Clinical application of laparoscopic bariatric surgery

A steady rise in obesity prevalence over the last 20 years has been experienced by whole world. This trend is ominous, because morbid obesity predisposes patients to co-morbid diseases which affect nearly every organ system. These include: type 2 diabetes, cardiovascular disease, hypertension, hyperlipidemia, hyperventilation syndrome, asthma, sleep apnea, stroke, pseudotumor cerebri, arthritis, several types of cancers, urinary incontinence, gallbladder disease, and depression. Life expectancy is shortened by Obesity. With increasing body mass index (BMI) resulting in proportionally shorter lifespan.

There has been a dramatic increase in gastrointestinal procedures that produce significant sustainable weight loss with low complication rates, due to the advent of minimally invasive therapies. Surgically induced weight loss is associated with resolution or improvement of co-morbid diseases in 75–100% of patients, and reduced mortality compared with medically treated patients. Along with improved systems for surgeon training and delivery of care, public awareness and demand have combined to fuel a national explosion in bariatric procedures.

Surgical treatment of obesity, its justification

- The most effective treatment for morbid obesity is Weight-loss surgery, producing durable weight loss, improvement or remission of co-morbid conditions, and longer life (level I, grade A).

Contemporary surgical options- Evolution

For half a century Operations to alter the gastrointestinal tract and produce weight loss have been applied. Weight-loss operations may cause malabsorption, restriction of food intake, or a combination of the two. The first original operation was performed in 1954 for morbid obesity, the jejunoileal bypass. However, this purely malabsorptive operation led to unacceptable morbidity and mortality related to bacterial overgrowth and liver damage. Focus shifted away from purely malabsorptive procedures until the 1970s when bilipancreatic diversion (BPD) was first described, with eventual description of duodenal switch (DS) in 1993. With effective weight loss this operation has been applied laparoscopically.

As a combined restrictive–malabsorptive procedure Gastric bypass was introduced by Mason in 1966. Several variations and modifications of the original procedure have evolved over time, such as complete gastric transaction, reduction in gastric pouch size, and application of a Roux-en-Y.

As of 2003, Roux-en-Y gastric bypass (RGB) accounted for over 80% of all bariatric procedures done in the USA. Laparoscopic RGB was popularized and validated in the early 1990s by Wilkove and Clark, and several corroborating series have followed. Differences exist in the technique for laparoscopic gastropasty as compared to open procedures, including transverse circular stapler, transgastric circular stapler, linear stapler, and handsewn, but all are supported in the literature as producing similar safety and weight loss results.

A purely restrictive operation was developed by Mason and Printen, the gastropasty, in the early 1970s. This operation later developed into vertical banded gastroplasty (VBG), and ultimately laparoscopic VBG by the 1990s. In 2002, despite efforts to simplify the procedure, gastropasty operations declined in favor of 70% of US bariatric procedures. Stomach banding for weight loss, originally introduced in the 1980s with non-adjustable devices, became popular in the early 1990s. In 1993, Belachew and Leprand placed the first laparoscopic adjustable gastric band (LRGB) using the LAP-BAND® system (Allergan Inc, Irvine, CA, USA). For laparoscopic use although there are multiple versions of AGB available, most published results derived from the LAP-BAND® system. Laparoscopic adjustable bands quickly became popular worldwide because of the relative ease of placement and safety. The LAP-BAND® system was not approved for use in the USA until 2001, and utilization has increased steadily. A recent worldwide survey revealed the laparoscopic AGB accounted for 24% of obesity operations, with 26% were laparoscopic RGB and 23% were open gastric bypass.

Another contemporary restrictive procedure that derives from the concept of vertical gastroplasty is the laparoscopic sleeve gastrectomy (LSG). Before duodenal switch or gastric bypass in high-risk patients, LSG developed as a first-stage procedure. Studies have shown that LSG used in this manner reduces weight, co-morbidities, and operative risk (ASA score) at the time of a second bariatric procedure. Application of LSG as a primary weight loss operation is increasing. Evolving data demonstrate LSG provides substantive weight loss and resolution of co-morbidities to 3–5 years (level II, grade C).

Guidelines for selecting validated bariatric procedures

- Laparoscopic RGB, gastric banding by VBG or AGB, and BPD+DS are established and validated bariatric procedures that may be performed laparoscopically (level II, grade A).
- LSG is validated as providing effective weight loss and resolution of co-morbidities to 3–5 years (level II, grade C).

Patient selection considerations

According to the 1991 National Institutes of Health (NIH) consensus conference on gastrointestinal surgery for severe obesity, patients are candidates if they are morbidly obese (BMI > 40 kg/m² or > 35 kg/m² with co-morbidities), have failed attempts at diet and exercise, are motivated and well informed, and are free of significant psychological disease. In addition, the expected benefits of operation must outweigh the risks. Surgery for morbid obesity has a low failure rate, with a mean BWL of 61.2%. Adverse events vary between procedures, but may reach 25% in high-risk patients. Mortality during surgery is 0.1% for gastric banding, 0.5% for RGB, and 1.1% for BPD. There are no absolute contraindications, but relative contraindications to surgery may include severe heart failure, unstable coronary artery disease, end-stage lung disease, active cancer diagnosis/treatment, cirrhosis with portal hypertension, uncontrolled drug or alcohol dependence, and severely impaired intellectual capacity. Crohn's disease may be a relative contraindication to RGB and BPD, and is listed by the manufacturer as a contraindication to the LAP-BAND® system.

With giant ventral hernias, Laparoscopic surgery may be difficult or impossible in patients, severe intra-abdominal adhesions, large liver, high BMI with central obesity or physiological intolerance of pneumoperitoneum. In the event it becomes necessary to convert to an open procedure Surgeons performing bariatric surgery should possess the necessary skills to perform open bariatric surgery.

Weight loss surgery for individuals with BMI ≤ 30–35 kg/m² and comorbidities merits consideration given the poor results of nonoperative weight loss regimens. One controlled trial of laparoscopic AGB in this group found superior weight loss, resolution of metabolic syndrome and improvement in quality of life versus medical management at 2-year follow-up. Another report of 37 patients undergoing RGB showed excellent weight loss and near-complete resolution of co-morbidities. Further data are necessary before surgery for BMI < 35 kg/m² becomes standard practice.

Early in the laparoscopic bariatric era, many traditional programs declined super-obese (BMI > 50 kg/m²) or super-super-obese patients (BMI > 60 kg/m²) because of perceived high risk and technical challenges. However, due to improvement in endoscopic techniques and equipment; laparoscopic RGB and AGB have been more liberally applied at extreme BMI's, with consequent health and quality of life benefits, acceptable rates of morbidity and mortality, but lower BWL. Laparoscopic BPD+DS may also be appropriate for super-obese patients given the superior weight loss over laparoscopic RGB.

In the current era of refined anesthesiology age restrictions are less rigidly employed, effective critical care, and high quality surgical outcomes. Laparoscopic bariatric surgery has been performed in patients older than 55–60 years, but with comparably less weight loss, longer length of stay, higher morbidity and mortality, and less complete resolution of co-morbidities compared with younger patients. Still, the reduction in co-morbidities supports use of laparoscopic RGB or laparoscopic AGB in well-selected older patients.

At the time of the NIH consensus conference in 1993, because of insufficient data, bariatric surgery for morbidly obese children and adolescents was not advised. However, with pediatric obesity increasing in prevalence and severity, interest in adolescent bariatric surgery is growing. In patients younger than 18 years with 10-year follow-up RGB is well tolerated and produces excellent weight loss. Advocates believe weight reduction at an early age will prevent or minimize emotional and physical consequences of obesity. Well-designed prospective studies are just emerging to better define the place for adolescent bariatric surgery.

Patient selection- Guidelines
Facility required and Bariatric program

The etiology of morbid obesity seems to involve following factors: genetic, environmental, metabolic, and psychosocial. Therefore, treatment of the bariatric patient lends itself to a team approach for systematic evaluation and management. Although a multidisciplinary team is seen as an important component of a bariatric surgery practice, no comparative clinical trials have proven this. The team leader is the surgeon, who is complimented by nurses, physician extenders and clerical staff for scheduling, insurance precertification, and coordination of patient flow. The surgeon must have acquired the proper education and hands-on training for Institutions Granting Bariatric Privileges Utilizing Laparoscopic Techniques. Other important team members include nutritionists, psychologists with specific training and experience, and medical subspecialists (endocrinologists, anesthesiologists, radiologists, pulmonologists, gaitmenterologists, etc.) to help evaluate and optimize patients preoperatively and to provide care postoperatively if necessary.

The institutional needs of a bariatric program extend across outpatient and inpatient environments. It is important to have office and hospital furniture, equipment, clothing, fixtures, beds, and wheelchairs that are appropriate and comfortable for patients with morbid and super-morbid obesity. In the operating room, specially rated tables and attachments, extra-long instruments, and appropriate staplers and retractors are necessary. To the special needs of bariatric patients, and protected against ergonomic and lifting injuries Healthcare providers and staff must be experienced with and sensitive.

Postoperative support groups are also an important aspect of a bariatric program and may improve postoperative results and limit relapse. Patients attending support groups achieve greater weight loss than those who do not show by two nonrandomized studies.

Hospital annual case volume above 100 may be associated with reduced morbidity and mortality and improved costs. Higher surgeon volume has been associated with reduced mortality. Center of Excellence designation programs have gained traction and are maintained by the American College of Surgeons and the American Society for Metabolic and Bariatric Surgery.

Bariatric programs and associated Guidelines

- Bariatric surgery programs should include multidisciplinary providers with appropriate training and experience (level III, grade C).
- Institutions must accommodate the special needs of bariatric patients and their providers (level III, grade C).
- Participation in support groups may improve outcomes after bariatric surgery (level II, grade B).

Necessary arrangement prior to operation

For all bariatric procedures the preoperative evaluation is similar. The components include determining a patient’s indications for surgery, identifying issues which may interfere with the success of the surgery, and assessing and treating co-morbid diseases. Typical assessment includes psychological testing, nutrition evaluation, and medical assessment.

Psychological evaluation

Patients referred for bariatric surgery are more likely than the overall population to have psychopathology such as somatization, social phobia, obsessive–compulsive disorder, substance abuse/dependency, binge-eating disorder, post-traumatic stress disorder, generalized anxiety disorder, and depression. Patients with psychiatric disorders may have a suboptimal outcome after bariatric surgery. However, no consensus recommendations exist regarding preoperative psychological evaluation. A recent survey reported that 88% of US bariatric programs utilize some psychological evaluation, with half requiring a formal standardized assessment. Many insurance companies require such psychological evaluation prior to granting pre-certification for a bariatric procedure. Nevertheless, the bulk of evidence shows no relationship between preexisting axis I psychiatric diagnosis or axis II personality disorder and total weight loss. It is not certain which psychosocial factors predict success following bariatric surgery, yet many programs exclude patients who are illicit drug abusers, have active uncontrolled schizophrenia or psychosis, severe mental retardation, heavy alcohol use, or lack of knowledge about the surgery.

Nutrition consult

For multidisciplinary bariatric care, the nutrition professional plays an integral part. He or she is charged with nutritional assessment, diet education regarding postoperative eating behaviors, and preoperative weight loss efforts. Preoperative very-low-calorie diet for 6 weeks has been shown to reduce liver volume by 22% and to improve access to the upper stomach during laparoscopic surgery, with 80% of the volume change occurring in the first 2 weeks. Moreover, patients who are able to achieve 10% EBWL preoperatively have shorter hospitalisation and more rapid weight loss.

Despite the wide utilization of preoperative nutritional efforts, and the requirement by many insurance companies for dietary counseling, data are still needed to prove association with postoperative weight loss or dietary compliance. No evidence-based, standardized dietary guidelines exist for either pre- or postoperative nutritional management of the bariatric patient, and no convincing data support the need for routine use of nutrition specialists after operation. To help define the role of the nutrition profession in the bariatric team outcome studies and clinical trials are necessary.

Preoperative medical evaluation

Routine laboratory evaluation typically includes complete blood count, metabolic profile, coagulation profile, lipid profile, thyroid function tests, and ferritin. Vitamin B12, and fat-soluble vitamin levels may be evaluated if considering a malabsorptive procedure. Cardiovascular evaluation includes electrocardiogram and possible stress test to identify occult coronary artery disease. Respiratory evaluation may include chest X-ray, arterial blood gas, and pulmonary function tests. Sleep apnea may be diagnosed by sleep study and the patient started on continuous positive airway pressure prior to surgery. Upper endoscopy may be used if suspicion of gastric pathology exists. If H. pylori infection is present, preoperative therapy is advised. The liver may be assessed by hepatic profile and ultrasound. In cases of suspected cirrhosis, biopsy may be indicated. Ultrasound may be used to detect gallstones, allowing the surgeon to decide on concomitant cholecystectomy.

Guidelines for preoperative preparation

- Treated psychopathology does not preclude the benefits of bariatric surgery (level I, grade B).
- A psychological evaluation is commonly part of the preoperative work-up of bariatric patients (level III, grade C).

- Individuals with BMI 30–35 kg/m may benefit from laparoscopic bariatric surgery (level I, grade B).

- Adolescents bariatric surgery (age < 18 years) has been proven effective but should be performed in a specialty center (level II, grade B). Patient selection criteria should be the same as used for adult bariatric surgery (level II, grade C).

- Patients > 60 years (level II, grade B).

- BMI > 60 kg/m (level II, grade B).
Preoperative weight loss may be useful to reduce liver volume and improve access for laparoscopic bariatric procedures (level II, grade B), but mandated preoperative weight loss does not affect postoperative weight loss or comorbidity improvements (level I, grade B).

Laparoscopic biliopancreatic diversion

Introduction

After jejunoileal bypass was abandoned, most of the bariatric community focused on restrictive operations. However in the late 1970s, Scopinaro revisited the value of malabsorption in his description of the BPD. Since then, modifications have included the duodenal switch, the sleeve gastrectomy, and the laparoscopic approach. DS diminishes the most severe complications of BPD, including dumping syndrome and peptic ulceration of the anastomosis. Sleeve gastrectomy spares the lesser curvature, vagus nerves and pylorus, in contrast to the original distal gastrectomy, though theoretical beneficial effects on eating behavior, weight loss and side-effects are not universally reported. The laparoscopic approach decreases wound complications, pain and hospital length of stay.

Technical considerations

Standard technique for BPD+DS involves dividing the small bowel 250 cm above the ileocecal valve with a stapler, and then forming a biliopancreatic limb by connecting the bowel proximal to the transaction point to a 100 cm above the ileocecal valve. The bowel distal to the transection is elevated as an alimentary limb to the upper abdomen. Sleeve resection creates a tubularized stomach of approximate 100 cm. The duodenum is divided 3 cm distal to the pylorus, and duodenal resection establishes continuity of the alimentary limb. Weight loss and complications are determined by Limb lengths. A common limb that is too long will provide inadequate weight loss, whereas one too short will cause debilitating diarrhea and nutritional deficiencies. Gastric remnant size should provide some restriction but not prevent initiation of protein digestion.

Whether BPD should be tailored to patient characteristics such as age, size or BMI is uncertain. Scopinaro, in his original animal study, found “insertion of the bypass into the ileum at a distance from the ileocecal valve equivalent to one-sixth of the intestinal length allows adequate weight loss with minimal complications.” However, by the time of his human studies, he noted that “the exact length of the common ileal segment and the length of the antrum in the biliopancreatic tract required to achieve maximum weight reduction with minimum complications have yet to be determined.” Hess reports excellent results by measuring small bowel length and then distributing 10% to the common channel and 40% to the alimentary limb. A large Spanish series reports excellent outcomes with a common channel of 60 cm and an alimentary limb of 200–300 cm.

A US study suggests common channels longer than 100 cm result in inferior results. In a comparative study of outcomes and complications, 50 cm common channel was inferior to 100 cm, and distal gastrectomy was inferior to sleeve gastrectomy. Though there is a paucity of comparative data between open and laparoscopic BPD, a few comments can be made on the utility of the minimally invasive procedure. Firstly, because the details of the resection and reconstruction are the same, long-term outcomes are likely to be similar. Indeed, at 1 and 3 years follow-up, weight loss is similar to that achieved by open surgery. Laparoscopic BPD has reduced hospital stay and complications, mainly due to a lower rate of wound infections and dehiscence. Laparoscopic BPD is an advanced, complex and feasible technique in bariatric surgery, and one which has a slow learning curve.

Outcomes

BPD ± DS initiates dramatic weight loss during the first 12 postoperative months, which continues at a slower rate over the next 6 months. Weight loss is durable up to at least 5 years postoperatively. Ninety-five percent of patients with BMI>50 kg/m² and 70% of those with BMI>50 kg/m² achieve greater than 50% excess body weight loss. Weight may be regained over time, highlighting the importance of long-term follow-up.

BPD dramatically impacts co-morbidities. At least 90% of patients with type 2 diabetes will cease diabetic medications by 12–18 months. Of hypertensive patients 50–80% will be cured, with another 10% experiencing improvement. Up to 98% of patients with obstructive sleep apnea symptoms will have resolution.

Although BPD, RYG, and AGB are all superior to nonsurgical therapy, the relative effectiveness of these procedures has not been fully compared. Data available are rarely randomized or controlled, and often compare non-equivalent cohorts. Nonetheless, available data suggest the weight loss effect of BPD is greater and more durable than laparoscopic AGB. Likewise, BPD may be superior to RYG in patients with BMI ≥50 kg/m².

Despite the favorable reports of the biliopancreatic diversion and duodenal switch procedure for the treatment of morbid obesity, it has been slow to gain widespread acceptance.

Postoperative

To exclude contrast extravasation, an upper gastrointestinal series is typically performed in the early postoperative period. If normal, a clear liquid diet is commenced, with gradual introduction of solids. Discharge is usually within 4–5 days.

In the postoperative period close follow-up is recommended. For example, visits at 2 and 6 weeks, then quarterly for the first year, biannually for the second year, and annually thereafter would be one acceptable strategy. Assessments are made by both the surgeon and nutritionist, and biochemical surveillance by complete blood count, chemical metabolic profile, and parathormone level is performed at intervals. An exercise program is helpful, as are multivitamin, iron, vitamin D, and calcium supplements.

Complications

The 30–day mortality of early laparoscopic BPD series ranges from 2.6 to 7.6%. Major complications, which occur in up to 25% of cases, may include early occurrence of anastomotic leak, duodenal stump leak, intra-abdominal infection, hemorrhage, and venous thromboembolism, or later bowel obstruction, incarceration or stricture.

Without specific food intolerances the performance of a sleeve gastrectomy as part of the BPD+DS allows patients two-thirds of their preoperative dietary volume. Between 70 and 98% maintain normal serum albumin 3 years after surgery. Diarrhea is a frequent chronic complication of BPD. Common channel length of 50 cm is associated with reports of diarrhea in most patients, whereas length of 100 cm is not. Iron deficiency is common, with serious iron deficiency anemia (hemoglobin <10 mg/dl) occurring in 6% of patients. Surveillance of biochemical and hematological markers of iron deficiency should drive replacement. Calcium and vitamin D malabsorption are also common, manifesting as secondary hyperparathyroidism. Supplements do not prevent development of secondary hyperparathyroidism. Increase in bone resorption is known to occur irrespective of parathormone levels, suggesting a phenomenon of bone reshaping parallel to the loss of weight. Supplementation of fat-soluble vitamins is recommended, due to fat malabsorption resulting from BPD. Deficiency of these vitamins is more likely with a shorter common channel.

Cholelithiasis postoperatively occurs in 6% to 25%. Some surgeons advocate for routine cholecystectomy given the alteration in endoscopic accessibility to the biliary tract, whereas others argue for delayed cholecystectomy only if symptoms develop, since cholecystitis occurs uncommonly after BPD.

Guidelines for laparoscopic BPD ± DS

- In BPD, the common channel should be 60–100 cm, and the alimentary limbs 200–360 cm (level II, grade C).
- After BPD ± DS, close nutritional surveillance and supplementation are needed (level III, grade C).
- Laparoscopic BPD provides equivalent weight loss, shorter hospital stay, and fewer complications than open BPD (level III, grade C).
- BPD is effective in all BMI>35 kg/m² subgroups, with durable weight loss and control of co-morbidities beyond 5 years (level II, grade A).
- DS diminishes the most severe complications of BPD, including dumping syndrome and peptic ulceration of the anastomosis (level II, grade C).
- BPD may result in greater weight loss (level II, grade A) and resolution of comorbidities (level II, grade B) than other bariatric surgeries, but with the highest mortality rate (level II, grade A).
Laparoscopic Roux-en-Y gastric bypass

Introduction

As a means to combine restrictive, malabsorptive, and behavioral components to achieve weight loss, gastric bypass was first developed in the 1960s. Physiologic changes in the gastrointestinal tract after gastric bypass (dumping, neuroendocrine responses, etc.) also appear to influence weight loss and comorbidity improvements which may precede weight loss. Since then, modifications have included use of a small lesser curvature-based gastric pouch, gastric transaction, Roux-en-Y reconstruction, and variations in length of the alimentary limb. Feasibility of the laparoscopic approach to RGB was first shown in the early 1990s.

Technical considerations

The stomach is divided to form a small proximal gastric pouch and the small intestine is reconstructed using a Roux-en-Y to form an alimentary limb. Due to lack of accurate measurement of pouch volume it has become difficult, a retrospective study has suggested that smaller pouches may be associated with greater weight loss. Most surgeons choose the trans-section point by measuring from the esophagogastric junction or by counting vascular arcades.

The jejunum is typically divided below the ligament of Treitz when creating the Roux en-Y bypass, and the distal segment is elevated and surgically connected to the gastric pouch to create the alimentary (Roux) limb, with variations on the path and method for anastomoses. The proximal bowel segment, also called the bilipancreatic limb, is usually connected to the alimentary limb 75–150 cm distal to the gastrojejunostomy. This reconstruction serves to bypass the distal stomach, duodenum and a portion of jejunum to create malabsorption.

Several authors have addressed the issue of limb length during RGB. In BMI ≤ 50 kg/m² patients, both retrospective and prospective data fail to show a benefit for alimentary limbs longer than 150 cm. However, BMI >50 kg/m² patients who were randomized to a 250 cm rather than a 150 cm alimentary limb did show improved weight loss at 18 months, though the study was not powered to confirm this benefit at longer follow-up. Other studies have examined the use of alimentary limbs longer than 300 cm for BMI > 50 kg/m² patients, and have found improved weight loss over standard RGB, but with increased nutritional deficiencies and need for reoperation.

the available literature suggests an experience of 50–150 cases is required for surgeons to become safe and proficient; Laparoscopic RGB is a technically demanding procedure

Outcomes

The literature comparing laparoscopic RGB to open RGB and to contemporary medical and surgical treatments for obesity includes several prospective randomized controlled trials, a large prospective case-controlled cohort study, numerous case series, and four meta-analyses.

In terms of weight loss and resolution of co-morbidities Surgical therapy is clearly more effective than medical therapy. Morbidity obese patients employing behavioral and medical therapies alone actually gain weight in the long term. Surgical patients have lower 5 year mortality versus non-surgical patients (0.68% versus 6.17%), despite 0.4% perioperative mortality.

Patients who undergo laparoscopic RGB typically experience 60–70% EBWL, with >75% control of co-morbidities. In general, these outcomes are better than banding procedures, which have 45–50% EBWL and less predictable improvement of co-morbidities, but are less than BPD ± DS which has 70–80% EBWL with excellent control of co-morbidities.

Improvement of co-morbidities after bariatric procedure:

Open and laparoscopic RGB have similar efficacy. In prospective randomized trials, there are no significant differences in weight loss up to 3 years follow-up. Similar results have been reported in cases series.

Postoperative

After bariatric surgery close, long-term follow-up is recommended for patients. A typical example for recommendations of follow-up after laparoscopic RGB would be at 1–3 weeks, followed by quarterly visits during the first year and annually thereafter, to assess weight loss, resolution of co-morbidities, long-term complications, and need for continuing education and support. Patients are counseled to eat small, frequent meals of high protein and low carbohydrate content.

They should take long-term vitamin supplements (multivitamins, Vitamin B12, and calcium with some patients requiring iron supplementation) and undergo periodic blood testing to identify and treat deficiencies early. Patients should be encouraged to develop regular exercise practices. Two retrospective studies on the impact of follow-up on outcomes after laparoscopic RGB have been done; one suggests patient follow-up does not play an important role while the other reports improved weight loss in patients compliant with follow-up at 1 year.

Complications

In controlled trials, the mortality rate after RGB ranges from 0.3% in case series to 1.0% and the rate of preventable and nonpreventable adverse surgical events is 18.7%. The mortality rate in a review of selected laparoscopic RGB series ranged from 0.5% to 1.1%. Safety of laparoscopic RGB has been compared to open RGB, with laparoscopic patients having reduced incidence of anastomotic leakage, wound infection, incisional hernia and perioperative mortality, but higher rates of bowel obstruction, intestinal hemorrhage, and stomal stenosis.

The most frequently reported perioperative complications associated with laparoscopic RGB are wound infection (2.98%), anastomotic leak (2.05%), gastrointestinal tract hemorrhage (1.93%), bowel obstruction (1.73%), and pulmonary embolus (0.41%), while the most frequently reported late complications are stomal stenosis (4.73%), bowel obstruction (3.15%), and incisional hernia (0.47%).

Guidelines for laparoscopic RGB

- In laparoscopic RGB, a small lesser-curvature-based pouch that excludes the gastric fundus and a 75–150 cm alimentary (Roux) limb are effective for most patients (level II, grade B).
- Alimentary limbs longer than 150cm may improve intermediate-term weight loss but also may increase nutritional complications (level III, grade C).
- Long-term follow-up is recommended and may improve weight-loss outcomes (level III, grade C).
- Laparoscopic RGB is similar in efficacy to open RGB (level I, grade A), with reduced early complications and risk of hernia (level II, grade B).

Laparoscopic adjustable gastric banding

Introduction

As an alternative to gastric bypass, adjustable gastric bands have been developed to provide weight loss through a combination of restrictive and malabsorptive properties. These bands are placed around the proximal stomach and anastomosed to an alimentary limb formed from a portion of the jejunum. The bands are then adjustable to control the size of the gastric pouch, which limits food intake. This approach allows for gradual weight loss and offers the potential for reversibility, which is not possible with gastric bypass or other restrictive procedures.

Technical considerations

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- Alimentary limbs longer than 150cm may improve intermediate-term weight loss but also may increase nutritional complications (level III, grade C).
- Long-term follow-up is recommended and may improve weight-loss outcomes (level III, grade C).
- Laparoscopic RGB is similar in efficacy to open RGB (level I, grade A), with reduced early complications and risk of hernia (level II, grade B).
In the 1980s, the most common restrictive bariatric procedure was gastroplasty, with the most commonly performed iteration being the vertical banded gastroplasty. However, due to poor long-term weight loss and a high rate of late complications, alternatives to this operation were sought.

Open gastric banding procedures inspired laparoscopic AGB. It was first described in 1993, which involves the placement of a restrictive inflatable balloon device around the gastric cardia, approximately 1 cm below the gastroesophageal junction. This balloon is connected by tubing to a subcutaneous port which is attached to the rectus sheath. Balloon inflation caused by Saline injection into the port which results in narrowing of the stomach at the level of the balloon.

Various brands of laparoscopic AGB exist, though only the LAP-BAND® system and the REALIZE™ adjustable gastric band (Ethicon EndoSynergy, Cincinnati, OH) currently have Food and Drug Administration (FDA) approval for use in the USA. The equivalence between the two FDA-approved devices in the USA has been demonstrated, but comparative trials with others devices do not yet exist.

Technical considerations

The laparoscopic AGB is best placed via a pars flaccida approach, that is, via a retrogastric tunnel between the pars flaccida medially and the angle of His laterally. This has equivalent efficacy to the initially described perigastric approach, but has a significantly decreased rate of band slippage (i.e., gastric prolapse). The pars flaccida approach results in more extraneous tissue, particularly the lesser curvature fat pad, being incorporated into the band. Compensation by placing a band of greater diameter may be required to limit stomal obstruction.

At the time of placement, a peroral calibration balloon may be placed into the stomach, filled with 15–25 cc of saline, allowing the band is to be fastened below this level. A 15–25 cc pouch is thereby created.

AGB avoids the risks of gastrointestinal stapling and anastomosis and allows complete reversibility. Most authors agree laparoscopic AGB is less technically demanding and less morbid than laparoscopic RGB. However, potential disadvantages of laparoscopic AGB compared to laparoscopic RGB include the ongoing need for band adjustments, delayed or unsatisfactory weight loss, and unique indications for re-operation such as pouch dilatation, esophageal dilatation, band slippage, band erosion, port-site complications, or leaks from the device.

Outcomes

Laparoscopic AGB has been compared to intensive pharmacotherapy, behavioral modification, diet modification, and exercise in patients with BMI 30–35 kg/m². In this population, laparoscopic AGB was seen to be more effective in inducing weight loss, resolving metabolic derangements, and improving quality of life.

Laparoscopic AGB is very useful at producing weight loss, with patients losing approximately 50% of their excess body weight. This weight loss occurs in a gradual manner, with approximately 35% EBWL by 6 months, 40% by 12 months, and 50% by 24 months. This percentage appears to remain stable after 2–3 years based on the few studies providing this length of follow-up. However, as many as 25% of laparoscopic AGB patients fail to lose 50% of their excess body weight by 5 years

Laparoscopic AGB has positive effects on the co-morbidities of obesity. Type 2 diabetes is improved in about 90% of patients, due to increased insulin sensitivity and increased pancreatic beta-cell function, and diabetics medications are eliminated in 64%. Following AGB, resolution of type 2 diabetes mirrors weight loss, and therefore is slower to occur than after RGB or BPD where the diabetes is seen to begin to improve before significant weight loss.

Symptoms of gastroesophageal reflux disease may be eliminated in at least 89% at 12 months, even in patients with large hiatal hernias, but with the side-effect of impaired lower esophageal sphincter relaxation and possible increased esophageal motility. Rate of obstrusive sleep apnea drops from 33% to 2% in laparoscopic AGB patients. Major quality-of-life improvements are seen after AGB placement, with all subscales of the SF-36 general quality-of-life questionnaire significantly improved, particularly in areas of bodily pain, general health perception, and mental health perception.

The short-term (< 12 months) weight loss of laparoscopic AGB is inferior to RGB. This inconsistency is seen to continue, with a randomized controlled trial illustrating that EBWL at 5 years was 47.9% for AGB versus 66.8% for RGB. Still, life-threatening complications are less frequent in laparoscopic AGB as compared to laparoscopic RGB.

Postoperative

Successful weight loss after laparoscopic AGB requires close follow-up for band adjustments, education, and support. In the absence of comparative data, guidelines for follow-up and adjustment are based on manufacturer recommendations and expert opinion. Physicians with extensive experience placing and managing the AGB adhere to a number of basic tenets necessary for successful weight loss. To prevent vomiting and dislodgment of the band immediately after operation, oral intake is restricted to liquids and soft foods. After a recovery period, the diet is transitioned to solid foods that induce satiety and no symptoms of satiety. Adjustment is not needed if there is adequate weight loss, satiety, and tolerance. Fluid should be removed for vomiting, coughing, choking, or significant food intolerance. Bands may be adjusted with or without radiographic guidance with acceptable results.

Complications

Case series and systematic reviews put early mortality rates after laparoscopic AGB at 0.05–0.4%, compared with laparoscopic RGB at 0.5–1.1%, open RGB at 0.5–1.0%, open BPD at 1.1%, and laparoscopic BPD at 2.5–7.0%.

Comparative data are few, regarding relative mortality rates. Overall complications and major complications are less common in laparoscopic AGB than laparoscopic RGB or laparoscopic BPD, in a single-center experience.

Mortality/morbidity after laparoscopic bariatric procedures

Recent reviews of a multicenter, prospective US trial of laparoscopic AGB placement by the perigastric approach found uncommon occurrence of gastrointestinal perforation (1%) or other visceral injury (1%). Band-related complications accumulated over 5-year follow-up, such as slippage/pouch dilatation (24%), esophageal dilatation (8%) and stomal obstruction (14%). Port-site complications, including pain, port displacement, and leak, arose in about 7% of patients. Mean explantation or major revision rate by 9 years was 39%.

In contrast, a parallel review of a subsequent trial which implemented the pars flaccida technique found reduced slippage/pouch dilatation (7%), esophageal dilatation (1%), and stomal obstruction (2%) at 1 year. Non-US surgeons have also outmatched the pars flaccida method to reduce band-specific complications. One pure pars flaccida series with 7-year follow-up reported 12% slippage/pouch dilatation, however the cumulative reoperation rate was 32%.

Guidelines for laparoscopic AGB

- The pars flaccida approach for laparoscopic AGB placement should be used in preference to the perigastric approach in order to decrease the incidence of gastric prolapse
- Laparoscopic AGB is effective in all BMI subgroups, with durable weight loss and control of comorbidities past 5 years (level I, grade A).
- Intermediate-term weight loss after laparoscopic AGB may be less than after laparoscopic RGB (level I, grade A).
- Frequent outpatient visits are suggested in the early postoperative period. Band filling should be guided by weight loss, satiety, and patient symptoms (level III, grade C).
Surgery—Revision

Patients may require revision of prior bariatric procedures because of: (1) anatomic failure with persistent or recurrent obesity, (2) need for reversal, or (3) development of secondary complications.

Anatomic failure

In planning revisional bariatric operations, surgeons must have an understanding of the prior procedures and typical anatomic complications, as well as the current state of the relevant anatomy. In past decades, several procedures have been tested and have since fallen out of favor. A number of pure restrictive procedures that involved gastric partitioning with staples have been limited by stomal dilatation or recanalization of nondilated staple lines. Even procedures acceptable by today’s standards, such as VBG, RGB, and AGB are at risk for anatomic derangement that may be amenable to surgical revision. In recent years, the explosion of bariatric surgery has also resulted in application of interventions that may create unfamiliar anatomy and complications for surgeons performing revisional procedures. For all these reasons, it is vital the surgeon makes every effort to define the prior procedure(s) performed by medical record review and preparative radiographic and endoscopic assessment.

Upper GI contrast studies may define the location and integrity of gastric staple lines, as well as the nature and patency of outflow from the proximal stomach. Endoscopy will assess for ulcers and internalized foreign bodies, and allow for therapeutic dilation in some cases. Indirect evidence of gastric or intestinal motor dysfunction may also be appreciated. Finally, in some cases, imaging by CT scan will allow for visualization of pathology in excluded portions of the anatomy or suggest internal hernias.

Patients who never lose weight may have had a technical complication such as incomplete stapling, or an inappropriate operation. Those who regain weight after years may have suffered staple line re-canilization or behavioral failure. Re-operation on a previous gastroplasty usually involves creating a Roux-en-Y, if not already present, to a newly stapled proximal stomach pouch above all prior gastric interventions. However, BPD, AGB, and other operations have also been employed in this setting. Likewise, most authors advocate RGB for revision of AGB because of complications or insufficient weight loss, although other operations have been applied. Finally, in cases of failed BPD+DS some have advocated use of a pouch reduction procedure, and in failed RGB use of either AGB to improve the restrictive component or lengthening to improve the malabsorptive component. Comparative data are lacking.

Secondary complications

When unexpected complications emerge over time, in some cases, bariatric procedures require revision. For example, the jejunoileal bypass resulted in dramatic weight loss, but became marred by the occurrence of malabsorptive complications including renal and hepatic failure. The importance of long-term follow-up is a lesson that must not be forgotten as new procedures are introduced.

Contemporary bariatric patients may seek revision due to evolution of other conditions or complications, such as gastrosophageal reflux (GER), bile reflux, complicated ulcers, or obstruction. Severe GER may occur after gastropasty or VBG in the absence of outflow obstruction, whereas bile reflux may occur in procedures that utilize Billroth II gastrojejunostomy. In either case, conversion to RGB is therapeutic. In the healing phase easily treated marginal ulcers are common, but later should raise concern for salicylate or NSAID abuse, or gastrogastric fistula. Late gastrojejunostomy fistula closure may be a difficult procedure requiring laparoscopy, sometimes with resection, whereas marginal ulcer perforation is more easily managed with a laparoscopic approach. Obstruction due to internal herniation may require major resection and intestinal reconstruction.

Excessive weight loss, statorrhoea, or evolution of severe nutritional complications, particularly protein-calorie malnutrition, may indicate an excessively long malabsorptive component. Proximal relocation of the pancreaticobiliary secretions by intestinal reconstruction should be considered. One option is to relocate the junction of the biliary and alimentary limbs more proximally, with a 50 cm distance being suggested by Hamoui. An alternative, and a technically easier operation is to leave the original anastomosis intact and to create another enterenterostomy 100 cm proximally, allowing for more proximal partial mixing of biliary and pancreatic secretions with the alimentary limb contents. This is effective in resolving malnutrition and diarrhea, while causing minimal weight gain. However, presumably due to the poor physiological state of the malnourished patient, complication rates are high even in this simple procedure.

Desire for reversal

Ease of reoperation after laparoscopic AGB is one of the putative benefits, and up to 33% of patients may come to reversal or major revision. Laparoscopic RGB and BPD cause more dramatic anatomic changes that trade ease and possibility of reversal for better weight loss outcomes and independence from an implantable device.

Role of laparoscopy in revisional procedures

Revisional bariatric operations may be performed laparoscopically or via open technique. Complications are more common after primary bariatric procedures than before re-operations. Surgeons may prefer an open approach to address severe adhesions, or to permit tactile localization of prior partitions in the stomach to avoid creating undrained or ischemic segments during restapling. Foreign-body removal and partial gastric resection may also be required. Drain placement is often performed in response to a recognized increased possibility of leak.

Guidelines for revision bariatric surgery

- Prior to elective procedures, anatomy should be defined by review of available records, plus radiographic and/or endoscopic assessment (level II, grade B).
- Laparoscopic revisional procedures may be performed safely, but with more complications than primary bariatric procedures, therefore the relative risks and benefits of laparoscopy should be considered on a case-by-case basis (level III, grade C).

Summary

Bariatric surgery is medically indicated for morbidly obese patients who fail to respond to dietary, behavioral, nutritional, and medical therapies, with clear evidence of efficacy and safety. If the risk-versus-benefit analysis favors surgery BMI and age-based candidacy guidelines should not limit access for patients suffering with progressive or poorly controlled obesity-related co-morbidities. Laparoscopic RGB, AGB, and BPD have all been proven effective.

Given the marked paucity of prospectively collected comparative data between the different bariatric operations, it remains impossible to make definitive recommendations for one procedure over another. At the present time, decisions are driven by patient and surgeon preferences, as well as considerations regarding the degree and timing of necessary outcomes versus tolerance of risk and lifestyle change.

Until the emergence of additional randomized controlled comparative studies, decisions between procedures will depend upon the present evidence and the relative importance placed by patients and surgeons on purported discriminating factors.