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Banded gastric bypass: Combining two principles

Mathias Fobi, M.D., F.A.C.S.*

Center for Surgical Treatment of Obesity, Tri-City Regional Hospital, Hawaiian Gardens, California

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The banded Roux-en-Y gastric bypass (BGBP) comprises a small ($\leq$ 20 mL) lesser curvature isolated pouch with a Silastic ring band around the lower third of the pouch to form the reinforced stoma. The transected edge of the pouch is covered with the Roux limb, which is brought up to establish bowel continuity. The gastrojejunostomy is a tangential large end-to-side anastomosis with a 2-layer closure. The biliopancreatic and alimentary limbs are both short, about 60 cm each (Fig. 1).

The BGBP operation evolved from the observation that in patients with inadequate weight loss from an anatomically and surgically intact vertical banded gastroplasty, conversion to a gastric bypass (GBP) with a gastroenterostomy anastomosis just distal to the band resulted in better and sustained weight loss than achieved by a nonbanded GBP [1]. The band was left in place because a polypropylene mesh band was used, as described by Mason [2], and removing the band at the time of the conversion operation proved technically difficult.

The first BGBP was done with a 5-cm Silastic band, as in the Silastic ring vertical gastroplasty operation described by Laws and Piantadosi [3], and with the pouch formed by stapling in continuity. This was called the Silastic ring BGBP. The restrictive banded pouch resulted in a high rate of solid food intolerance [4] and a high incidence of staple line breakdown and marginal ulcerations [5,6]. These problems have been resolved by using a 6-cm band in women and a 6.5-cm band in men and transecting the pouch to minimize the incidence of staple line breakdown [6,7]. The transected edge of the pouch is covered with a serosal patch using the jejunal limb that is brought up for the gastrojejunostomy, minimizing the incidence of bleeding, leaks, and gastrogastric fistula formation.

Finally, to address the inherent problems of acute gastric distension and of ready access to the bypassed segment, a temporary gastrostomy tube is placed in the bypassed stomach, and a radio-opaque marker is placed around this site to facilitate radiologic percutaneous access to the bypassed segment [8]. This composite operation can be described as a transected Silastic ring vertical BGBP with a temporary gastrostomy and a gastrostomy site marker. It is generically called the BGBP, and is also known as the Fobi pouch operation.

Surgical technique

The BGBP operation can be performed through either a laparoscopic or an open technique. A lesser curvature vertical pouch $<$ 20 mL in size is made by transecting the stomach. A band (6 cm circumference in women; 6.5 cm in men) is placed around the pouch not more than 2 cm from the distal aspect of the pouch to create the functional stoma. Placement of the band further decreases the functional capacity of the proximal pouch. The Roux-en-Y limb that will provide gastrointestinal continuity is formed by transecting the jejunum at a point 40 to 60 cm from the ligaments of Treitz and creating a side-to-side enteroenterostomy with a 60-cm Roux limb. The mesenteric gap is closed. The Roux limb is brought through the mesocolon retrocolic and retrogastric, then anastomosed to the pouch distal to the band. A temporary gastrostomy tube is placed in the bypassed stomach for postoperative decompression or feeding as needed. A permanent gastrostomy site marker is placed to facilitate radiologic access to the bypassed segment for either diagnostic intervention or nutritional support as necessary [8]. The operation is completed by closing the space between the Roux limb and the retroperitoneal space and then closing the defect in the mesocolon, to prevent internal herniation [7].

BGBP operations have been performed at the Center for Surgical Treatment of Obesity since 1985, starting with conversion of gastroplasties to BGBPs, then the Silastic ring

*Reprint requests: Mathias Fobi, M.D., 21520 S. Pioneer Boulevard, Suite 204, Hawaiian Gardens, CA 90706.

E-mail: fobimal@aol.com

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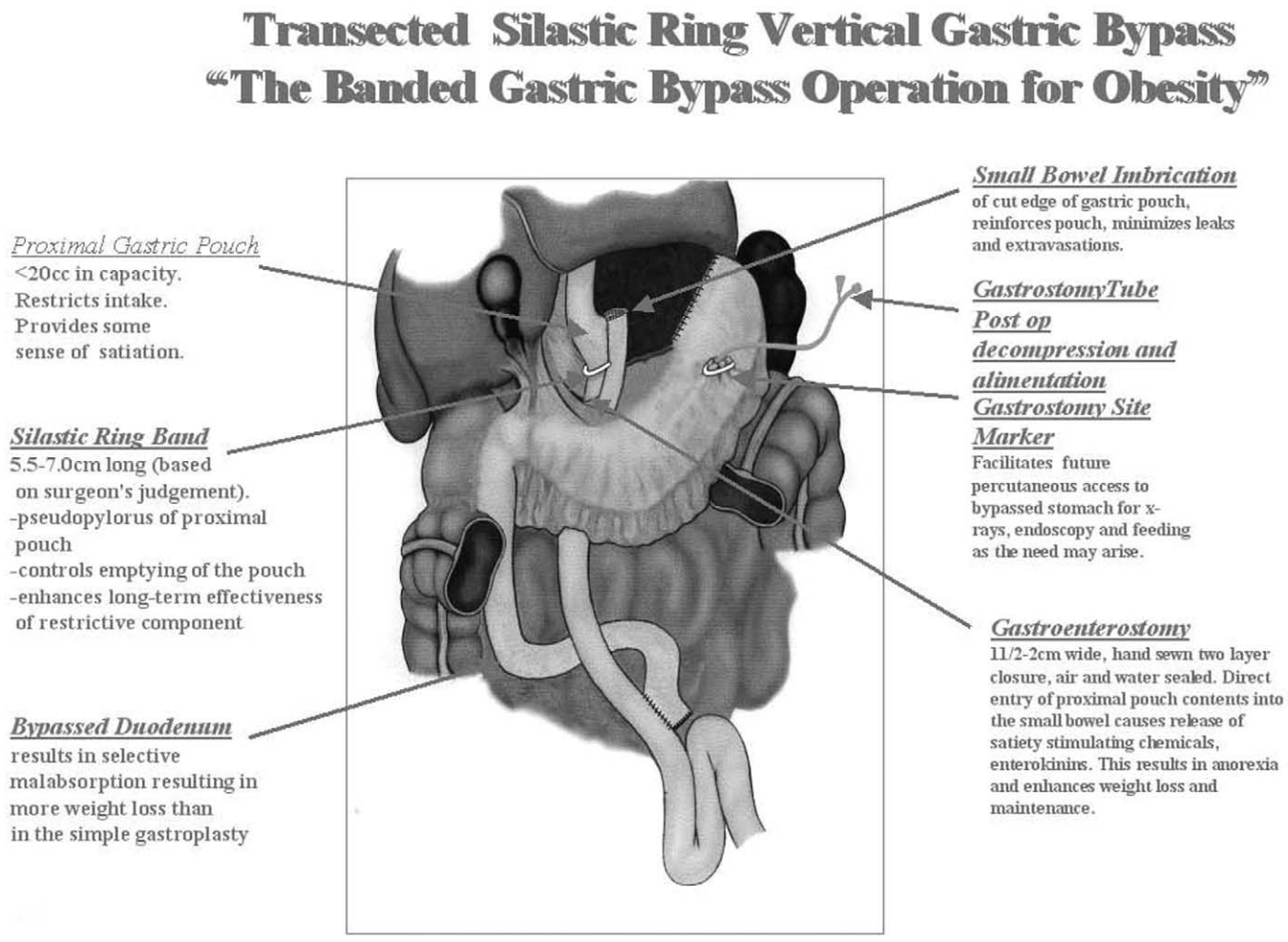

Figure 1. Transected Silastic ring vertical BGBP. Reprinted with permission from Fobi M, Lee H, Felahy B, Che K, Ako P, Fobi N. Choosing an operation for weight control, and the transsected banded gastric bypass. Obes Surg 2005;15:114–21.

vertical BGBP, and finally the transected Silastic ring vertical BGBP. This review summarizes the long-term outcome with BGBP primary, secondary, and revised operations from 1992 through 2002 (Table 1).

Table 1
Banded gastric bypass operation; Number of procedures over 10 years

Total	Primary procedure	Secondary procedure	Revision
1992	50	42	5
1993	115	65	5
1994	209	45	10
1995	203	49	16
1996	166	31	13
1997	188	27	11
1998	296	32	33
1999	468	29	28
2000	470	27	30
2001	410	28	40
2002	432	30	29
Total	3,007	405	220
%	83	11	6

Concurrent operations

Certain other surgical pathologies can also be addressed at the time of BGBP operation [9,10]. Concurrent operations in this series included, but were not limited to, cholecystectomy (61%), panniculectomy (29%), herniorraphy (9.5%), ovarian cystectomy (4%), bilateral tubal ligation (2.5%), and hysterectomy and oophorectomy (< 1%).

Secondary operations

Secondary operations included BGBP operations on patients who had undergone previous bariatric operations, including jejunoileal bypass, gastric banding, various gastroplasties, biliopancreatic diversion, and other GBP operations. These operations accounted for about 11% of all of the BGBP operations performed (Table 1). BGBP in a patient who has undergone a previous bariatric operation should be done only if a vertical pouch on the lesser curvature can be formed safely. Secondary operations carry a higher incidence of complications than primary operations [11,12].

Revision/conversion/reversal operations

The common indications for revision of BGBP included inadequate weight loss, weight regain, excessive weight loss, mechanical failure of the operation (eg, outlet stenosis, obstruction), band erosion, and gastrogastric fistula with marginal ulceration and pain. Other rare indications included patient request, intractable diarrhea, intractable nausea, recurrent marginal ulcers, intractable anemia, patient intolerance, and old age. Approximately 6% of the BGBPs performed entailed band revision (Table 1).

The most common revision operation after BGBP involved shortening the common limb to produce more weight loss [13]. When weight regain or inadequate weight loss was not due to any mechanical or anatomic dysfunction of the operation, the BGBP was revised to produce more weight loss by increasing the malabsorptive component of the operation through shortening of the common limb. Shortening of the common limb was also indicated in patients who experienced significant weight regain after band removal. Occasionally this was done to maximize weight loss at the patient's request when performed concurrent with another planned procedure.

How short the common limb should be made depends on how much weight the patient needs to lose and also on the patient's current bowel habits. Most commonly, the enteroenteric anastomosis that forms the Roux limb is taken down and a new one created so that the biliopancreatic limb (the bypassed small bowel) is equal in length to the functional alimentary segment, the efferent limb plus the common limb. Because this revision results in increased stool frequency with watery consistency, it should not be done in a patient who already passes more than 6 watery stools a day. Patients with increased malabsorption have lost an average of 7 additional body mass index (BMI) points, or 60 lb, after this revision, but at the cost of increased frequency of protein malnutrition; foul body, flatus, and stool odor; and the need for more frequent biochemical monitoring [13,14].

A few revision operations have been done to take down gastrogastric or gastrojejunal fistulas. There have also been conversions to a vertical banded gastroplasty because of excessive weight loss, intractable nausea, intractable diarrhea, and intractable marginal ulceration not responsive to medications. Two cases were converted to a banded gastroplasty because of short bowel syndrome. Anatomic reversals of the operation have been done because of patient request, recurrent marginal ulcers, patient intolerance, anorexia, old age, and in 1 patient with amyotrophic lateral sclerosis (ALS). All reversal operations resulted in rapid regain of the lost weight in all patients except the patient with ALS.

Perioperative care

Patient selection (with few exceptions) followed the 1991 National Institutes of Health Consensus Statement on Gastrointestinal Surgery for Obesity [15]. The patient characteristics are listed in Table 2. Preoperative evaluation entailed a complete history and physical examination, including a detailed dietary history and report of previous efforts at weight loss. All patients were seen by a multidisciplinary team composed of a surgeon, cardiologist, pulmonologist, psychologist/psychiatrist, patient counselor, nutritionist, and other consultants as needed. All patients underwent laboratory evaluation, including *Helicobacter pylori* titers, morning cortisol levels, and triiodothyronine and thyroxine levels. A sleep study, pulmonary function tests, an upper gastrointestinal radiographic study and electrocardiogram, and abdominal and pelvic ultrasounds were also part of the preoperative evaluation.

Table 2
Banded gastric bypass operation, 10 year experience: Patient demographics

Male	13%
Female	87%
White	56%
Black	36%
Hispanic	7%
Other	1%
Private insurance	73%
Medicaid/Medicare	16%
Self-pay	11%
Mean age	40 years
Mean weight	136 kg
Mean excess weight	68 kg
Mean BMI	47 kg/m^2

Perioperative antibiotics, subcutaneous heparin, antithromboembolic stockings, an intermittent venous sequential compression device, incentive spirometry, and, as indicated, nasal continuous positive airway pressure (C-PAP) or Bi-PAP machines were used as needed. Early ambulation was routine. The gastrostomy tube was connected to gravity drainage and plugged after 24 hours if the total drainage was $<$ 200 mL. This tube was removed before discharge from the hospital, usually on the third postoperative day. If copious drainage from the temporary gastrotomy tube was seen, then the tube was kept open until the drainage was $<$ 200 mL/24 hr and the cause of the increased drainage resolved. This tube was used for fluid and nutrient supplements as the need arose. Patients were started on ice chips 4 hours after returning from the recovery room. A prescribed diet was started on the second day after surgery and the patient followed with a progressive increase in diet on an outpatient basis. A contrast study of the pouch and outlet was obtained on the second postoperative day.

The patients were discharged home on the third or fourth postoperative day on a puree diet. They were seen in the office within 7 to 10 days and then at 6 weeks, 3 months, 6 months, and 1 year after the surgery.

Perioperative complications

The perioperative complications after BGBP were the same as with other short-limb GBP operations

Table 3
Banded gastric bypass: Long-term follow-up

Time	No. of patients	No. of eligible patients	%
Preoperative	576	576	100
3 Months	547	576	95
6 Months	527	576	92
1 Year	508	576	88
2 Years	464	576	81
3 Years	430	576	75
4 Years	377	576	66
5 Years	317	576	55
6 Years	286	576	50
7 Years	250	576	43
8 Years	154	373	41
9 Years	51	166	31
10 Years	14	51	28

[11]. These included intraoperative complications, atelectasis, wound problems (8.8%), deep venous thrombosis (2.5%), outlet stenosis (2%), leaks (1.6%), pulmonary embolism (0.85%), pulmonary problems, nausea, vomiting, mood swings, and depression. There were 16 perioperative (within 30 days) deaths (0.44%). It should be noted that the band markedly reduced the incidence of outlet stenosis requiring endoscopic dilatation [11,16–18].

Long-term complications

Long-term complications after BGBP were also similar to those for most reported series of short-limb GBP, except for a lower frequency of inadequate weight loss and a lower frequency and magnitude of weight regain. These long-term complications included incisional hernias (5.8%) small bowel obstruction (2.8%), band erosion (2.5%), solid food intolerance (1.7%), marginal ulcers (1.6%), protein malnutrition (1%), anorexia, transient hair loss, diarrhea, hypoglycemia, dumping syndrome, excessive weight loss, inadequate weight loss, weight regain, and vitamin A, vitamin D, vitamin E, calcium, and iron deficiency syndromes. Band complications included band erosion and gastrojejunal or gastrogastric fistula (Table 3). Band erosions were treated expectantly by spontaneous extrusion or endoscopic removal (Fig. 2) [12].

Weight loss

A total of 576 patients were eligible for 7 to 10 years of follow-up analysis (Fig. 3). Weight loss after BGBP was rapid during the first 6 months and continued at a slower pace for up to 18 months after the operation. The average percentage excess weight loss (%EWL) in the first year was 77%, and this was maintained for 3 to 5 years [6,11,18–21]. By the tenth year after surgery, the average %EWL was 69.8% (Fig. 3). Similarly, the average BMI was maintained

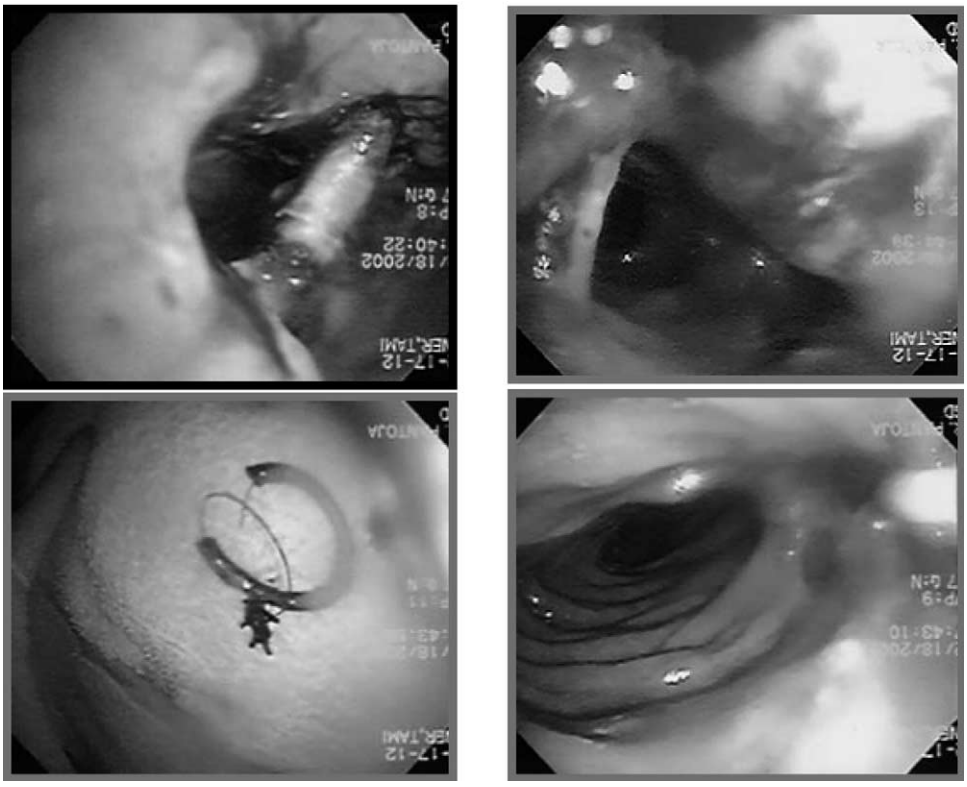

Figure 2. Endoscopic removal.

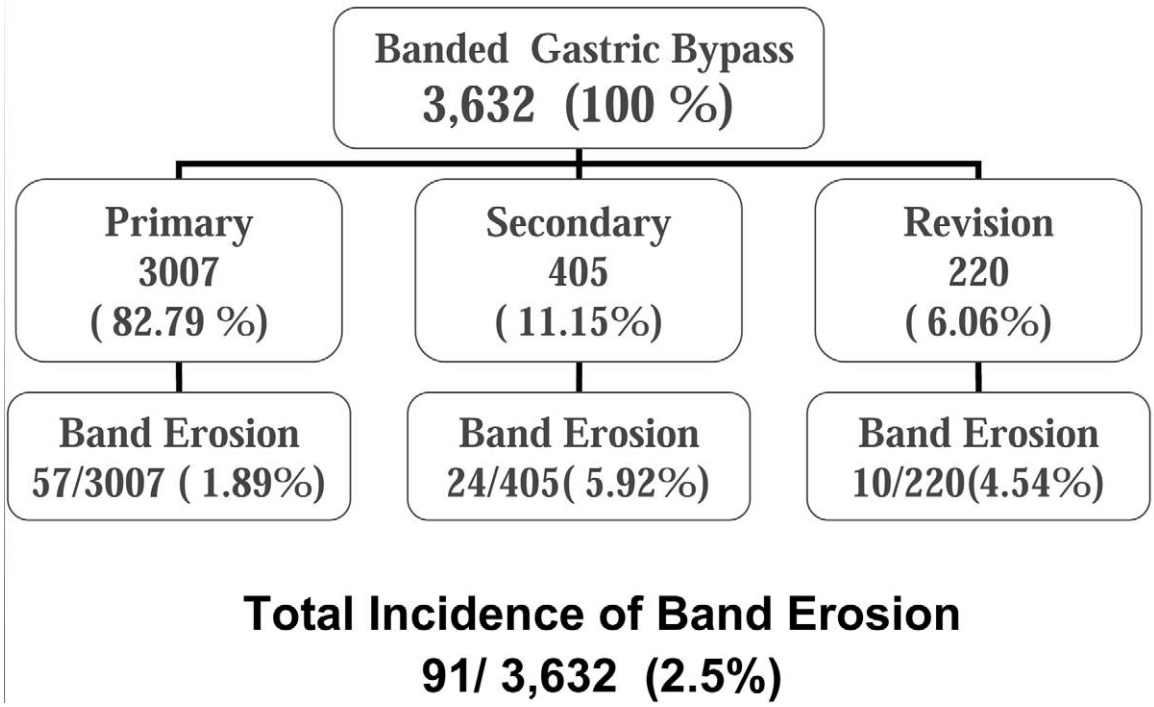

Figure 3. Incidence of ring band erosion (May 1992–May 2002).

around 30 kg/m^2 even after 10 years. BGBP was very effective in those with a BMI between 32 and 40 kg/m^2 and less so in patients who weighed $>$ 500 lb and those older than 60 years. In our experience, primary BGBP yielded better weight loss and maintenance than standard GBP, gastroplasty, and secondary BGBP. The success rate at 7 to 10 years after BGBP is 90% (ie, 90% of those followed had lost and maintained $>$ 50% EWL), assuming that the patients lost to follow-up had results identical to those followed. The outcomes after BGBP have been corroborated by reports and presentations by other bariatric surgeons [4,6,19] (Fig. 4).

Resolution of comorbid conditions

All patients with hyperglycemia and non–insulin-dependent type 2 diabetes mellitus became euglycemic within days of the operation. Some 91% of patients with insulin-

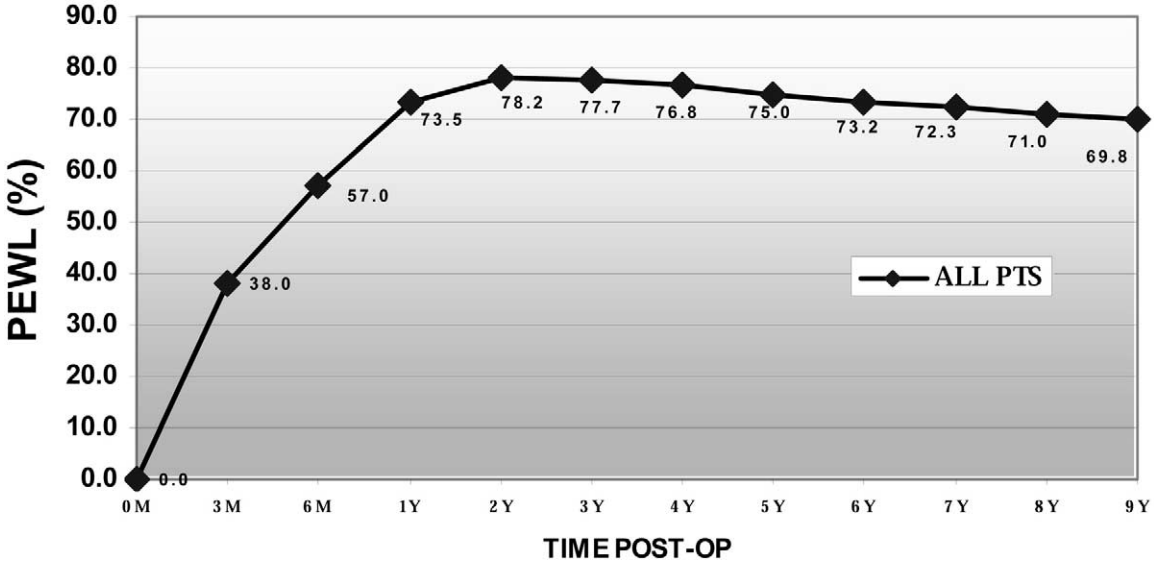

Figure 4. Average PEWL (all pts) ring banded gastric bypass.

dependent type 2 diabetes mellitus became euglycemic after BGBP. Those taking medications can now take much-reduced doses. There was 100% control of sleep apnea, hypertriglyceridemia, hypercholesterolemia, venous stasis, and headaches due to pseudotumor cerebri. There was improvement and less need for medications in patients with gastroesophageal reflux disease, hypertension, depression, urinary incontinence, chronic fatigue syndrome, fibromyalgia, asthma, arthritis, insomnia, and listlessness. Patients have reported increased activity levels, self-esteem, employability, sexual satisfaction, and social interaction and less prejudice and discrimination against them. Patients look and act younger after the sustained weight loss. In patients with malignant obesity (ie, those 200 lb or more above ideal weight), BGBP was a life-saving and life-prolonging operation. In patients with a BMI between 32 and 39.9 kg/m^2, BGBP prevented the development of co-morbidities and enhanced many socio-psycho-economic aspects of their lives [21].

Laparoscopic banded gastric bypass

Starting in October 2001, BGBP has been performed laparoscopically at our center. Currently 80% of the BGBP operations are done laparoscopically. There were 323 attempted laparoscopic BGBPs, including 312 completions and 11 conversions to an open procedure, between October 1, 2001 and April 23, 2004. The average operating time was 246 minutes.

Complications included 14 cases of outlet stenosis (4.58%), 12 cases of leak (3.9%), 4 cases of small bowel obstruction (1.3%), 4 cases of marginal ulcers, (1.3%), 3 cases of band erosion (0.96%), and 2 cases of postoperative bleeding (0.64%), for an overall perioperative complication rate of 8.0%. We have not had a single case of deep venous thrombosis or pulmonary embolus in our first 323 laparoscopic cases.

Conclusion

The BGBP operation enhances the restrictive component of the nonbanded short-limb GBP. The increased benefit of the decreased incidence of outlet stenosis requiring endoscopic dilatation; increased %EWL in the obese, the morbidly obese, and the superobese; and increased weight loss maintenance observed with BGBP outweigh the 3% frequency of band-related complications, which are usually inconsequential. Fisher and Barber [22] summed up the effectiveness of BGBP when they wrote that “adding the band to the GBP results in more weight loss in more patients that is maintained over a longer period of time.” Failed GBP, gastroplasty, banding, biliopancreatic bypass, and jejunoileal bypass operations can be revised to the BGBP in selected cases at an increased risk of wound problems and leaks. Revision of a failed BGBP to a distal BGBP results in increased weight loss, but at the expense of an increased incidence of protein and nutrient malabsorption.

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