RESEARCH ARTICLE

The Prevalence of Obstructive Sleep Apnea in Bariatric Surgery Patients

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ABSTRACT

Objective: Obesity is one of the most important risk factors and also consequences of obstructive sleep apnea (OSA). Weight loss and positive airway pressure therapy are the main approaches in the treatment of OSA. In this study, it was aimed to evaluate the prevalence of OSA in obesity patients scheduled for bariatric surgery.

Methods: In the University Hospital Obesity Center, 141 consecutive patients who were candidates for bariatric surgery in 2015 were clinically evaluated preoperatively for sleep-related respiratory disorders. Preoperative polysomnographic examination was recommended to all cases.

Results: Of 141 bariatric surgery candidates with a mean age of 37±10 years, and 103 (73%) were female. The mean body mass index of the cases was 46.9±6.4 kg/m2. Among the major symptoms of OSA, snoring was present in 119 (84.4%), daytime sleepiness in 63 (44.7%) and witnessed apnea in 49 (34.8%) patients. OSA was detected because AHI>5/hour was found in 75.7% (84/111) of the patients who accepted the polysomnographic evaluation. 24.3% (27/111) of the cases who underwent polysomnography had non OSA, 29.7% (33/111) mild OSA, 17.1% (19/111) moderate OSA, and 28.8% (32 /111), severe OSA was detected. AHI was positively correlated with age (p=0.003), neck and waist diameter (p<0.001), and negatively correlated with percent of the forced vital capacity (p<0.001). In polysomnographic controls performed an average of 9 months after bariatric surgery, an average of 41.2% improvement in AHI was observed, compared to an average of 22.8% decrease in BMI.

Conclusions: OSA prevalence was found to be very high in bariatric surgery candidates. It was thought that polysomnographic examination should be performed before bariatric surgery not only in symptomatic cases but also in all cases. Bariatric surgery can help improve OSA.

Keywords: Obesity, Bariatric Surgery, Sleep Apnea, CPAP Therapy, Laparoscopic Sleeve Gastrectomy.

Obezite Cerrahisi Hastalarında Obstrüktif Uyku Apne Sıklığı

ÖZET

Amaç: Obezite, obstrüktif uyku apnesinin (OUA) en önemli risk faktörlerinden ve sonuçlarından biridir. Kilo verme ve pozitif hava yolu basıncı tedavisi OUA tedavisinde başlıca yaklaşımlardır. Bu çalışmada bariatrik cerrahi planlanan obezite hastalarında OUA prevalansının değerlendirilmesi amaçlandı.

Gereç ve Yöntem: Üniversite Hastanesi Obezite Merkezi'nde 2015 yılında bariatrik cerrahi adayı ardışık 141 hasta, uyku ile ilişkili solunum bozuklukları açısından ameliyat öncesi klinik olarak değerlendirildi. Tüm olgulara ameliyat öncesi polisomnografik inceleme önerildi.

Bulgular: Yaş ortalaması 37±10 olan 141 obezite cerrahisi adayının 103'ü (%73) kadındı. Olguların ortalama vücut kitle indeksi 46,9±6,4 kg/m2 idi. OUA'nın majör semptomları değerlendirildiğinde; 119 (%84,4) hastada horlama, 63 (%44,7) hastada gündüz uyku hali ve 49 (%34,8) hastada tanıklı apne vardı. Polisomnografik değerlendirmeyi kabul eden hastaların %75,7 'sinde (84/111) AHİ>5/saat bulunması nedeniyle OUA saptandı. Polisomnografi yapılan olguların %24,3'ünde (27/111) OUA negatifdi, %29,7'sinde (33/111) hafif OSA, %17,1'inde (19/111) orta derecede OUA ve %28,8'inde (32/111) şiddetli OUA saptandı. AHİ ile yaş (p=0.003), boyun ve bel çapı (p<0.001) arasında pozitif, zorlu vital kapasite yüzdesi arasında negatif korelasyon (p<0.001) bulundu. Obezite cerrahisinden ortalama 9 ay sonra yapılan polisomnografik kontrollerde AHİ'de ortalama %41,2 iyileşme, VKİ'de ortalama %22,8 azalma gözlendi.

Sonuç: Obezite cerrahisi adaylarında OUA prevalansı oldukça yüksek bulunmuştur. Obezite cerrahisi öncesi sadece semptomatik olgularda değil tüm olgularda polisomnografik inceleme yapılması gerektiği düşünülmektedir. Bariatrik cerrahi OSA'yı iyileştirmeye yardımcı olabilir.

Anahtar Kelimeler: Obezite, Bariatrik Cerrahi, Uyku Apnesi, CPAP Tedavisi, Laparoskopik Sleeve Gastrektomi.

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INTRODUCTION

Obstructive sleep apnea (OSA), the most common sleep breathing disorder, is a syndrome characterized by recurrent partial or complete collapses of the upper airway during sleep. OSA is common worldwide and is estimated to affect approximately 1 billion people globally, with a prevalence exceeding 50% in some countries (1).

Obesity is one of the most important risk factor and also consequences of OSA. OSA prevalence is very high in obese individuals and there is a high prevalence of obesity in patients with OSA. The pathophysiology of OSA is closely linked to obesity (2). Increased sleep collapsibility due to anatomical and/or functional disorders of the upper respiratory tract plays a key role in the pathogenesis of obstructive sleep apnea (2, 3). Obesity and especially central adiposity are strong risk factors for sleep apnea. Obesity may increase pharyngeal collapse through mechanical effects on pharyngeal soft tissues and lung volume and through central nervous system interacting signaling proteins (adipokines) that may affect airway neuromuscular control (3). Various behavioral, pharmacological, and surgical approaches to weight loss can improve patients with OSA, with differential effects on the mass and activity of regional adipose depots (3).

Numerous diseases are associated with both OSA and obesity, and these associations are clearly driven by complex mechanisms. OSA and its accompanying diseases and the mechanisms of these diseases show that obesity is one of the most important factors in OSA. Positive airway pressure (PAP) therapy, oral appliance therapy and some nose-throat surgeries are the main approaches in the treatment of OSA (3).

The fact that the multiple adverse health effects of severe obesity can be corrected by successful weight loss is the mainstay of obesity treatment. Bariatric surgery is applied to lose weight in patients who cannot lose weight with non-surgical methods. It is common among people with severe obesity that medical treatments to achieve sustainable weight loss fail. Indications for bariatric surgery are evolving rapidly, taking into account the severity of obesity as determined by BMI and co-existing conditions (4).

Bariatric surgery is relatively inexpensive when compared to the cost associated with severely obese inability to lose weight. As the popularity of bariatric surgery increases, its impact on diabetes, cardiovascular diseases and total mortality can be better documented (5, 6). The ultimate benefit of medical or surgical weight loss is related to the reduction of comorbidities, all cause mortality and increase in quality of life. Despite the successful implementation of non-surgical effective health management in the treatment of obesity, there is increasing evidence that bariatric surgery is more effective (7-9). A meta-analysis of bariatric surgery studies reported that weight loss ranged from 15% to 30%, depending on the specific surgical procedure performed, and decreased cardiovascular and overall mortality (10).

In this study, it was aimed to evaluate the frequency of OSA in obesity patients who will undergo bariatric surgery and the changes in the severity of the disease after weight loss in the postoperative period in patients with OSA.

MATERIAL AND METHODS

Study Population: All consecutive patients who were candidates for bariatric surgery (laparoscopic sleeve gastrectomy) in 2015 at Düzce University Hospital Obesity Center were clinically evaluated preoperatively in terms of sleep breathing disorders. In our center, laparoscopic sleeve gastrectomy is applied to all cases as bariatric surgery. All patients were questioned in detail in terms of OSA symptoms and Epworth Sleepiness Scale questionnaire was applied. In addition, concomitant diseases and regularly used drugs were noted. Ear, nose and throat (ENT) examinations, chest X-rays and spirometric tests were routinely performed in the preoperative period. Polysomnographic examination was recommended to all cases before surgery. Full polysomnography was performed in the laboratory all night in the patients who accepted. Positive airway pressure (PAP) titration was performed with full polysomnographic examination before bariatric surgery in patients with moderate and severe OSAS who had significant daytime sleepiness and/or accompanying cardiovascular risk factors. Symptomatic moderate and severe OSAS patients were treated with preoperative PAP for 8 weeks, as before all elective surgeries, and were carefully followed up in terms of complications related to OSAS in the postoperative period. It was planned to re-evaluate weight loss and OSAS status by polysomnography 6 months after surgery for patients who were found to have OSAS before bariatric surgery.

Our study was approved by the Duzce University Faculty of Medicine Non-Invasive Clinical Research Ethics Committee (41/2014). The study was also supported by Düzce University as a Scientific Research Project (Project number: 2014.04.03.268).

Polysomnographic Sleep Study: All-night polysomnography (Philips Respironics Model: Alice-6 PSG, Germany) was performed in the laboratory in 111 consecutive patients who were candidates for bariatric surgery and accepted polysomnographic examination. Three-channel EEG (electroencephalography), 2-channel EOG (electrooculography), 1-channel chin EMG (electromyography), mouth and nose airflow (with thermistor and nasal cannula), thorax and abdomen movements, body position, snoring, electrocardiography (ECG) and pulse oximetry recordings were made (> 6 hours). All records were scored manually on the computer according to the 2012 criteria of the American Academy of Sleep Medicine (AASM) (11). Patients with an apnea-hypopnea index (AHI) <5/hour were classified as no OSA, patients with AHI 5-15/hour were classified as mild OSA, patients with AHI 16-30/hour were classified as moderate OSA, and patients with AHI>30/hour were classified as severe OSA.

Statistical Analysis: Statistical analyzes were performed using the SPSS 15.0 program. In cases with OSA (+) and (-) candidates for bariatric surgery, clinical numerical parameters were compared with Student's t-test and categorical parameters were compared with chi-square test. Pearson correlation analysis was used to determine whether there was a correlation between the AHI and clinical parameters. P value <0.05 was considered statistically significant.

RESULTS

Of 141 bariatric surgery candidates with a mean age of 37±10 years, 38 (27%) were male and 103 (73%) were female. The mean body mass index of the cases was 46.9±6.4 kg/m2. Among the major symptoms of OSA, snoring was present in 119 cases (84.4%), daytime sleepiness was present in 63 cases (44.7%), and witnessed apnea was present in 49 cases (34.8%) (Figure 1).

OSA was detected in 84 (75.7%) of 111 subjects who underwent polysomnographic evaluation due to AHI above 5/hour (79 women, 32 men). 24.3% (27/111) of the cases who underwent polysomnography had nonOSA, 29.7% (33/111) mild OSA, 17.1% (19/111) moderate OSA, and 28.8% (32 /111), severe OSA was detected (Figure 2).

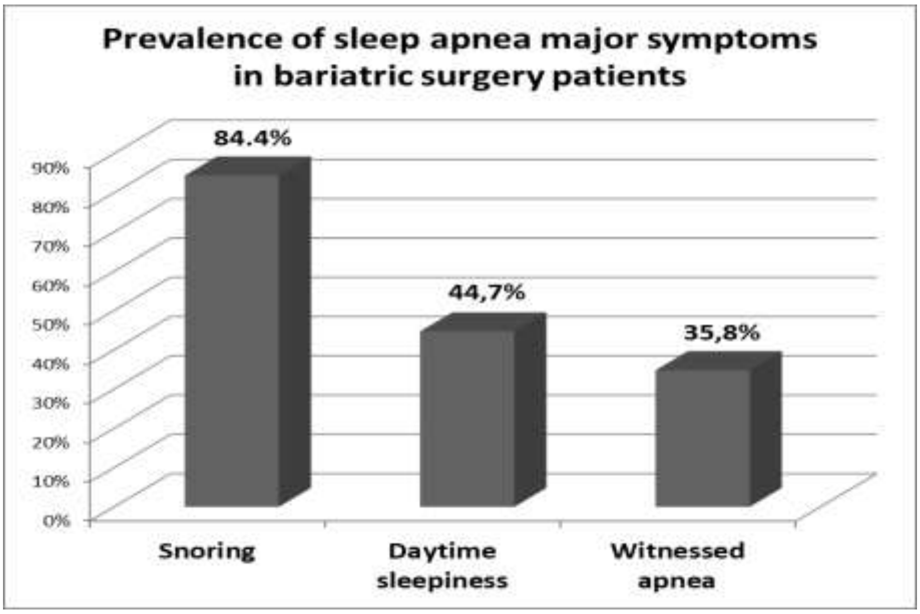

Figure 1. Prevalence of obstructive sleep apnea majör symptoms in bariatric surgery patients

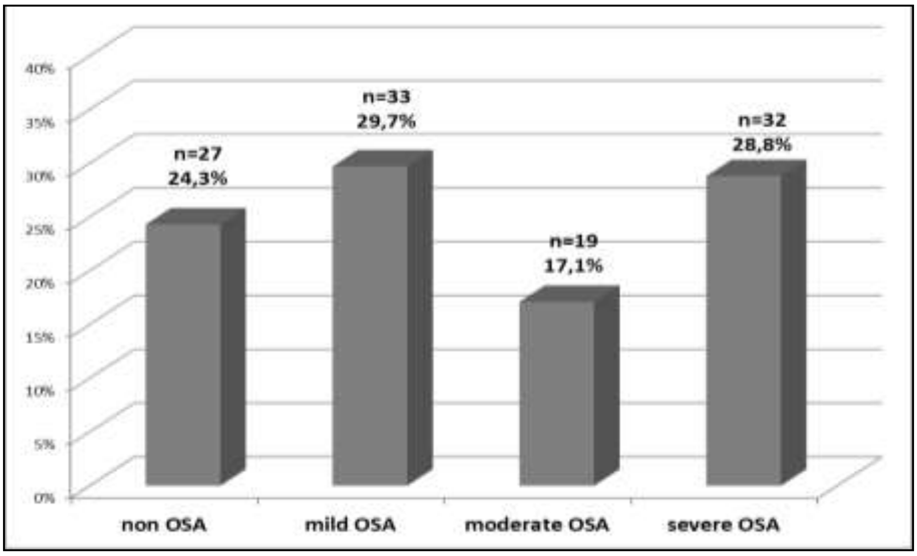

Figure 2. OSA severity in bariatric surgery patients

A coexistence of OSA and obesity hypoventilation syndrome was detected in 10 (9%) of the patients who underwent polysomnography. OSA was diagnosed by polysomnography at a statistically significantly higher rate in those with snoring, daytime sleepiness, and witnessed apnea than those without these symptoms (respectively 83%, 90.6%, 97.6% vs. 31.3%, 61.4%, 61.8%, p<0.001) (Table 1). The frequency of OSA was found to be significantly higher in male candidates for bariatric surgery than females (90.6% vs. 69.6%, p=0.027). In bariatric surgery candidates, the frequency of diabetes and hypertension in patients with OSA was found to be statistically significantly higher than in patients without OSA (Table 1).

Table 1. Comparison of some clinical parameters in bariatric surgery candidates according to OSA status

	OSA (+) n (%)	**OSA (-) n (%)**	***p***
Gender			
Female	55 **(69.6)**	24 (30.4)	***0.027***
Male	29 **(90.6)**	3 (9.4)	
Major seymptoms of OSA			
Snoring			
Yes	78 **(83.0)**	16 (%17.0)	***<0.001***
No	5 **(31.3)**	11 (68.8)	
Daytime sleepiness			
Yes	48 **(90.6)**	5 (9.4)	***<0.001***
No	35 **(61.4)**	22 (38.6)	
Witnessed apnea			
Yes	41 **(97.6)**	1 (2.4)	***<0.001***
No	42 **(61.8)**	26 (38.2)	
Diabetes mellitus			
Yes	30 **(88.2)**	4 (11.8)	***0.032***
No	49 **(68.1)**	23 (31.9)	
Hypertension			
Yes	27 **(93.1)**	2 (6.9)	***0.006***
No	52 **(67.5)**	25 (32.5)	
Hypothyroidism			
Yes	15 **(83.3)**	3 (16.7)	*0.267*
No	64 **(72.7)**	24 (27.3)	
Gastro-esophageal reflux			
Yes	26 **(78.8)**	7 (21.2)	*0.632*
No	66 **(72.2)**	23 (25.8)	
Asthma/COPD			
Yes	6 **(85.7)**	1 (14.3)	*0.675*
No	73 **(73.7)**	26 (26.3)	

OSA: obstructive sleep apnea; COPD: chronic obstructive pulmonary disease

In bariatric surgery candidates, the group with OSA was statistically significantly older. Epworth sleepiness scale value and sleep efficiency rate were significantly higher in OSA patients than in those without. There was no statistically significant difference between neck and waist diameter, smoking and pulmonary function test parameters between the groups with and without OSA in bariatric surgery candidates (Table 2).

AHI was positively correlated with age (p=0.003), neck and waist diameter (p<0.001), and negatively correlated with percent forced vital capacity (p<0.001), (Figure 3-6).

Table 2. Comparison of some clinical parameters in bariatric surgery candidates according to OSA status

	OSA (+) Mean ± SD	**OSA (-) Mean ± SD**	***p***
Age *(years)*	39 ± 9	33 ± 9	***0.009***
Body mass index *(kg/m²)*	46.8 ± 5.5	45.4 ± 6.7	*0.281*
Neck diameter *(cm)*	42 ± 5	41 ± 4	*0.459*
Waist diameter *(cm)*	126 ± 14	118 ± 14	*0.059*
Smoking *(paket-yıl)*	7.2 ± 12.0	3.6 ± 6.3	*0.054*
FVC *(%)*	88 ± 14	89 ± 10	*0.764*
FEV1 *(%)*	88 ± 14	91 ± 10	*0.361*
FEV1/FVC *(%)*	83 ± 6	84 ± 5	*0.461*
Apnea Hypopnea Index	29.7 ± 26.6	2.6 ± 1.6	***<0.001***
Epworth sleepiness scale	7.8 ± 5.1	4.9 ± 4.7	***0.012***
Sleep efficiency *(%)*	80 ± 13	71 ± 14	***0.002***

OSA: obstructive sleep apnea; SD: standard deviation; FVC: forced vital capacity; FEV1: forced expiratory volume 1 second

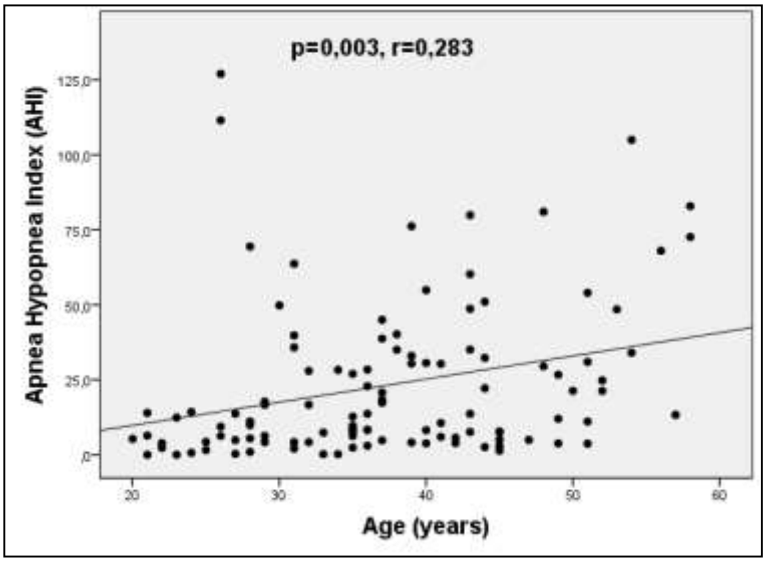

Figure 3. Correlation between apnea hypopnea index and age in bariatric surgery candidates

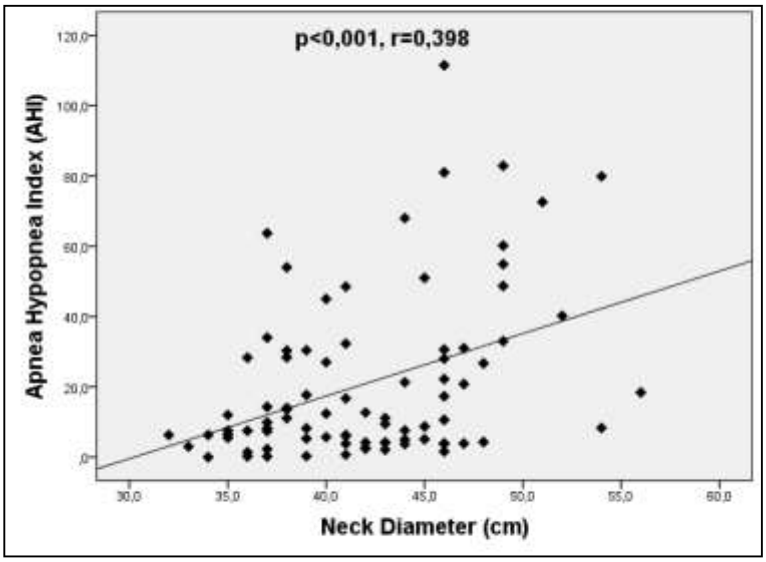

Figure 4. Correlation between apnea hypopnea index and neck diameter in bariatric surgery candidates

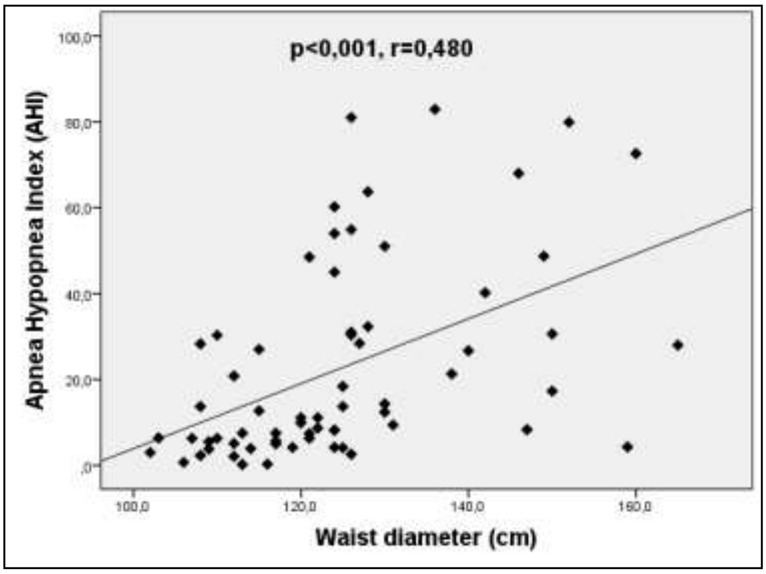

Figure 5. Correlation between apnea hypopnea index and waist diameter in bariatric surgery candidates

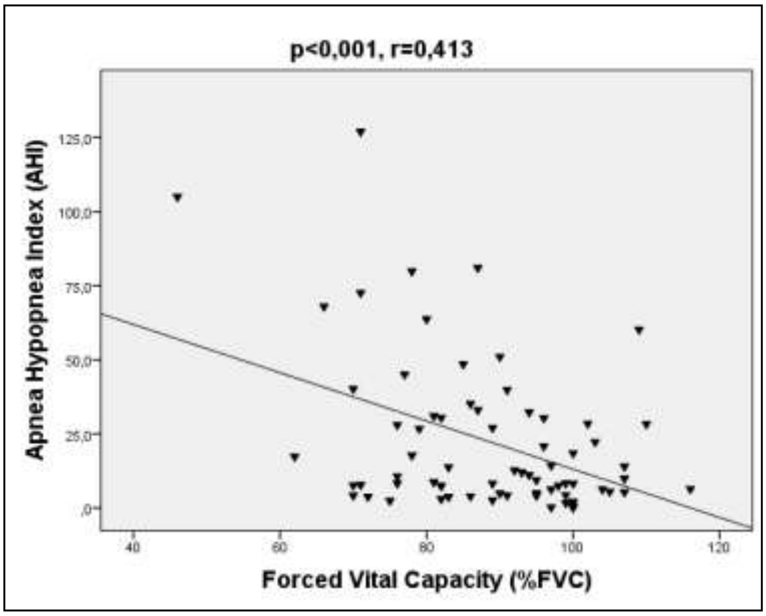

Figure 6. Negative correlation between apnea hypopnea index and FVC percentage in bariatric surgery candidates

Postoperative respiratory complication after bariatric surgery (laparoscopic sleeve gastrectomy) was not observed in any of the cases.

The changes in BMI and AHI values of 6 cases controlled after bariatric surgery (Laparoscopic sleeve gastrectomy) are shown in Table 3. In polysomnographic controls performed an average of 9 months after bariatric surgery, an average of 41.2% improvement in AHI was observed, compared to an average of 22.8% decrease in BMI.

Table 3. Change in AHI with control polysomnography of patients who lost weight after bariatric surgery

Case	Gender	Age (years)	BMI	BMI	Follow-up (months)	AHI	AHI	AHI reduction (%)
			Before	After		Before	After	
1	Female	40	47.7	36.7	8	8.2	4.9	41
2	Male	30	40.1	28.2	16	35.1	12.1	65
3	Female	26	42.1	35.2	6	25.9	18.1	30
4	Female	49	44.1	38.3	9	111.2	68.4	38
5	Female	43	62.1	44.2	8	72.3	56.6	22
6	Female	37	48.2	38.4	8	17.1	8.4	51
Means		**37.5**	**47.4**	**36.6**	**9**	**44.9**	**28.1**	**41.2**

BMI: body mass index (kg/m2); AHI: apnea hypopnea index/hour

DISCUSSION

As a result of this study, the prevalence of OSA in bariatric surgery candidates was found to be very high (75.7%). More importantly, nearly half of the cases had clinically significant moderate and severe OSA (45.9%). Moreover, OSA was present in at least 30% of patients having no major symptoms. Although all patients were obese, the severity of OSA increased as waist and neck circumferences increased. Again, advanced age was found to be an important factor increasing the prevalence of OSA in bariatric surgery candidates. It was determined that there was a significant improvement in AHI in patients with OSA who lost weight after bariatric surgery and had polysomnographic control.

In previous studies in bariatric surgery candidates, the frequency of OSA was reported to be between 77% and 96.7% (11-13).

Although the presence of major symptoms was found to be a significant indicator for the presence of OSA in the clinical evaluation for OSA in this study, the prevalence of OSA detected by polysomnography was much higher than the incidence of clinical major symptoms. Previous clinical studies have also shown a high prevalence of OSA in patients with obesity, despite the absence of patient-reported symptoms (14).

It has been reported that documentation of OSA and initiation of treatment before bariatric surgery can minimize possible complications of OSA in the postoperative period (15).

Based on this study, we recommend routine polysomnographic evaluation of all patients undergoing bariatric surgery. Prior to bariatric surgery, encouraging patients to lose 5-6 kilos with a low-calorie liquid diet and applying PAP therapy for at least 4-8 weeks before surgery in patients with moderate and severe OSA were routinely performed in this study. These two measures contributed to subjective improvement of OSA before surgery and minimizing pulmonary complications after surgery. In this study, postoperative respiratory complication after laparoscopic sleeve gastrectomy was not observed in any of the cases.

Our data show that weight loss obtained by obesity surgery provides clinical and polysomnographic improvement to morbid obese patients with OSA. Advantages include AHI reduction, reducing or termination of CPAP therapy, and the healing of the Epworth Sleepiness Scale (ESS) scores, which reflect the healing of daytime sleepiness. Following bariatric surgery, very few patients have entered into the polysomnographic evaluation at the end of an average follow -up of 9 months. Although the BMI values (average 36.6) in control cases are still high, even an average of 22.8% weight loss rates in BMI have caused an average improvement in an average of 41.2 %in AHI. However, in control cases, the average AHI level (28.1) is still above clinical desired levels.

Haines et al. OSA was found in 289 (83%) of 349 patients with preoperative polysomnography. Postoperative polysomnography was performed in 101 patients, and the mean AHI index (RDI) decreased from 51±4 to 15±2 at a median 11 months. ESS score decreased from 10±1 to 6±1 after 3 months. These results are consistent with the results of our study. However, the follow-up period in the study was longer, resulting in a greater reduction in AHI compared to our study (16). Similar improvements in OSA have been reported after bariatric surgery in many other studies (17-19).

Healing of sleep apnea is related to weight loss and reduction of upper airway adipose tissue. Reduction in visceral adiposity leads to improved diaphragm motion and improved ventilation and oxygenation (20). It is known that pro-inflammatory cytokine levels such as interleukin 6 (IL-6) and tumor necrosis factor-alpha (TNF-α) increase in patients with sleep apnea and obesity. Bariatric surgery leads to a decrease in IL-6 and other systemic inflammatory markers, and an increase in the anti-inflammatory IL-8 cytokine (21). Soluble TNF-α receptor 2 level has been reported to be an independent predictor of the development of sleep apnea and decreased after bariatric surgery (22).

One of the key observations in the Varela et al studies was that improvement in OSAS began immediately after surgery, before the desired level of weight was lost 23]. Similar findings were also reported by Haines et al. (16). The potential for improvement in OSA following bariatric surgery can be explained by two main factors. Effects associated with weight loss (reduced mechanical force on the cervical region, upper airway and diaphragm) and metabolic effects independent of weight loss. Ashrafian et al. suggested that metabolic surgery improves type 2 diabetes mellitus, insulin resistance, and metabolic syndrome through the BRAVE effect (bile flow alteration, restriction of stomach size, anatomical intestinal reorganization and altered nutrient flow, vagal manipulation and enteric bowel hormone modulation) (23). Since OSA and metabolic syndrome trigger each other, improvement in metabolic syndrome will lead to early recovery of OSA (24).

Almost all of the bariatric surgery and OSA studies showed a decrease in both AHI and BMI in the early period. In many studies with relatively short follow-up times, it was reported that the postoperative AHI was reduced to less than 20/hour (25). This finding may be explained by the fact that the subjects in these studies were relatively younger people with milder forms of OSA. Conversely, there are studies showing that the longer the follow-up, the greater the likelihood of OSA relapse (26). In the Feigel-Guiller et al study, a significant decrease in AHI was observed from 56.5/hr to 31.5/hr at 12 months, followed by an increase to 40.7/hr at 3 years (27).

One systematic review reported recurrence of OSA in the following years, possibly due to causes other than weight gain (26). Most studies suggest that weight loss continues in the short/medium term (1-2 years), and after this period, the probability of recurrence of OSA is higher. Therefore, the results may be inconsistent (25). Prospective studies with longer follow-up periods are needed.

Although there was no weight loss at the targeted level after surgical intervention in our study, there was significant improvement in AHI. However, the mean AHI score was still well above the target level. Since OSA is a disease with multiple risk factors, there may be permanent structural changes in the airways and/or central nervous system structures that cannot be reversed by bariatric surgery, despite good post-operative weight loss. This suggests that patients should be followed up regularly after bariatric surgery and polysomnographic controls should be performed when necessary.

There are some limitations in our study. The number of patients who had control polysomnography after bariatric surgery is very small. In addition, the short follow-up period of the patients and the postoperative polysomnography before the target BMI is reached are another handicap. Positive results reported in short-term studies may be affected by concurrent short-term behavioral changes, such as increased exercise and healthy eating. Post-surgery weight loss is gradual, with patients usually achieving their lowest weight 12-24 months after surgery. However, after successful weight loss and improvement in quality of life following bariatric surgery, patients are reluctant to undergo overnight polysomnography. We need to follow these patients longer to document long-term outcomes after surgery.

In addition, since obesity, not OSA, was the predominant medical condition in this study, generalizing the results to the entire population of OSA patients may be objectionable.

CONCLUSION

As a result of the study, it was thought that all patients who will undergo bariatric surgery should be evaluated in detail in terms of sleep breathing disorders in the preoperative period and preoperative polysomnographic examination should be performed not only in symptomatic patients but also in all patients.

Bariatric surgery may also help improve clinical symptoms in patients with OSA, as well as AHI. Targeted weight loss may not be achieved in all patients after bariatric surgery, and the improvement may not be at the same level in all patients with OSA. Therefore, it was thought that the patients should be followed for a long time in terms of OSA in the postoperative period.

More randomized controlled studies with well-standardized and long follow-up are needed to reliably confirm the effects of bariatric surgery on OSA.

Declarations

Ethics approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Ethics committee approval was received for this study from the ethics committee of Duzce University (2014).

Informed consent Informed consent was obtained from all individual participants included in the study.

Conflict of interest The authors declare no competing interests.

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My manuscript has no associated data

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