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Bariatric surgery for treatment of sleep apnea syndrome in 15 morbidly obese patients: Long-term results

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OBJECTIVE: To evaluate the long-term outcomes of bariatric surgery with respect to respiratory disturbance index (RDI) in sleep apnea syndrome (SAS).
DESIGN: Case series with long-term follow-up (1 to 12 years).
SETTING: Private clinic in an academic tertiary referral center.
PATIENTS: Fifteen morbidly obese patients (10 men, 5 women) who were referred for the treatment of severe SAS.
INTERVENTION: For all 15 patients who presented with severe SAS, nasal positive airway pressure breathing was either not available or was not tolerated by the patient; therefore, bariatric surgery was performed as a means of treatment for SAS.
MAIN OUTCOME MEASURES: RDIs and minimum oxygen saturation were measured both preoperatively and postoperatively (1 to 12 years after surgery).
RESULTS: Weight loss ranged from 60 to 220 pounds (27 to 100 kg). RDI decreased by at least 55% in each patient, and all patients with tracheostomies (8 of 15) had their tracheostomy tubes removed. Average RDI preoperatively was 96.9 and average RDI postoperatively was 11.3. Results were similar for all 15 patients in that minimum oxygen saturation increased during sleep from an average preoperative minimum oxygen saturation of 58.7% to an average postoperative minimum oxygen saturation of 85.2%.
CONCLUSIONS: Bariatric surgery as a means of treating SAS in the morbidly obese provides effective long-term reduction in RDI. Bariatric surgery also significantly improves minimum oxygen saturation in morbidly obese patients with SAS. Biliopancreatic bypass is more effective in reducing RDI to normal values than vertical banded gastroplasty. (Otolaryngol Head Neck Surg 2001;125: 299-302.)

For over 25 years, the clinical importance of sleep apnea has been recognized.[1] Sleep apnea syndrome (SAS), defined as repeated episodes of obstructive apnea and hypopnea during sleep, together with daytime sleepiness or altered cardiopulmonary function, is a common condition,[2] especially among the morbidly obese. It is estimated that as high as 1.25% of all adult men are affected by SAS and that SAS is at least 25 times more common among morbidly obese patients.[3] Data from the studies of He et al[4] show significant morbidity and mortality associated with SAS, even for those younger than 50 years of age. Preliminary reports suggest that patients with SAS have an increased susceptibility to cardiovascular complications such as hypertension,[5,6] cardiac arrhythmias,[7,8] stroke,[7,9,10] and myocardial infarction.[11,12]

SAS in the obese is felt to be caused in part by upper-airway (velopharynx, oropharynx, hypopharynx) narrowing or obstruction by soft tissues, as well as increased upper-airway collapsibility.[13] Rubinstein et al[14] concluded that weight loss was associated with marked improvement in upper-airway function and suggested that this improvement may partly explain the improvement in sleep apnea. Weight loss in morbidly obese patients with sleep apnea has been shown to relieve hypersomnia and increase both awake and asleep arterial oxygen saturation.[15] Weight loss may also decrease the work of breathing, decrease arterial partial pressures of CO_2, and expand lung volumes.[16]

Diet controlled weight loss is often recommended for morbidly obese patients with SAS. Although dieting can be effective in the short term, its efficacy for long-term reduction in body mass is low because of recidivism. Greater than 95% of patients who attempt to reduce their weight with dieting alone will regain their prediet weight.[17]

Surgical procedures resulting in significant weight loss have demonstrated that weight loss alone can be satisfac-

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tory in treating SAS. Charuzi et al[16] reported in a long-term follow-up study that bariatric surgery was the treatment of choice for morbidly obese patients with SAS. They studied 46 morbidly obese patients (39 male, 7 female) with sleep apnea who underwent bariatric surgery, and observed significant improvement in both the patients' symptoms as well as improvement in sleep laboratory recordings at 1 year and at 7 years after surgery.

METHODS

A medical history was obtained on all patients regarding their snoring, observed apnea spells, and excessive daytime sleepiness. All patients underwent a sleeping polysomnographic sleep evaluation at the Dartmouth Sleep Laboratory. Polysomnographic evaluation was attended via closed-circuit video by a laboratory technician. Electromyography, electrocardiography, oximetry, and electroencephalography were all monitored as part of the sleep evaluation using Mallinkrodt-Sandman recording equipment. Often the initial polysomnograph resulted in the nearly immediate performance of a tracheostomy, due to discovered excessively long apnea periods (up to 2 minutes) and oxygen desaturation levels below 50% (one case below 25%). Diet therapy was always suggested. Patients undergoing diet therapy were referred to a dietician at the Dartmouth-Hitchcock Medical Center (DHMC) and were placed on calorie-restricted diets based on their daily caloric requirements. These diets ranged between 1000 and 2000 calories per day. With the exception of 1 patient, none were able to lose enough weight to resolve the SAS symptoms. At this point intestinal bypass surgery or gastroplasty was suggested.

Before the performance of such surgery, patients were screened and counseled by the operating surgeon, staff from the department of endocrinology, and the dietitian. After surgery, appropriate vitamin supplementation was given, and close endocrine and nutritional vigilance was observed. A sleeping polysomnographic study was performed after significant weight loss (>60 pounds [27 kg]) and a decision was made about removing the tracheostomy tube. A final sleep study was performed when weight loss had stabilized.

The surgical method of biliopancreatic bypass with two-thirds distal gastrectomy was undertaken for the majority of the patients in this study. This procedure was first described by Scopinaro (Fig 1).[19] Gastroplasty was a preferred method by a general surgeon at the DHMC and was performed on 4 patients in this study.[20]

PATIENTS

We reviewed all morbidly obese patients at the DHMC who had been diagnosed with SAS based on polysomnography and who had also undergone a bariatric procedure to treat sleep apnea. Of these patients, only those having adequate sleep studies both preoperatively and postoperatively, including a postoperative sleep study conducted at least 1 year (range, 1 to 12 years) after surgery, were included in the final cohort. A total of 14 patients met these criteria. One additional patient was added to this group. This particular patient (no. 2, Table 1) had excessive daytime sleepiness that improved dramatically with her bariatric procedure; however, her preoperative respiratory disturbance index (RDI) was only 21 (mild sleep apnea).

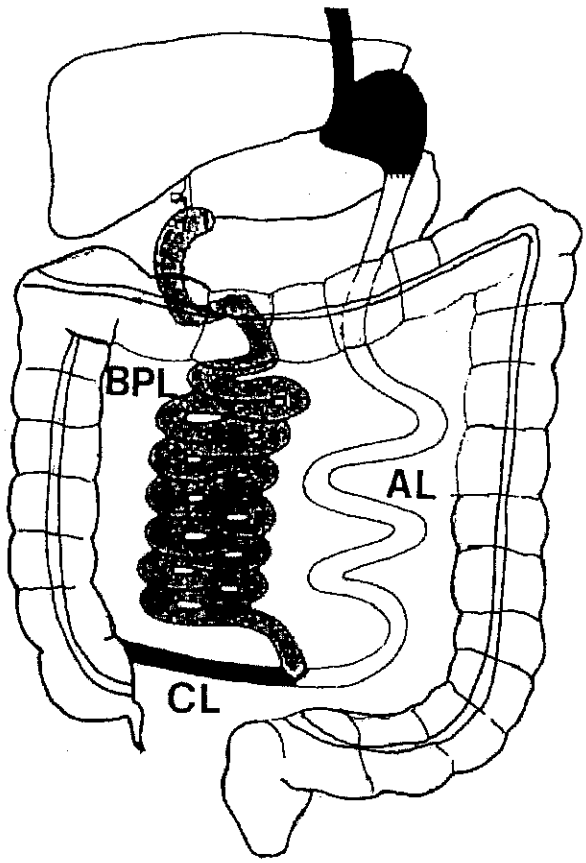

Fig 1. Scopinaro technique of biliopancreatic bypass. (*AL*, Alimentary loop, *BPL*, biliopancreatic loop, *CL*, common loop.) (Reprinted with permission from The British Institute of Radiology, Bertolotto et al. 1996; 69:707-16.)

RESULTS

The average age of the group of 15 patients (10 men, 5 women) in this study was 34.7 years. The average preoperative weight of these patients was 351.3 pounds (159.6 kg). The average postoperative weight was 231.2 pounds (105.0 kg). This resulted in an average weight loss of 120.3 pounds (54.7 kg) (Table 1).

All 15 patients achieved weight loss in excess of 60 pounds (27 kg), and all patients had improved RDIs as well as improved minimum oxygen saturation. The 8 patients who had tracheostomies were able to have them

Table 1. Respiratory disturbance index (RDI) as a function of surgical weight loss

Patient number	Age (years)	Gender	Weight preop*	Weight postop*	Weight loss total*	RDI preop	RDI postop	Min O_2 Sat Preop	Min O_2 Sat Postop	Method of loss
1	35	Male	382	230	152	70	11	56	89	PBBG
2	20	Female	407	290	117	21	0	79	92	PBBG
3	25	Male	420	230	190	88	2	64	88	PBBG
4	31	Male	270	195	75	58	9	20	77	PBBG
5	38	Male	300	210	90	64	24	74	85	PBBG
6	31	Male	400	180	220	132	0	45	78	PBBG
7	36	Male	400	302	98	118	37	51	83	VBG
8	33	Male	390	270	120	136	1	66	91	PBBG
9	31	Male	400	266	134	190	2	63	79	VBG
10	48	Male	360	300	60	149	45	70	76	VBG
11	36	Female	226	160	66	96	1	59	83	PBBG
12	43	Female	320	259	61	104	29	65	83	VBG
13	35	Female	300	184	116	63	4	49	93	PBBG
14	43	Female	310	204	106	49	2	82	90	PBBG
15	35	Male	388	188	200	115	2	37	91	PBBG
Average	34.7		351.3	231.2	120.3	96.9	11.3			

*Weight in pounds.
PBBG, Pancreaticobiliary bypass with subtotal gastrectomy.
VGB, vertical banded gastroplasty.

decanulated and closed. Fourteen of fifteen patients achieved a stable weight, and only 1 patient (no. 9, Table 1) relapsed (weight gain and resumption of SAS). Patient 9 had undergone vertical banded gastroplasty (VBG) and the staples did not hold. This patient (whose sleep apnea was initially well controlled with surgical weight loss) regained significant weight and had a return of SAS symptoms because of the ultimate failure of the surgical procedure. He is currently under treatment with continuous positive airway pressure.

As a group, the patients who had the biliopancreatic bypass procedure tended to approach a more ideal weight as reported by life insurance "height-weight" tables. Of the 11 patients who underwent biliopancreatic bypass, 10 had both a postoperative RDI < 20 and also a reduction in RDI > 50%. The 4 patients in the VBG group seldom reached the ideal weights quoted in such tables, but did lose sufficient weight to demonstrate improvement of SAS. Three of the 4 patients who underwent VBG did not meet the success criteria of postoperative RDI < 20 although in all 4 cases the RDI reductions were greater than 50% from preoperative values. VBG is less complex surgically and has fewer complications, and was used in the "sicker" patients as evidenced by preoperative RDIs averaging 140.3 in the VBG group compared with preoperative RDIs averaging 81.1 in the biliopancreatic bypass (PBBG) group (Figs 2 and 3).

DISCUSSION

First-line therapy for SAS at the DHMC is a trial of continuous positive airway pressure and is usually effective if tolerated by the patient. However, continuous positive airway pressure is not well tolerated among many patients, and the noncompliance rate is as high as 30%.[21] It should be noted that continuous positive airway pressure was not available to our earlier patients and was not well tolerated by many of those who presented to us after its availability.

The 15 patients in the present study had certain experiences in common: all were grossly overweight and had at various times in life seriously attempted diet therapy without lasting success. All were overweight throughout their high school years. Some had played sports when they had been at lighter weights than they were at the time of presentation to the DHMC. By the time this group of patients had counseling for either biliopancreatic bypass surgery or gastroplasty, those with tracheostomies had an overwhelming desire to have the tracheostomy tube removed. Several had already undergone tonsillectomy, uvulopalatopharyngoplasty, submucous resection, or turbinoplasties in an attempt to improve their SAS or as a treatment for other pathologic condition such as chronic tonsillitis or nasal obstruction.

Once patients had gone through the stages of rapid weight loss with all the associated complications (eg, multiple soft stools, nausea, vomiting, iron deficiency anemia, fat-soluble vitamin deficiencies) they seemed to equilibrate well and required only interval examinations. All were cured of their SAS. All have experienced consistency at their new lower weights. In addition to the cure of SAS with its attending elimination of the

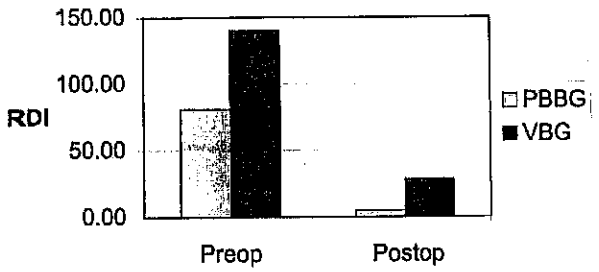

Fig 2. Respiratory disturbance index (RDI) as a function of 2 different bariatric surgical procedures; biliopancreatic bypass (PBBG) and vertical banded gastroplasty (VBG).

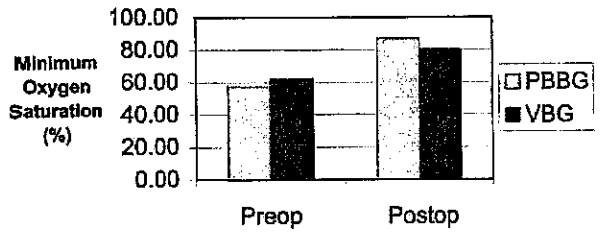

Fig 3. Minimum oxygen saturation as a function of 2 different bariatric surgical procedures; biliopancreatic bypass (PBBG) and vertical banded gastroplasty (VBG).

tracheostomy tube, all patients have achieved an improved quality of life. They have returned to normal activities, including the ability to participate in sports, and have achieved a healthier self-image. Additional benefits seen in some of our patients included the following: improved memory; ability to resume normal physical functions such as participation in athletics (hiking, climbing, biking); the experience of fewer accidents (stumbling, tripping) common in obese people; decreased food intake and decreased grocery bills.

As seen in Table 1, 4 patients continued to have postoperative RDI values in the range of mild-to-moderate sleep apnea. Three of these 4 patients received vertical banded gastroplasty, and only 1 of the 4 patients received a biliopancreatic bypass. However, these patients reported dramatic decrease in their symptoms of excessive daytime somnolence. In all 4 patients who underwent a bariatric procedure and continued to have RDI values greater than 20, the majority of their respiratory disturbances were hypopneas and not apneas. In all cases, the minimum oxygen saturation improved significantly.

CONCLUSION

Bariatric surgery in the morbidly obese effectively reduces the respiratory disturbance index in patients with severe obstructive sleep apnea. Biliopancreatic bypass was more effective in lowering RDI than vertical banded gastroplasty. Patients maintained their improved RDI for the follow-up time ranging from 1 to 12 years. Bariatric surgery can be considered as a viable long-term treatment for severe SAS in the morbidly obese population.

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