Prevalence of Sleep Apnea in Morbidly Obese Patients Who Presented for Weight Loss Surgery Evaluation: More Evidence for Routine Screening for Obstructive Sleep Apnea before Weight Loss Surgery

PETER P. LOPEZ, M.D.,* BIANCA STEFAN, M.S.,† CARL I. SCHULMAN, M.D.,† PATRICIA M. BYERS, M.D.†

From the Department of Surgery, University of Texas Health Science Center–San Antonio, San Antonio, Texas; and the †Dewitt Daughtry Family Department of Surgery, University of Miami Miller School of Medicine, Miami, Florida

The incidence of obstructive sleep apnea has been underestimated in morbidly obese patients who present for evaluation for weight loss surgery. This retrospective study shows that the incidence of obstructive sleep apnea in this patient population is greater than 70 per cent and increases in incidence as the body mass index increases. Obstructive sleep apnea (OSA) is a common comorbidity in obese patients who present for evaluation for gastric bypass surgery. The incidence of sleep apnea in obese patients has been reported to be as high as 40 per cent. A retrospective review of our prospectively collected database was performed. All patients being evaluated for weight loss surgery for obesity were screened preoperatively for OSA using a sleep study. The overall incidence of sleep apnea in our patients was 78 per cent (227 of 290). All 227 were diagnosed by formal sleep study. There were 63 (22%) males and 227 (78%) females. The mean age was 43 years (range, 17–75 years). The mean body mass index (BMI) was 52 kg/m^2 (range, 31–94 kg/m^2). The prevalence of OSA in the severely obese group (BMI 35–39.9 kg/m^2) was 71 per cent. For the morbidly obese group (BMI 40–40.9 kg/m^2), the prevalence was 74 per cent and for the superobese group (BMI 50–59.9 kg/m^2) 77 per cent. Those with a BMI 60 kg/m^2 or greater, the prevalence of OSA rose to 95 per cent. The incidence of sleep apnea in patients presenting for weight loss surgery was greater than 70 per cent in our study. Patients presenting for weight loss surgery should undergo a formal sleep study to diagnose OSA before bariatric surgery.

IN OUR SOCIETY TODAY, nearly one-third of all adults and an increasing number of children are obese, making obesity a major public health problem whose prevalence continues to increase.[1, 2] Obese and overweight individuals are at the highest risk for the development of obstructive sleep apnea (OSA). Obstructive sleep apnea is characterized by repetitive episodes of nighttime cessation of breathing resulting from obstruction of the upper airway during inspiration associated with intermittent hypoxemia. Obstructive sleep apnea has been reported to be present in approximately 40 per cent of obese individuals, and approximately 70 per cent of OSA patients are obese.[3–5]

Obstructive sleep apnea is an underrecognized, underdiagnosed, and undertreated comorbidity of obesity. It is associated with a significant increase in morbidity and mortality. Obstructive sleep apnea has been linked to a number of cardiovascular diseases, including hypertension, pulmonary hypertension, increase in sympathetic tone, greater prevalence of atherosclerosis, and a possible contributor to the development of atrial fibrillation. Treatment of OSA with continuous positive airway pressure (CPAP) reduces blood pressure[6] and decreases daytime sympathetic drive.[7] OSA has also been associated with insulin resistance and treatment with CPAP can decrease insulin resistance in patients with OSA.[8]

It is imperative that physicians be able to recognize and treat obese patients at risk for OSA. Morbidly obese individuals who are enrolled in surgical weight

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Address correspondence and reprint requests to Peter P. Lopez, M.D., Assistant Professor of Surgery, Department of Surgery, University of Texas Health Science Center–San Antonio, 7703 Floyd Curl Drive, MC 7248, San Antonio, TX 78229. E-mail: Lopez@uthscsa.edu.

loss programs should be screened for OSA. If these patients are diagnosed with OSA, they should be treated with CPAP before surgery. This will reduce the postoperative morbidity associated with OSA in these patients by improving the underlying negative physiological consequences of OSA. This study was undertaken to report on the prevalence of OSA in morbidly obese patients presenting for weight loss surgery.

Methods

A retrospective review of our prospectively collected database was performed for a period of 5 years (1999 to 2003). All patients being evaluated for weight loss surgery during this period were screened preoperatively for OSA by a formal sleep study. The study was approved by the Institutional Review Board at our institution.

The apnea–hypopnea index (the number of apnea and hypopnea events per hour) was used to diagnosis the presence of and the severity of OSA.[9] In this study, apnea was defined as airflow cessation lasting more than 10 seconds, and hypopnea was defined as air flow that decreased below a given percentage of the "surrounding baseline" air flow and that may have involved some degree of oxyhemoglobin desaturation.[10] OSA was defined in each obese patient by their average number of apnea–hypopnea incidents per hour, or their apnea–hypopnea index (AHI). During each obese patient's polysomnography "sleep study test," the average number of apneas and hypopneas per hour were recorded and their AHI was then calculated. Sleep apnea syndrome was defined in our study as an AHI greater than 5; this criteria has been shown to be diagnostic of sleep apnea syndrome by others.[11] All sleep studies were performed at a sleep center by trained technicians. The patients had their test performed at night to first diagnose sleep apnea. If the sleep study diagnosed the patient with sleep apnea, then a second sleep study would be performed on another night to see how much CPAP was needed to treat their sleep apnea. During the sleep study, a technician would place small sensors and bands on the patient to record and track their various body functions, including brain wave activity, respiratory movement, heart rate, blood oxygen concentration, leg and chin muscle activity, rapid eye movement, snoring, and body position. All patients had their oxygen monitored along with a monitor to measure air flow. All sleep studies were reviewed by a pulmonologist with special training in sleep disorders. Severity of OSA was categorized by calculating each patient's AHI {apneas plus hypopneas per hour of sleep} or respiratory disturbance index (RDI) {apneas plus hypopneas plus respiratory event-related arousals per hour) (mild AHI less than 5 or RDI less than 15, moderate AHI less than 15 or RDI less 30, severe AHI or RDI greater than 30).[12]

Patients were divided into five groups based on their weight at the time of their first visit to the weight loss clinic according to the groupings defined by O'Keefe and Patterson[13] based on the patients' body mass index (BMI); Group 1 had BMIs of 29 to 34.9 kg/m^2 (obese), Group 2 had BMIs of 35 to 39.9 kg/m^2 (severely obese), Group 3 had BMIs of 40 to 49.9 kg/m^2 (morbidly obese), Group 4 had BMIs of 50 to 59.9 kg/m^2 (superobese), and Group 5 had BMIs of greater than 60 kg/m^2 (supersuperobese). Our data will be presented in the same fashion.

Results

There were 290 patients who presented for weight loss surgery and all were screened for OSA by a formal sleep study over the 5-year study period. There were 63 males and 227 females. The mean age was 43 years (range, 17–75 years). The mean BMI was 52 kg/m^2 (range, 31–94 kg/m^2) (Table 1). All 227 patients found to have OSA were diagnosed after undergoing a formal sleep study. The AHI defined sleep apnea in 203 patients. Twenty-four patients were diagnosed with OSA but had no AHI reported. These 24 patients had their sleep studies interpreted as positive for sleep apnea based on their patterns of sleep during their test and response of their sleep disturbance to CPAP treatment.

The prevalence of OSA in the severely obese group (BMI 35–39.9 kg/m^2) was 71.43 per cent, for the morbidly obese group (BMI 40–40.9 kg/m^2) it was 74 per cent, for the superobese group (BMI 50–59.9 kg/m^2) it was 77 per cent, and for the supersuperobese group (BMI 60 kg/m^2 or greater), the prevalence rose to 95 per cent (Table 2). The overall incidence of sleep apnea in this study was 78 per cent.

The AHI is also reported for each BMI class; the severity of OSA increases as the number of apnea–hypopnea events occur per hour (Table 3).

Discussion

Obstructive sleep apnea is characterized by repetitive occlusion of the upper airway associated with

TABLE 1. *Demographics*

	Males	Females
Age (years)	17–74	20–75
BMI 25–34.9 kg/m^2	0	3
BMI 35–39.9 kg/m^2	1	6
BMI 40–49.9 kg/m^2	26	106
BMI 50–59.9 kg/m^2	16	74
BMI 60+ kg/m^2	20	38
Total	63	227

BMI, body mass index.

TABLE 2. *Number of Patients with OSA Stratified by BMI*

	No OSA	OSA	Total No.	Percent OSA
BMI 25–34.9 kg/m²	2	1	3	33.33
BMI 35–39.9 kg/m²	2	5	7	71.43
BMI 40–49.9 kg/m²	35	97	132	73.48
BMI 50–59.9 kg/m²	21	69	90	76.67
BMI 60+ kg/m²	3	55	58	94.83
Total	63	227	290	78.27

OSA, obstructive sleep apnea; BMI, body mass index.

TABLE 3. *Severity of OSA Stratified by Patient BMI*

	Mild	Moderate	Severe	AHI Unknown
BMI 25–34.9 kg/m²	1	0	0	0
BMI 35–39.9 kg/m²	2	2	0	1
BMI 40–49.9 kg/m²	31	28	32	6
BMI 50–59.9 kg/m²	20	17	24	8
BMI 60+ kg/m²	10	5	31	9
Total	64	52	87	24

OSA, obstructive sleep apnea; BMI, body mass index; AHI, apnea–hypopnea index.

oxygen desaturation and interruption of sleep. Sleep apnea should be considered in all patients who are obese, hypertensive, habitual snorers, and who present with persistent daytime sleepiness or drowsiness while driving.[14] Clinical examination carries a diagnostic sensitivity of only 50 per cent to 60 per cent for sleep apnea when performed by an experienced physician.[15] Others believe that patients can be screened with questionnaires so that only high-risk obese patients should undergo a formal sleep study.[16] One such test to help screen for OSA is the Epworth Sleepiness Scale. The Epworth Sleepiness Scale has been used as a tool to screen for daytime sleepiness as a manifestation of sleep apnea.[17] A patient's score of greater than 10 has been associated with a high risk for having sleep apnea. Serafini and associates have used the Epworth Sleepiness Scale to screen their preoperative bariatric patients. In their patients who had an Epworth Sleepiness Scale score of greater than 6, a polysomnography study was performed. In the patients who had a positive screening test, the incidence of sleep apnea was 96.3 per cent. Their overall incidence of sleep apnea for their patient population supposing all patients with an Epworth Sleepiness Scale of less than 6 did not have sleep apnea was only 40 per cent (26 of 27).[18] Screening tests are not designed to predict who has or who does not have sleep apnea. They merely identify individuals at risk and should be designed with reasonable sensitivity to be cost-effective and an extremely high specificity to avoid false-negatives. To examine the best diagnostic test for sleep apnea, Ross and his colleagues[19] did a systemic review of the literature and concluded that an overnight polysomnography (sleep) study is the most accurate screening test for diagnosing sleep apnea in adults. Currently, polysomnography remains the test of choice to accurately diagnose sleep apnea and allows one to individualize the treatment of each patient's sleep apnea by seeing how CPAP improves their sleep apnea.[20]

Obstructive sleep apnea has been associated with many negative physiological effects. Recurrent nightly episodes of hypoxia and swings in intrathoracic pressure, which arise during a patient's apnea and hypopnea events, lead to a sustained elevation of blood pressure. Several epidemiologic studies have consistently shown a positive association between OSA and hypertension.[21, 22] OSA has been associated with an ongoing inflammatory response with elevated levels of C-reactive protein, serum amyloid A, and an increase in leukocyte adherence to endothelial cells, all of which lead to an accelerated increase in the development of arteriosclerosis.[23] Treatment of OSA improves insulin resistance,[24] decreases blood pressure, improves pulmonary hypertension, decreases the number of inflammatory markers in the serum, and decreases the number of cardiac arrhythmias. Gupta et al.[25] reported that patients with OSA who were receiving CPAP treatment before surgery had less postoperative complications compared with patients with undiagnosed and untreated OSA. It is only reasonable to expect that morbidly obese patients with sleep apnea who have their sleep apnea treated with CPAP would also have less postoperative complications after their elective weight loss surgery. All 224 patients diagnosed with sleep apnea were treated for 3 to 6 months with CPAP before their bariatric procedures to improve the negative physiological consequences of their sleep apnea. Retrospective studies suggest that crude mortality is increased in untreated patients with OSA,[26] which may be the result of coexisting cardiovascular morbidity.[27] Continuous positive airway pressure, which is recognized as a major treatment modality in OSA,[28] not only reduces daytime sleepiness and improves cognitive function,[29] but also has beneficial effects on hypertension,[30] cardiac failure,[31] and nocturnal angina[32] in patients with OSA. In addition, long-term CPAP treatment has been shown to reduce the need for acute hospital admission resulting from concomitant cardiovascular and pulmonary disease in patients with OSA.[33] As our knowledge grows as to the negative physiological effects of untreated OSA, it is important that we diagnose OSA in obese patients and treat them to decrease their morbidity and mortality both preoperatively and postoperatively.

Many obese patients presenting for weight loss surgery who have sleep apnea remain undiagnosed. A recent study by O'Keefe and Patterson[13] noted that the incidence of sleep apnea ranged from 75.9 per cent to

86.9 per cent across all BMI groups presenting for bariatric surgery. This is consistent with the average incidence of sleep apnea of 78.3 per cent that we found in our obese patients who were evaluated for weight loss surgery. We also showed that the incidence of OSA also increased as the BMI increased. For our patients with a BMI between 40 and 50 kg/m^2, the incidence was 73.4 per cent and increased to 94.8 per cent for those who had a BMI of greater than 60 kg/m^2. The severity of sleep apnea also increased with BMI. The severity of sleep apnea has been defined by the total number of apnea and hypopnea events that occur per hour (AHI) or by the total number of apnea and hypopnea events plus respiratory event-related arousals per hour (RDI).[34] It is felt that as the number of apneic and hypopneic episodes per hour increases, the more symptomatic the patient becomes from the more severe physiological consequences induced from these hypoxic events.

The importance of diagnosing and treating OSA syndrome in obese patients before surgery is well known. Preoperative treatment improves exercise tolerance and reduces the negative cardiopulmonary physiological consequences that are caused by OSA. The likelihood of respiratory complications such as atelectasis, pneumonia, and hypoxia occurring after surgery in obese patients, especially those with OSA, is increased. As the number of patients undergoing weight loss surgery increases, more patients will be at risk for these potentially life-threatening postoperative pulmonary complications. Because the diagnosis and treatment of patients with OSA reduces postoperative pulmonary complications such as the incidence of pneumonia, need for mechanical ventilation, intensive care unit days, and postoperative hypoxic events, by diagnosing and treating patients preoperatively for sleep apnea, significant perioperative morbidity can ne prevented. It may also improve the patient's comorbidities such as pulmonary and systemic hypertension, depression, and diabetes before surgery.

In conclusion, because the incidence of sleep apnea is high (78.3%) in patients undergoing a workup for bariatric surgery, all such patients should have a formal sleep study performed to rule in or out the diagnosis of sleep apnea before bariatric surgery not to miss the chance to improve the negative physiological consequences of sleep apnea before metabolic weight loss surgery.

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