JSLS

Alternative Operative Techniques in Laparoscopic Roux-en-Y Gastric Bypass for Morbid Obesity

Frank J. Borao, MD, Terisa A. Thomas, MD, Felicien M. Steichen, MD

ABSTRACT

The only effective treatment for patients with morbid obesity is surgery. Laparoscopic bariatric surgery has become quite popular in attempts to decrease the morbidity associated with laparotomy. In this article, we describe the technical details of laparoscopic Roux-en-Y gastric bypass with three different techniques for creating the 15-cc gastric pouch. These techniques avoid upper endoscopy for the transoral introduction of the 21-mm circular stapler anvil down to the gastric pouch.

Key Words: Gastric bypass, Morbid obesity, Obesity surgery, Laparoscopic gastric bypass.

INTRODUCTION

Obesity has become a growing problem in the United States and Europe. At present, surgical therapy represents the only treatment for the morbidly obese.[1] In the past, morbid obesity was defined as being more than 100 pounds above the ideal body weight (IBW) using the height/weight tables from the Metropolitan Life Insurance Company.[2] Currently, body mass index (BMI), which is the patient's weight in kilograms divided by the patient's height in meters squared, is used to determine the degree of obesity. Patients can be classified according to their BMI into the following categories: morbid obesity (BMI 40-49 kg/m^2), super obesity (BMI 50-59 kg/m^2), and super/super obese (BMI > 60 kg/m^2).[3]

Over the last few years, the laparoscopic approach to the surgical treatment of morbid obesity has been developed and increasingly accepted. The most frequently performed laparoscopic operations are the Roux-en-Y gastric bypass (LRYGB) and the vertical banded gastroplasty.[4-6] Laparoscopic adjustable gastric banding is also being performed abroad and is currently under Food and Drug Administration (FDA) trial in various designated centers in the United States.[7-9]

The first description of a laparoscopic Roux-en-Y gastric bypass was by Wittgrove et al[4] in a preliminary report of five patients in 1994 followed by a 3 to 30 month follow-up of 75 patients in 1996.[10] This technique was later modified by Schauer et al[11] and recently by several other authors.[12,13] The creation of the Roux-en-Y gastro-jejunal anastomosis initially required esophagogastroscopic guidance for introduction of the 21-mm circular stapler anvil into the gastric pouch.[4,10] A technique for introducing the anvil into the stomach through a gastrotomy, therefore avoiding the esophagus as a conduit for anvil placement, was first described in an animal model by Frantzides et al in 1995.[14] De la Torre and Scott,[12] in 1999, described a series of 49 patients that underwent a totally intraabdominal approach for anvil placement into the gastric pouch. Their technique requires a 2-cm gastrotomy for intragastric placement of the anvil using a cholangiogram catheter, prior to division of the stomach. A retro-colic anterior gastric pouch-jejunostomy is constructed to complete the procedure. Teixeira et al[13]

Department of Surgery, Institute for Minimally Invasive Surgery, White Plains, New York, USA (all authors).

Address reprint request to: Frank J. Borao, MD, 1131 Broad Street, Shrewsbury, NJ 07702, USA. Telephone: (732) 389-1331, Fax (732) 542-8587, E-mail: laparoscopic@netscape.net

Table 1.
Indications for Laparoscopic Roux-en-Y Gastric Bypass.

- Patients whose BMI exceeds 40.
- Patients with BMIs between 35 to 40 with high-risk comorbid conditions, such as life-threatening cardiopulmonary problems (ie, Pickwickian syndrome, severe sleep apnea, and obesity-related cardiomyopathy) or severe diabetes mellitus.
- Children and adolescents are not recommended for surgery because of insufficient studies.

Table 2.
Special Preparations.

- Adequate support staff for all aspects of perioperative assessment and management, preferably at a bariatric center.
- Preoperative psychological testing.
- Hospital facilities with patient support groups, psychological support, medical specialty (ie, cardiology and pulmonary) availability, dietary and nutritional counseling.

recently described a different technique performed on 18 consecutive patients in which the anvil is placed into the gastric pouch after it has been separated from the stomach through a transperitoneal approach. Although we have used this method on over 40 patients without any anastomotic leak or operative mortality, we propose three alternative methods for gastric pouch anvil placement in an attempt to possibly expedite and simplify this challenging step of the operation. All three techniques require a gastrotomy for placement of the 21-mm circular stapler anvil into the gastric pouch possible, prior to division of the stomach. **Table 1** summarizes the patient requirements for Roux-en-Y gastric bypass surgery.

Surgical Risks and Benefits

The immediate operative mortality rate for Roux-en-Y gastric bypass is relatively low. Early postoperative morbidity, ie, wound infections, dehiscence, marginal ulcers, deep venous thrombosis, pulmonary embolism, anastomotic leaks, and stomal stenosis may be as high as 10% or more. The risk for development of an internal hernia with closed loop obstruction and bowel strangulation is also increased. Long-term micronutrient deficiencies, especially iron, folate, and vitamin B12 are common and must be treated accordingly. Vitamin D and calcium absorption may also be affected. Dumping syndrome occurs in the majority of patients, and it is actually a desired side effect because it prevents these patients from continuing to eat sweets.

Many patients report improvement in mood and psychosocial function after surgery. Weight reduction also improves several comorbid conditions, such as diabetes mellitus, hypertension, pulmonary problems, and serum lipid abnormalities.[1]

Table 2 describes the special preparations necessary for optimal surgical outcomes.

OPERATIVE TECHNIQUE

The patient is placed in the supine position with the surgeon on the patient's right side. Lower extremity pneumatic compression devices are used for deep venous thrombosis prophylaxis. A pneumoperitoneum is established using a Veress needle placed in the left upper quadrant, midclavicular line. A total of five ports are used: two 12-mm, two 5-mm and one 15-mm port **(Figure 1)**. The left lobe of the liver is retracted via the right lateral port, and the patient is placed in a steep reverse Trendelenburg position. A baker tube is inserted, and the balloon is inflated with 15 cc of air and pulled

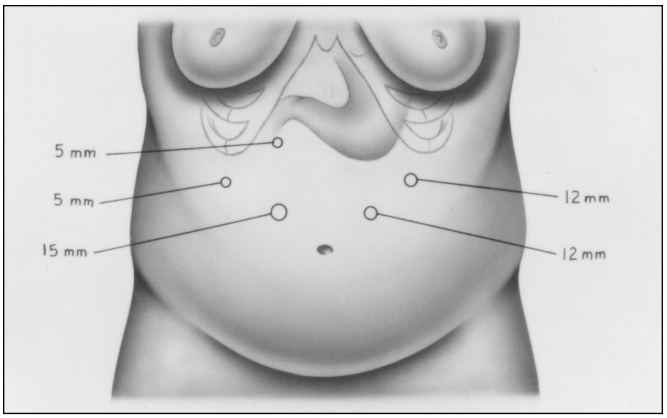

Figure 1. Position the patient in the supine position with the surgeon standing on the patient's right side. A total of 5 ports: One 5-mm port in the right flank at the mid-axillary line for retraction of the left lateral lobe of the liver. Two operative ports (5-mm and 15-mm) right midclavicular and one left 12-mm port located in the left flank at the midaxillary line for the assistant. The camera (45-degree scope) is placed through a 12-mm left paramedian port above the level of the umbilicus.

back against the gastroesophageal junction to estimate the size of the gastric pouch. The boundary line between the pouch and the remaining stomach is lightly "tattooed" onto the serosa of the anterior gastric wall with the electro-cautery. The balloon is then deflated and the tube removed.

Method 1

A naso-gastric tube is inserted transorally and advanced until it is visualized in the body of the stomach. Using the harmonic scalpel, an anterior transverse gastrotomy measuring 2.5 cm in length is made over the naso-gastric tube. The tip of the tube is grasped with an EndoGrasp device via the 15-mm port site and pulled outside the abdominal cavity. The head of a 21-mm circular stapler anvil is secured to the tip of the naso-gastric tube with a 2-0 Prolene suture **(Figure 2, top left)**. A 6-inch Prolene suture with a swaged-on needle on the other end is then tied through the hole in the tip of the anvil. The naso-gastric tube is pulled back by the anesthesiologist introducing the anvil through the dilated 15-mm port site into the peritoneal cavity and into the lumen of the stomach through the gastrotomy **(Figure 2, bottom right)**. The anvil is slowly advanced into the esophagus by pulling back on the naso-gastric tube. The tip of the driver holding the needle at the end of the redundant suture, trailing through the gastrotomy, is then advanced to the position where the tip of the anvil should ultimately pass

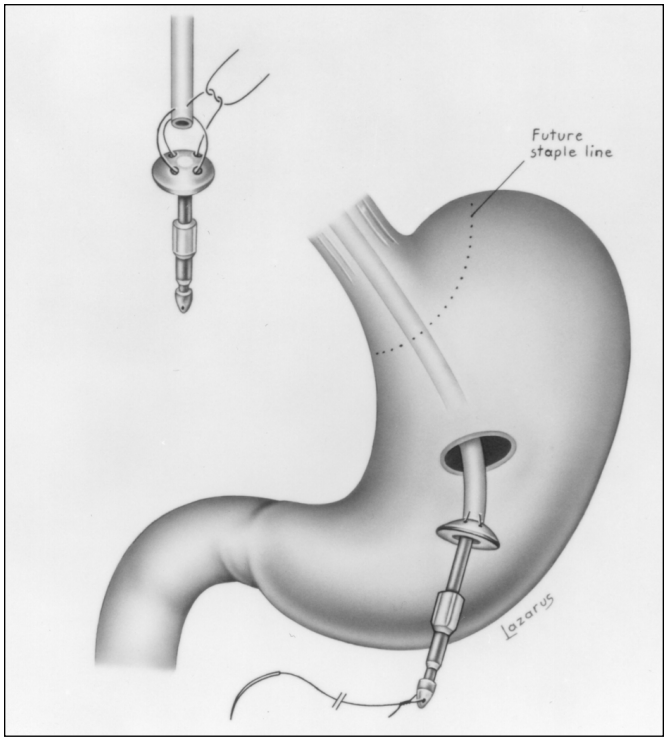

Figure 2. (top left) The head of the 21-mm circular stapler anvil is secured to the tip of the nasogastric tube with a 2-0 Prolene suture. This is performed outside the abdominal cavity after the naso-gastric tube has been pulled through the gastrotomy site and brought out through the 15-mm port site. **(bottom right)** The anvil is introduced into the stomach through the gastrotomy by having the anesthesiologist pull back on the naso-gastric tube. Note the needle site is closed with a linear stapler. The 15-cc pouch is created by stapling below the shaft of the anvil.

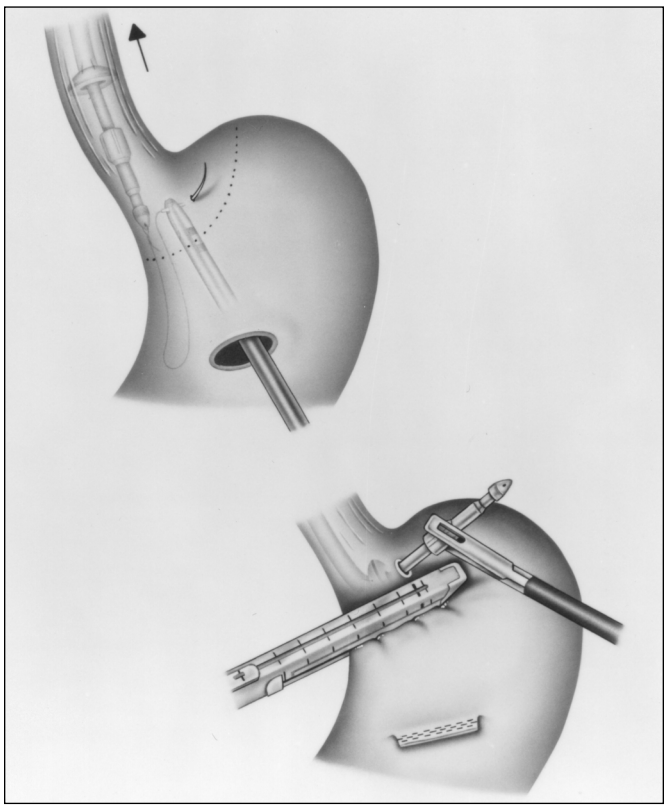

Figure 3. (top left) The anvil is positioned within the esophagus by pulling back on the nasogastric tube. The needle is positioned on a needle holder and inserted through the gastrotomy site and then advanced through the anterior gastric wall at the desired location. Electro-cautery is applied to the gastric serosa adjacent to the needle. The needle is then completely passed through the stomach wall allowing the anvil shaft to follow. **(bottom right)** The gastrotomy site is closed with a linear stapler. The 15-cc pouch is created by stapling below the shaft of the anvil.

through the anterior gastric wall. The needle is passed at the chosen spot through the anterior gastric wall and held in position **(Figure 3, top left)**. Electro-cautery is applied directly to the anterior gastric wall adjacent to the needle to widen the space that will allow passage of the shaft of the anvil. A gentle pull on the Prolene suture draws the anvil shaft through this opening. The gastrotomy is closed with the Endo-GIA II 45-4.8 linear stapler (USSC). A 15-cc pouch is created by stapling below the shaft of the anvil, along the previously established serosal tattoo in the gastric cardia, starting at the lesser curvature approximately 1 cm below the gastroesophageal junction **(Figure 3, bottom right)**.

The patient is now returned to the supine position, and the ligament of Treitz is identified after retracting the greater omentum and transverse colon upwards. The jejunum is divided 35 cm from the ligament of Treitz using the Endo-GIA stapler with a 3.5-mm cartridge. Two applications of the vascular Endo-GIA are used to transect the mesentery. Prior to dividing the mesentery with the linear stapler locked in place, visualization of pulsations on both sides of the potential staple line should be confirmed. If pulsations are not seen, the stapler should be repositioned to avoid compromise of the viability of the two jejunal stumps. A Penrose drain is sutured to the distal transected jejunal limb. The Roux-limb is measured to be 100 to 150 cm in length depending on the patient's body mass index. A stapled side-to-side jejuno-jejunostomy is created using an Endo-GIA 60-2.5-mm stapler, and the remaining enterotomy is closed with an Endo-GIA 60-3.5-mm stapler. A 3.5-mm stapler may also be used initially instead of the 2.5-mm stapler. Once the remaining enterotomy is stapled closed, visualization within the lumen is no longer possible and formation of a hematoma could occur. The mesentery is closed with a few simple interrupted Vicryl sutures.

A window is then created in the transverse mesocolon just lateral to the ligament of Treitz using the harmonic scalpel. The Penrose drain attached to the distal jejunal limb is passed through the retro-colic tunnel with a reticulating grasper behind the distal gastric stump. The Penrose drain is then removed, along with the transverse staple line that closes the jejunal limb, to allow passage of the 21-mm circular stapler from the left lateral port site. The port site must be serially dilated to allow the circular stapler, housed within a protective plastic drape, to easily enter the peritoneal cavity. The stapler is carefully inserted into the open jejunal lumen and advanced

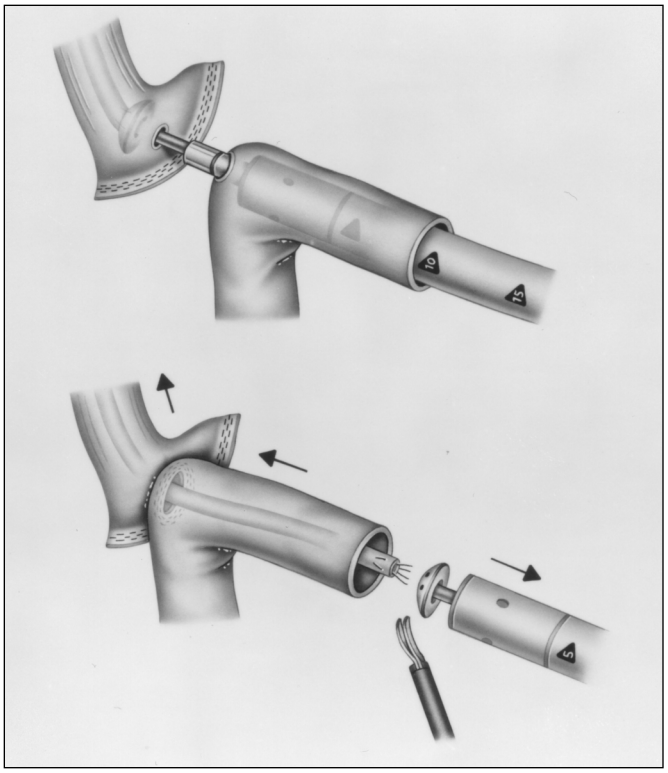

Figure 4. (top) The 21-mm circular stapler is carefully inserted into the end of the open jejunal lumen and advanced 8 to 10 cm. The cartridge spike is deployed through the anti-mesenteric wall and connected to the anvil shaft. An end-to-side gastro-jejunal anastomosis is created. **(bottom)** The circular stapler is withdrawn, and the suture securing the head of the anvil to the naso-gastric tube is cut with the Endoshears. The naso-gastric tube is removed by the anesthesiologist, and the stapler is removed within the protective plastic covering.

approximately 8 to 10 cm. The cartridge spike is deployed through the antimesenteric wall, then removed, and the hollow central portion of the cartridge is connected to the shaft of the anvil in the gastric pouch **(Figure 4, top)**. The end-to-side gastro-jejunal anastomosis is created, and on withdrawal of the circular stapler, the suture securing the head of the anvil to the tip of the naso-gastric tube is cut with the Endoshears **(Figure 4, bottom)**. The naso-gastric tube is removed by the anesthesiologist, and the stapler is removed within the protective plastic covering. The open end of the Roux-limb is closed with the Endo-GIA very close to the circular gastro-enterostomy, and the excess jejunal end is removed **(Figure 5)**. The gastro-jejunal anastomosis is

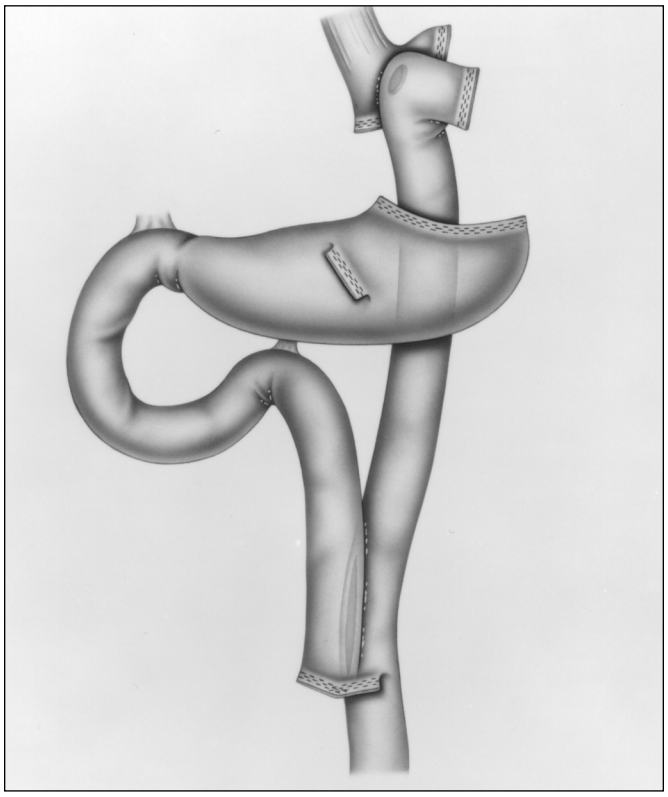

Figure 5. Roux-en-Y gastric bypass after the open end of the Roux-limb is closed with a linear stapler.

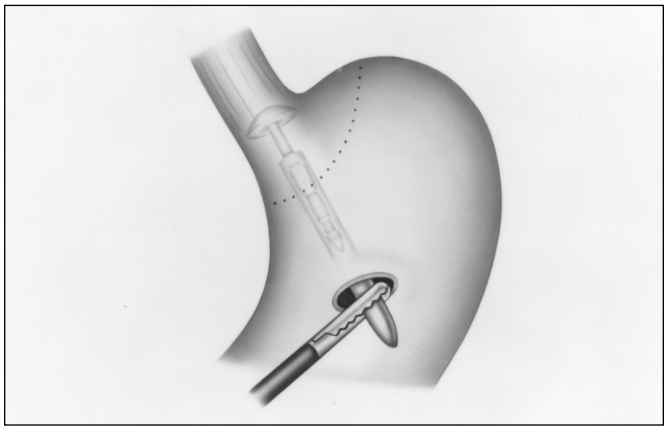

Figure 6. Introduction of the 21-mm circular stapler anvil into the stomach through a gastrotomy using a red rubber catheter cut 10-cm proximal from the tip.

reinforced with a running suture of 3-0 Vicryl circumferentially and then checked for leaks. The mesenteric defect in the transverse mesocolon is closed with a few simple interrupted sutures to prevent herniation and obstruction of the bowel.[15] A Jackson Pratt drain is placed in the area of the gastro-jejunostomy and brought out through the right subcostal 5-mm port site. All fascial port sites greater than 5 mm are closed with the Endoclose suture carrier (USSC).[3]

Method 2

The patient is positioned, and all ports are placed as previously described. An anterior transverse gastrotomy, 2.5 cm in length, is created using the harmonic scalpel. After measuring and marking the future gastric pouch, the tube with balloon is now removed by the anesthesiologist. A red rubber catheter of appropriate diameter, cut 10 cm proximal to the tip, is placed over the shaft of the 21-mm anvil outside of the peritoneal cavity. The anvil/catheter complex is introduced into the peritoneal cavity through the dilated 15-mm port site. The head of the anvil is advanced through the previously created gastrotomy into the esophagus using a grasper to maneuver the tip of the catheter **(Figure 6)**. The tip of the rubber catheter is positioned in the area where the anvil shaft should ultimately pass through the anterior gastric wall. Using a Maryland dissector, through the left lateral port, electro-cautery is applied directly to the gastric wall overlying the catheter tip to make a small opening **(Figure 7, top)**. The catheter tip is then advanced through the opening and pulled from the other end with a grasper, facilitating the passage of the anvil shaft through the anterior gastric wall **(Figure 7, bottom)**. The gastrotomy is closed with a linear stapler, and the 15-cc pouch is created by stapling below the shaft of the anvil and along the "tattooed" boundary line. The rubber catheter is removed from the anvil shaft and the gastro-jejunostomy is constructed as previously described in method 1.

Method 3

This technique involves an anterior gastrotomy, after "tattooing" the gastric pouch boundary, as previously described. The end of a long silk suture, secured to the tip of the 21-mm anvil shaft, is carried through the gastrotomy to the future site of the gastro-jejunal anastomosis with a right angle dissector. The anterior gastric wall is incised over the tip of the right angle clamp using the

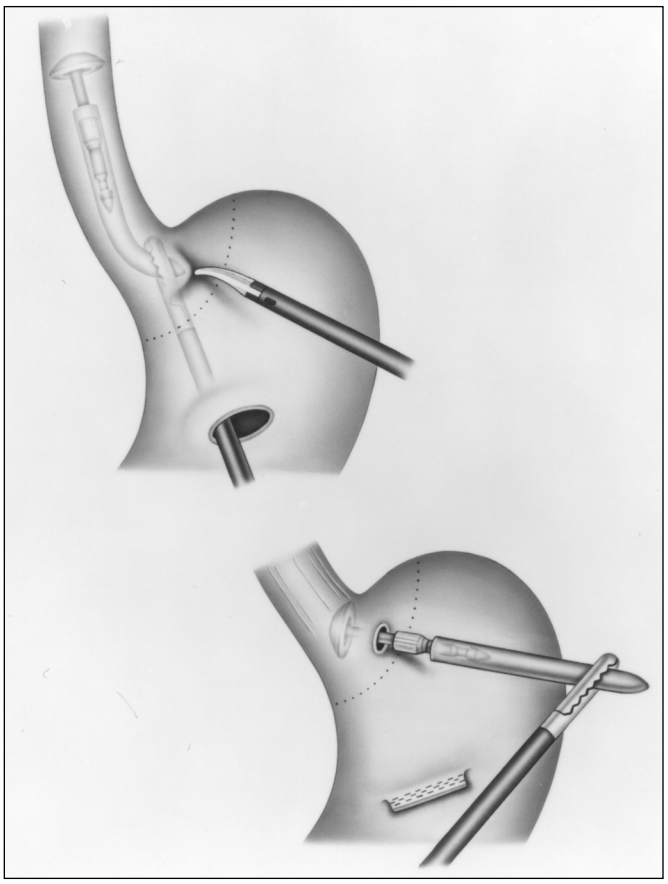

Figure 7. (top) The tip of the red rubber catheter is positioned in the area where the anvil shaft will ultimately pass through the anterior gastric wall. Electro-cautery is applied directly to the gastric wall overlying the tip of the catheter. **(bottom)** The tip of the rubber catheter is passed through the anterior gastric wall along with the anvil shaft.

harmonic scalpel. The suture is then grasped and pulled, with a dissector from the left lateral port site, allowing proper placement of the anvil shaft through the gastric wall **(Figure 8)**. The gastrotomy is closed, and the remainder of the procedure is as described in method 1.

DISCUSSION

Laparoscopic Roux-en-Y gastric bypass is a technically demanding and challenging operation requiring appropriate laparoscopic skills. Established complications related to RYGB include pulmonary embolism, deep venous thrombosis, hernia formation, respiratory compromise,

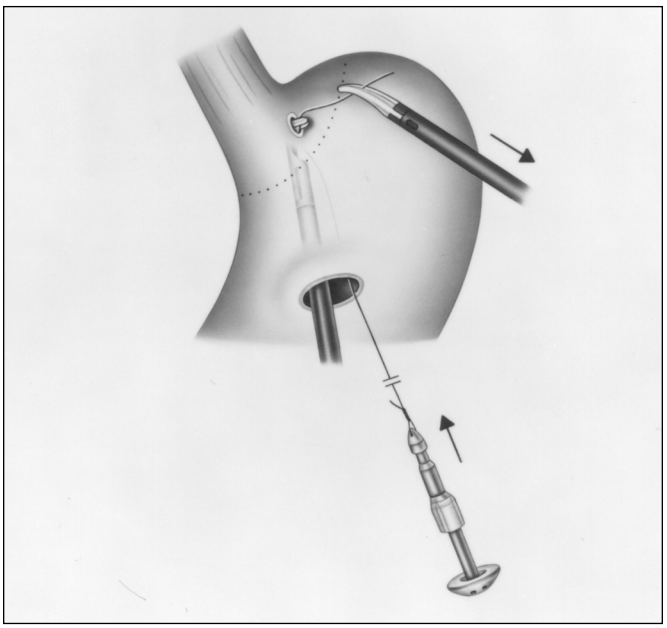

Figure 8. Introduction of the anvil into the stomach and through the anterior gastric wall using a right angle dissector and a long silk suture.

anastomotic leaks, intraoperative splenic injury, and wound infections.[16,17] The benefits of the laparoscopic approach include shorter hospital stay and quicker recovery time.[4,10] Other benefits include gratifying cosmetic results and reduced incisional hernia rates and wound complications.

To provide safe and appropriate care, the laparoscopic procedure should be identical to the open procedure except in the approach. The surgeon should not alter the procedure because a particular step may be technically difficult or time-consuming. For example, Lonroth et al[18] reported performing laparoscopic antecolic loop gastric bypass although that operation is no longer an accepted open procedure. In the late 1960s Manson[19] performed loop gastric bypass, but this was modified to a Roux-en-Y gastro-jejunostomy because of the high incidence of postoperative esophagitis and bile gastritis.[20] It is imperative that we do not compromise a patient's health by performing an operation that is laparoscopically easier to perform but not accepted worldwide in the open approach. We realize that the skill and learning curve required to perform a laparoscopic Roux-en-Y gastric bypass are extensive. The creation of a small (15 cc) gas-

tric pouch with anvil placement is the most challenging portion of the operation and potentially the limiting factor. Emphasis must be placed on how crucial a small gastric pouch is in determining a good future outcome.

CONCLUSIONS

We describe here three alternative techniques for introduction of the 21-mm circular stapler anvil and creation of the 15-cc gastric pouch. These techniques use a gastrotomy prior to division of the stomach and avoid upper endoluminal endoscopy for anvil placement. The risk of injuring the esophagus or pharynx with manipulation of the anvil is totally avoided. Although laparoscopic Roux-en-Y gastric bypass surgery is technically demanding and requires advanced laparoscopic skills, it can be performed safely and with good results.

References:

1. Gastrointestional Surgery for Severe Obesity. NIH Consensus Statement. 1991 March 25-27;9(1):1-20.

2. Metropolitan Life Insurance Company. New weight standards for men and women. *Stat Bull Metrop Ins Co*. 1959:40:1.

3. Committee on standards for reporting results. American Society for Bariatric Surgery guidelines for reporting results in bariatric surgery. *Obes Surg*. 1997;7:521-522.

4. Wittgrove AC, Clark WG, Schubert KR. Laparoscopic gastric bypass, Roux en-Y: technique and results in 75 patients with a 3-30 months follow up. *Obes Surg*. 1996;6:500-504.

5. Nguyen NT, Ho HS, Mayer KL, Palmer L, Wolfe BM. Laparoscopic Roux-en-Y Gastric Bypass for Morbid Obesity. *JSLS*. 1999;3:193-196.

6. Lonroth H, Dalenback J, Haglind E, et al. Vertical banded gastroplasty by laparoscopic technique in the treatment of morbid obesity. *Surg Laparosc Endosc*. 1996;6:102-107.

7. Belachew M, Legrand M, Vincent V, Lismonde M, LeDocte N, Deschamps V. Laparoscopic adjustable gastric banding. *World J Surg*. 1998;22:955-963.

8. Holeczy P, Payer J Jr, Kralova A. Laparoscopic adjustable gastric banding: first experience in Slovakia. *Obes Surg*. 1999;9:198-201.

9. Dargent J. Laparoscopic adjustable gastric banding: lessons in the first 500 patients in a single institution. *Obes Surg*. 1999;9:446-452.

10. Wittgrove AC, Clark WG, Tremblay LJ. Laparoscopic gastric bypass, Roux en-Y: preliminary report of five cases. *Obes Surg*. 1994;4:353-357.

11. Schauer PR, Ikramuddin S, Gourash WF. Laparoscopic Roux-en-Y gastric bypass: a case report at one-year follow-up. *J Laparoendosc Adv Surg Tech A*. 1999;9:101-106.

12. De la Torre RA, Scott JS. Laparoscopic Roux-en-Y gastric bypass: a totally intra-abdominal approach-technique and preliminary report. *Obes Surg*. 1999;9:492-498.

13. Teixeira J, Borao FJ, Thomas TA. An alternative technique in laparoscopic Roux-en-Y gastric bypass for morbid obesity: experience with twenty-eight consecutive patients. *Obes Surg*. 2000;10:240-244.

14. Frantzides CT, Carlson MA, Schulte WJ. Laparoscopic gastric bypass in a porcine model. *J Laparoendosc Surg*. 1995;5:97-100.

15. Serra C, Baltaser A, Bou R, Miro J, Cipagauta LA. Internal hernias and gastric perforation after a laparoscopic gastric bypass. *Obes Surg*. 1999;9:546-549.

16. Yale CE. Gastric surgery for morbid obesity. Complications and long-term weight control. *Arch Surg*. 1989;124:941-946.

17. Manson EE, Renquist KE, Jiang D. Perioperative risks and safety of surgery for severe obesity. *Am J Clin Nutr*. 1992;55:573S-6S.

18. Lonroth H, Dalenback J, Haglind E, Lundell L. Laparoscopic gastric bypass. Another option in bariatric surgery. *Surg Endosc*. 1996;10:636-638.

19. Manson EE, Ito C. Gastric Bypass. *Ann Surg*. 1969;170:329-339.

20. McCarthy HB, Rucker RD, Chan EK, et al. Gastritis after gastric bypass surgery. *Surgery*. 1985;98:68-71.

Acknowledgments: The authors would like to thank Robin Lazarus for the medical illustrations.

Disclosure: None of the authors has a financial interest in any commercial device, equipment, or instrument discussed in this article.