Research Article / Araştırma Makalesi

Evaluation of OSAS in Patients Planned Bariatric Surgery Who Has Morbid Obesity

Bariatrik Cerrahi Planlanan Morbid Obezli Hastaların OSAS Açısından Değerlendirilmesi

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Background: Before bariatric surgery, diagnosis of OSAS is vital for the prevention of both operative and postoperative complications. İn diagnosing of OSAS, polysomnography (PSG) is the gold-standard method, but it cannot be performed on all patients due to cost and time limitations. We aimed to determine the new predictive factors that we can use to identify patients on whom we will perform PSG.
Materials and Methods: Preoperative height, weight, body mass index (BMI), neutrophil-lymphocyte ratio (NLR), mean platelet volume (MPV), platelet mass index (PMI), and platelet-lymphocyte ratio (PLR) of the patients were recorded. PSG was performed, and apnea-hypopnea indices (AHI) were determined. This process was repeated one year after the surgery.
Results: A laparoscopic sleeve gastrectomy (LSG) was performed in 57 patients. There were statistically significant differences regarding age, height, BMI, and PMI values between the patients with and without OSAS before surgery ($P < 0.05$). Also, statistically significant differences were detected in preoperative and postoperative BMI and PMI values of patients whose OSAS ultimately improved ($P < 0.05$).
Conclusions: LSG is an effective method to reduce weight and, therefore, to improve OSAS. Also, BMI and PMI parameters are the most important predictive values in predicting OSAS. PSG can be performed on selected patients based on predictive values.

Key Words: Obesity, obstructive sleep apnea, polysomnography, bariatric surgery, platelet mass index

ÖZ.

Amaç: Bariatrik cerrahi öncesi OUAS (Obstrüktif uyku apne sendromu) tanısı, hem operatif hem de postoperatif komplikasyonların önlenmesi için hayati önem taşımaktadır. Polisomnografi (PSG) OUAS tanısında altın standart yöntem olmasına rağmen maliyet ve zaman kısıtlılığı nedeniyle tüm hastalara uygulanamamaktadır. PSG uygulayacağımız hastaları belirlemek için kullanabileceğimiz yeni prediktif faktörleri belirlemeyi amaçladık
Materyal ve Metod: Hastaların ameliyat öncesi boy, kilo, vücut kitle indeksi (VKİ), nötrofil-lenfosit oranı (NLO), ortalama trombosit hacmi (OTH), trombosit-lenfosit oranı (PLR) ve trombosit kitle indeksi (PKİ) kaydedildi. PSG yapıldı ve apne-hipopne indeksleri (AHİ) belirlendi. Bu işlem ameliyattan bir yıl sonra tekrarlandı.
Bulgular: 57 hastaya laparoskopik sleeve gastrektomi (LSG) yapıldı. Ameliyat öncesi OUAS olan ve olmayan hastalar arasında yaş, boy, VKİ ve PMI değerleri istatistiksel olarak anlamlı derece farklıydı ($P < 0.05$). Ayrıca, OUAS'ı nihai olarak düzelen hastaların ameliyat öncesi ve sonrası BMI ve PMI değerlerinde istatistiksel olarak anlamlı farklılıklar tespit edildi ($P < 0.05$).
Sonuç: LSG, ağırlığı azaltmak ve dolayısıyla OSAS'ı iyileştirmek için etkili bir yöntemdir. Ayrıca BMI ve PMI parametreleri OUAS'ı tahmin etmede en önemli prediktif değerlerdir. PSG, prediktif değerlere dayalı olarak seçilmiş hastalarda yapılabilir.

Anahtar kelimeler: Obezite, Obstruktif uyku apnesi, Polisomnografi, Bariatrik cerrahi, trombosit kitle indeksi

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Introduction

Obesity is an increasing problem in worldwide and an excessive or abnormal increase in body fat, disrupting human health, and shortens life expectancy. There are many complications associated with obesity, one of which is obstructive sleep apnea syndrome (OSAS) (1). The most effective long-term treatment of obesity is bariatric surgery. In many cases, bariatric surgery provides dramatic weight loss and significant improvements in sleep disturbances and other comorbidities. The surgical intervention aims to lose at least 50% of excess weight with low operative morbidity, improve comorbidities with no long-term complications (2). In 5-year follow-up, laparoscopic sleeve gastrectomy (LSG) resulted in excess weight loss in 58.4% of body weight (3). OSAS is characterized by recurrent upper airway obstruction and recurrent intermittent hypoxia during sleep. The prevalence of OSAS in the general population is reported to be 2-4%. Advanced age, obesity, anatomical anomalies, and genetic factors are proposed risk factors for OSAS (4, 5). It was reported that OSAS was detected in 50-77% of obese patients. Obesity narrows the upper airway due to increased adipose tissue around the neck and especially the pharynx. It has been shown that the tendency for the upper airway narrowing was increased in obese people (6, 7).

There is no precise diagnostic physical examination finding in OSAS. History, physical examination, and questionnaires guide the diagnosis. (8, 9).

Routine laboratory test not helps to diagnose or determine the severity of OSAS. Mean platelet volume (MPV), platelet-to-lymphocyte ratio (PLR), and neutrophil-to-lymphocyte ratio (NLR), which are simply detectable inflammatory markers with complete blood count test, have been investigated in some studies recently. However, different results have been reported in previous studies conducted in OSAS cases (10,11).

OSAS causes hypoxia and is associated with inflammation, increased platelet activity, and atherosclerosis. Increased platelet activation in patients with OSAS has been reported in previous studies (12,13). Some studies have shown that the platelet volume and the platelet count can serve as indicators of platelet activity, leading to the definition of the platelet mass index (PMI) as an indicator that considers two parameters (14). Based on this, we hypothesized that PMI could be an important new predictive factor in OSAS patients.

Polysomnography (PSG) is the gold standard in OSAS research, its application requires technical equipment, personnel, time and high cost. The Apnea-Hypopnea Index (AHI) is a parameter used to indicate the severity of sleep apnea. It is determined by the number of apnea and hypopnea events per hour of sleep. AHI results of adults are classified as follows;

AHI < 5: Normal,

5≤AHI<15: Mild sleep apnea,

15≤AHI<30: Moderate sleep apnea,

AHI≥30 (15) : Severe sleep apnea.

The objectives of this study were:

1) To determine the prevalence of OSAS in patients planned for obesity surgery.

2) To evaluate bariatric surgery's success after one year and determine the improvement in OSAS after surgery.

3) To investigate whether PMI is a new predictive factor.

Materials and Methods

Patients scheduled for bariatric obesity surgery and agreed to participate and signed informed consents at the Sanliurfa Education and Research Hospital between 2018 and May 2019 were included in the study. Ethical approval was obtained from Harran University Faculty of Medicine. Demographic features, preoperative height, weight, and BMI of the patients were recorded. MPV, NLR, PLR, and PMI were calculated. Finally, PSG was performed, and the AHI classification was performed. The patient's OSAS levels were determined according to AHI values. One year after the surgical intervention, all of these procedures were repeated, and the changes were compared statistically. Before surgery, the values of patients with and without OSAS were also compared. In addition, we provided dual control by comparing the values of those who had OSAS before surgery and recovered OSAS after surgery. The total weight loss (% TWL) was defined as ((operative weight − the follow-up weight)/(operative weight) × 100). Percentage of excess weight loss (%EWL) was defined as ((operative weight − follow-up weight)/(operative weight − ideal weight) × 100) with ideal weight based on body mass index (BMI) of 25 kg/m2. PMI was calculated using the following formula: PMI = platelet count × mean platelet volume/103 (fL/nL). Platelet mass index (PMI) is associated with platelet functionality. The distribution and effects of the collected data were examined.

Statistical analysis

Data were analyzed using Statistical Package for Social Science for Windows (SPSS) 24.0. The gender and OSAS data of the patients were presented with percentages and frequencies. Mean and standard deviation were examined to determine the patients' NLR, PLR, MPV, and PMI values .

Paired Samples t-Test was used to examine the differences in weight, BMI, AHI, NLR, PLR, MPV, and PMI values before and one year after surgery.

One Way ANOVA was used to determine the differences in weight, BMI, AHI, NLR, PLR, MPV and PMI values of the patients regarding OSAS degrees. LSD and Tukey tests were applied to determine between which groups the differences found as a result of variance analysis were significant. The difference in OSAS levels of patients before and after surgery was determined using the Chi-Square Test.

Results

The same surgeon performed the LSG surgical procedure for all patients. Overnight polysomnography was performed with a 44 channel E- series (Compumedics,Abootsford, VIC, Australia) via continuous sleep monitoring technique. No complications were observed in patients during their 1-year follow-up. A total of 57 patients, including 30 women (52.6%) and 27 (47.3%) men, were included in the study. The mean age was 37.5 ± 9.8 years.

Mean preoperative BMI was 47.8 ± 5.8 kg/m2. One year after LSG, the patient's mean BMI was 33.4 ± 3.5 kg/m2, while the mean TWL was 30.4 ± 7.5%, and EWL was 67.6 ± 18.7%. A statistically significant difference was found between preoperative and postoperative values in weight, BMI, and AHI parameters (Table 1). AHI decreased from 26.7 (s.d 8.3) to 9.9 (s.d 7.1). The decrease in BMI and weight reflects the success of surgical intervention regarding obesity.

Table 1. Preoperative and postoperative values in the parameters.

Parameters		Mean	s.d.	*p*
Weight (kg)	Preoperative	130.1	22.8	.000**
	Postoperative	90.8	10.4	
BMI (kg/m^2)	Preoperative	47.8	5.8	.000**
	Postoperative	33.4	3.5	
AHI	Preoperative	26.7	8.3	.000**
	Postoperative	9.9	7.1	

Paired Samples t-Test; p<0.05; p<0.01
BMI (body mass index)
AHI (apnea-hypopnea indices)

Table 2. OSAS degrees of patients before and after surgery

	OSAS Degrees	N(57)	%
Before Surgery	**None** (AHI mean 3.2)	18	31.5
	Mild (AHI mean 12.7)	12	21.1
	Moderate (AHI mean 27.6)	19	33.3
	Severe (AHI mean 37.3)	8	14.1
	OSAS Degrees		
After Surgery (1 year)	**None** (AHI mean 2.9)	26	45.6
	Mild (AHI mean 10.8)	17	29.8
	Moderate (AHI mean 19,7)	14	24.6
	Severe	-	-

OSAS (obstructive sleep apnea syndrome)
AHI (apnea-hypopnea indices)

A statistically significant change was observed in the OSAS levels of patients before and after surgery. The OSAS degree of eight patients was severe before surgery, while none of the patients had severe OSAS degrees after surgery. Similarly, there were 18 patients without OSAS before surgery and 26 patients with OSAS after surgery (Table 2).

Firstly, the differences in patients' preoperative parameters regarding the presence of OSAS were examined. There were statistically significant differences in age, height, BMI, and PMI values. The age, BMI, and PMI increased with an increase in patients' OSAS degrees. Also, patients' OSAS degrees increased with a decrease in height. The difference found for the age variable was found to be significant between patients without OSAS and those with moderate OSAS. The differences found for BMI and PMI parameters were significant between patients without OSAS and patients with moderate and high OSAS (Table 3).

Preoperative and postoperative parameters of 8 patients who had preoperative OSAS and recovered OSAS postoperatively in the first year were compared. Differences were detected in BMI and PMI values (Table 4).

Discussion

Platelet mass index is an indicator of platelet function, and small platelets are enzymatically less active than large platelets (16). VEGF production is initiated by factors such as platelet-derived growth factor-BB, keratinocyte growth factor, epidermal growth factor, tumor necrosis factor-α, and transforming growth factor-β1, and interleukin-β1. However, among those factors, hypoxia is probably one of the most effective stimuli that induce the construction of VEGF and its receptors. The data obtained showed that PMI values might increase parallel with VEGF increase during hypoxia (16, 17). In general, platelet function can be more accurately reflected by platelet mass than platelet count alone. This issue was first explored by Gerday et al, who found that the use of platelet mass reduces the number of platelet transfusions (18). OSAS is an increasingly prevalent disease globally; it is characterized by recurrent intermittent hypoxia, and intermittent hypoxia plays a role in increased platelet activity. To our knowledge, this is the first study to investigate the possible association between PMI and OSAS. We found a significant positive correlation between PMI and OSAS. PMI was significantly high in OSAS and was an independent factor for the prediction of OSAS. However, in future studies, this correlation should be demonstrated with more details by studying PMI in larger OSAS patient groups.

O'Keeffe et al. used preoperative PSG and reported an OSAS prevalence of 77% in obese patients before surgery (19). Frey et al. was studied in 40 consecutive patients who were evaluated bariatric by polysomnography. Obstructive insomnia disorder was present in 88% of the patients. OSAS was present in 29 of 41 (71%) patients, while upper airway resistance syndrome was present in 7 of 41 (17%) (20). In our study, the mean BMI value of morbidly obese patients before the operation was 47.8 kg/m2, and OSAS was present in 68.5% of these patients.

Table 3. Preoperative parameters in terms of OSAS degrees.

	No OSAS	**OSAS**			***p***	***Difference***
Parameters	**1** No OSAS (AHİ<5) (Mean ± s.d.)	**2** Mild OSAS (5<AHİ<15) (Mean ± s.d.)	**3** Moderate OSAS (15<AHİ<30) (Mean ± s.d.)	**4** Severe OSAS (AHI >30) (Mean ± s.d.)		
Age	34,4±11,0	35,1±10,2	41,8±8,1	38,88±13,88	**.038***	**1-3**
Weight	139,2±29,6	130,3±25,1	127,0±12,5	123,11±18,10	.468	-
BMI	46,2±5,8	47,1±5,7	49,2±6,0	49,46±6,05	**.047***	**1-3** **1-4**
Mpv	6,9±1,2	7,1±1,2	7,4±2,1	8,08±1,69	.294	-
NLR	1,2±0,4	1,5±0,7	1,6±0,9	1,89±0,91	.311	-
PLR	96,1±34,3	97,7±56,7	107,9±41,5	121,7±57,4	.613	-
PMI	1943.2±712.2	2084.7±652.6	2218.3±751.9	2357.7±803.2	**.026***	**1-3** **1-4**

*One Way ANOVA ; *p<0.05 ; **p<0.01*
OSAS (obstructive sleep apnea syndrome) BMI (body mass index) AHI (apnea-hypopnea indices)
MPV(mean platelet volume) NLR (neutrophil lymphocyte ratio) PLR (platelet lymphocyte ratio) PMI (platelet mass index)

Table 4. Comparison of preoperative and postoperative parameters of patients whose OSAS completely disappeared

Parameters	**Preoperative** **OSAS** (AHİ>5) (Ort ± s.s.)	**Postoperative** **No OSAS** (AHİ<5) (Ort ± s.s.)	***p***
Weight	91,40±9,54	91,00±11,30	.957
BMI	35,34±4,01	31,94±2,48	**.023***
Mpv	7,90±0,96	7,15±1,01	.178
NLR	1,93±0,72	2,08±0,76	.302
PLR	120,94±32,75	102,49±29,75	.203
PMI	2176.8±769.1	1878.4±657.8	**.021***

*One Way ANOVA ; *p<0.05 ; p<0.01*
OSAS (obstructive sleep apnea syndrome) BMI (body mass index) AHI (apnea-hypopnea indices)
MPV(mean platelet volume) NLR (neutrophil lymphocyte ratio) PLR (platelet lymphocyte ratio) PMI (platelet mass index)

Genio et al. showed that a significant improvement was observed at a 5-year follow-up after sleeve gastrectomy. The AHI improved in 80.6% (29/36) of patients after surgery (from 32.8 ± 1.7 to 5.8 ± 1.2) (21). Also, we observed a significant improvement in OSAS after LSG at the one-year follow-up. There were no patients with severe OSAS after the operation. OSAS rate decreased to 54.4%. The AHI improved from 26.7 ± 8.3 to 9.9 ± 7.1.

Similar to our study, Szczepaniak et al. reported a TWL of % 29.5 and EWL of % 60.2 one year after sleeve gastrectomy (22). One year after LSG, we obtained 30.4 ± 7.5% TWL and 67.6 ± 18.7% EWL.

We observed that the presence of OSAS was directly related to age, height, BMI and PMI. This result differs from previous studies in which there was no correlation. According to Rajala et al. studied 27 morbidly obese patients (13 men and 14 women) with a BMI ≥40 kg/m2. The mean BMI was 50 ± 12 kg/m2. The incidence of AHI >10 in men and women was 77% and 7%, respectively. They found no difference in mean BMI or neck circumference in subjects with and without OSAS. There was no significant relationship between BMI and apnea severity during polysomnography (23). However, Dixon et al. Examined the predictors for OSAS in 99 morbidly obese subjects with a BMI >35 kg/m2 and found four clinical and two biochemical factors that were independently predictive of AHI: observed sleep apnea, male gender, age, higher BMI, fasting insulin, and glycosylated hemoglobin A. OSAS had a prevalence of severe sleep apnea in 71% and 23.3% of participants (24). In addition to advanced age and BMI, we found PMI useful in predicting OSAS.

PLR, NLR and MPV have been studied in patients with

OSAS and different results have been obtained in the literature. According to Varol et al. found that MPV was significantly higher in severe OSAS patients compared to the control group (25). Yeo-Jeong et al. They reported that as AHI values increased, PLR increased (11). Sunbul et al. found that the NLR value was significantly higher in patients with OSAS compared to the control group (26). In our study, we did not find a relationship between OSAS and NLR, PLR and MPV. In addition, we found that PMI was significantly higher in OSAS patients.

PSG is a comprehensive test used to diagnose sleep oxygen disorders by examining brain waves, blood level, heart rate and breathing, as well as eye and leg movements during the night in a sleep lab. PSG is time-consuming, requires a special team, and is costly. Also, the number of sleep labs is limited worldwide. Therefore, the selection of patients who needs PSG is challenging. Our study shows that age, height, BMI, and PMI are important predictive values. PSG should only be requested by examining these parameters in patients presenting with sleep apnea complaints to prevent unnecessary testing.

CONCLUSION

In order to ensure the accuracy of the predictive values, the parameters of patients who had preoperative OSAS and patients who recovered OSAS after surgery were compared. As a result, it was concluded that BMI and PMI were the most important predictive values. It can be said that PSG before bariatric surgery not be a routine test; it can be performed on patients based on predictive values.

Ethical Approval: *The study was approved by Harran University Local Ethics Committee (approval date:17.01.2019, decision number:HRU/19.01.37)*

Author Contributions:
Concept: M.E.K, H.E.
Literature Review: H.E.
Design : M.E.K, H.E.
Data acquisition: H.E.
Analysis and interpretation: M.E.K.
Writing manuscript: M.E.K.
Critical revision of manuscript: H.E.

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