Laparoscopic Gastroplasty (Adjustable Silicone Gastric Banding)

Guy-Bernard Cadière, Jacques Himpens, Marc Vertruyen, Olivier Germay, Franco Favretti, and Giani Segato

Until now, for treatment of morbid obesity in the long term, surgery remained as the final option. For 40 years, surgeons looked at the best procedure. Among the restrictive procedures (gastroplasty), the laparoscopic adjustable silicone banding is the least invasive surgical treatment of morbid obesity. Between October 1992 and January 1998, we performed this procedure on 652 patients. Median body mass index was 45 (range, 35-65). Median hospital stay was 3 days (range, 2-10 days). The mean operative time was 80 minutes (range, 40-240 minutes). Four patients (0.6%) presented early complications: bleeding (1 patient), gastric perforation (2 patients), and pneumonia (1 patient). Forty-seven (7.2%) patients presented late complications and needed to be reoperated. There is one case of mortality. Loss of mass body weight was 62% in 2 years. According to these results, laparoscopic adjustable silicone gastric banding seems to be a safe and efficient technique.

Key words: Gastroplasty, obesity surgery, gastric banding, laparoscopic adjustable silicone gastric banding.

In obesity, when all other treatments have failed,[1,2] surgery remains as the final option. Obesity surgery is high risk and technically demanding. The mere placement of the patient, the anesthesia, and the approach to the operative site are all technically difficult. The operative risk lies in the high incidence of deep venous thrombosis and pulmonary embolism in the perioperative period. In this field, however, perioperative mortality is hardly justifiable.

The ideal procedure should meet several criteria:

1. It should be highly efficient, ie, 50% of the excess weight should be eliminated within 5 years. This weight loss is associated with cure of most of the obesity-induced morbidities.
2. It should be as little invasive as possible and carry a small morbidity percentage.
3. It should carry few long-term complications.
4. The operative risk should be lower than the risk of the natural evolution of the disease.

The indications have been specified by the Metropolitan life insurance company.[3,4] They are: (1) a body mass index (weight in kilogram divided by the square of the patient's height in meters) of at least 40 or 35 in case of associated diabetes, sleep apnea syndrome, severe arthritis, or arterial hypertension; and (2) a history of stable obesity of at least 5 years, unresponsive for diets for at least 1 year. There should be no endocrine or psychiatric condition and no history of alcohol or drug abuse. The patient should be a reasonable operative risk and should be over 18 and under 55 years old. Contraindications are inflammatory bowel disease, severe organic disease, and significant psychiatric disorders.

Several procedures have been described for the past 40 years or so in obesity treatment. Two large categories of operations can be distinguished: restrictive procedures, in which caloric intake is reduced at the level of the mouth or the stomach, and malabsorptive procedures, in which caloric uptake is reduced.

Malabsorptive Procedures

Jejuno-ileal Bypass

The first procedure was described by Payne in 1967. In brief, an anastomosis was carried out between jejunum and ileum, hereby bypassing most of the small bowel (Fig 1). Although highly efficient (85% excess weight loss at 2 years and lasting for at least 5 years), up to 50% of the patients developed severe side effects because of a blind loop syndrome, characterized by intractable diarrhea, rectal complications (proctitis, anal fissure), hypoproteinemia, hypovitaminosis, liver steatosis, and cirrhosis, and invalidating abdominal pain attributable to bacterial overgrowth in the shunted loop. Popular in the 1970s (over 12,000 cases), the procedure has been generally abandoned.

Biliopancreatic Derivation

This procedure was described by Scopinaro. It consists of a cholecystectomy, a distal gastrectomy with gastrojejunal anastomosis in Roux-en-Y with

From the Gastro Intestinal Surgery Department, CHU Saint-Pierre, Brussels, Belgium, and the University Hospital of Padua, Italy.

Address reprint requests to Professor G.B. Cadiere, University Hospital Saint-Pierre, Department of Gastrointestinal Surgery, 322 rue Haute, 1000 Brussels, Belgium.

1071-5517/00/0701-0006$10.00/0

Figure 1. Jejuno-ileal bypass.

only 50 cm of functional small bowel left in which biliary and pancreatic secretions are first mixed with the food bolus. Because the afunctional loop is constantly washed out by the biliopancreatic secretions, no blind loop syndrome develops. Because of the short common limb, a selective malabsorption for fatty stuffs is caused.

Postoperative complications are frequent. Anastomotic stenosis and/or fistula occurs in 4% of the cases. Gastrointestinal bleedings can occur as well. Hypoproteinemia, low lipid counts, and hypovitaminosis are frequent and count up to a 50% complication rate, except Scopinaro, who has an extensive experience of this type of surgery in a well-defined population in Italy, reports 83% weight loss at 5 years with an operative mortality of 0.5%.

Restrictive Procedures

These procedures aim for a faster stimulation of gastric fullness by reducing the gastric reservoir and stimulation of the center of satiety because the patient has to eat slowly.

Gastric Bypass

The stomach is stapled shut 3 cm distal to the gastroesophageal (GE) junction and a Roux-en-Y proximal gastrojejunostomy is carried out (Fig 2). Besides the already mentioned aims, as with every restrictive procedure, this operation induces a voluntary dumping syndrome situation creating severe postprandial discomfort in sweet eaters. The downside of this technique is its technical difficulty and the problems encountered in distal gastric bleeding that can no longer be treated endoscopically. Five year

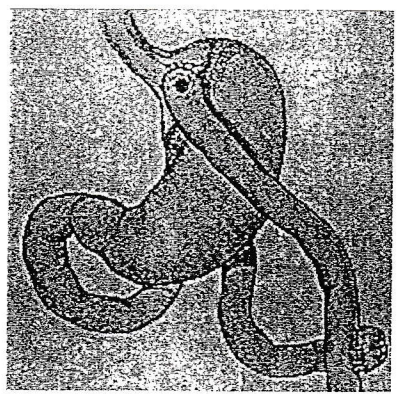


Figure 2. Gastric bypass.

weight loss of 63% to 77% of excess weight can be achieved with a morbidity of 0.5% to 2.5% and a mortality of 0.5%.[5] This procedure is the procedure of choice in super obese, in sweet eaters, and in patients with significant GE reflux.

Gastroplasty

This procedure avoids bowel suture–associated morbidity. The principle is to partition the stomach in two: one proximal small pouch and one distal, larger pouch, while the two parts are connected by a narrow opening (stoma). The patient experiences fullness early on. Because he must eat slowly, the satiety receptors are triggered and induce a cortical stimulation resulting in efficient reduced oral intakes.

Horizontal gastroplasty. Here the staple line is horizontal and the stoma is located either in the middle or in an excentric position (Fig 3). Staple line breakdown is avoidable by transsecting the stomach except at the stoma site, which needs to be reinforced so as to avoid dilation. Failures are frequent by proximal pouch dilation.[6]

Vertical gastroplasty. Mason introduced the vertical banded gastroplasty, in which the proximal pouch is located at the lesser curvature and is limited laterally by a multiple vertical staple line (Fig 4). The stoma is calibrated very small and is reinforced with

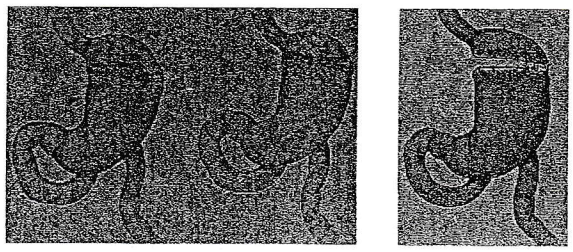


Figure 3. Horizontal gastroplasty.

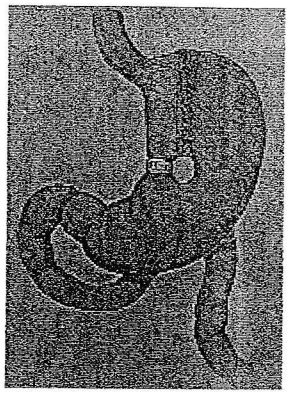


Figure 4. Vertical gastroplasty.

inert material. Originally Marlex was used for the latter purpose, but frequent erosions occurred with intragastric migration.[7,8] Since Marlex was substituted by a silastic ring (SRVBG), operative morbidity came down to 1.9% and no more erosions were seen. Long-term stenosis, however, is quite frequent and accounts for 4% of the cases. Up to 25% of the patients need a reoperation at one point. The mean weight loss is 60% at 2 years.[9,10] The procedure can be carried out laparoscopically as well.[11]

Gastric banding. Gastric banding creates an hourglass stomach as well. However, partitioning is made by an extragastric ring, which can be adjusted postoperatively by inflating or deflating the elastic chamber of the ring (Fig 5). This is done by simple puncture of a subcutaneous container connected with the band. This procedure was first described by Kuzmak in the 1980s.[12,13]

The laparoscopic adjustable silicone gastric banding (LASGB) technique is the least invasive surgical treatment of morbid obesity because it respects gastric wall integrity. The laparoscopic approach reduces invasiveness even further.

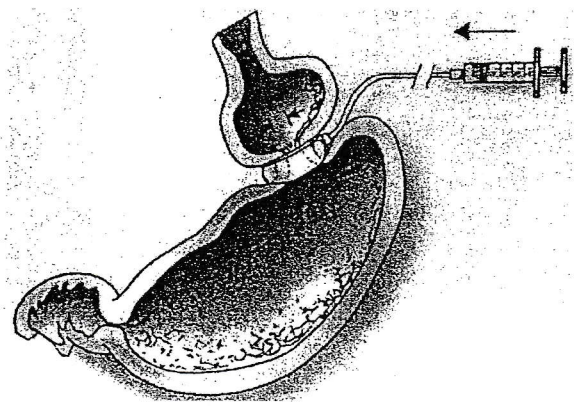


Figure 5. Adjustable gastric banding.

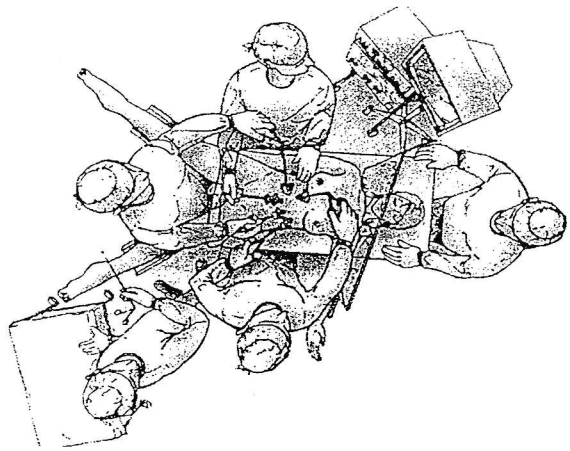


Figure 6. Positioning of the patient.

In October 1992, we showed the feasibility of the laparoscopic technique.[14] Since that time, the silicone band technique has been adapted for the laparoscopic approach and the procedure standardized.[15-18]

We would like to present the procedure as well as our clinical results.

Technique of LASGB

Positioning of the Patient

The patient lies supine, thighs fully abducted and slightly bent. The operating table has a 30° reversed Trendelenburg tilt. The surgeon stands between the patient's legs, the first assistant to the patient's left and the second assistant to the right (Fig 6).

Insufflation

A long Verres needle is introduced above the umbilicus so as to avoid the fatty hepatic ligament. Intra-abdominal pressure is maintained at 15 mm Hg (Fig 7).

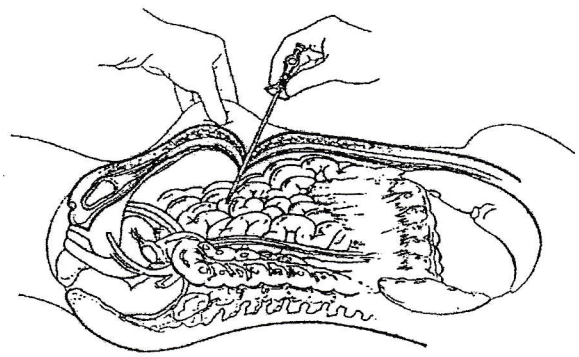


Figure 7. Placement of the Verres needle.

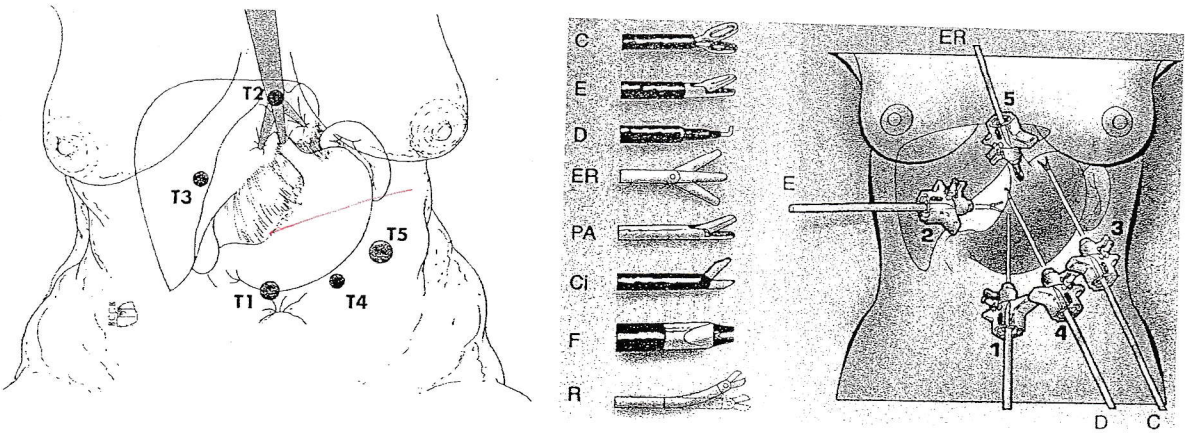


Figure 8. Disposition of the trocars and instrumentation.

Placement of Trocars and Instrumentation

Five trocars are placed in the following sequence: (1) a long 10-mm trocar for a 30° optical system 6 fingerbreadths below the xiphoid; (2) a 10-mm trocar for the liver retractor subxiphoid; (3) a 10-mm trocar for a grasping forceps and the Lap-Band Closure Tool (in right upper quadrant); (4) a 5-mm trocar for the cautery hook, needle holder, and grasping forceps (in left upper quadrant); and (5) a 10-mm trocar for an atraumatic grasping forceps replaced later on by a 18-mm trocar for band introduction and reservoir placement (on the left anterior axillary line below the costal margin) (Figs 8 and 9).

Initial Dissection

The anesthetist introduces a balloon-tipped nasogastric tube inside the stomach. Twenty-five milliliters of fluid are injected in the intragastric balloon after which the balloon is pulled backed until it is blocked at the GE junction. The bulge seen on the stomach allows the surgeon to decide on the level of initial dissection. The correct level is the equator of the bulge. This level is then marked by scoring the peritoneum on the lesser curvature with the coagulating hook.

Dissection of the Lesser Curvature

The lesser curvature is dissected with the coagulating hook about 2 cm distal to the GE junction. The grasping forceps coming from the right upper quadrant grasps the gastrohepatic ligament while another grasping forceps coming from the most lateral trocar grasps the gastric wall (Fig 10). This puts the peritoneum on the lesser curvature under tension. Dissection should be undertaken as close as possible to the gastric wall, with care being taken not to damage it, and should preserve the nerve of Latarjet. Under direct vision the full thickness of the hepatogastric

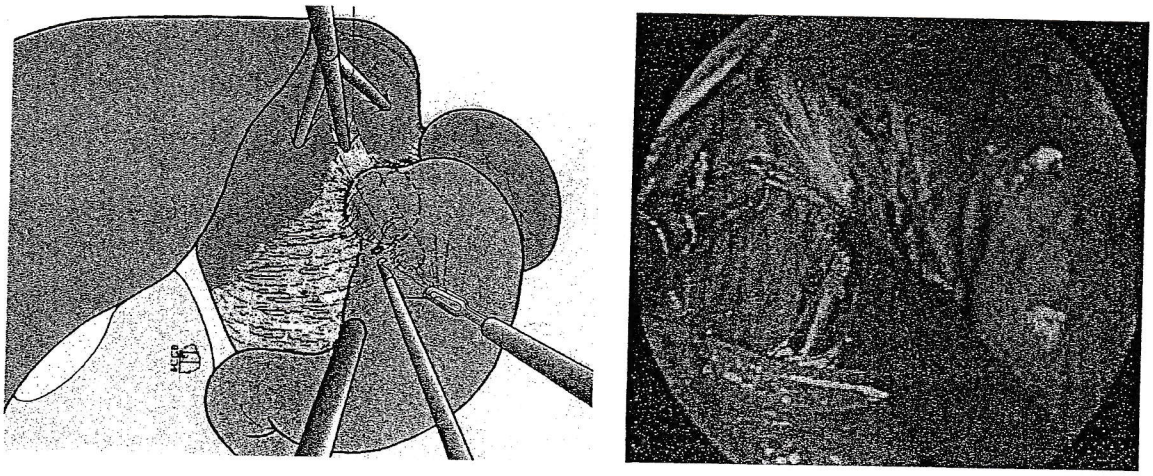


Figure 9. Dissection of the lesser curvature.

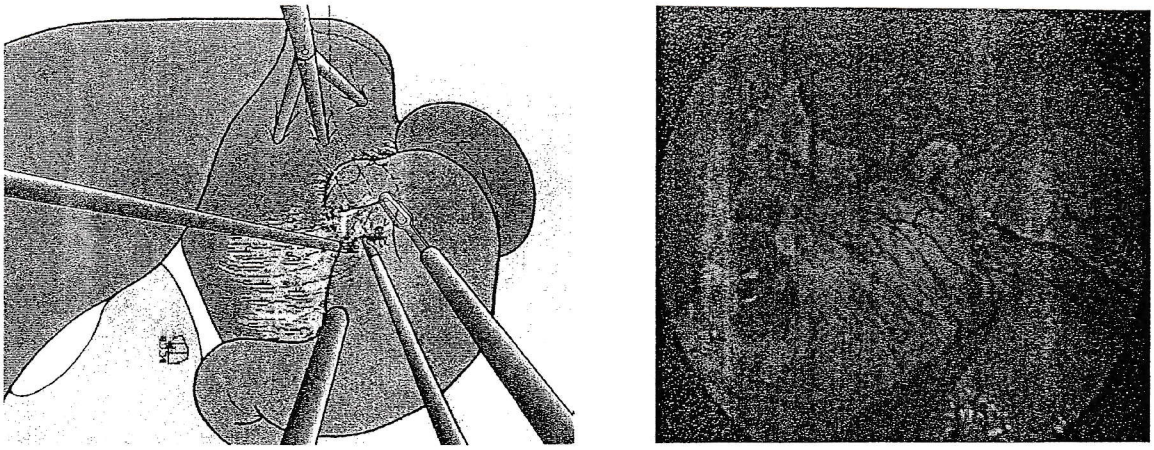


Figure 10. Dissection of the phrenogastric ligament.

ligament is dissected from the gastric wall so as to make a narrow and limited opening (Fig 11). The way of dissection is above the reflexion of the peritoneal sheet covering the lesser sac.

Dissection of the Phrenogastric Ligament

The gastric fundus is pulled distally by the grasper in the most lateral left trocar, hereby putting the phrenogastric ligament under tension. A small window is now created in this ligament by using the coagulation hook. Location of this second window is usually halfway between the upper pole of the spleen and the esophagus or the left side of the left crus.

Retrogastric Tunnel

An Endograsp Roticulator (US Surgical Corp, Norwalk, CT) is introduced in the right upper quadrant trocar and is advanced in the retrogastric tunnel under direct vision. The instrument is then curved and its tip becomes visible in the dissected area of the phrenogastric ligament. The coagulating hook can deal with the remaining fibrous strings, and the endograsp is advanced until it emerges above the spleen where the diaphragm is grasped (Fig 12).

Introduction and Placement of the LASGB

The most lateral left 10-mm trocar is replaced by an 18-mm cannula. A silicone band (BioEnterics, Carpinteria, CA) with its tubing is introduced intraperitoneally, grasped by the endograsp Roticulator (United States Surgical Corporation, Norwalk, CT), and looped around the stomach at the level of dissection. The tip of the tubing is introduced in the locking area of the band. The silicone band is tightened around the stomach (Fig 13).

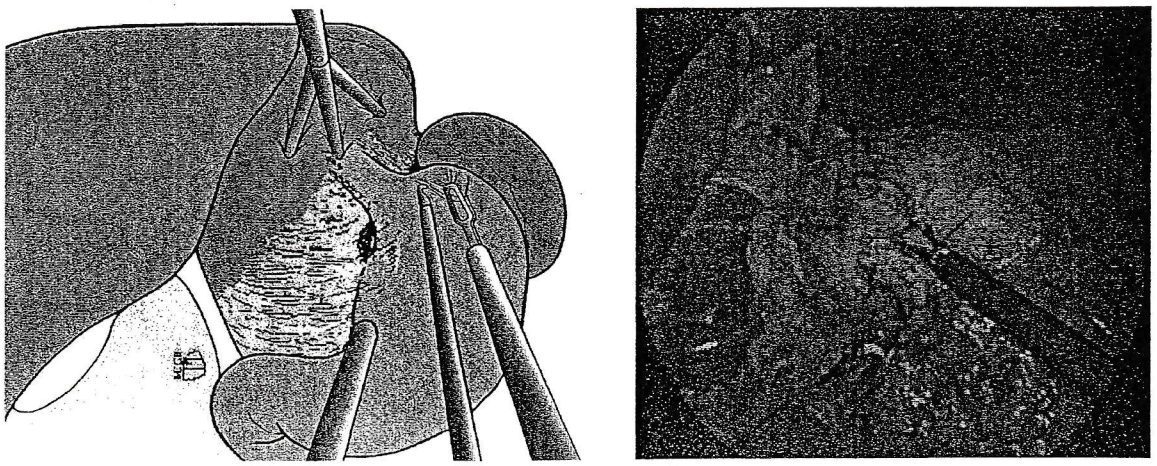


Figure 11. Level of the starting point of dissection of the lesser curvature.

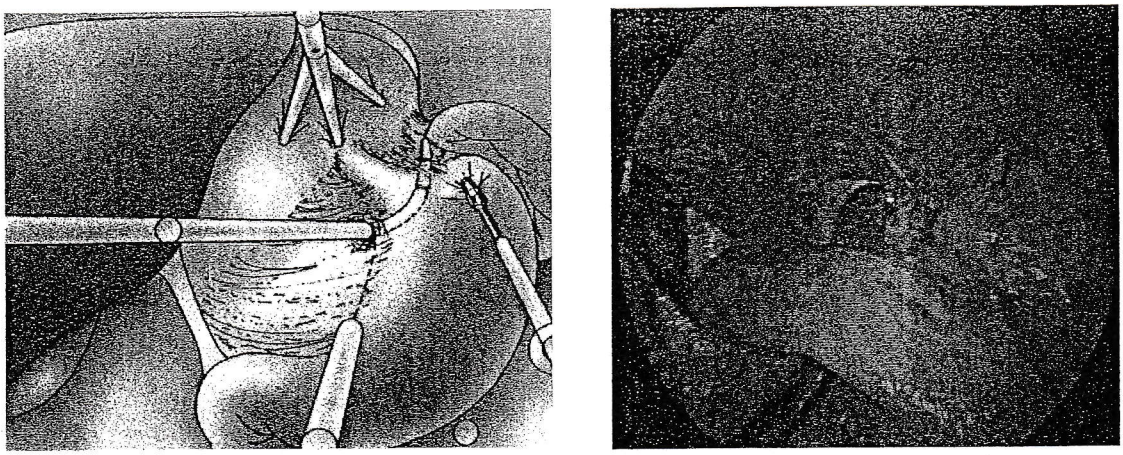


Figure 12. Retrogastric tunnel.

Tightening

The anesthetist reinsufflates 15 mL in the balloon-tipped nasogastric tube and again pulls it back until it hits the GE junction. The surgeon can now be certain of the correct positioning of the band. A specific tool for tightening the band is introduced through the right upper quadrant trocar and the band is tightened and locked (Fig 14).

Calibration of the LASGB

The tip of the nasogastric tube contains pressure sensors. Saline solution is injected into the inflatable balloon of the silicone band with a syringe connected to the end of the nonkinking tube outside the 18 mm port (Fig 15). This will displace the sequential lights on a gastrotonometer electronic sensor to the right till the fourth light is reached. The fourth light corresponds to a 12-mm stoma. This calibration is usually achieved with 2 to 4 mL of saline.

Suture Stabilization of the LASGB

Four to 5 stitches are placed between the serosa of the stomach just proximal and distal to the band to avoid slipping (Fig 16).

Placement of the Injection Reservoir

The 18-mm port is removed, and the nonkinking tube is cut to an appropriate length and connected to the injection reservoir (Fig 17). The reservoir is buried, convex side up, and stitched to the anterior thoracic fascia overlying the costal margin to the left (Fig 18).

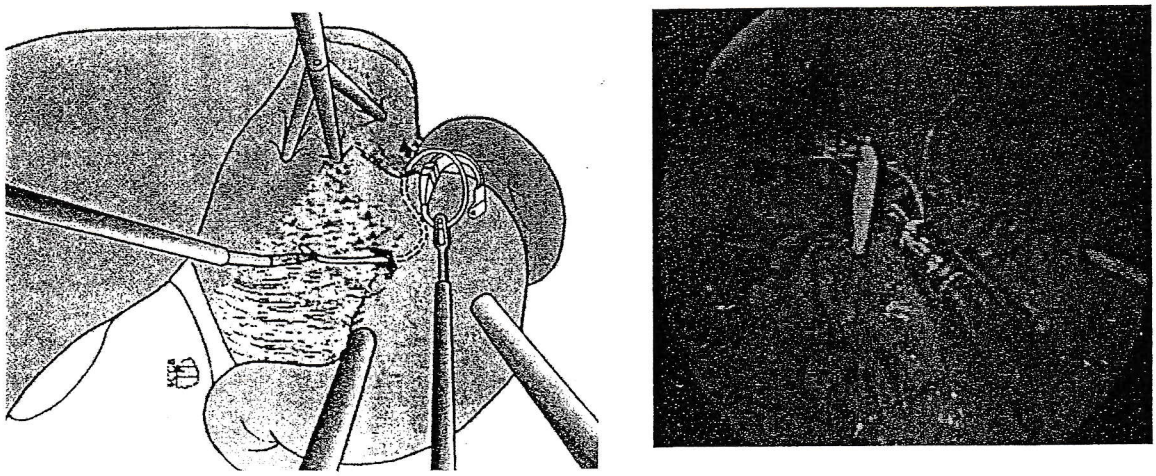


Figure 13. Placement of the LASGB around the stomach.

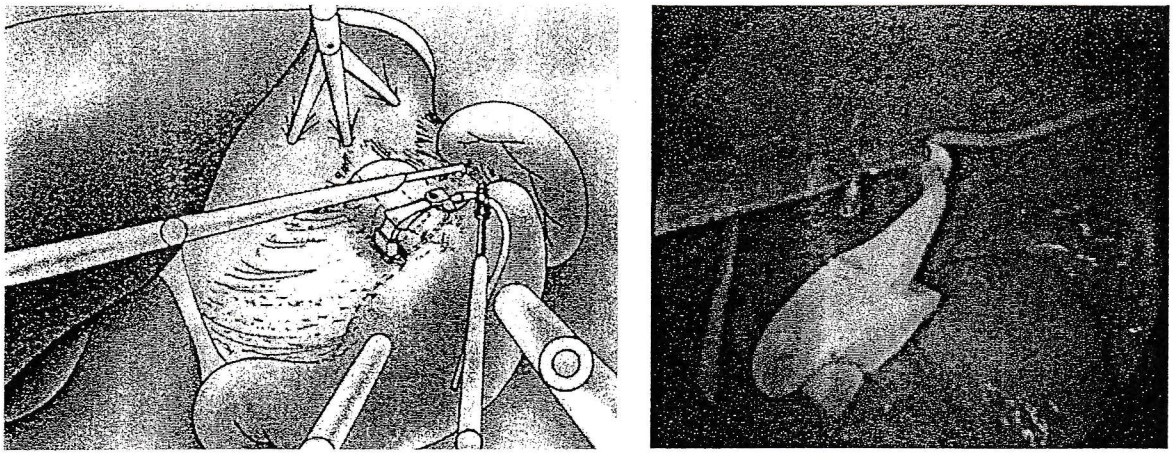


Figure 14. Tightening of the LASGB.

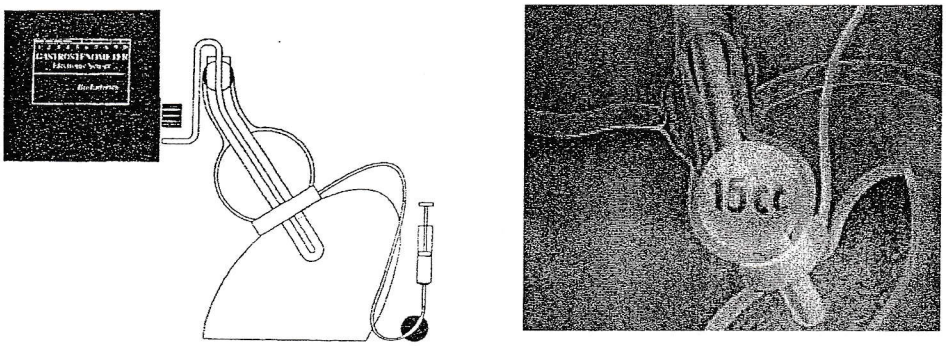


Figure 15. Calibration of the LASGB.

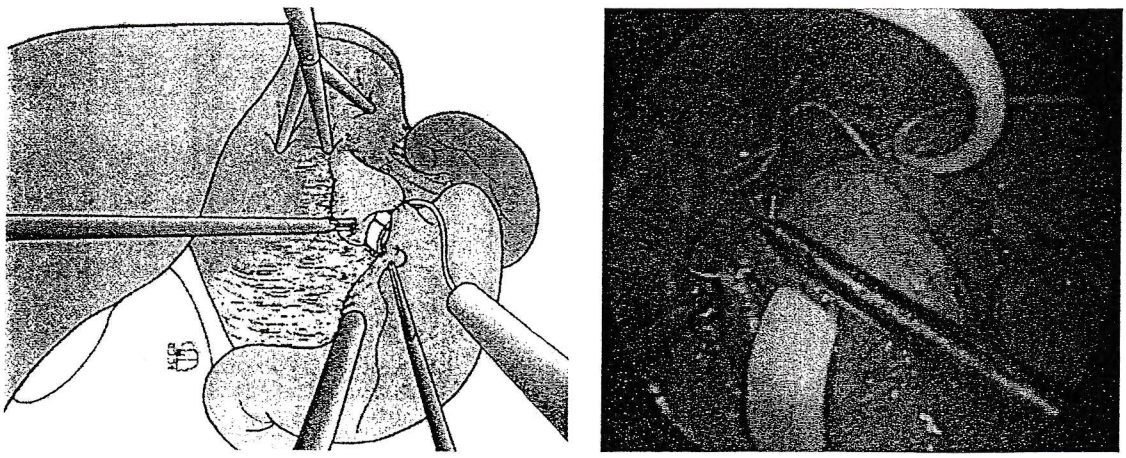


Figure 16. Suture stabilization of the LASGB.

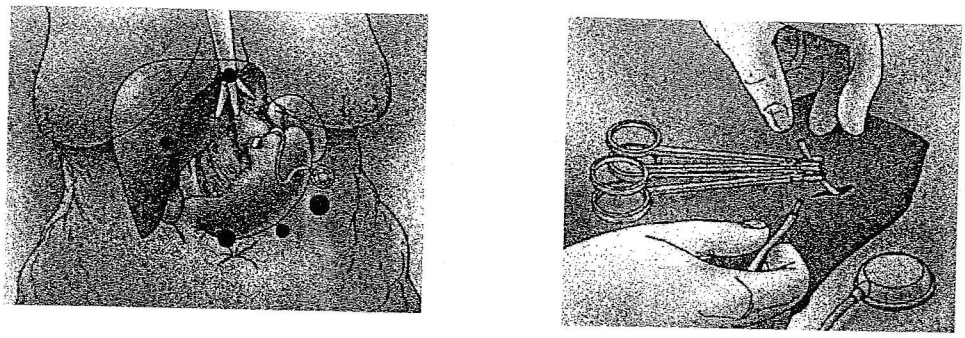


Figure 17. Placement of the injection reservoir.

LASGB Adjustment

The reservoir enables adjustments of the fascia stoma by inflating the gastric band (Fig 19).

This adjustment is performed by a radiologist 1 month after surgery. Stoma size will be established depending on complications (reflux, food intolerance), on the weight loss curve, and on the radiograph.

Present Experience

Patients

After performing 177 open gastric banding procedures, we started using the laparoscopic approach in October 1992. Changes were made to the device to make it more suitable for the laparoscopic approach. These changes were realized with the help of the technicians from BIOENTERICS.

Between October 1992 and January 1998, 652 patients (155 males and 497 females), median age 40 (15 to 65 years), median body weight 120 kg (90 to 225 kg), median percentage of excess body weight compared with the ideal weight 199% (125% to 278%), and median body mass index 45 kg/m^2 (35 to 65 kg/m^2), underwent Kuzmak's gastric banding gastroplasty by the laparoscopic approach. Seventy patients had had previous abdominal surgery (10.5%). Associated disease was found in the following: 273 patients had esophagitis (240 stage I, 37%; 32 stage II, 5%; and 1 stage III, 0.15%); 189 arterial hypertension (29%), 150 type II diabetes (23%), 160 patients with sleep apnea syndrome (25%), 352 hiatal hernias of less than 2 cm (54%), and 115 cases of painful degenerative joint disease (18%).

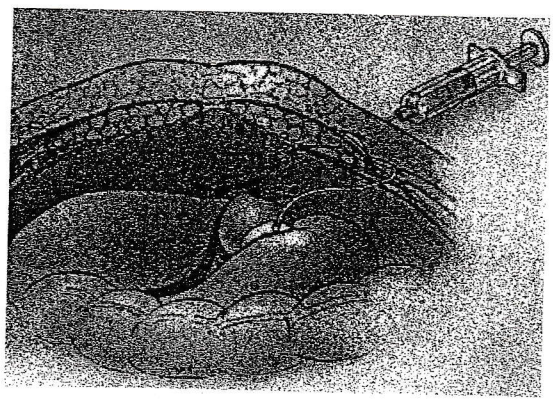


Figure 18. LASGB adjustment.

Results

Mean operative time in our series was 80 minutes (40 to 240 minutes). In 8 (1.2%) cases, the size of the left liver lobe did not allow successful performance of the laparoscopic approach. In 17 other patients, conversion was necessary because of: (1) perigastric dissection risks (10 patients); (2) inadequate instruments (3 patients); (3) gastric perforation (1 patient); (4) band malposition (1 patient); (5) bleeding (1 patient); and (6) defective band (1 patient). Hospital stay was 3 days on average (range, 2 to 10 days).

Early postoperative complications were: 2 gastric perforations on postoperative day 1 caused by traumatic placement of a nasogastric tube (1 treated by closure of the perforation at laparotomy and 1 treated by laparoscopy); 1 aspiration pneumonia treated medically; and 1 slipping of the band because of poor fixation. There were no complications of wound healing, and pulmonary embolism or deep vein thrombosis did not occur.

Late complications were (N = 47; 7.2%): (1) Major (N = 29; 4.1%): 25 patients with total food intolerance, resulting in dilatation of the pouch (9 treated by removal of the band and 16 by repositioning of the band); 2 gastric erosion; and 2 psychological intolerance (Table 1). All these complications needed reoperation. (2) Minor (N = 18; 2.7%): 2 patients with

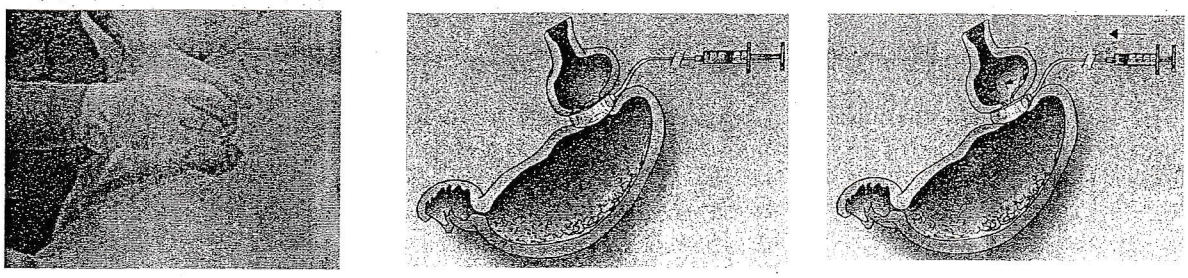


Figure 19. LASGB adjustment.

infection of the reservoir; 8 with a twist of reservoir; 4 break down connecting tube; and 4 reservoir leakage. These complications need extraperitoneal reoperation.

There was one mortality. A patient with a Pradder-Willy syndrome, in whom Mallory Weiss bleeding was treated endoscopically, resulted in esophageal perforation and mediastinitis. The Mallory Weiss syndrome was caused by hyperdilatation of the gastric pouch in a bulimic binge. Loss of excess body weight was 28% at 6 months, 38% at 12 months, and 62% at 2 years (Fig 20).

Discussion

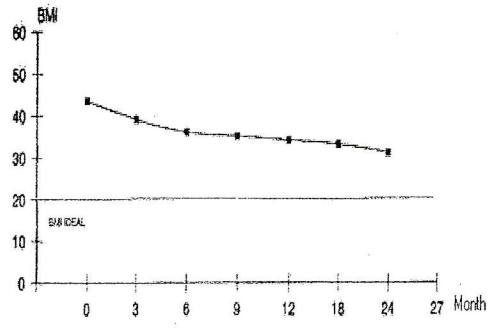
Operative time has a tendency to go down as experience shows and is at the present time about the same as in classic laparotomy (around 1 hour). This is an important element in laparoscopy because the increased intraabdominal pressure immobilizes the diaphragm in an elevated position and favors the occurrence of actelectasis especially in obese patients.[19]

Hypertrophy of the left lobe of the liver impairs exposure of the hiatus. It has indeed caused conversion in 8 cases. Solutions to this problem are 2-fold. First, the liver retractor can be positioned more to the left, thereby shifting the liver from left to right. Second, if left liver hypertrophy is diagnosed preoperatively, the patient can be put on a low caloric diet, which dramatically reduces the volume of the left liver lobe. After patient number 32, no further conversions were noted.

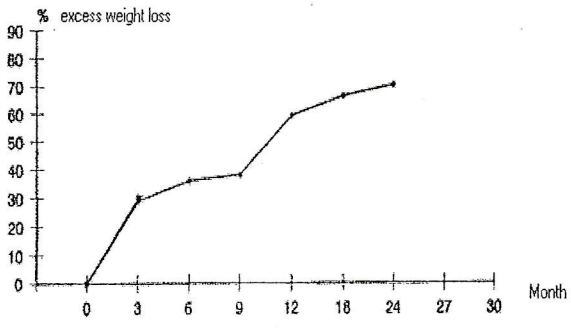
In obese patients, the number of trocars is critical; moreover, the use of 5-mm trocars has to be encour-

Table 1.

Late Complications N = 47 (7.2%)	
Major	N = 29 (4.1%)
Total and irreversible food intolerance	25
Ring removal	9
Reposition	16
Gastric erosion	2
Psychological intolerance	2
Minor	N = 18 (2.7%)
Infection of reservoir	2
Twist of reservoir	8
Breakdown connecting tube	4
Reservoir leakage	4



BMI depending on time



Loss of excess weight depending on time

Figure 20. Body mass index (BMI) and loss of excess weight depending on time.

aged. Five-millimeter trocars present less of a tendency to cause bleeding in the abdominal wall, which is extremely cumbersome in obese patients. Additionally, 5-mm trocars are easy to manipulate because of the reduced contact surface with the sizeable fat layer in the abdominal wall.

The magnified picture allows for accurate dissection and better visual exposure for the assistant, as well as the absence of traction on the spleen, are contributory to the fact that no splenectomy needed to be performed in this series. This is in contrast with the 1% of splenectomies occurring in the open procedure.

In obese patients, morbidity caused by parietal trauma after laparotomy occurs in up to 30% (infections and incisional hernias) of the patients. In our series we did not encounter these complications.

Like Meir and Van Baden,[20] we have also seen cases of gastric erosion. There are only 2 cases of erosion through the gastric wall. This is probably attributable to the absence of direct fixation of the band to the stomach. There seems to be a liquid-filled capsul appearing around the silicone allowing motions of the band without eroding the stomach wall. The presence of such capsula was confirmed in reoperations we needed to perform.

A more worrying complication is pouch dilation, most likely caused by slipping of the posterior gastric wall, especially in cases in which the prosthesis is left unattached in the lesser sac. In our series all cases of dilation of the proximal pouch occurred before our practice of fixing the prosthesis posteriorly (before patient 34) when the prosthesis is placed through the lesser sac.[21]

Another facilitating factor for this condition may be distention of the gastric wall, which might also be avoided by reducing the initial volume of the pouch to less than 15 mL.[22] Since our practice of limiting the pouch to 15 mL (from patient number 34 on), we did not encounter any more dilations of the pouch. Early dilation with aspiration pneumonia (patient 7) can be avoided by delaying insufflation of the band until several weeks postoperatively.

The only fatality we encountered was in a patient with a Pradder Willy syndrome. Emphasis must be put on the need for the patient to fully understand the principle of the procedure. If the patient does not comprehend this, he will continue to eat.

Intractable vomiting and massive gastrointestinal bleeding could follow, as in our patient. It is even so important that the patient understands the obligation not to eat over pouch capacity. Overeating creates excessive traction on the gastric pouch and atonic dilation will ensue. Tilting of the band with functional obstruction will eventually occur. This obstruction, however, remains functional because it can be surmounted by the endoscope, whereas barium will not pass.

Laparoscopic adjustable silicone gastric banding ensures similar weight loss as more invasive techniques like vertical-banded gastroplasty and gastric bypass. It is a safe technique for the treatment of morbidly obese patients provided sufficient precautions are respected and complications are recognized early and treated accordingly.

References

1. Lichtman SW, Pisarka K, Berman ER, et al: Discrepancy between self-reported and actual caloric intake and exercise in obese subjects. N Engl J Med 327:1893-1898, 1992
2. Robert J, Greenstein MD: Bariatric surgery vs conventional dieting in morbidly obese. Obes Surg 4:16-25, 1994
3. National Institutes of Health Consensus Development Conference Statement. Obes Surg 1:257-265, 1991
4. Deitel M, Stalin B: Morbid obesity: Selection of patients for surgery. J Am Coll Nutr 11:447-462, 1992
5. Sugarman HJ, Londrey GL, Kellum JM, et al: Weight loss with vertical banding gastroplasty and Roux-Y gastric bypass for morbid obesity with selective versus random assignment. Am J Surg 157:93-100, 1989
6. Fisher BL: Erosive esophagitis following horizontal gastroplasty for morbid obesity. Obes Surg 1:89-93, 1991
7. Deitel M, Jones BA, Petrov I, et al: Vertical banded gastroplasty: Results in 233 patients. Can J Surg 28:322-324, 1986
8. Mason EE, Doherty C, Scott D, et al: Vertical banded gastroplasty: An eight year review. American Society for Bariatric Surgery. Sixth Annual Meeting, Nashville, TN, 1989
9. Desaive C: A critical review of a personal series of 1000 gastroplasties. Int J Obes 19:561-565, 1995 (suppl 3)
10. Ismail T, Kirby, Crowson MC, et al: Vertical silastic ring gastroplasty: A 6 Years experience. Br J Surg 77:80-82, 1990
11. Azagra JS, Goergen M, Ansay J, et al: Laparoscopic gastric reduction surgery:. Preliminary results of a randomized, prospective trial of laparoscopic vs open vertical banded gastroplasty. Surg Endosc 13:555-558, 1999
12. Kuzmak L: A review of seven years experience with silicone gastric banding. Obes Surg 1:403-408, 1991
13. Kuzmak L: Silicone gastric banding: A simple and effective operation for morbid obesity. Contemp Surg 28:13-18, 1986
14. Cadière GB, Bruyns J, Himpens J, et al: Laparoscopic gastroplasty for morbid obesity. Br J Surg 81:1524, 1994
15. Cadière GB, Favretti F, Bruyns J, et al: Gastroplastie par coelio-vidéoscopie: Technique. Le Journal de coelio-chirurgie 10:27-31, 1994
16. Chelala E, Cadière GB, Favretti F, et al: Conversions and complications in 185 laparoscopic adjustable silicone gastric banding cases. Surg Endosc 11:268-271, 1997
17. Favretti F, Cadière GB: Laparoscopic placement of adjustable silicone gastric banding: Early experience. Obes Surg 5:71-73, 1995

18. Doherty C, Maher JW, Heitshusen DS: An interval report on prospective investigation of adjustable silicone gastric banding devices for the treatment of severe obesity. Eur J Gastroenterol Hepatol 11:115-119, 1999
19. Laurent P, Joris J, Hinque V, et al: Pulmonary dysfunction after gastroplasty with either laparoscopy or laparotomy in morbidly obese patients. Anesthesiology 83:3A, 1995
20. Meir E, Van Baden M: Adjustable silicone gastric banding and band erosion: Personal experience and hypotheses. Obes Surg 9:191-193, 1999
21. Favretti F, Cadière GB, Segato G, et al: Laparoscopic adjustable silicone gastric banding (Lap-Band): How to avoid complications. Obes Surg 7:352-358, 1997
22. Desaive C: Influence of the initial volume of the gastric pouch on the rate of complication after adjustable silicone gastric banding. Obes Surg 5:247, 1995 (abstr)