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Determining the Priority of Polysomnography in Obstructive Sleep Apnea Syndrome

Obstrüktif Uyku Apne Sendromunda Polisomnografi Önceliğinin Belirlenmesi

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Abstract

Objective: The growing awareness of obstructive sleep apnea syndrome (OSAS) has resulted in a backlog in sleep laboratories. This study aimed to assess the severity of OSAS using anthropometric and cardiac parameters before polysomnography (PSG), helping to prioritize patients for PSG.

Materials and Methods: In this cross-sectional study, 91 patients with OSAS symptoms were included from an accredited sleep laboratory in a research hospital. Demographic and clinical data, including body mass index (BMI) and neck circumference (NC), were collected. The Epworth Sleepiness Scale (ESS) was used to assess sleepiness, while transthoracic echocardiography measured cardiac parameters, including maximal pulmonary artery pressure (PAP maximum), interventricular septum thickness (IVST), aortic root diameter (ARD), right atrium diameter (RAD), and B-type natriuretic peptide (BNP) levels. Based on PSG results, patients were categorized into non-OSAS/mild OSAS [Apnea-hypopnea Index (AHI) <15] or moderate/severe OSAS (AHI ≥15) groups. Data were analyzed using SPSS software.

Results: Of the 91 patients, 49 were in the moderate/severe OSAS group and 42 in the non-OSAS/mild OSAS group. Statistically significant differences were observed between the groups regarding ESS, BMI, NC, BNP, IVST, ARD, RAD, and PAP max ($p<0.05$). Cut-off values were determined for each parameter. Multivariate logistic regression analysis showed that BMI, PAP max, and BNP were significant predictors of OSAS severity ($p<0.05$).

Conclusion: BMI, BNP, and PAP max were identified as the key parameters in predicting OSAS severity. These factors can be used to prioritize patients for PSG, improving the efficiency of diagnosis and treatment.

Keywords: Obstructive sleep apnea syndrome, Epworth Sleepiness Scale, anthropometric measurements, B-type natriuretic peptide, echocardiography

Öz

Amaç: Obstrüktif uyku apne sendromu (OUAS) konusunda artan farkındalık, uyku laboratuvarlarında yığılmaya neden olmuştur. Bu çalışmanın amacı, polisomnografi (PSG) öncesinde antropometrik ve kardiyak parametreleri kullanarak OUAS'nin ciddiyetini değerlendirmek ve PSG için hastalara öncelik verilmesine yardımcı olmaktır.

Gereç ve Yöntem: Bu kesitsel çalışmaya, bir araştırma hastanesindeki akredite bir uyku laboratuvarından OUAS semptomları olan 91 hasta dahil edildi. Vücut kitle indeksi (VKİ) ve boyun çevresi (NC) dahil olmak üzere demografik ve klinik veriler toplandı. Uykululuk halini değerlendirmek için Epworth Uykululuk Ölçeği (ESS) kullanılırken, transtorasik ekokardiyografi ile pulmoner arter basıncı (PAP maksimum), interventriküler septum kalınlığı (IVST), aort kökü çapı (ARD), sağ atriyum çapı (RAD) ve b-tipi natriüretik peptid (BNP) düzeyleri gibi kardiyak parametreler ölçüldü. PSG sonuçlarına göre hastalar OUAS olmayan/hafif OUAS [Apne-hipopne İndeksi (AHİ) <15] veya orta/ağır OUAS (AHİ) ≥15 gruplarına ayrıldı. Veriler SPSS yazılımı kullanılarak analiz edildi.

Bulgular: Doksan bir hastanın 49'u orta/ağır OUAS grubunda ve 42'si OUAS olmayan/hafif OUAS grubundaydı. Gruplar arasında ESS, VKİ, NC, BNP, IVST, ARD, RAD ve PAP maks açısından istatistiksel olarak anlamlı farklılıklar gözlendi ($p<0,05$). Her parametre için kesme değerleri belirlenmiştir. Çok değişkenli lojistik regresyon analizi VKİ, PAP maks ve BNP'nin OUAS şiddetinin anlamlı belirleyicileri olduğunu gösterdi ($p<0,05$).

Sonuç: VKİ, BNP ve PAP maks, OUAS şiddetini öngörmede anahtar parametreler olarak tanımlanmıştır. Bu faktörler PSG için hastalara öncelik vermek için kullanılabilir ve tanı ve tedavinin etkinliğini artırabilir.

Anahtar Kelimeler: Obstrüktif uyku apne sendromu, Epworth Uykululuk Ölçeği, antropometrik ölçümler, b-tipi natriüretik peptid, ekokardiyografi

Introduction

Obstructive sleep apnea syndrome (OSAS) is a sleep disordered breathing condition characterized by recurring episodes of apnea (complete cessation of breathing) and hypopnea episodes (insufficient breathing) due to collapses in the upper airway during sleep. These episodes of apnea and hypopnea occur repeatedly throughout sleep, disrupting sleep quality and leading to oxygen desaturation.[1,2]

OSAS is not only a problem that affects the quality of sleep of an individual but also a serious public health issue that directly

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impacts public health, work, and traffic safety. Especially in professional drivers, OSAS poses a significant threat to traffic safety. Lack of restful sleep causes excessive daytime sleepiness, negatively affecting driving performance and increasing the risk of accidents. Studies have shown that professional drivers are at a higher risk of OSAS than the general population. For example, while 26% to 50% of professional drivers are at risk of OSAS, this figure is only about 3% to 7% in the general adult population, highlighting the critical need for early detection and effective management of the disease in professional drivers.[2-4]

In OSAS cases, overcoming episodes of apnea and hypopnea episodes during sleep leads to increased breathing effort, resulting in increased negative intrathoracic pressure. Consequently, this increase in negative intrathoracic pressure affects the cardiovascular system, leading to severe cardiac complications such as right heart failure.[5,6] Furthermore, increased breathing effort disrupts sleep architecture, preventing the individual from achieving deep and restful sleep, which results in symptoms such as excessive daytime sleepiness, concentration problems, and fatigue.[7,8]

Over time, these negative pathophysiological processes affect mental and physical health in multiple ways, leading to a complex set of complications, including hypertension, cardiovascular diseases, type 2 diabetes, obesity, stroke, and even sexual dysfunction.[9,10] Long term, structural cardiac changes detectable by echocardiography (ECHO) and an increase in B-type natriuretic peptide (BNP) levels, a biochemical marker of cardiac load, are observed.[11,12]

The diagnosis of OSAS begins with the evaluation of excessive sleepiness during the day.[13] Furthermore, factors such as advanced age, male, obesity, large neck circumference (NC), retrognathia, and tonsillar hypertrophy are important risk factors for OSAS.[14,15] The presence of hypertension and other metabolic-cardiovascular comorbidities in a patient with OSAS symptoms may suggest the likelihood of a severe and complicated case of OSAS.[16] After completing all clinical, anthropometric, and laboratory evaluations, polysomnography (PSG) is the ultimate test requested to diagnose and determine the severity of OSAS. However, due to insufficient sleep laboratories and increasing demand, waiting times for PSG appointments range from 3 to 12 months in many countries. These long waiting periods may prevent moderate and severe cases of OSAS from receiving effective treatment on time, leading to the progression of the disease, worsening health conditions, and negatively impacting public health by posing risks to work and traffic safety. This situation has created the need to classify moderate and severe OSAS cases for priority PSG performing.[17-19]

Our study aims to evaluate the predictive ability of the Epworth Sleepiness Scale (ESS), anthropometric measurements, serum BNP levels, and ECHO parameters to identify moderate and severe cases of OSAS before PSG.

Materials and Methods

This study included 91 patients who underwent PSG testing at the accredited sleep laboratory of a training and research hospital. The study was conducted in accordance with the Declaration of Helsinki and was approved by the Ethics Committee of İstanbul Göztepe Training and Research Hospital (current: Göztepe Prof. Dr. Süleyman Yalçın City Hospital) (approval number: 54/A, date: 10.02.2009) and informed consent was obtained from all participants.

Patient Selection

The study included patients aged between 18 and 65 years old who had no known chronic respiratory, cardiovascular, or metabolic comorbidities and who gave informed consent for the research. Patients with a known history of respiratory, cardiovascular, or metabolic diseases, pregnant women, those outside the 18-65 age range, or those who did not provide informed consent were excluded from the study.

Physical Examination, Anthropometric Measurements, and Blood Sampling

The age, sex, and smoking history (pack-year) of all patients were recorded, and the Turkish-adapted ESS was administered. Body mass index (BMI) and NC were observed. Blood samples from all cases were collected in EDTA tubes before getting out of bed on the morning of the PSG study duo to minimize individual variations, and serum BNP levels were analyzed using the minividas device (Biomerieux, France) via an enzyme-linked fluorescence assay method. To further reduce variability, the arterial blood pressure of each patient was manually measured on the morning of the PSG study using an Erka-brand sphygmomanometer applied to the right arm before getting out of bed.

Echocardiography

ECHO was performed on all patients in the left lateral decubitus position at a 45° angle at rest. To minimize individual variability, a single cardiologist performed M-mode, two-dimensional, and colour flow doppler recordings using Siemens Acuson Sequoia C256 and GE Vivid 3 ECHO devices. The following ECHO parameters were measured and recorded: left ventricular end-systolic and end-diastolic volumes (LV-ESV and LV-EDV), left ventricular ejection fraction (LV-EF), left atrium diameter (LAD), left ventricular end-systolic and end-diastolic diameters (LV-ESD and LV-EDD), right atrium diameter (RAD), interventricular septum thickness (IVST), aortic root diameter (ARD), and maximal pulmonary artery pressure (PAP max).

Polysomnography

PSG was recorded using the Grass-Telefactor Comet device by a certified sleep technician and evaluated by a pulmonologist experienced in diagnosing and treating sleep-related breathing disorders, according to current guidelines of the American Academy of Sleep Medicine. The patients in our study were divided into two groups according to their Apnea-hypopnea Index (AHI). The patients with an AHI ≥15 were classified as moderate/severe OSAS cases, while those with an AHI <15 were classified as non-OSAS or mild OSAS cases.

Statistical Analysis

Data from both groups were analyzed using IBM Statistical Package for the Social Sciences for Windows 29.0 (IBM

Corp., Armonk, NY). The following parameters were compared between the two groups: age, sex, smoking status, systolic blood pressure (SBP), diastolic blood pressure (DBP), ESS, BMI, NC, BNP, IVST, ARD, RAD, LV-ESD, LV-EDV, LV-ESV, LV-EDD, LV-EF%, LAD, and PAP max. Descriptive statistics were presented as frequencies and percentages for categorical variables and as means and standard deviations for continuous variables. An independent samples t-test was used to compare the two groups, and the Pearson chi-square test was used for categorical variables. The Youden Index formula was used to determine the optimal cut-off points in the receiver-operating characteristic (ROC) curve analysis:

Youden Index = Sensitivity + specificity-1

Thus, the cut-off points showing the best performance in sensitivity and specificity were identified. The statistical significance of the results was accepted at a p-value <0.05.

Results

Of the 91 cases included in the study, 72.5% (n=66) were male, and 27.5% (n=25) were female. The mean age was 46.03 years (standard deviation=9.27), with an age range of 28 to 67 years. While 45.1% (n=41) of the cases were in the group of "non-OSAS or mild OSAS", 54.9% (n=50) were in the moderate and severe OSAS groups.

In the analysis of the mean values of the two OSAS groups, significant differences were found between the ESS, BMI, NC, BNP, and SBP parameters ($p<0.05$). Furthermore, significant differences in echocardiographic parameters, were observed, including measurements of IVST, ARD, PAP max, and left LV-ESD between the two groups ($p<0.05$). However, there were no significant differences in age, smoking status, DBP, LV-EDV, LV-ESV, LAD, and LV-EF% values between the two groups ($p>0.05$) (Table 1).

The results of the Spearman correlation analysis revealed significant correlations between OSAS severity and various parameters. Among the non-PSG parameters, serum BNP, BMI, and PAP max values strongly correlated with OSAS severity ($r=0.650$-0.676, $p<0.001$). Another anthropometric measurement, NC, and the ECHO parameters, ARD and IVST, showed moderate positive correlations ($r=0.469$-0.541, $p<0.001$). RAD and ESS showed moderate correlations with OSAS severity ($r=0.428$ and 0.444, $p<0.001$), whereas SBP and LV-ESD showed lower but statistically significant correlations ($p<0.05$). DBP and other echocardiographic parameters did not correlate significantly (Table 2).

Logistic regression analysis evaluated the cumulative effect of the parameters that showed correlations in predicting OSAS severity. BMI ($p=0.033$), BNP ($p=0.049$), and PAP max ($p=0.031$) were found to have statistically significant performance in

Table 1. Statistical analysis of the differences between the mean of continuous variables between the non-OSAS and mild OSAS group and the moderate OSAS and severe OSAS groups

Parameter	Mann-Whitney U	Wilcoxon W	Z value	2-Way P
BMI (kg/m^2)	240.000	1101.000	-6.262	0.001
PAP max (mmHg)	252.500	1113.500	-6.162	0.001
BNP (pg/mL)	221.000	1082.000	-6.413	0.001
NC (cm)	385.500	1246.500	-5.134	0.001
IVST (cm)	498.500	1359.500	-4.447	0.001
ARD (cm)	466.000	1327.000	-4.470	0.001
RAD (cm)	518.500	1379.500	-4.060	0.001
ESS	498.000	1359.000	-4.216	0.001
SBP (mmHg)	676.500	1537.500	-2.822	0.005
LV-ESD (cm)	760.000	1621.000	-2.141	0.032
LV-EDV (mL)	828.000	2103.000	-1.572	0.116
Age (year)	851.000	1712.000	-1.389	0.165
Smoking (pack year)	871.500	2146.500	-1.246	0.213
DBP (mmHg)	891.500	1752.500	-1.102	0.270
LV-ESV (mL)	879.000	2154.000	-1.165	0.244
LV-EDD (cm)	865.500	1726.500	-1.278	0.201
EF (%)	975.500	1836.500	-0.395	0.693
LAD (cm)	1007.500	1868.500	-0.141	0.888

p<0.05 was considered statistically significant.

BMI: Body mass index, PAP max: Maximal pulmonary arterial pressure, BNP: B-type natriuretic peptide, NC: Neck circumference, IVST: Interventricular septum thickness, ARD: Aortic root diameter, RAD: Right atrium diameter, ESS: Epworth sleepiness scores, SBP: Systolic blood pressure, LV-ESD: Left ventricle end systolic diameter, LV-EDV: Left ventricle end diastolic volume, DBP: Diastolic blood pressure, LV-ESV: Left ventricle end systolic volume, LV-EDD: Left ventricle end diastolic diameter, EF: Ejection fraction, LAD: Left atrium diameter, OSAS: Obstructive sleep apnea syndrome

determining OSAS severity. Each unit increase in BMI was found to increase the likelihood of OSAS severity by 9.56 times (odds ratio=9.563). On the contrary, increases in BNP and PAP max values increased OSAS severity 1.16 and 4.48 times, respectively. Other parameters, including ESS, NC, SBP, LV-ESD, ARD, IVST, and RAD, did not show significant performance in this model (p>0.05) (Table 3).

ROC curve analysis determined the highest sensitivity and specificity parameters to predict the severity of OSAS using the Youden Index. The optimal cut-off value for BNP was calculated to be 27.07 pg/mL, with 94% sensitivity and 75.6% specificity. A 31.2 kg/m^2 cut-off value for BMI provided 82% sensitivity and 78% specificity. For PAP max, a cut-off value of 21.27 mmHg provided 94% sensitivity and 58.5% specificity.

Table 2. Spearman correlation coefficient and correlation directions of data between non-OSAS and mild

Parameter	Spearman correlation coefficient (rho)	2-way p-value
BNP (pg/mL)	0.676	0.001
BMI (kg/m^2)	0.660	0.001
PAP max (mmHg)	0.650	0.001
NC (cm)	0.541	0.001
ARD (cm)	0.471	0.001
IVST (cm)	0.469	0.001
ESS	0.444	0.001
RAD (cm)	0.428	0.001
SBP (mmHg)	0.297	0.004
LV-ESD (cm)	0.226	0.032

p<0.05 was considered statistically significant.

BNP: B-type natriuretic peptide, BMI: Body Mass Index, PAP max: Maximal pulmonary arterial pressure, NC: Neck circumference, IVST: Interventricular septum thickness, ARD: Aortic root diameter, RAD: Right atrium diameter, ESS: Epworth sleepiness scores, SBP: Systolic blood pressure, LV-ESD: Left ventricle end systolic diameter, OSAS: Obstructive sleep apnea syndrome

Among other variables, NC, ARD, IVST, and ESS performed less in the ROC analysis (Table 4). LV-ESD and SBP showed limited sensitivity and specificity values.

Discussion

In our study, serum measurements of BNP, BMI, and PAP max were paramount in determining moderate and severe cases of OSAS and prioritizing PSG.

Excessive daytime sleepiness, the primary symptom of OSAS, is typically evaluated using the ESS in clinical practice. An ESS score of 11 or higher indicates-OSAS risk, and PSG is recommended.[3,8] Our study found a cut-off value of 11 for ESS, which was 70% sensitivity and 65.9% specificity in predicting moderate and severe OSAS. In a study by Walker et al.[14] ESS was highlighted as an effective tool for detecting daytime sleepiness symptoms of OSAS. However, it was noted that ESS is a subjective assessment tool and should be supported by more objective diagnostic methods. In our study, ESS did not perform significantly in the multivariate regression model, which supports the notion that, as a subjective measure, ESS provides a limited contribution to determining OSAS severity, which aligns with the literature.

In our study, BMI and NC were found to have significant correlations with OSAS severity as anthropometric measurements. When the cut-off value for BMI was established at 31.2 kg/m^2, 82% sensitivity and 78% specificity were achieved. BMI demonstrated significant performance in predicting moderate and severe OSAS cases in the multivariate regression model. Although NC had a cut-off value of 38.5 cm, with 76% sensitivity and 70.7% specificity, it did not show significant performance in predicting moderate and severe OSAS cases in the multivariate regression model. In the literature, Dong et al.[15] found a strong relationship between obesity, overweight status, and OSAS. In a systematic review and meta-analysis, 12 case-control studies were examined, and data from 3.214 participants were analyzed. The findings revealed that an increase in BMI significantly increases the risk of OSAS in both

Table 3. Evaluation of factors affecting OSAS severity by logistic regression analysis

Variable	B	S.E.	Wald	p	Exp (B)
PAP max (mmHg)	1.5	0.695	4.665	0.031	4.484
BMI (kg/m^2)	2.258	1.06	4.541	0.033	9.563
BNP (pg/mL)	0.15	0.076	3.859	0.049	1.162
NC (cm)	-1.546	0.886	3.044	0.081	0.213
SBP (mmHg)	0.12	0.082	2.134	0.144	1.127
LV-ESD (cm)	4.783	4.456	1.152	0.283	119.484
ARD (cm)	-1.28	2.105	0.37	0.543	0.278
IVST (cm)	10.255	17.3	0.351	0.553	28428.13
RAD (cm)	-1.926	5.309	0.132	0.717	0.146
ESS	-0.003	5.309	0.132	0.989	0.997

p<0.05 was considered statistically significant.

PAP max: Maximal pulmonary arterial pressure, BMI: Body Mass Index, BNP: B-type natriuretic peptide, NC: Neck circumference, SBP: Systolic blood pressure, LV-ESD: Left ventricul end systolic diameter, ARD: Aortic root diameter, IVST: Interventricular septum thickness, RAD: Right atrium diameter, ESS: Epworth sleepiness scores, OSAS: Obstructive sleep apnea syndrome, S.E.: Standard error

Table 4. OSAS weight and AUC values of associated variables					
Test result variables	**Cut-off**	**Sensitivity (%)**	**Specifity (%)**	**AUC**	**p value**
BNP (pg/mL)	27.07	94	75.6	0.892	0.001
BMI (kg/m^2)	31.2	82	78	0.883	0.001
PAP max (mmHg)	21.27	94	58.5	0.877	0.001
NC (cm)	38.5	76	70.7	0.812	0.001
ARD (cm)	2.85	92	46.3	0.773	0.001
ESS	11	70	65.9	0.757	0.001
IVST (cm)	1.05	54	82.9	0.757	0.001
RAD (cm)	3.75	92	48.8	0.747	0.001
SBP (mmHg)	122.5	62	63.4	0.670	0.005
LV-ESD (cm)	2.7	98	34.1	0.629	0.035

p<0.05 was considered statistically significant.

BNP: B-type natriuretic peptide, BMI: Body Mass Index, PAP: Pulmonary arterial pressure, NC: Neck circumference, ARD: Aortic root diameter, ESS: Epworth sleepiness scores, IVST: Interventricular septum thickness, RAD: Right atrium diameter, SBP: Systolic blood pressure, LV-ESD: Left ventricle end systolic diameter, OSAS: Obstructive sleep apnea syndrome, AUC: Area under the curve

adults and children. However, severe OSAS cases can also be observed in individuals who are not obese or who do not have thick NC due to genetic factors and clinical conditions affecting upper airway muscle tone. This multifactorial nature of OSAS risk may explain why NC did not perform significantly in our study's multivariate regression model.

BNP was identified as one of the most decisive parameters for predicting OSAS severity, providing 94% sensitivity and 75.6% specificity with a cut-off value of 27.07 pg/mL in the ROC analysis. A meta-analysis by Wu et al.[16] reported that continuous positive airway pressure therapy reduced NT-pro-BNP levels, lowering cardiovascular risks. A review article by Lee and Sundar[19] also highlighted the role of biomarkers such as BMI, NC, and BNP in diagnosing OSAS. BNP is considered an essential marker in evaluating the cardiovascular effects of OSAS and should be considered in managing treatment and follow-up.[17] Our study supports the literature by showing that BNP and other parameters contribute to PSG triage for moderate and severe OSAS cases.

The relationship between ECHO parameters and OSAS severity is particularly notable in severe cases where chronic structural cardiac changes have developed. In the pathophysiology of OSAS, repeated episodes of apnea and hypopnea cause changes in intrathoracic negative pressure, leading to increased cardiac preload and resulting in respiratory failure and pulmonary hypertension.[5,6,11,12] In their study, Malhotra et al.[20] emphasized that while the AHI is commonly used to assess the severity of OSAS, alternative metrics, such as cardiopulmonary load indicators, are also beneficial for this assessment.

In this context, PAP max values measured by standard chest ECHO emerged as a significant parameter for predicting the severity of OSAS, providing 94% sensitivity and 58.5% specificity with a cut-off value of 21.7 mmHg in our study. In a study published by Chetan et al.[21] it was suggested that right ventricular dysfunction in OSAS cases could be associated with parameters such as aortic ARD and RAD and that 3D speckle tracking ECHO (3D-STE) could be a sensitive method to evaluate right ventricular functions to determine OSAS severity. In our study, the measurements of ARD, RAD, and IVST showed significant correlations with OSAS severity; however, they were insufficient to predict the severity of OSAS in the multivariate logistic regression model, probably due to the exclusion of cases with known cardiovascular disease and the use of standard chest ECHO for cardiac measurements.

When examining the pathophysiology of OSAS, hypertension has been reported to lead to impaired left heart function, triggering left ventricular dilation, left atrial enlargement, and diastolic dysfunction.[6,12,21] A study by Xu et al.[22] reported that moderate and severe OSAS significantly increased blood pressure variability in hypertensive patients. The same study showed a negative relationship between high blood pressure and AHI, oxygen desaturation, and the dureation of mean apnea. In our study, systolic and DBP values and left heart ECHO findings in individuals without known cardiovascular comorbidities showed a limited relationship with OSAS severity.

Study Limitations

The results of this study should be considered in light of several limitations:

1. ECHO measurements in this study were performed using standard transthoracic methods, but more advanced imaging techniques (eg, 3D ECHO) could provide more precise results.
2. Since individuals with a known history of cardiovascular disease were excluded from the study, the evaluation of blood pressure values, particularly the ECHO parameters, may be limited.
3. The small sample size limits the generalizability of the findings to a larger population.

Future studies conducted in different centers with more extensive case series, including patients with comorbidities, may enhance the validity of the results.

Conclusion

In our study, serum measurements of BNP, BMI, and PAP max significantly identified moderate and severe OSAS cases. BNP,

in particular, emerged as a robust biomarker, not only for predicting OSAS severity but also for assessing cardiovascular risk. Although, BMI provided high sensitivity and specificity in predicting moderate and severe OSAS, NC showed limited performance. Due to its subjective nature, ESS was not found to be significant in the multivariate regression analysis and should be supported by more objective methods. Among the ECHO parameters, PAP max was the strongest predictor of OSAS severity.

In conclusion, the maximum values of BNP, BMI, and PAP can be used to determine the severity of OSAS before PSG and to classify the cases of priority PSG in sleep laboratories. However, further large-scale studies evaluating different patient groups are needed to confirm these findings.

Ethics

Ethics Committee Approval: The study was conducted in accordance with the Declaration of Helsinki and was approved by the Ethics Committee of İstanbul Göztepe Training and Research Hospital (current: Göztepe Prof. Dr. Süleyman Yalçın City Hospital) (approval number: 54/A, date: 10.02.2009).

Informed Consent: Informed consent was obtained from all participants.

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Footnotes

Authorship Contributions

Surgical and Medical Practices: M.S.B., Concept: B.Ç., Design: M.S.B., B.Ç., Data Collection or Processing: M.S.B., Analysis or Interpretation: B.Ç., Literature Search: M.S.B., Writing: M.S.B.

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