

## Laparoscopic Roux-en-Y Gastric Bypass for the Treatment of Morbid Obesity: Experience with 50 Patients

Abed Khalaileh MD<sup>1</sup>, Idit Matot MD<sup>2</sup>, Chaya Schweiger BSc RD<sup>3</sup>, Liat Appelbaum MD<sup>4</sup>, Ram Elazary MD<sup>1</sup> and Andrei Keidar MD<sup>1</sup>

<sup>1</sup>Department of General Surgery and Trauma Unit, and Departments of <sup>2</sup>Anesthesia, <sup>3</sup>Clinical Nutrition and Diet, and

<sup>4</sup>Imaging, Hadassah-Hebrew University Medical Center (Ein Kerem Campus), Jerusalem, Israel

**Key words:** bariatric surgery, gastric bypass, laparoscopy, morbid obesity, obesity, Roux-en-Y gastric bypass

### Abstract

**Background:** Roux-en-Y gastric bypass is currently considered the gold standard surgical option for the treatment of morbid obesity. Open RYGB is associated with a high risk of complications. Laparoscopic RYGB has been shown to reduce perioperative morbidity and improve recovery.

**Objectives:** To review our experience with laparoscopic RYGB during a 19 month period.

**Methods:** The data were collected prospectively. The study group comprised all patients who underwent laparoscopic RYGB for treatment of morbid obesity as their primary operation between February 2006 and July 2007. The reported outcome included surgical results, weight loss, and improved status of co-morbidities, with follow-up of up to 19 months.

**Results:** The mean age of the 50 patients was 36.7 years. Mean body mass index was 44.7 kg/m<sup>2</sup> (range 35–76 kg/m<sup>2</sup>); mean duration of surgery was 171 minutes. There was no conversion to open surgery. The mean length of stay was 4 days (range 2–7 days). Five patients (10%) developed a complication, but none of them required early reoperation and there were no deaths. Mean follow-up was 7 months (range 40 days–19 months). The excess body weight loss was 55% and 61% at 6 and 12 months respectively. Diabetes resolved completely or significantly improved in all five patients with this condition, as did hypertension in eight patients out of nine.

**Conclusions:** Laparoscopic RYGB is feasible and safe. The results in terms of weight loss and correction of co-morbidities are comparable to other previously published studies. However, only surgeons with experience in advanced laparoscopic as well as bariatric surgery should attempt this procedure.

*IMAJ 2008;10:350–353*

Obesity is a major epidemic in developed countries. It induces or exacerbates hypertension, diabetes mellitus, obstructive sleep apnea, dyslipidemia, and many other disease processes that cumulatively contribute to premature mortality on a scale rivaling that of smoking [1]. Almost 3% of the male population and 9% of the female population in Israel have a body mass index of over 35, and up to 60% are overweight [2]. This growing prevalence of obesity, together with the absence of effective conservative treatment, is responsible for the increasing number of bariatric surgical procedures performed worldwide [3].

Among the many operations designed to effect weight loss,

gastric bypass, which combines gastric restriction with very mild malabsorption, is considered to be the optimal procedure due to its satisfying long-term weight loss and acceptable complication rate. Gastric bypass has therefore become the procedure of choice for many surgeons, especially in the United States where it accounts for up to 75% of all surgeries performed for morbid obesity [4]. The recent introduction of this technique into the bariatric surgery armamentarium in Israel added an efficient surgical modality to the list of procedures.

Open bariatric surgery is associated with relatively high rates of cardiopulmonary, thromboembolic and incision-related post-operative complications. Laparoscopy has been shown to reduce this type of morbidity for a variety of procedures in both the obese and non-obese populations. The success of the operation derives from the surgeon's ability to perform it reliably, using the laparoscopic technique, with low mortality and morbidity [5]. In this paper we present our initial experience with laparoscopic Roux-en-Y gastric bypass.

### Patients and Methods

The study was approved by the Research Ethics Committee of the Hadassah-Hebrew University Medical Center, and written informed consent was obtained from each patient. Over a 19 month period 50 consecutive patients scheduled to undergo RYGB for morbid obesity were studied prospectively.

All morbidly obese patients referred to our obesity clinic for potential surgical treatment undergo a multidisciplinary evaluation by a dietitian, psychologist, anesthesiologist and bariatric surgeon. Other consultants (cardiologist, endocrinologist) are involved in the patients' management as needed. In addition, all patients attend a lecture that provides a comprehensive description of the indications, risks and benefits of the different bariatric procedures.

The indications for surgery include a body mass index exceeding 40 kg/m<sup>2</sup>, or > 35 kg/m<sup>2</sup> with at least one severe obesity-related co-morbidity (diabetes type 2, hypertension, sleep apnea, osteoarthropathy, etc.) and a failure of previous conservative attempts to lose weight. The choice of procedure is made according to the individual characteristics of the patient, such as age, BMI, health-related conditions, previous operations, medica-

RYGB = Roux-en-Y gastric bypass

BMI = body mass index

tions taken, degree of self-discipline, eating habits (sweet-eaters, binge eaters), anatomic conditions (large hiatal hernia), and the patient's individual preferences.

All patients who underwent a laparoscopic RYGB as a primary operation for morbid obesity were included in this study. All revisional procedures were excluded.

### Operative management

The operative technique described here represents our current practice, which is the result of several modifications made over time. The study patients received a standardized general anesthetic. One dose of cefamezine was given at the induction of anesthesia. Subcutaneous enoxaparine (Clexane®) was given on the morning of the operation and daily until discharge. This routine, however, was abandoned due to the high rate of bleeding complications (see results).

The pneumoperitoneum is created by an insertion of an optic trocar to the left of the midline above the umbilicus. After insufflation, additional 12 mm working trocars are introduced under direct vision. Dissection is performed using 5 mm ultrasonic shears (Ethicon Endosurgery, Cincinnati, OH, USA). The first step of the procedure consists of constructing the Roux loop of jejunum, and jejunojejunostomy. After exposure of the angle of Treitz, the jejunum and its mesentery is divided 30–50 cm distally using an Endo-GIA ETS-Flex45 stapler with blue (3.5 mm) cartridges (Ethicon Endosurgery). As a rule, we create a 100 cm Roux-en-Y loop for patients with a BMI < 50 kg/m<sup>2</sup> and 150 cm in patients with BMI > 50 kg/m<sup>2</sup>. A side-to-side anastomosis is then fashioned between the two jejunal segments using the same stapler. The common jejunostomy opening is closed using a hand-sewn technique. The second step of the procedure is the creation of a small 10–20 ml proximal gastric pouch. The retro-gastric tunnel is made by a blunt and sharp dissection, started at the lesser curvature. The proximal stomach is then divided using an Endo-GIA II with 45 mm blue (3.5 mm) cartridges. In most cases, five cartridges are necessary to form a small 10–20 ml gastric pouch. The third and last operative step consists of the creation of an end-to-side or side-to-side antecolic antegastric gastrojejunal anastomosis between the proximal gastric pouch and the Roux limb. This anastomosis is performed by means of a totally intracorporeal two-layered hand sewn technique, or is fashioned by using a linear Endo-GIA stapler (3.5 mm) with hand-sewn closure of the common enterotomy. The anastomosis is then tested with methylene blue dye injected through the nasogastric tube.

### Postoperative period

All patients are encouraged to sit in a chair on the evening of the operation or to ambulate if able, and to walk on the first postoperative day. Also on the first postoperative day, a water-soluble contrast study is performed to verify the absence of anastomotic leak. If the study is negative, oral liquids are started the same day. The patients are advanced to a semi-liquid diet on the second postoperative day, which they are instructed to maintain until the end of the fourth postoperative week.

Postoperative visits were scheduled for after 2 weeks, 1 month, every 3 months during the first year, and biannually thereafter. Follow-up was performed by both the surgical and the medical team. Results were evaluated with respect to weight loss, complications, improvement in quality of life, and correction of co-morbidities. All data were collected prospectively and entered into a computerized database. Weight loss was assessed by percentage of excess body weight loss and decrease in BMI.

Statistical analysis included calculation of mean and standard deviation that was performed using the Microsoft Excel for Windows 2003.

## Results

Data are presented as range, mean and standard deviation where appropriate. The follow-up period ranged between 40 days and 19 months. Only one patient was lost to follow-up.

Fifty patients undergoing RYGB as a primary procedure were operated between February 2006 and July 2007 by a single surgeon (A.K.). The study group comprised 33 females (66%) and 17 males (34%), with a mean age of 36.7 ± 11.59 (range 17–61 years). The mean BMI was 44.7 ± 9.46 kg/m<sup>2</sup> (range 35–76 kg/m<sup>2</sup>); nine patients (18%) were super-obese (BMI > 50). Demographic and anthropometric data are summarized in Table 1. Thirty-eight patients (78%)

**Table 1.** Demographic and anthropometric characteristics of the patients

Study period	February 2006 to July 2007
No. of patients (female/male)	50 (33/17)
Age (yrs)	37
Range	17–61
BMI (kg/m <sup>2</sup> )	44.7
Range	35–76
Weight (kg)	128.5
Range	90–268
Super-obese (BMI > 50)	9

**Table 2.** Preoperative co-morbidities related to morbid obesity

Co-morbidity	No. of patients (%)
Overt diabetes or impaired glucose tolerance	9 (18)
Hypertension	13 (26)
Hyperlipidemia	12 (24)
Gastroesophageal reflux disease	8 (16)
Hyperuricemia	5 (10)
Osteoarthritis of weight-bearing joints	3 (6)
Cancer (previous)	2 (4)
Obesity hypoventilation syndrome	6 (12)
Venous stasis, varicose veins	2 (4)
Different stages of fatty liver	15 (30)
Polycystic ovary	2 (4)
Carpal tunnel syndrome	5 (10)
Total no. of patients with co-morbidities	38 (76)

suffered from co-morbidities possibly related to morbid obesity, and many had more than one co-morbidity [Table 2].

### Surgical data

RYGBP was completed laparoscopically in all patients. The mean operative time was  $172 \pm 52.2$  minutes (range 115–420 minutes). The mean duration of postoperative stay was  $4 \pm 1.27$  days (range 2–7 days). There were no reoperations in the perioperative period (within 30 days of surgery). In one patient the jejunojejunostomy was redone immediately after its completion because torsion was observed, and this event accounts for the longest operative time (420 minutes) in our series. This patient recovered well and has had no further problems. Four additional concurrent procedures were performed during the index operation: incisional hernia repair in three patients and cholecystectomy in one patient.

### Outcome

There was no mortality in the series. Five patients (10%) developed five early postoperative complications, all of which were bleeding complications. In four of them postoperative bleeding stopped spontaneously after discontinuation of Clexane® and there was no need for blood transfusion. One patient who bled postoperatively received two units of packed red blood cells. This patient developed an infected hematoma that was drained percutaneously and converted later into a controlled fistula from the gastrojejunal anastomosis. This leak, the only leak in this series, was treated successfully with antibiotics and complete bowel rest and intravenous fluids for 3 weeks.

There were only two rehospitalizations (4%) during the entire follow-up period: one in the previously described patient who developed a leak, and the other in a patient who developed small bowel obstruction one year following the operation. This patient underwent a laparoscopic lysis of a single adhesive band, with a hospital stay of one day.

We did not encounter any anastomotic stricture or marginal ulcers in this series, and only one patient was referred for an upper endoscopy due to complaints of mild epigastric distress one year postoperatively.

The weight loss curve is shown in Figure 1. At 6 months and at 1 year of follow-up the excess body weight loss was 55.5% and 61% respectively (in the group of patients who completed 6

months and 1 year of follow-up). The mean BMI decrease was 15 at 6 months postoperatively (from 48 to 35).

Among patients who completed at least 6 months follow-up, diabetes resolved completely or significantly improved in all five patients with the condition, as did hypertension in eight patients out of nine (one patient was lost to follow-up).

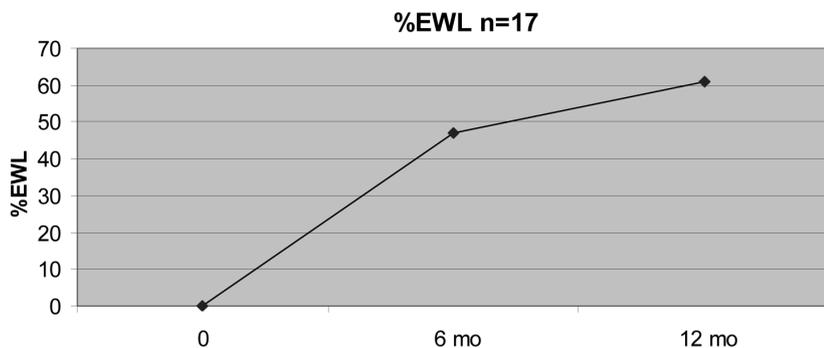
### Discussion

There has been a recent dramatic increase in the number of bariatric surgeries, and RYGBPs in particular, performed in Europe and Israel [1,6]. This increase can be attributed to many factors, but mostly to the drastically increasing prevalence of the disease of obesity and its growing public awareness [4]. Disappointment from the existent purely restrictive procedures, and the successful evolution of the procedure from open to laparoscopic technique were also important contributing factors. The gastric bypass procedure accounts for about 70% of all bariatric surgeries performed in the U.S. [4,5]. Long-term maintenance of weight loss after gastric bypass has been excellent. Pories et al. [7] reported a series with 58%, 55% and 49% loss of excess weight at 5, 10 and 14 years from surgery, respectively. More recently, Jones [8] reported a 62% loss of excess weight at 10 years.

The procedure has undergone several modifications to make it safer. These include not only the introduction of minimally invasive technologies but also improvements in patient preparation, anesthetic management and postoperative care. The mortality and morbidity rates reported in the literature are 0.5% and 10–15% respectively [9] and appear to be lower than in most elective major general surgery procedures. In order to put the surgical risk into proportion it is wise to compare the risks of surgery and lifelong possibility of impending hazards of obesity-related complications. It was proven unequivocally that morbid obesity shortens longevity. It is worth mentioning that a 20 year old white male with a BMI > 45 is estimated to have 13 years of life lost due to obesity, which actually represents a 22% reduction in the remaining years of life [10]. Obesity is undoubtedly one of the most common causes of diabetes [11] and, so far, bariatric surgery is one of the most efficient methods to control both. The statistically significant longevity prolongation in bariatric surgery patients as compared to conservatively treated morbidly obese matched subjects was recently demonstrated in the Swedish Obesity Subjects study [12].

We report here on our initial experience with laparoscopic Roux-en-Y gastric bypass for the treatment of morbid obesity. The leak and complication rates of 2% and 10% respectively in our series are well within the standards reported in the literature. The zero conversion rate to open procedure attests to the feasibility of the laparoscopic technique in an Israeli morbidly obese population.

There are several indexes in use for measuring the efficiency of surgery for weight loss. The excess body weight is the most important indi-



**Figure 1.** The curve of excess weight loss after surgery for the patients who completed 12 months follow-up

cator of operation success [13]. Our EBW loss at 1 year was 61%, which is comparable with results published by others [9]. There were two weight loss failures, as defined by weight loss less than 50% EBW loss after one year. These failures were seen in two super-obese males (BMI > 50), confirming the knowledge that super-obese persons might require more extensive procedures. The other marker of success is resolution of co-morbidities due to the morbid obesity. Preoperatively, 37 patients had co-morbidities [Table 2]. After the operation we noted a tremendous improvement or complete resolution of the co-morbidities related to obesity. Unfortunately, as of today, we have documented data on the resolution of hypertension and diabetes only.

Bariatric surgery has been of tremendous overall benefit to the patients but it is also a double-edged sword. The procedure is performed in deep abdominal cavities and requires exposure of the gastroesophageal junction. The liver is often steatotic and enlarged, limiting exposure. Massive abdominal adiposity also compromises exposure to the viscera. Despite these hazards, the operation requires proximal gastric staple division and the creation of two anastomoses. As with other complex procedures, it is strongly felt that these procedures have a long and steep learning curve of at least 100 cases per surgeon [14]. In surgery, the learning curve is defined as the number of cases necessary to acquire a familiarity with the operative technique, and the level of performance where the rate of complications and mortality reach the lowest possible number for a specific surgeon or institution [15]. Hence, it is highly advisable that a surgeon undertakes prolonged specialty training in the form of a structured fellowship. However, the learning curve applies not only to a surgeon but also to the hospital as a team. The volume should be sufficient to provide the necessary experience for all health care professionals involved.

Our data revealed an improvement in operating time and we are still climbing the learning curve for laparoscopic RYGB; the operating time was 188 and 153 minutes for the first and last 25 cases, respectively. Since our bariatric surgery program was reestablished in our institution (previous experience is with mostly restrictive procedures) in February 2006, the number of bariatric cases performed is rising and today stands at about 80 cases a year.

It is our opinion that a caseload of approximately seven major bariatric cases monthly was sufficient to provide the necessary experience for the entire team. We now have a multidisciplinary team that consists of surgeons, dietitians, psychology specialists, an anesthesiologist and a radiologist. The association between case volume and outcome has also been reported for bariatric surgery. Courcoulas et al. [16] analyzed the 3 year results of gastric bypass surgery in Pennsylvania from 1993 to 2000. They found that surgeons who performed fewer than 10 procedures

per year had a statistically significantly higher risk of adverse outcome (28% vs. 14%) and risk of death (5% vs. 0.3%) than higher-volume surgeons.

In conclusion, laparoscopic Roux-en-Y gastric bypass provides an excellent long-term solution for the morbidly obese and has an acceptable rate of complications. The learning curve is steep for this procedure, and surgeon and team training are essential for the overall success and low complication rate.

## References

1. Consensus Development Conference Panel. Gastrointestinal surgery for severe obesity: consensus development conference statement. *Ann Intern Med* 1991;115:956-61.
2. Keinan-Boker L, Noyman N, Chinich A, Green MS, Kaluski DN. Overweight and obesity prevalence in Israel: findings of the First National Health and Nutrition Survey (MABAT). *IMAJ* 2005;7:219-23.
3. Steinbrook R. Surgery for severe obesity. *N Engl J Med* 2004; 350:1075-9.
4. Santry HP, Gillen DL, Lauderdale DS. Trends in bariatric surgical procedures. *JAMA* 2005;294:1909-17.
5. Crookes PF. Surgical treatment of morbid obesity. *Annu Rev Med* 2006;57:243-64.
6. Suter M, Paroz A, Calmes JM, Giusti V. European experience with laparoscopic Roux-en-Y gastric bypass in 466 obese patients. *Br J Surg* 2006;93:726-32.
7. Pories WJ, Swanson MS, MacDonald KJ, et al. Who would have thought it? An operation proves to be the most effective therapy for adult-onset diabetes mellitus. *Ann Surg* 1995;222:339-52.
8. Jones KB Jr. Experience with the Roux-en-Y gastric bypass, and commentary on current trends. *Obes Surg* 2000;10:183-5.
9. Buchwald H, Avidor Y, Braunwald E, et al. Bariatric surgery: a systematic review and metaanalysis. *JAMA* 2004;292:1724-37.
10. Fontaine KR, Redden DT, Wang C, Westfall AO, Allison DB. Years of life lost due to obesity. *JAMA* 2003;289:187-93.
11. Raz I. Complex impact of obesity on type 2 diabetes. *IMAJ* 2005;7:402-3.
12. Sjöström L, Narbro K, Sjöström D, et al. Effects of bariatric surgery on mortality in Swedish obese subjects. *N Engl J Med* 2007;357:741-52.
13. Reinhold RB. Critical analysis of long-term weight loss following gastric bypass. *Surg Gynecol Obstet* 1982;155:385-94.
14. Schauer P, Ikramuddin S, Hamad G, et al. The learning curve for laparoscopic Roux-en-Y gastric bypass is 100 cases. *Surg Endosc* 2003;17:212-15.
15. Schauer P, Ikramuddin S, Hamad G, et al. Laparoscopic gastric bypass surgery: current technique. *J Laparosc Adv Surg Tech* 2003;13:229-39.
16. Courcoulas A, Schuchert M, Gatti G, et al. The relationship of surgeon and hospital volume to outcome after gastric bypass surgery. *Surgery* 2003;134:613-21.

**Correspondence:** Dr. A. Keidar, Dept. of Surgery, Hadassah-Hebrew University Medical Center (Ein Kerem Campus), P.O. Box 12000, Jerusalem 91120, Israel.

Phone: (972-2) 677-7384 (78800)

Fax: (972-2) 641-9923

email: andreik@hadassah.org.il

EBW = excess body weight