Original Article

Improvement in Obstructive Sleep Apnea (OSA) in Super Morbidly Obese Patients After Bariatric Surgery

Nitipatana Chierakul, MD[1], Phasawee Thangdechahirun, MD[1], Voraboot Taweerutchana, MD[2], Auamporn Kodchalai, MSc[3], Tawatchai Panuchawan, MSc[3], Kusuma Mamanee, BSc[3]

[1] Division of Respiratory Disease and Tuberculosis, Department of Medicine, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand

[2] Division of Minimally Invasive Surgery, Department of Surgery, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand

[3] Siriraj Sleep Center, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand

Background: Lifestyle modification is the mainstay therapy for obese patients with obstructive sleep apnea (OSA). However, most of these patients are unable to lose the necessary weight, and bariatric surgery (BS) has been proven to be an effective modality in selected cases.

Objective: To provide objective evidence that BS can improve OSA severity.

Materials and Methods: A prospective study was conducted in super morbidly obese patients (body mass index [BMI] greater than 40 kg/m^2 or BMI greater than 35 kg/m^2 with uncontrolled comorbidities) scheduled for BS. Polysomnography (PSG) was performed for preoperative assessment and OSA was treated accordingly. After successful surgery, patients were invited to perform follow-up PSG at 3, 6, and 12 months.

Results: Twenty-four patients with a mean age of 35.0±14.0 years were enrolled. After a mean follow-up period of 7.8±3.4 months, the mean BMI, Epworth sleepiness scale (ESS), and apnea-hypopnea index (AHI) significantly decreased from 51.6±8.7 to 38.2±6.8 kg/m^2 ($p<0.001$), from 8.7±5.9 to 4.7±3.5 ($p=0.003$), and from 87.6±38.9 to 28.5±21.5 events/hour ($p<0.001$), respectively.

Conclusion: BS was shown to dramatically improve clinical and sleep parameters in super morbidly obese patients.

Keywords: Morbid obesity, Bariatric surgery, Obstructive sleep apnea (OSA)

Received 23 Sep 2019 | Revised 11 Jun 2020 | Accepted 12 Jun 2020

J Med Assoc Thai 2020;103(8):725-8
Website: http://www.jmatonline.com

Obstructive sleep apnea (OSA) is a disorder of sleep caused by repetitive complete collapse (apnea) or partial collapse (hypopnea) of the upper airways. Sleep fragmentation and intermittent hypoxia can lead to excessive daytime sleepiness and poor performance(1). An accumulation of fat tissue in the superior portion of the thorax and neck of obese patients may increase upper airway collapsibility and obstruction during sleep. Even though nearly 45% of patients with OSA in Thailand have a body mass index (BMI) of less than 27 kg/m^2, most patients with OSA are obese(2).

Correspondence to:

Chierakul N.

Division of Respiratory Disease and Tuberculosis, Department of Medicine, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand.

Phone: +66-2-4197757 ext. 11, **Fax**: +66-2-4197758

Email: nitipatana.chi@mahidol.ac.th

How to cite this article:

Chierakul N, Thangdechahirun P, Taweerutchana V, Kodchalai A, Panuchawan T, Mamanee K. Improvement in Obstructive Sleep Apnea (OSA) in Super Morbidly Obese Patients After Bariatric Surgery. J Med Assoc Thai 2020;103:725-8.

doi.org/10.35755/jmedassocthai.2020.08.10650

An important prerequisite of caring for obese OSA patients is an effective treatment for obesity. Even mild weight loss (of less than 5% from baseline) by lifestyle modification was shown to reduce the severity of OSA, and 50% of mild OSA were in remission(3,4). Unfortunately, few patients succeed at losing their weight, and those that do most often regain the weight they lost. Bariatric surgery (BS) is a treatment alternative, especially in super morbidly obese (BMI greater than 40 kg/m^2 or BMI greater than 35 kg/m^2 with uncontrolled comorbidities). Permanent weight reduction after BS has been shown to reduce the severity and symptoms of OSA, and results in complete resolution of OSA in some cases(5-7). The aim of the present study was to provide objective evidence that BS-induced weight loss can improve

Table 1. Baseline characteristics of 24 studied patients

Variable	n (%)
Sex: male	14 (58.0)
Age (years); mean±SD	35.0±14.0
Comorbidities	
Hypertension	16 (58.3)
Type 2 diabetes	7 (29.2)
Dyslipidemia	6 (25.0)
Allergic rhinitis	3 (12.5)
Asthma	2 (8.3)
Symptoms	
Habitual loud snoring	24 (100)
Witnessed pauses in breathing	12 (50.0)
Unrefreshing sleep	12 (50.0)
Poor performance	11 (45.8)
Choking/gasping	8 (33.3)
Morning headache	7 (29.2)

SD=standard deviation

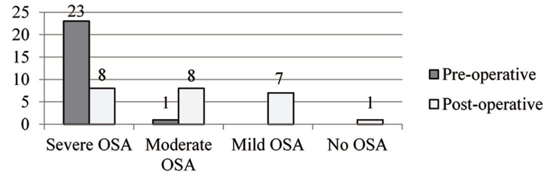

Figure 1. Improvement in OSA stratified by OSA severity group according to apnea-hypopnea index (AHI); mild OSA AHI ≥5 but <15, moderate ≥15 but <30, severe ≥30 events/hour.

OSA severity in Thai super morbidly obese patients.

Materials and Methods

The present prospective study was conducted between January 2018 and March 2019 at the Division of Respiratory Disease and Tuberculosis, Department of Medicine, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand. All super morbidly obese patients scheduled for BS were enrolled. Standard in-hospital polysomnography (PSG) using SOMNOscreen™ was performed for preoperative assessment with manual scoring conducted by sleep technicians under the guidance of certified sleep medicine physicians that complied to the American Academy of Sleep Medicine (AASM) standard 2012[8]. Established OSA was treated both pre- and post-operatively. After successful surgery, PSG was repeated at 3, 6, and 12 months. A sample size of 22 patients was calculated to yield statistical power of 90% to detect a 60% reduction in mean AHI from 39.5±31.7 to 15.6±17.4 events/hour after successful BS[5].

Statistical analysis was based on a variable scale using PASW Statistics, version 18.0 (SPSS Inc., Chicago, IL, USA). Patient characteristics were summarized using descriptive statistics, and normality of data distribution were examined using Kolmogorov-Smirnov test. Student's t-test was used to compare means according to the nature of variables. For dichotomous variables, chi-square test was used. Bivariate correlation was calculated by Pearson's correlation coefficient for parametric data and by Spearman's rank correlation coefficient for non-parametric data. A p-value of less than 0.05 was considered statistically significant. A linear mixed model was used to calculate the correlation between postoperative parameters after BS.

The protocol for the present study was approved by the Siriraj Institutional Review Board (SIRB) (COA no.041/2561), and all patients provided written informed consents.

Results

There were 24 patients in the present cohort. The mean age of patients was 35.0±14.0 years, and 58% were male. Fifty-eight percent had hypertension, 29% had diabetes, and 25% had dyslipidemia. Symptoms included habitual loud snoring (100%), choking or gasping (33%), witnessed pauses in breathing (50%), unrefreshing sleep (50%), poor performance (49%), and morning headache (29%) (Table 1).

Pre-operatively, all included patients had OSA. Twenty-three (95.8%) had severe OSA, and one had moderate severity disease. At the time of analysis, only seven patients had received postoperative PSG at 12 months, so the mean follow-up time was 7.8±3.4 months. Postoperative PSG with the least apnea-hypopnea index (AHI) was selected for comparison with preoperative PSG. One patient with severe OSA (AHI greater than 30 events/hour) had disease resolution (AHI less than 5 events/hour) after surgery. The evolution of OSA severity according to AHI is shown in Figure 1.

Patients lost weight from 145.0±27.0 to 107.0±21.0 kg for a mean reduction of 26.3%. The mean BMI decreased from 51.6±8.7 to 38.2±6.8 kg/m² (mean reduction 25.9%), and the mean neck circumference decreased from 46.9±5.0 to 40.2±4.3 cm (mean reduction 14.3%). The mean AHI was

Table 2. Changes in anthropometric and sleep parameters after bariatric surgery of 24 studied patients

Parameter	Before Mean±SD	After Mean±SD	Mean reduction	p-value	95% CI
Weight (kg)	145.0±27.0	107.0±21.0	–39.0±17.0	<0.001	–45.6 to –31.6
BMI (kg/m^2)	51.6±8.7	38.2±6.8	–13.4±6.6	<0.001	–16.2 to –10.6
Neck circumference (cm)	46.9±5.0	40.2±4.3	–6.7±3.2	<0.001	–8.1 to –5.4
ESS (total score=24)	8.7±5.9	4.7±3.5	–4.0±6.0	0.003	–6.5 to –1.5
AHI (events/hour)	87.6±38.9	28.5±21.5	–59.1±37.8	<0.001	–75.1 to –43.1
3% desaturation index (events/hour)	72.3±38.1	24.4±20.7	–47.8±40.6	<0.001	–65 to –30.7

BMI=body mass index; ESS=Epworth sleepiness scale; AHI=apnea-hypopnea index; SD=standard deviation; CI=confidence interval
A p-value <0.05 indicates statistical significance

significantly decreased from 87.6±38.9 to 28.5±21.5 events/hour (mean reduction 67.5%). Somnolence score from the Epworth sleepiness scale (ESS), and 3% desaturation index (events/hour) from PSG were also both significantly reduced after surgery (Table 2).

A reduction in BMI was found to be positively correlated with a reduction in neck circumference (r=0.74, p<0.01), AHI (r=0.49, p<0.05), and 3% desaturation index (r=0.46, p<0.05).

Discussion

The present prospective study aimed to monitor the effect of BS on OSA at three intervals post-operatively. Similar to the results reported from previous studies, weight loss during the first few months was rapid in the present cohort, and it continued for at least one year after successful surgery[4-7]. As a result, BS induced fast and dramatic improvement in clinical and sleep parameters during the first six months followed by continued improvement at a slower rate. Therefore, performance of a follow-up post-operative PSG is recommended to fine-tune the adjustment of optimum pressure provided by continuous positive airway pressure (CPAP), the mainstay of OSA treatment.

The largest study in obese OSA patients (n=119) that underwent BS and were followed-up for 12 months found that the prevalence of OSA decreased from 70.7% to 54.6% with a reduction in severity, and the mean AHI decreased from 27.8 to 9.9 (mean reduction 40%)[5]. Consistent with the present study, severity of OSA was reported to be significantly reduced in 30 obese patients two years after successful BS, with a mean AHI that decreased from 65.0 to 39.5 events/hour (mean reduction 25.5%)[6]. A 5-year follow-up of 36 adult patients after BS found that seven (19.4%) of those patients had a persistently high AHI and ESS score[9]. Another study in 110 patients that underwent a first PSG at a mean 7.7 months after surgery found that the mean AHI significantly decreased from 39.5 to 15.6 events/hour (mean reduction 60%), and that 28 (25.5%) patients showed no signs of disease (AHI less than five events/hour). The mean BMI significantly decreased from 45.4 to 36.3 kg/m² (mean reduction 20%). Fifty patients underwent a second PSG at a mean 16.9 months after surgery, and the mean AHI further decreased from 49.1 to 17.4 events/hour[10].

A factor that may significantly contribute to decreased severity of respiratory events is reduction in neck circumference. Increased neck circumference may compromise upper airway patency during sleep in morbidly obese patients. However, subjective improvement in sleepiness as measured by ESS was less obvious in the present study when compared to reduction in BMI and neck circumference. This may be due to the complex interaction between OSA and hypersomnolence via various neuropeptides and metabolic hormones[11]. Long-term evaluation for anthropometric changes and outcome of OSA after successful BS will enhance our understanding of this pathophysiology.

The strengths of the present study include its prospective design and the fact that the authors used in-hospital monitoring of standard PSG, which is in contrast to at-home monitoring that was used in some previous studies. The present study also had some mentionable limitations. First, the selection of only super morbidly obese patients for the present study reduced the number of eligible subjects, which resulted in a relatively small study population. Second, the extreme weight and BMI in the present study population could contribute to residual morbid obesity after successful surgery, and this could result in persistent, but perhaps less severe sleep-related breathing disorder.

Conclusion

In summary, dramatic reduction in the weight and BMI of super morbidly obese patients with OSA after successful BS can improve both clinical and sleep parameters. Follow-up PSG should be performed at least eight months after successful surgery.

What is already known on this topic?

Surgical-induced weight reduction (BS) is an effective treatment for morbidly obese patients.

What this study adds?

After successful weight loss following BS, obese patients with concomitant OSA also demonstrated dramatic improvement in OSA disease severity or even a complete cure.

Acknowledgement

The authors gratefully acknowledge the patients who generously agreed to participate in the present study, and Ms. Khemajira Karaketklang for assistance with statistical analysis.

Conflicts of interest

All authors declare no personal or professional conflicts of interest, and no financial support from the companies that produce or distribute the drugs, devices, or materials described in this report.

References

1. Young T, Finn L, Peppard PE, Szklo-Coxe M, Austin D, Nieto FJ, et al. Sleep disordered breathing and mortality: eighteen-year follow-up of the Wisconsin sleep cohort. Sleep 2008;31:1071-8.
2. Chierakul N, Chaipattarapol C, Ruttanaumpawan P, Nana A, Naruman C, Tangchityongsiva S. Comparison of clinical and polysomnographic characteristics of non-obese and obese patients with obstructive sleep apnea. J Med Assoc Thai 2007;90 Suppl 2:48-53.
3. Fredheim JM, Rollheim J, Sandbu R, Hofsø D, Omland T, Røislien J, et al. Obstructive sleep apnea after weight loss: a clinical trial comparing gastric bypass and intensive lifestyle intervention. J Clin Sleep Med 2013;9:427-32.
4. Tuomilehto H, Seppä J, Uusitupa M, Peltonen M, Martikainen T, Sahlman J, et al. The impact of weight reduction in the prevention of the progression of obstructive sleep apnea: an explanatory analysis of a 5-year observational follow-up trial. Sleep Med 2014;15:329-35.
5. Peromaa-Haavisto P, Tuomilehto H, Kössi J, Virtanen J, Luostarinen M, Pihlajamäki J, et al. Obstructive sleep apnea: the effect of bariatric surgery after 12 months. A prospective multicenter trial. Sleep Med 2017;35:85-90.
6. Dixon JB, Schachter LM, O'Brien PE, Jones K, Grima M, Lambert G, et al. Surgical vs conventional therapy for weight loss treatment of obstructive sleep apnea: a randomized controlled trial. JAMA 2012;308:1142-9.
7. Fritscher LG, Canani S, Mottin CC, Fritscher CC, Berleze D, Chapman K, et al. Bariatric surgery in the treatment of obstructive sleep apnea in morbidly obese patients. Respiration 2007;74:647-52.
8. Berry RB, Budhiraja R, Gottlieb DJ, Gozal D, Iber C, Kapur VK, et al. Rules for scoring respiratory events in sleep: update of the 2007 AASM Manual for the Scoring of Sleep and Associated Events. Deliberations of the Sleep Apnea Definitions Task Force of the American Academy of Sleep Medicine. J Clin Sleep Med 2012;8:597-619.
9. Del Genio G, Limongelli P, Del Genio F, Motta G, Docimo L, Testa D. Sleeve gastrectomy improves obstructive sleep apnea syndrome (OSAS): 5 year longitudinal study. Surg Obes Relat Dis 2016;12:70-4.
10. Ravesloot MJ, Hilgevoord AA, van Wagensveld BA, de Vries N. Assessment of the effect of bariatric surgery on obstructive sleep apnea at two postoperative intervals. Obes Surg 2014;24:22-31.
11. Sánchez-de-la-Torre M, Barceló A, Piérola J, Esquinas C, de la Peña M, Durán-Cantolla J, et al. Plasma levels of neuropeptides and metabolic hormones, and sleepiness in obstructive sleep apnea. Respir Med 2011;105:1954-60.