

Laparoscopic vs Open Gastric Bypass in the Management of Morbid Obesity: A 7-year Retrospective Study of 1,364 Patients from a Single Center

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Abstract

Methods We performed a retrospective analysis of 1,364 consecutive morbidly obese patients who underwent restrictive–malabsorptive Roux-en-Y gastric bypass (RYGBP) between January 1998 and December 2004. A selective use of open and laparoscopic approaches was employed since 2001. Patients were seen in the office at 1 week; 2, 3, 6, 9, 12, and 24 months; and yearly thereafter. During visits, each patient was weighed and dietary intake and exercise regimen were recorded.

Results We report a sustained weight reduction in over 90% of patients. The anastomotic leak rate was 0.15%, the 30-day readmission rate was 1.17%, and the overall mortality rate was 0.15%. Minor surgical site infection rate was 0.5%, and revision to long limb RYGBP rate was 0.07%.

Conclusions Morbid obesity represents a significant health issue. None of the medical methods of weight reduction provide a lasting weight reduction. Surgery offers the only achievable long-term solution. Although not yet universally employed, laparoscopic RYGBP is rapidly becoming the standard operation for the surgical treatment of clinically severe obesity.

Keywords Morbid obesity · Bariatric surgery · Outcomes · Roux-en-Y gastric bypass

Introduction

Despite repeated warnings by Western governments of the dangers of being overweight, obesity remains a major health problem. Over the past two decades, the prevalence of overweight and obesity has increased markedly in the USA. The number of pediatric patients classified as overweight or obese is approaching alarming proportions [1]. The health implications of this epidemic are unimaginable.

Although many patients have tried dietary restriction and exercise programs, most of the gains achieved are lost once the patient discontinues the program. Surgery, therefore, is the only form of treatment that can consistently offer a significant and sustainable weight reduction, as well as improvement in associated comorbidities and substantial improvement in quality of life [2, 3]. Bariatric surgery acceptance has increased dramatically because the operations can be performed laparoscopically and most procedures are associated with low mortality, especially compared to no treatment [3]. Across the USA, two types of bariatric procedures are commonly in use. Gastric banding, which is purely restrictive, and gastric bypass, which is combined restrictive and malabsorptive. Restrictive procedures are not as popular in our institution as gastric bypass due to patient preference. We report on our 7 years experience with gastric bypass and compare our outcomes with the national standards.

Methods

We performed a retrospective review of case notes, cross-sectional imaging, and telephone interview with all patients who underwent restrictive–malabsorptive procedure for

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morbid obesity in a high-volume tertiary center between January 1998 and December 2005. Two attending Bariatric surgeons were involved in 1,364 consecutive procedures. Between 1998 and January 2001, based on surgeon's experience, we employed only open procedure, but by February 2001, we instituted laparoscopic approach for our initial 100 highly selective patients.

Consistent with the American Society of Bariatric Surgery/National Institutes of Health (NIH consensus group), we defined morbid obesity as body mass index (BMI) greater than 35 kg/m^2 with coexisting comorbidities or $\text{BMI} > 40 \text{ kg/m}^2$. All patients had attempted medical weight loss programs without sustained weight reduction. The primary outcome was weight change and a secondary outcome was complications.

To identify morbidly obese patients who underwent restrictive-malabsorptive bariatric procedures, the International Classification of Diseases (ninth edition) clinical modification code for morbid obesity (278.01) and current procedural terminology (44.38) codes were used. In performing the surgical procedure, both laparoscopic and open Roux-en-Y gastric bypass (RYGBP) approaches were employed. Initially, All patients were placed in a supine position and had an indwelling Foley catheter inserted. Prophylactic antibiotics (Cefoxitin) and heparin were given at the time of induction of general anesthesia. Pneumatic compression boots (Venodyne®) were placed on both lower extremities for deep venous thrombosis prophylaxis. All patients were mobilized within 6 h after surgery.

Open gastric bypass was performed through an upper midline incision. In constructing the gastric pouch, an anterior gastrotomy was created, and the anvil of the stapling device was inserted into the stomach and positioned through the anterior gastric wall. A 15- to 30-mL gastric pouch was created along the lesser curvature with linear staplers. In fashioning the gastrojejunostomy, the jejunum was divided 30 cm distal to the ligament of Treitz and tunneled in a retrocolic manner to be anastomosed end-to-side with the gastric pouch using a circular stapler. The Roux limb length of 75–150 cm was created using a circular stapler. The anastomosis was tested using Methylene Blue introduced via a nasogastric tube. A standard Jackson–Pratt drain was placed adjacent the gastric pouch and brought out through the left side of the abdomen. The abdominal cavity was closed using loop polydioxanone suture ($\times 2$) and surgical skin staples.

Access for laparoscopic gastric bypass was obtained through six abdominal ports (1×15 - and 2×12 -mm port, 1×10 - and 2×5 -mm retracting ports). We employed the previously described technique of laparoscopic gastric bypass [4]. Briefly, a pneumoperitoneum was established via a Verres needle inserted into the umbilicus; intra-abdominal pressure was maintained between 12 and 15 mm Hg. As

in the open gastric bypass, a 15–30-cm gastric pouch was created along the lesser curvature using linear staplers. The jejunum was divided 30-cm distal to the ligament of Treitz. The 75–150-cm Roux limb length was measured, and the jejunojunctionostomy anastomosis was constructed with a 60-mm linear stapler. The Roux limb was approximated to the gastric reservoir in an antecolic, antegastric position. The gastrojejunostomy anastomosis was performed using a circular stapler. The small bowel mesenteric defect was closed with sutures. Wounds were closed using Polyglactin (Vicryl®) and subcuticular biosynthetic sutures.

All patients were given patient-controlled analgesia for pain controlled and incentive spirometry. In selected patients, gastrograffin studies were performed on postoperative day 1 (less than 150 patients) to assess anastomotic integrity. Once the anastomosis was found to be intact, a gastric bypass clear liquid diet (sugar free) was commenced, and the patient was slowly advanced to a regular gastric bypass diet. For an in-depth evaluation of the data, the patients were analyzed on the basis of associated comorbidities, sex, age, length of stay in hospital, 30-day readmission, complications, and 1- and 12-month mortality.

Each patient was seen initially at 1 week after discharge; subsequently at 2, 3, 6, 9, 12, and 24 months; and yearly thereafter. During each visit, the patient's weight was measured, and each patient was asked specifically about his/her health and self-esteem, as well as vitamins and nutritional supplemental intake.

Results

Between January 1998 and December 2004, a total of 1,364 consecutive patients underwent RYGBP for morbid obesity. Average operative time was 90 min (open RYGBP=90 min, laparoscopic RYGBP=116 min). Patients and their associated comorbidities were nearly identical (Tables 1 and 2). Hypertension and sleep apnea were the two most common coexisting comorbidities (46% and 37%, respectively). Most patients with type 2 diabetes mellitus reported resolution of their illness with improvement in their weight (75%).

Table 1 Characteristics of patients who underwent RYGBP

	Lap RYGBP	Open RYGBP
No. of patients	806	561
Male/female ratio	0.98:1.02	0.55:1.81
Mean BMI	46.2	47.6
Standard deviation (SD)	4.7	5.69
95% confidence interval	45.89–46.54	47.20–48.14

Table 2 Comorbidities among RYGBP recipients

Comorbidity	No. (%)	Lap RYGBP	Open RYGBP
Hypertension	631 (46)	563	68
Sleep apnea	511 (37)	306	205
GERD	412 (30)	300	112
Diabetes mellitus	278 (20)	133	145
Osteoarthritis	275 (20)	200	75
Gallstones	161 (12)	80	81
Psychiatric disorder	155 (11)	75	80
Lumbar disc prolapse	108 (8)	53	55
Umbilical hernia	29 (2)	15	14
Stress incontinence	27 (2)	10	17

One hundred and fifty five patients had a psychiatric disorder in the form of mild depression prior to operation. Furthermore, 95% ($n=147$) felt better and had an improved personal image with the sustained weight reduction. Twenty-three patients (1.6%) suffered complications, with two fatalities (Table 3). Both fatalities followed open RYGBP and occurred within 30 days of the procedure. One patient died from cardiac arrhythmia unrelated to surgery at home, and the other death occurred as the patient was going home following discharge from the hospital.

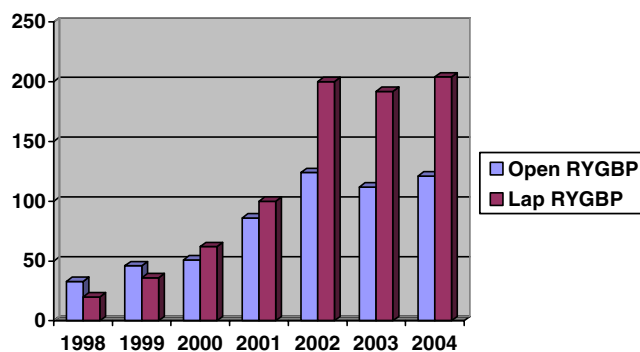
Two patients suffered an anastomotic dehiscence. Significantly, both leaks occurred at the gastrojejunal anastomosis. Both patients were treated surgically and made a full recovery. Two patients had a distended distal gastric remnant and underwent fluoroscopic decompression. Both patients recovered and were subsequently discharged. One patient, who initially had a laparoscopic RYGBP, underwent an open revision with creation of a long-limb gastric bypass for ineffective weight loss. She subsequently achieved a satisfactory result.

During the initial stage of introduction of laparoscopic RYGBP in our practice, two of the initial highly selective

Table 3 Length of stay, complications, and mortality

Characteristics	Lap RYGBP	Open RYGBP
Average length of stay (days)	2.4	4.3
Complications [no. (%)]		
Anastomotic leak	1 (0.12)	1 (0.17)
DVT	2 (0.25)	3 (0.54)
Pneumonia	3 (0.4)	1 (0.17)
Wound infection	2 (0.25)	5 (0.53)
Distal gastric distension	2 (0.25)	0
Revision of RYGBP	1 (0.12)	0
Readmission	6 (0.75)	10 (1.78)
Mortality		
30 days	0	2 (0.15)
12 months	0	0

Parentheses are in percent

**Fig. 1** Growth of RYGBP 1998–2004

100 patients required conversion to an open procedure. Subsequently, we had a further 16 conversions (conversion rate=2%). Sixteen patients were readmitted (6 lap RYGBP and 10 open RYGBP) with a small bowel obstruction secondary to suspected adhesions 6, 9, and 12 months after operation. All of these patients were treated conservatively, with good results.

Four patients developed postoperative pneumonia. Three of these patients were treated in the surgical intensive care unit. The other was successfully treated on the floor with appropriate antibiotics. All four patients recovered satisfactorily. Deep-vein thrombosis (DVT) was seen in five patients despite adequate DVT prophylaxis. Although none of these patients developed pulmonary embolism (PE), we suspected that one of the deaths might have been due to PE, as the patient died on her way out of the hospital. Post mortem examination was not performed at the request of the family.

Seven patients developed minor surgical-site infections. None of these was significant enough to warrant antibiotic treatment. All infections resolved by simple surgical staple removal, free drainage. The average length of hospital stay significantly improved as the trend toward laparoscopic RYGBP increased (Table 3 and Fig. 1). The desired weight reduction was highest during the first 18 months and continued into the second year (Table 4). Sixteen patients, representing 1.17% of all patients, were readmitted several months after the procedure (6–48 months) for various reasons ranging from subacute obstruction to diarrhea; none of these patients required reoperation.

Table 4 Preoperative and postoperative BMI of RYGBP patients

	N	Mean BMI	Range
Preoperative BMI	1,364	48.7	45–60
Postoperative BMI			
12 months	1,361	37.3	29.2–38.1
18 months	1,361	23.0	22.0–33.2
24 months	1,361	21.0	21.0–30.2

Discussion

The RYGBP is the most popular procedure among bariatric surgeons in the USA. It has consistently demonstrated excellent qualitative results [5–8]. Our study corroborates these results. In the first 3 years of the study, all patients were electively offered an open procedure primarily due to our experience with this approach. Subsequently, once the learning curve for laparoscopic approach was achieved, all patients were offered this approach unless met by hostile abdomen, multiple procedures, hepatomegaly, or patient's preference. Although, in some series, high-risk patients were offered open procedure because it is generally believed that the laparoscopic approach took a longer time to complete. In our experience, the average time to completion of an open procedure was 115 min, compared to 160 min for the laparoscopic approach. In our opinion, this difference does not justify the needs for an open procedure with its additional risk of wound-related complications. In our view, these high-risk patients should be prime candidates for the least invasive procedure.

We recorded a 1.17% readmission rate. Most of the readmission occurred early during the study. This seems to have coincided with the program employing a full-time hospital-based bariatric nurse practitioner. As in other series, readmission may be largely due to intestinal obstruction. Higa et al. [7] recorded an incidence of 2.5% (26 internal hernias) after 1,040 lap RYGBP; Schauer [9] reported an incidence of 1.1% and Nyugen [5] observed a higher intestinal obstruction rate after lap RYGBP among their patients.

Although intestinal obstruction due to stricture at the gastrojejunal anastomosis may be a cause for obstruction in some series [5], we did not encounter any such complication in the present series. A tension-free anastomosis coupled with a good blood supply may be a factor. In the present series, the 30-day mortality rate was 0.15%. This compares favorably with the 2% rate reported by Flum et al. [9]. We also agree that the volume of bariatric surgery performed is directly related to the mortality risk. This risk is also directly related to the patient age because both patients who expired were over the age of 45.

Two patients required revision of their procedure because they were unable to achieve an acceptable weight reduction. This highlights the challenges associated with bariatric surgery. It may not be effective for all people to the same degree. This finding is similar to the experience of other investigators [3, 10]. Both patients underwent open distal bypass. We have found an open RYGBP that employs a long Roux limb to be more effective in super-obese individuals. Indeed, this observation is supported by Brolin et al. [11], who observed that the long-limb modification of

RYGBP is a safe and effective procedure in super-obese patients.

Sugerman [12], on the other hand, found this modification to be associated with significant complications. Indeed, the group reported two deaths from hepatic failure and severe malnutrition that required nutritional supplementation. None of our patients to date suffered any significant complications following revision.

Most of our patients achieved a significant weight reduction during the first 18 postoperative months. This continued into the second year. Most patients believed that the gain achieved by surgery was worthwhile and would recommend bariatric surgery to their friends. Our findings support the observation by previous authors [10, 11, 16].

The average length of stay was 2.4 days for lap RYGBP and 4.3 days for open RYGBP, respectively. In the earlier part of the study, the average length of stay was 6 days. Our experience is similar to previous reported shorter hospital stay as the learning curve for a procedure is exceeded.

Of the many potential complications associated with RYGBP in a morbidly obese patient, anastomotic dehiscence and PE are the most feared. We reported an anastomotic dehiscence rate of 0.15% for all comers. This measures favorably with the results in other series, which reported a leak rate of 1–2% [13, 14]. Although earlier reports on laparoscopic RYGBP suggested a higher leak rate among this cohort [15, 16], we believe that the initial high leak rate may be due to a learning curve, which improved over time. Indeed, of the 803 laparoscopic RYGBP performed in our series, only one patient suffered an anastomotic dehiscence. This leak occurred early in the study. Similarly, in the series by Wittgrove [16] et al., the initial leak rate of 3% (9 patients) in their first 300 cases was reduced to 1% (2 patients) in their last 200 cases. Two patients had gastric remnant distension, which was successfully treated with the placement of CT-guided gastrotomy tube.

Morbid obesity is an independent risk factor for venous thromboembolism (VTE) and DVT [17]. In the present series, five patients (0.34%) developed DVT. Although none of the five patients developed a PE, we suspect one of the patients who died on her way home from the hospital to have died from PE. Post mortem examination was refused by the patient's family.

Our low rate of VTE and DVT supports the findings by Westling et al. [18] who, in a prospective controlled trial, found a low incidence of VTE among patients undergoing RYGBP. Hill and Sue-Ling in two separate studies failed to demonstrate a correlation between obesity and postoperative DVT using ¹²⁵I-fibrinogen uptake as the diagnostic tool [19, 20]. While it is hard to explain the low incidence of DVT among our patients, we believe that the combination

of sequential pneumatic compression boots, anticoagulation, and early mobilization played a significant role in ensuring this low incidence.

Unlike in other series, where prophylactic placement of inferior vena cava filter is recommended [21], we believe that the current evidence does not support this approach; instead, the above aggressive measures are advocated. The conversion rate in this study was 2%. This rate is comparable with the rate of 4.1% in the series by Schwartz et al. [22]. The commonest reason for conversion to an open procedure was due to steatohepatitis. Other reasons include adhesion and technical factors. Minor wound infections were treated simply with adequate drainage at the bedside. None of these required an operating room setting.

Conclusions

As our results have shown, it is possible to achieve satisfactory results that parallel the national standard in most hospitals in the country. Laparoscopic RYGBP is the future of bariatric surgery. It is associated with early discharge, less pain, faster recovery, and return to normality, but the procedure, however, should not be taken lightly, as it is associated with rare but serious complications.

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