

Laparoscopic Gastric Bypass, Roux en-Y: Technique and Results in 75 Patients With 3–30 Months Follow-up

Alan C. Wittgrove*, MD, FACS; G. Wesley Clark, MD; Katherine R. Schubert, MPH

*Co-Medical Director of the Bariatric Surgery Program at Alvarado Hospital Medical Center, San Diego, CA, USA

Background: Laparoscopic Roux en-Y Gastric Bypass (RYGB) has been performed in 100 patients, in our series.

Methods: The results of surgery, including 3–30-months follow-up, are described with 100% follow-up, for the first 75 patients. Weight loss, operative morbidity and relief of co-morbidities have been thoroughly studied in a prospective fashion.

Results: Diabetes mellitus was normalized in 22 of 24 patients and gastroesophageal reflux was relieved in all patients. Length of stay, recovery time and cosmetic results are superior to the 'open' technique, and the operative times are competitive.

Conclusion: Laparoscopic RYGB deserves a place in the operative repertoire of bariatric surgeons.

Key words: Gastric bypass, laparoscopy, gastroesophageal reflux, diabetes mellitus, sleep apnea, morbid obesity.

Introduction

We previously described our technique for Laparoscopic Roux en-Y Gastric Bypass (LapRYGB),¹ and reported the early results in the first 27 cases, demonstrating very satisfactory early weight loss. We also developed a unified grading scale for co-morbidities, and described very gratifying improvement with LapRYGB.²

The authors have now performed over 100 Laparoscopic RYGB procedures, since October 1993. We report herein results of the first 75 procedures, with at least 3 months follow-up.

Material and Methods

All patients undergo a detailed review of their history, laboratory evaluation, and selected consultation as indicated. They participate in a multi-stage educational and information program to complete the process of informed consent. Patients are advised of the bariatric procedures available, and of the limited access options for their performance.

Each patient's co-morbidities are diagnosed and graded for severity. Indications for bariatric surgery are thus established, consistent with recognized criteria published by the Consensus Development Panel of the National Institutes of Health.³ Presently, we select patients for laparoscopic surgery based upon an expressed desire to undergo bariatric surgery by that method, and absence of any history of prior open upper abdominal surgery.

As our experience has increased, and our techniques have been refined, we no longer limit the LapRYGB procedure to patients in the lower range of body weight and BMI. We have successfully performed laparoscopic bypass in patients with body weights up to 168 kg (370 lb). We exclude super-obese patients, with body weight greater than 175 kg, primarily due to technical limitations associated with the length of endoscopic instruments.

Technique

We have made several alterations to the technique originally described, for performance of LapRYGB. The proximal gastric pouch continues to be

Correspondence to: Alan C. Wittgrove, MD, 6719 Alvarado Road, Suite 308, San Diego, CA 92120, USA. Tel: (619) 229-3940 or (800) 342-3944; fax: (619) 229-2951.

sized by inflation of a 15 cc balloon in the upper stomach. We now perform the lesser curvature dissection with a hook cautery, creating a tract toward the lesser peritoneal sac, through which the linear endoscopic stapler is inserted. We can, thereby, reduce the number of stapler applications to two, shape the proximal gastric pouch more reliably, and obtain a more uniform size, based upon the lesser curvature.

Endoscopy, for introduction of the 21-mm circular stapler anvil, can be performed immediately after gastric division, or just prior to gastroenterostomy. We use the Percutaneous Endoscopic Gastrostomy technique to introduce a pull-wire, drawing the stapler anvil down the esophagus into the gastric pouch. No esophageal injuries, or even abrasions, have been observed.

Enteroenterostomy is now performed immediately after division of the proximal jejunum, using two intraluminal applications of the 35-mm linear stapler, followed by a tangential application of the 60-mm stapler to close the remaining bowel wall defect. Performance of this procedure before gastroenterostomy improves exposure and access.

The proximal Roux limb is passed retrocolic and retrogastric, through the upper recess of the lower abdomen, at the base of the transverse mesocolon, and just cephalad to the ligament of Treitz. This provides a very short (3–4 cm) path to the proximal gastric pouch. We continue to use a pull-through technique, using a length of Penrose drain threaded through the tip of a Greenstein dissector, having had little success with more direct methods of passage. The Penrose drain is retrieved through the clear area of the lesser omentum, near the caudate lobe of the liver, and the small bowel limb is drawn into the upper abdominal space in relation to the proximal gastric pouch.

All patients undergo repeat endoscopy on completion of the gastroenterostomy, with the proximal small bowel crossclamped to prevent distal inflation. The gastro-enterostomy is observed (laparoscopically) for air leakage while the lumen is distended with air from the endoscope.

Results

Weight loss results with LapRYGB are comparable to those reported with open surgical technique.^{4,5} Weight lost exceeds 50% of excess weight body weight (EBW) within 6 months of surgery, and rises steadily to a mean of 95% EBW at 30 months

following surgery. Table 1 shows average per cent of EBW lost at various increments postoperatively as well as the ranges for each period. The follow-up rate for the series is 100%, with terms ranging from 3 to 30 months post-operatively. Figure 1 displays percentages of EBW lost, over the term of the study.

Overall occurrence of co-morbidities was reduced from 298 pre-operatively, to 12 post-operatively. Post-operative co-morbidities tended to be reduced in severity. Symptoms of gastroesophageal reflux disease were completely eliminated in 100% of patients afflicted pre-operatively. Clinical parameters of diabetes mellitus were eliminated in 92%, and reduced in the remaining patients. Sleep apnea was clinically resolved in 100% of afflicted patients. Of 18 hypertensive patients, 94% experienced clinical remission, while one remained mildly hypertensive, on medications. Comparison of pre-operative and post-operative co-morbidities is shown in Table 2.

Table 1. Excess weight loss with laparoscopic gastric bypass

Follow-up	n	Mean (%)	Range (%)
3 Months	75	45	14–81
6 Months	62	62	33–100
9 Months	48	77	45–107
12 Months	39	81	50–111
18 Months	23	85	60–107
24 Months	9	91	60–113
30 Months	4	95	69–106

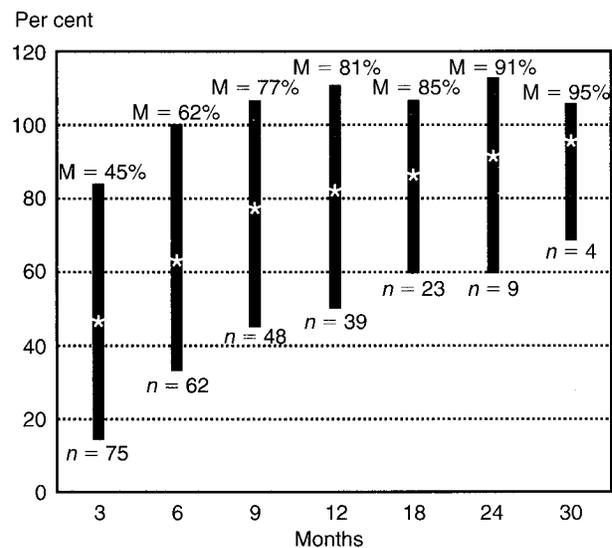


Figure 1. Excess weight loss with laparoscopic gastric bypass.

Table 2. Co-morbidity comparison in laparoscopic gastric bypass

Condition	Pre-operative	Post-operative
Gastroesophageal reflux disease	53	0
Hypercholesterolemia	38	5 (Mild)
Hypertriglyceridemia	26	0
Diabetes	24	2
Glucose intolerance	4	0
Stress urinary incontinence	44	2 (Mild)
Arthritic symptoms of weight-bearing joints	63	2
Sleep apnea	28	0
Hypertension	18	1 (Mild)
Total	298	12

n = 75 patients.

Although previously reported, complications from the first 27 patients are included in this report, for completeness. Wound infections tend to be minor, and typically affect only one of the several trochar sites. Respiratory problems were minor and transient, even in this high-risk patient group. Hemorrhage (two cases) tended to occur intraluminally, did not require transfusion, and was primarily related to technical factors of stapler function. Pyelonephritis occurred in a patient with known stone disease, who had a history of multiple prior similar infections.

In the first third of the series (33 patients), gastroenterostomy leakage occurred in three cases. One was repaired laparoscopically and caused

minimal prolongation of hospital stay. One required open repair and resulted in a major complication with total parenteral nutrition and prolonged hospital stay. The third instance was controlled by the intra-operatively placed drain, and did not require another operation. No leaks occurred in the middle third of the series, and the single leak in the last 33 patients was small, contained and required no further operation. This patient was discharged at 2 days with a normal upper gastrointestinal series. He was back to work in 3 days, but experienced some fever 1 week post-operatively, when a repeat study demonstrated a small contained leak. He was managed with oral antibiotics, prolongation of liquid diet, and observation.

Types and incidence of post-operative complications are shown in Table 3, for our first 99 patients – the entire series of operated patients. Table 4 shows incidence of post-operative complications in relation to position in the series, as an indicator of the effect of experience.

Hospital length of stay averaged 2.8 days, and 2.5 days when two outliers were excluded. Length of stay is shown in Table 5. The two outlying patients suffered major complications. One patient

Table 4. Complication frequency with laparoscopic gastric bypass

Patients	Frequency
1–33	11
34–66	5
67–99	3

Table 3. Complications with laparoscopic gastric bypass by frequency and type

Condition	Patients		
	1–33	34–66	67–99
Wound	1	1	1
Infections	Minor	Major intra-peritoneal	Minor
Leak	3	0	1 Contained
Transient respiratory	2	1	1
Stenosis	2	0	0
Small bowel obstruction	1	0	0
Hernia	0	0	0
Other	1 Viral	1 Pyelonephritis	0
	1 Cholecystectomy	2 Bleeding	

Table 5. Length of stay with laparoscopic gastric bypass

Hospital Days	Frequency
2	54
3	13
4	2
5	1
6	2
9	1
34	1
75	1

Average = 2.8 days; average without outliers = 2.5 days; 34-day patient was a leak; 75-day patient no leak; first day septic with pan-resistant enterococcus.

had an early leak from the gastroenterostomy which required re-operation within 36 h. Despite the early re-operation, she had prolonged, controlled fistula drainage and required intravenous nutrition. The second patient had no leakage but a large intra-peritoneal hematoma became infected with Vancomycin-resistant Enterococcus. This patient became septic on the evening of the day of surgery, and required multiple open operations to drain abscesses. She was treated with experimental antibiotics, high dose conventional antibiotics, total parenteral nutrition, and heroic intensive medical care. She is recovering at this time.

Patients affected with diabetes, and its severity, are demonstrated in Table 6. Post-operative status for these patients is shown in Table 7. Only two of 24 diabetics had elevated glycosylated hemoglobin (Hgb-A1C) levels after the operation. One male, who required oral medication pre-operatively,

Table 6. Diabetics having laparoscopic gastric bypass

Pre-operative	Frequency
Insulin	1
Oral medications	7
New diagnosis	16
Glucose intolerance	4

n = 24 of 75 patients. Seventeen patients had elevated pre-operative Hgb A1C levels.

Table 7. Diabetes mellitus II and laparoscopic gastric bypass

	Pre-operative	Post-operative
Medication	8	0
Elevated Hgb A1C	17	2
		Improved

n = 24 of 75 patients. Other than the patients with high Hgb A1C, all have normal fasting and 2-h post-prandial blood glucose.

showed marked improvement by 3 months post-operatively in HgbA1C values, while taking no medication. The second patient was a known diabetic for 8 years, and was poorly controlled on insulin and oral agents pre-operatively. Post-operatively, her Hgb A1C remains mildly elevated, while she uses no medications.

Operative times have markedly decreased, as experience has developed, and techniques have been standardized and refined. Table 8 summarizes the operative times as experience has increased.

Discussion

A basic tenet of limited access surgery states that the operative procedure should not be compromised or degraded, to enable its performance laparoscopically. We have performed Roux en-Y Gastric Bypass as our predominant bariatric procedure, and we accomplish the laparoscopic approach using identical anatomy and pouch sizes, varying only the instruments and technique to permit limited access.

The laparoscopic technique is daunting, and far more demanding of the surgeon's patience and tenacity; yet it is within the reach of any advanced laparoscopic surgeon. As the operative maneuvers and methods are learned and systematized, operating times approach those of the open operation (approximately 90–120 min) in uncomplicated procedures. The authors no longer assist each other on every case, but rather have trained another physician, very experienced in assisting on bariatric operations, in the skills of assisting on the LapRYGB.

The present results demonstrate that weight loss and reversal of co-morbidities with the LapRYGB are comparable to those achieved with open technique. When employed in the context of a comprehensive bariatric surgery program, stressing long-term follow-up and maintenance of a healthy

Table 8. Operating-room times with laparoscopic gastric bypass

Cases	Average (min)
First 9	343
Second 9	210
Last 12	159 (including 3 cholecystectomies)

n = 75 patients. We are now doing the operation in 2–2.5 h and have trained other first assistants.

lifestyle, we expect persistence of successful weight management in most patients. We believe that laparoscopic bariatric surgery should only be performed in this context.

Morbidity has been comparable to the open operation, as well. We have experienced no peri-operative mortality. Lesser complications, as well as two major complications – with prolonged hospitalization – have demonstrated that the gastroenterostomy remains the high risk anastomosis, deserving of careful evaluation. We now re-examine the anastomosis by endoscopy and insufflation, at the end of each operation. The change in complication frequency noted in Table 4 is attributable to experience and refinement of technique. We have not altered the suite of staplers used to perform the procedure, and continue to use stapling devices from Ethicon Endo-Surgery, as originally reported.

Hemorrhage from the staple-lines, both intra-peritoneal and intraluminal, has been experienced on multiple occasions. Care and patience are required to obtain meticulous hemostatic control. As described, infection of a hemoperitoneum led to a near-lethal infection in one patient. She apparently had pre-operative colonization within her bowel lumen.

Hospital stays are shorter, and return to full activity levels and to full employment are more rapid, following laparoscopic surgery. In particular, patients with physically demanding occupations are often able to return to full employment several weeks earlier. Incisional hernia has not been observed in our series, despite careful follow-up.

Cosmetic results have previously been demonstrated,² and are very gratifying to our patients, and to us. The short transverse incisions tend to heal with minimal scarring, and the length of the scars actually diminishes with reduction of the abdominal girth. Patients exhibit a new-found pride and excitement in their bodies.

Reversal and resolution of co-morbidities has been striking. We have shown profound relief of hypertension, sleep apnea, and gastroesophageal reflux in a very high proportion of afflicted patients. Asthma, stress incontinence, and degenerative musculoskeletal processes are also markedly improved. The response of type II diabetes has been impressive and exciting, and corroborates previously reported information.^{6,7} The complica-

tions of diabetes have been shown to be reduced by tight control of glucose levels.^{8,9} The dramatic normalization of clinical parameters of glucose tolerance promises essentially normal physiology and an expectation of freedom from progressive complications for these patients. No other therapy for diabetes can equal these results.

Laparoscopic gastric bypass is a technically feasible procedure, which can be accomplished with acceptable morbidity, reasonable operating times, and excellent clinical results. It deserves a place in the operative repertoire of modern bariatric surgeons.

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(Received 7 August 1996; accepted 25 September 1996)