uyku apne (OUA) gece boyunca devam eden hipoksemi ataklarına bağlı mortalite ve morbiditeyi etkileyen bir durumdur. Teşhisinde kullanılan polisomnografinin (PSG) az bulunan ve pahalı bir yöntem olması nedeniyle son yıllarda portable uyku monitörlerinin kullanımı araştırılmaktadır. Çalışmamızda Türk toplumunda portable monitör (PM) ve PSG uyumluluğunu araştırmayı amaçladık.

Gereç ve Yöntem: Obstrüktif uyku apne semptomları ile başvuran 62 hastanın demografik kayıtları alındı ve kulak burun boğaz muayeneleri yapıldı. Önce PM ile uyku kayıtları alındı, daha sonra PSG uygulandı.

Bulgular: Portable monitör ve PSG bulgularında apne-hipopne indeksi (AHİ) ve oksijen desatürasyon indeksi (ODI) parametreleri açısından bir fark bulunamadı. Portable monitörlerin sensitivitesi %89, spesifitesi %100 olarak bulundu.

Sonuç: Obezite ve bağlı olarak OUA'nın çok yaygın olduğu günümüzde daha ucuz, basit ve evde çekim imkanı veren portabl monitörlerin OUA teşhisinde kullanılabileceği sonucuna vardık.

Anahtar Sözcükler: Obstrüktif uyku apne; polisomnografi; portable monitör.