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Sleep Disturbance in Systemic Sclerosis and the Associations Between Sleep and Pulmonary Hypertension: A Pilot Study

Sistemik Sklerozda Uyku Bozukluğu ve Uyku ile Pulmoner Hipertansiyon Arasındaki İlişkilerin Sonuçları: Bir Pilot Çalışma

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Abstract

Objective: Major differences in sleep architecture are observed in patients with systemic sclerosis (SSc). The aim of this study was to investigate the sleep pattern and frequency of obstructive sleep apnea (OSA) in patients with SSc, and compare sleep patterns in patients with and without pulmonary hypertension (PH).

Materials and Methods: Patients with SSc and symptoms of hypersomnia or insomnia who underwent polysomnography examinations were evaluated. The clinical data of patients were obtained from the patient files. The subjects were separated into two groups (PH-positive and PH-negative). OSA was defined as an apnea-hypopnea index (AHI) ≥5. Sleep parameters were evaluated between the groups.

Results: Thirty-six patients with SSc (88.9% females; mean age: 53.1±11.2 years), 27 with diffuse SSc, and 9 with limited-type SSc were enrolled in the study. Approximately 30.6% of the patients with SSc had AHI ≥5 and 13.9% of patients had AHI ≥15. Eight patients with SSc (22.2%) had a periodic leg movement index (PMLI) above 5/h. The percentages of patients with AHI ≥5 and AHI ≥15 were 25.9% and 7.4% in the PH-negative group and 44.4% and 33.3% in the PH-positive group, respectively. The duration of the rapid eye movement sleep stage was significantly shorter in patients with SSc and PH than in those without PH (p=0.02). The percentages of patients with PMLI >5/h were 14.8% in the PH-negative group and 44.4% in the PH-positive group (p=0.086).

Conclusion: Sleep disorders are more commonly observed in patients with SSc. Furthermore, OSA and PH are associated with SSc.

Keywords: Obstructive sleep apnea, systemic sclerosis, pulmonary hypertension, apnea-hypopnea index

Öz

Amaç: Sistemik sklerozlu (SSk) hastalarda uyku yapısında önemli farklılıklar bulunur. Bu çalışmanın amacı, SSk hastalarında uyku düzenini ve obstrüktif uyku apne (OUA) sıklığını araştırmak ve pulmoner hipertansiyonu (PH) olan ve olmayan hastalardaki uyku paternlerini karşılaştırmaktı.

Gereç ve Yöntem: Polisomnografi incelemesi yapılan hipersomni veya uykusuzluk semptomları olan SSk hastaları değerlendirildi. Hastaların klinik bilgileri hasta dosyalarından elde edildi. Hastalar iki gruba ayrıldı (PH-pozitif ve PH-negatif). OUA, apne-hipopne indeksi (AHİ) ≥5 olarak tanımlandı. Uyku parametreleri gruplar arasında değerlendirildi.

Bulgular: Çalışmaya 27 diffüz ve 9 sınırlı tip olmak üzere 36 SSk hastası (%88,9 kadın; ortalama yaş: 53,1±11,2 yıl) alındı. SSk'lu hastaların yaklaşık %30,6'sında AHİ ≥5 ve %13,9'unda AHİ ≥15 idi. SSk'lu sekiz hastada (%22,2) 5/saat'in üzerinde periyodik bacak hareket indeksi (PMLI) vardı. AHİ ≥5 ve AHİ ≥15 olan hasta yüzdeleri sırasıyla PH-negatif grupta %25,9 ve %7,4; PH-pozitif grupta %44,4 ve %33,3 idi. Hızlı göz hareketi uyku evresi süresi PH'si olan SSk hastalarda PH olmayanlara göre anlamlı olarak daha kısaydı (p=0,02). PMLI >5/h olan hastaların yüzdesi PH-negatif grupta %14,8, PH-pozitif grupta %44,4 idi (p=0,086).

Sonuç: Uyku bozuklukları SSk hastalarında daha sık görülür. Ayrıca SSk hastalarında OUA ve PH ilişkilidir.

Anahtar Kelimeler: Obstrüktif uyku apnesi, sistemik skleroz, pulmoner hipertansiyon, apne-hipopne indeksi

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Introduction

Obstructive sleep apnea (OSA) syndrome is characterized by recurrent upper airway obstructions during sleep. Sleep disorders have been reported in many rheumatic diseases such as collagen tissue diseases, Behçet's disease, seronegative spondyloarthropathies, and sarcoidosis.[1] OSA can cause significant functional deterioration and impaired quality of life. Importantly, OSA can lead to a variety of clinical consequences, including cerebrovascular events, glucose metabolism disorders, cardiovascular disease and hypertension.[2]

Systemic sclerosis (SSc) is a chronic inflammatory disease characterized by extensive fibrosis of the skin and internal organs. Sleep problem is a common issue in SSc, with 76% of patients reporting difficulty sleeping and 59% of moderate to severe effects on routine function.[3] Reduction of mouth opening, gastro-esophageal dysmotility and reflux, fibrosis of the pharynx and esophagus might be the causes of the tendency for sleep-disordered breathing (SDB) in patients with SSc.[1,4] The pulmonary fibrosis and hypertension seen in patients with SSc may lead to cardio-respiratory problems and contribute to sleep disruption.[5]

There are different results about the frequency and risk of OSA in patients with SSc. Prado et al.[5] found that no patients had OSA in their study, which evaluated 27 patients with SSc. Yakut et al.[6] found that 32% of patients with SSc had apnea-hypopnea index (AHI) more than 15/h in their cohort. Gundogdu et al.[7] showed that 58% of patients with SSc who had lung involvement had AHI ≥5. Until now, few studies have been conducted on the relationship between sleep and pulmonary hypertension (PH) in patients with SSc. Yakut et al.[6] showed that OSA was associated with a risk for PH in their study in which overnight sleep recording was made using home sleep apnea testing. Home sleep apnea testing may not be truly reflective, however. Polysomnography (PSG) is recommended instead of home sleep apnea testing to diagnose OSA in patients with considerable cardiorespiratory disease.[8] Additionally, patients with SSc have a high mortality rate compared with the normal population.[9] In a study involving 879 patients with SSc, PH was the leading cause of death.[10] Could OSA be an unrecognized risk factor for SSc mortality? With this background, the study aimed to investigate the sleep pattern and frequency of OSA in patients with SSc. Furthermore, we also aimed to compare sleep patterns in patients with and without PH. We used PSG, which enables a comprehensive evaluation of sleep architecture.

Materials and Methods

We performed a single-center review of patients with SSc with symptoms of hypersomnia or insomnia who underwent PSG examinations. Patients with a diagnosis of SSc using the American College of Rheumatology/European League Against Rheumatism 2013 criteria were included in the study.[11] Patients with SSc were categorized as diffuse or limited by LeRoy's criteria.[12] Patients were excluded if they were unable to complete PSG recording and were aged <18 years. Ethical approval was received from the Çukurova University Faculty of Medicine Non-Interventional Clinical Research Ethics Committee (date: 02.09.2016, decision number: 21).

The body mass index (BMI) (kg/m^2) values of the patients were noted. The modified Rodnan skin score which assesses the patient's skin thickness as graded using a 0-3 scale for 17 regions of the body was determined.[13] The presence of digital ulcer and gastroesophageal reflux was noted. Pulmonary function test and Doppler echocardiography results were obtained from the hospital database. The mean pulmonary artery pressure (PAP) values of the patients with right heart catheterization were recorded. PH was accepted when systolic PAP was >40 mm Hg using a Doppler echocardiogram or when the mean PAP was 25 mm Hg at rest as assessed using right-sided heart catheterization.[14] Brain natriuretic peptide (BNP) values at the last visit of the patients were recorded. Computed tomography appearance compatible with interstitial lung disease (ILD) with the restrictive pattern was considered as ILD.[15] The clinical data of patients were obtained from the hospital files. Laboratory results were extracted from the hospital database.

Full-night PSG was conducted using a computerized system (Kommet, Grass telefactor), and the parameters given below were recorded: electrooculogram (2 channels), electroencephalogram (6 channels), sub-mental muscle electromyogram (2 channels), anterior tibial muscle electromyogram for both legs (2 channels), electrocardiogram (1 channel), airflow (oro-nasal pressure adjusted cannula), chest and abdominal movements respiratory inductance plethysmography (2 channels), and arterial oxyhemoglobin saturation with finger-probe pulse oximetry (SaO_2: 1 channel). Records were made with a sweep speed of 10 mm/s. Sleep stages, apnea, and hypopnea scoring were made according to the American Academy of Sleep Medicine 2007 standard criteria.[16] Apnea was defined as complete cessation or a drop in the peak signal excursion by ≥90% of the pre-event baseline of the airflow ≥10 s. Hypopnea was defined as the peak signal excursions drop by ≥30% of the pre-event baseline of the airflow ≥10 s, and there was a ≥3% oxygen desaturation from the pre-event baseline or the event was associated with an arousal. The parameters written below were examined: time in bed, total sleep time (TST), total non-rapid eye movement/rapid eye movement (REM) time, sleep onset latency, sleep efficiency (TST divided by total recording time), wakefulness after sleep onset, duration and percentage of wakefulness, and sleep stages N1, N2, N3 and REM, mean oxygen saturation (SpO_2) in wakefulness and sleep, minimum (SpO_2), mean heart rate in sleep, respiratory disturbance index (RDI, the sum of apneas, hypopneas and respiratory effort-related arousals/TST), and the periodic leg movement index (PLMI) (number of PLM/TST). AHI was defined as the number of apnea and hypopnea events per hour of sleep. OSA was determined as AHI ≥5 in the presence of OSA-related symptoms.[17]

Epworth sleepiness scale (ESS) is a self-administered measure that includes 8 different questions. ESS is used to determine excessive daytime sleepiness. As a result of the test, the total score ranges from 0-24, with increasing values indicating increased sleepiness.[18] The validity and reliability of the Turkish

language version of ESS was conducted and it was reported that the Turkish version was effective in demonstrating daytime sleepiness.[19]

Statistical Analysis

Variables were shown as mean ± standard deviation, median (minimum-maximum) or percentage. The Shapiro-Wilk test was used to test whether continuous variables provided the assumption of normal distribution. Chi-square test, the student's t-test or Mann-Whitney U test was used to compare variables. In the analysis results, $p<0.05$ values were evaluated as significant. Analyses were performed by IBM SPSS Statistics Version 20.0 package program IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.

Results

One hundred and two patients with SSc were screened. Hypersomnia or insomnia symptoms were detected in 45 patients. Of the 45 patients, 36 patients with PSG tests were included in the study. Seven patients were unable to complete PSG recording, and two patients had localized scleroderma, all of whom were excluded from the research. Thirty-six patients with SSc (88.9% females; mean age 53.1±11.2 years), 27 with diffuse, and nine with limited-type SSc were enrolled in the study. PH was present in nine patients (25%), four of whom had diffuse and five had limited-type SSc. The demographic and clinical properties of the patients with SSc are shown in Table 1, and a comparison of clinical parameters between patients with and without PH is shown in Table 2. The sex ratio and BMI were similar between the PH-positive and negative groups, but there was a difference in ages between the groups (Table 2). Also, 30.6% of the patients with SSc had an AHI ≥5 and 13.9% of the patients had an AHI ≥15. Eight patients with SSc (22.2%) had PMLI above 5/h. BNP values were found to be higher in patients with PH.

The PSG parameters of the PH-positive and negative groups are given in Table 3. The number of awakenings, AHI score, AHI score in the REM period, and duration of SpO_2 <88% were considerably higher in the PH-positive group compared with the PH-negative group but the difference was not significant. This may have been due to the low number of patients. The percentages of patients with AHI ≥5 were 25.9% in the PH-negative group and 44.4% in the PH-positive group. There were more patients with an AHI ≥15 in the PH-positive group compared with the PH-negative group (33.3%, and 7.4%, respectively; p=0.088). The duration of the REM sleep stage was significantly shorter in patients with SSc with PH compared with the patients without PH (p=0.02) (Table 3). The percentages of patients with a PMLI >5/h were 14.8% in the PH-negative group and 44.4% in the PH-positive group (p=0.086). The percentage of patients with ESS scores >10 was higher in the group with AHI ≥15 compared with the group with AHI <15 (50%, 11.1%, respectively; p=0.033). During the recording, the O_2 saturation of 17 patients was detected below 88%.

Discussion

Sleep disorders (SDs) reduce quality of life and lead to various health problems. SDs are reported in many inflammatory rheumatologic conditions and major differences in sleep architecture have been found in rheumatologic diseases. For example, in a study conducted by Iaboni et al.[20], patients with systemic lupus erythematosus (SLE) had impaired sleep efficiency, increased stage 1 sleep, and decreased stage 3/4 slow-wave sleep compared with healthy controls. Prado et al.[5] found that while sleep efficiency (82±12.3%) and REM sleep decreased in patients with SSc, slow-wave sleep and arousal index increased. Similar to the abovementioned studies, in our study, the patients had reduced sleep efficiency. In our study, the reduced sleep efficiency compared with the study conducted by Prado et al.[5] may be associated with the higher percentage of patients with ILD (88.9%), PH (25%), and cardiac involvement (25%).

OSA is more common in men in the population.[21] Nevertheless, studies investigating the frequency of OSA in patients with SSc could not show any relationship between the presence of OSA and gender, since SSc is predominantly a female disease.[6,7] Despite the fact that women are more likely to have pulmonary arterial hypertension (PAH), it has been reported that survival is better in women.[22] When PAH studies conducted with SSc patients are examined, there are different

Table 1. Socio-demographic and clinical characteristics of SSc patients

Age (years), mean ± SD	53.14±11.15
Female sex, n (%)	32 (88.9)
History of smoking, n (%)	5 (14.3)
Disease subset Diffuse type n (%) Limited type n (%)	 27 (75) 9 (25)
Disease duration (months) median (min-max)	84 (4-288)
BMI (kg/m^2), mean ± SD	27.28±6.186
mRSS, mean ± SD	18.97±8.1
History of DU n (%)	31 (86.1)
PH n (%)	9 (25)
Cardiac involvement n (%)	9 (25)
Presence of ILD n (%)	32 (88.9)
FVC predicted (%), mean ± SD	74.33±20.14
DLCO predicted (%), mean ± SD	52.39±18.93
GER n (%)	28 (77.8)
BNP, median (min-max)	153 (5-9103)
Auto antibodies ANA (%) Anti-scl-70 n (%) Anti-centromere antibody n (%)	 33 (91.7) 23 (63.9) 3 (8.3)

SSc: Systemic sclerosis, BMI: Body mass index, mRSS: Modified rodnan skin score, DU: Digital ulcer, PH: Pulmonary hypertension, ILD: Interstitial lung disease, FVC: Forced vital capacity, DLCO: Diffusing capacity for carbon monoxide, GER: Gastroesophageal reflux disease, BNP: Brain natriuretic peptide, ANA: Anti-nuclear antibody, Anti-scl-70: Anti-topoisomerase I, SD: Standard deviation, min-max: Minimum-maximum

Table 2. Comparison of clinical parameters between patients with and without PH				
	PH - (n=27)	**PH + (n=9)**	**Total**	**p**
Age (years), mean ± SD	50.8±11.2	60.1±7.9	53.1±11.2	0.028
Disease duration (months) median (min-max)	84 (4-288)	81 (24-240)	84 (4-288)	0.802
Female sex, n (%)	24 (88.9)	8 (88.9)	32 (88.9)	1.00
BMI (kg/m^2), mean ± SD	26.9±6.2	28.2±6.3	27.2±6.1	0.604
Disease subset Diffuse type n (%) Limited type n (%)	 23 (85.2) 4 (14.8)	 4 (44.4) 5 (55.6)	 27 (75) 9 (25)	0.026
mRSS, mean ± SD	18.3±8.08	21±8.26	18.97±8.1	0.393
Presence of ILD n (%)	25 (92.6)	7 (77.8)	32 (88.9)	0.255
FVC predicted (%), mean ± SD	77.04±19.78	65.88±20.13	74.33±20.14	0.176
DLCO predicted (%), mean ± SD	56.40±15.31	39.88±24.48	52.39±18.93	0.029
BNP, median (min-max)	97 (5-1104)	498 (97-9103)	153 (5-9103)	0.004
ESS >10 n (%)	5 (19.2)	2 (22.2)	7 (20)	1.00
ESS, median (min-max)	3.5 (0-12)	3 (0-13)	3 (0-13)	0.753

PH: Pulmonary hypertension, BMI: Body mass index, mRSS: Modified rodnan skin score, ILD: Interstitial lung disease, FVC: Forced vital capacity, DLCO: Diffusing capacity for carbon monoxide, BNP: Brain natriuretic peptide, ESS: Epworth sleepiness scale, SD: Standard deviation, min-max: Minimum-Maximum

Table 3. Comparison of PSG parameters between patients with and without PH				
	PH - (n=27)	**PH + (n=9)**	**Total (n=36)**	**p**
Sleep efficiency, (%) mean ± SD	74.9±22.0	73.1±17.3	74.5±20.7	0.541
Number of awakenings n, median (min-max)	9 (0-15)	11 (1-14)	9 (0-15)	0.157
Sleep latency (min) median (min-max)	16 (4-191)	20 (4-85)	19 (4-191)	0.830
Stage N1 sleep, (% TST) Mean ± SD	11.6±8.9	9.6±5.7	11.1±8.2	0.641
Stage N2 sleep, (% TST) Mean ± SD	55.9±11.3	62.8±10.4	57.7±11.3	0.117
Stage N3 sleep, (% TST) Mean ± SD	15.6±7.1	16.7±6.6	15.9±6.9	0.590
REM sleep, (% TST) Mean ± SD	16.8±7.2	10.6±4.5	15.2±7.1	0.023
Arousal index	17.9±10.2	17.5±10.1	17.8±10.0	0.954
AHI, n mean ± SD median (min-max)	5.75±10.49 1.1 (0-40.6)	11.86±13.55 3.1 (0.6-38.4)	7.27±11.44 1.9 (40.6)	0.093
AHI ≥5, n (%)	7 (25.9)	4 (44.4)	11 (30.5)	0.409
AHI ≥15, n (%)	2 (7.4)	3 (33.3)	5 (13.9)	0.088
AHI REM, n mean ± SD median (min-max)	13.74±22.15 1.1 (0-83)	29.62±28.91 27.2 (0-73)	17.71±24.58 2.65 (0-83)	0.073
PLMI n, mean ± SD median (min-max)	3.6±8.0 0 (0-31.7)	16.2±29.2 4.9 (0-91)	6.7±16.5 0.05 (0-91)	0.295
PLMI >5, n (%)	4 (14.8)	4 (44.4)	8 (22.2)	0.086
O_2 saturation < 88% (min), mean ± SD median (min-max)	16.3±69.2 0 (0-357.5)	38.8±59.3 1.1 (0-148)	21.9±66.8 0 (0-357)	0.109
Minimum SaO_2	89±9.73	79.78±13.95	86.80±11.53	0.031

REM: Rapid eye movement, AHI: Apnea-hypopnea index, PMLI: Periodic leg movement index, TST: Total sleep time, SD: Standard deviation, Min-Max: Minimum-Maximum, PSG: Polysomnography, PH: Pulmonary hypertension

results regarding gender. In some studies, an increase in risk was reported with female and some with male gender.[23] In our study, the gender distribution was similar in the groups with and without PH.

According to our study, the percentage of patients with an AHI ≥5 was 30.5% and AHI ≥15 was 13.9%. In a study by Prado et al.,[5] which investigated 27 patients with SSc, there were no patients with AHI higher than 5. In that study, the percentages of lung involvement, heart involvement, and PH were not given in detail. The clinical features of patients were evaluated by the presence of dysphagia, dyspnea, hypertension, abnormal pulmonary function, and esophageal dyskinesia. In our study, 88.9% of patients had ILD, and the prevalence of pulmonary function test abnormality was 48.2% in the study by Prado et al.[5] There were more patients with organ involvement in our study than in Prado et al.[5]'s study. In addition, patients with hypersomnia or insomnia complaints were included in our study. The higher rate of OSA in our study compared to the study conducted by Prado et al.[5] might be associated with the abovementioned reasons. In a study by Yakut et al.,[6] OSA (AHI ≥15) was observed in 32.3% of patients with SSc in which overnight sleep recordings were made using home sleep apnea testing. In the study by Gundogdu et al.,[7] 58% of patients with SSc who had lung involvement had AHI ≥5. Different results might be associated with distinct clinical features of patients in these studies. Altered cytokine levels were identified in autoimmune diseases. Patients with SSc demonstrated elevated interleukin (IL)-17, IL1β, and IL6 expression.[24] These abnormalities in cytokines may have effects on sleep and daytime function or the disrupted sleep might cause elevation of the cytokines expression in the patients.[1] Although not statistically significant, the prevalence of OSA was higher in the patients with SSc with PH compared with the patients without PH in our study. The prevalence of sleep breathing disorders (SBD) in patients with PH ranges based on the criteria employed for the diagnosis of SBD. Ulrich et al.[25] showed up to 45% (17/38) of PH had AHI more than 10/h in their study. According to the study conducted by Dumitrascu et al.,[26] it was reported that 26.6% (45/169) of patients with precapillary PH had AHI more than 10/h. In the literature, it was shown that nocturnal oxygen desaturation is common in PH and that patients with PH may exhibit both OSA and central sleep apnea.[26] In a study by Minai et al.[27] significant nocturnal hypoxemia was reported in 30 out of 43 patients with PH. Prado et al.[5] reported that dyspnea was associated with sleep disturbances. Nocturnal oxygen desaturation, which is common in PH, may lead to dyspnea, which may in turn contribute to the development of SDB. Based on these studies, the prevalence of OSA may be higher in patients with SSc with PH.

In our study, not reaching statistical significance, the number of REM AHI was higher in the group with PH compared to the group without. REM AHI levels are high and nocturnal SpO_2 are low in patients with PH. Consequently, these impair the quality of sleep and may cause increased inflammatory cytokines. REM OSA is shown to be associated with adverse cardiovascular and metabolic outcomes.[28] Nagaoka et al.[29] reported that mortality in patients with lower average SpO_2 was higher than in those with higher SpO_2 in patients with PAH. Chronic hypoxemia may promote pulmonary artery vasoconstriction and remodelling, and as a result, it may contribute to the poor prognosis. Accordingly, high REM AHI level and low nocturnal SpO_2 may trigger disease progression and increase the risk of mortality. Although total AHI is important in this group of patients, patients with high REM AHI should be evaluated in terms of starting treatment, taking into account the physiopathology.

According to our study, patients with PH had a reduced percentage of REM sleep compared with patients without PH. In the study by Prado et al.,[5] patients with SSc showed less REM sleep compared with age-adjusted norms. Furthermore, patients with dyspnea had less REM sleep than those without dyspnea.[5] In the study conducted by Koo and Nam,[30] three groups were formed according to the percentage of REM sleep of the patients (<20%, 20-25% and >25% of TST), and it was demonstrated that the little-REM sleep group had a higher AHI and greater reductions in SpO_2 with the another groups. In the same study, it was emphasized that decrease in REM sleep may be an adaptation to reduce the severity of apnea episodes. In addition, more severely disrupted sleep was found in patients with little-REM sleep. In our study, the percentage of patients with SBD was higher among patients with PH. According to the abovementioned studies, reduced REM sleep in patients with PH may be the result of the higher prevalence of OSA in these patients.

We found that 22.2% of patients with SSc had PMLI above 5/h. The percentage of patients with PMLI >5/h was 14.8% in the PH-negative group, and the rate rose to 44.4% in the PH-positive group. Prado et al.[5] showed that 48% of patients with SSc had PLMI above 5/h. Negative correlation between PLMI and sleep efficiency was detected only in patients with restless legs syndrome.[5] In the literature, increased periodic leg movements during sleep were shown in patients with rheumatoid arthritis[31] and SLE.[32] Patients with OSA may report restlessness and have movements range from simple movements (for example periodic leg movements) to larger movements of the extremities. The movement alterations may be related to the alterations in respiration.[32] The high prevalence of coronary artery disease in subjects with periodic limb movements during sleep was highlighted.[33] As a result, patients who have PH with high PMLI might have a worse prognosis.

In this paper, we explored the sleep pattern and frequency of OSA in patients with SSc. As far as we know, this is the first study to examine the sleep architecture in patients with SSc with and without PH.

Study Limitations

The most important limitation of the study was that there were only nine patients in the PH group. However, SSc is a rare disease and PSG is an examination that requires hospitalization. Secondly, the study excluded severe SSc patients with multi-organ involvement whose PSG test could not be performed. This may have caused differences in results. Nevertheless, the findings of this study may guide further studies.

Conclusion

In conclusion, in our study, the prevalence of OSA was 30.5% in patients with SSc, whereas it was 44% in patients with SSc with PH. Major differences in sleep architecture are found in patients with SSc, and SDs are more commonly observed in this group of patients. Patients with SSc should be questioned in terms of OSA symptoms in routine clinical visits. Sleep apnea syndrome should be evaluated due to its prognostic and therapeutic importance, especially in patients with SSc with PH. PSG is required to determine sleep patterns and to plan treatment for patients with SSc at the time of diagnosis and with clinical progression. Further studies with larger study populations are needed in this respect.

Ethics

Ethics Committee Approval: Ethical approval was received from the Çukurova University Faculty of Medicine Non-Interventional Clinical Research Ethics Committee (date: 02.09.2016, decision number: 21).
Informed Consent: Informed consent was not obtained due to the retrospective nature of the study.

Authorship Contributions

Surgical and Medical Practices: İ.T., K.A.K., Concept: İ.T., D.A., K.A.K., D.K.G., Ç.E.Ç., İ.H., İ.Ü., Design: İ.T., D.A., K.A.K., D.K.G., Ç.E.Ç., İ.H., İ.Ü., Data Collection or Processing: İ.T., D.A., K.A.K., D.K.G., Ç.E.Ç., İ.H., İ.Ü., Analysis or Interpretation: İ.T., D.A., K.A.K., D.K.G., Ç.E.Ç., İ.H., İ.Ü., Literature Search: İ.T., D.A., K.A.K., Writing: İ.T., K.A.K.
Conflict of Interest: Authors declare that they have no conflict of interest.
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