Practice/Clinical Guidelines published on: 06/2008
by the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES)

SAGES guideline for clinical application of laparoscopic bariatric surgery

SAGES Guidelines Committee
endorsed by the ASMBS

Received: 20 March 2008 / Accepted: 25 March 2008

Abbreviations	
AGB	Adjustable gastric band
BMI	Body mass index
BPD	Biliopancreatic diversion
DS	Duodenal switch
EBWL	Excess body weight loss
RGB	Roux-en-Y gastric bypass
NIH	National Institutes of Health

Preamble

Approximately one-third of US adults are obese [1]. The health consequences of severe obesity have been well described [2]. Current evidence suggests surgical therapies offer the best hope for substantial and sustainable weight loss in the extremely obese [3], with resultant mortality reduction [4]. These truths, coupled with improved minimally invasive bariatric procedures, have driven a fourfold increase in the population-based rate of bariatric surgery over recent years [5].

This document is intended to guide surgeons applying laparoscopic techniques to the practice of bariatric surgery. It will not address credentialing of surgeons or centers, which is the focus of SAGES Guideline for Institutions Granting Bariatric Privileges Utilizing Laparoscopic Techniques and ASMBS Guideline for Granting Privileges in Bariatric Surgery. The current recommendations are graded and linked to the evidence utilizing the definitions in appendices A and B.

This statement was prepared by the Guidelines Committee of the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES), with input from the Clinical Issues Committee of the American Society for Metabolic and Bariatric Surgery (ASMBS). The final document was approved by the SAGES Board of Governors June, 2008, and co-endorsed by the ASMBS Board of Governors June, 2008.

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SAGES Disclaimer

Clinical practice guidelines are intended to indicate the best available approach to medical conditions as established by a systematic review of available data and expert opinion. The approach suggested may not necessarily be the only acceptable approach given the complexity of the healthcare environment. These guidelines are intended to be flexible, as the surgeon must always choose the approach best suited to the patient and to the variables at the moment of decision. These guidelines are applicable to all physicians who are appropriately credentialed regardless of specialty and address the clinical situation in question.

These guidelines are developed under the auspices of SAGES, the guidelines committee and approved by the Board of Governors. The recommendations of each guideline undergo multidisciplinary review and are considered valid at the time of production based on the data available. New developments in medical research and practice pertinent to each guideline are reviewed, and guidelines will be periodically updated.

ASMBS Disclaimer

Guidelines are not intended to provide inflexible rules or requirements of practice and are not intended, nor should they be used, to state or establish a local, regional, or national legal standard of care. Ultimately, there are various appropriate treatment modalities for each patient, and the surgeon must use judgment in selecting from among feasible treatment options.

ASMBS cautions against the use of guidelines in litigation in which the clinical decisions of a physician are called into question. The ultimate judgment regarding appropriateness of any specific procedure or course of action must be made by the physician in light of all the circumstances presented. Thus, an approach that differs from this guideline, standing alone, does not necessarily imply that the approach was below the standard of care. To the contrary, a conscientious physician may responsibly adopt a course of action different from that set forth in the guideline when, in the reasonable judgment of the physician, such course of action is indicated by the condition of the patient, limitations on available resources or advances in knowledge or technology.

All that should be expected is that the physician will follow a reasonable course of action based on current knowledge, available resources, and the needs of the patient, in order to deliver effective and safe medical care. The sole purpose of this guideline is to assist practitioners in achieving this objective.

Introduction and rationale for surgery

The United States of America has experienced a steady rise in obesity prevalence over the last 20 years and currently ranks second in the world [6]. At the turn of the millennium, nearly two-thirds of Americans were overweight or obese, and almost 5% were morbidly obese [7]. This trend is ominous, because morbid obesity predisposes patients to comorbid diseases which affect nearly every organ system. These include: type 2 diabetes, cardiovascular disease, hypertension, hyperlipidemia, hypoventilation syndrome, asthma, sleep apnea, stroke, pseudotumor cerebri, arthritis, several types of cancers, urinary incontinence, gallbladder disease, and depression [8–10]. Obesity shortens life expectancy [11], with increasing body mass index (BMI) resulting in proportionally shorter lifespan [12]. With over 300,000 victims in the USA each year, morbid obesity is projected to overtake smoking as the leading cause of death in the near future [13].

There are now more than nine million morbidly obese Americans who need help. However, nonoperative management with diet, exercise, behavior modification, and medications rarely achieves adequate durable weight loss [14]. Four long-term studies of nonoperative management of obesity showed an average weight loss of only 4% [15–18]. In the recent Swedish Obese Subjects prospective controlled study, medical management over ten years was associated with 1.6% increase in body weight compared with 13.2% weight loss after gastric band and 25% weight loss after gastric bypass [19].

Since the advent of minimally invasive therapies, there has been a dramatic increase in gastrointestinal procedures that produce significant sustainable weight loss with low complication rates [19–22]. Surgically induced weight loss is associated with resolution or improvement of comorbid diseases in 75–100% of patients [22], and reduced mortality compared with medically treated patients [23–25]. Public awareness and demand, along with improved systems for surgeon training and delivery of care, have combined to fuel a national explosion in bariatric procedures. In 2003, 102,798 operations were performed in the USA, compared with only 13,365 in 1998 [26].

Justification for surgical treatment of obesity

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

Evolution of contemporary surgical options

Operations to alter the gastrointestinal tract and produce weight loss have been applied for half a century. Weight-loss operations may cause malabsorption, restriction of food intake, or a combination of the two. The original operation for morbid obesity, the jejunoileal bypass, was first performed in 1954. However, this purely malabsorptive operation led to unacceptable morbidity and mortality related to bacterial overgrowth and liver damage [27]. Focus shifted away from purely malabsorptive procedures until the 1970s when biliopancreatic diversion (BPD) was first described [28], with eventual description of duodenal switch (DS) in 1993 [29]. This operation has been applied laparoscopically with effective weight loss [30].

Gastric bypass was introduced by Mason in 1966 as a combined restrictive–malabsorptive procedure [31]. Several variations and modifications of the original procedure have evolved over time, such as complete gastric transection, reduction in gastric pouch size, and application of a Roux-en-Y[32].

As of 2003, Roux-en-Y gastric bypass (RGB) accounted for over 80% of all bariatric procedures done in the USA [26]. Laparoscopic RGB was popularized and validated in the early 1990s by Wittgrove and Clark [33], and several corroborating series have followed [34–37].Differences exist in the technique for laparoscopic gastrojejunostomy as part of the procedure, including transoral circular stapler [33], transgastric circular stapler [35], linear stapler [36], and handsewn [37], but all are supported in the literature as producing similar safety and weight loss results.

Mason and Printen developed a purely restrictive operation, the gastroplasty, in the early 1970s [38]. This operation later developed into vertical banded gastroplasty (VBG) [39], and ultimately laparoscopic VBG by the 1990s [40]. Despite efforts to simplify the procedure [41], gastroplasty operations decreased and only accounted for 7% of US bariatric procedures in 2002 [26]. Stomach banding for weight loss, originally introduced in the 1980s with non-adjustable devices, became popular in the early 1990s [42]. In 1993, Belachew and Legrand placed the first laparoscopic adjustable gastric band (AGB) using the LAP-BAND® system (Allergan Inc, Irvine, CA, USA) [43]. Although there are multiple versions of AGB available for laparoscopic use, 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, while 26% were laparoscopic RGB and 23% were open gastric bypass [44].

Another contemporary restrictive procedure that derives from the concept of vertical gastroplasty is the laparoscopic sleeve gastrectomy (LSG). LSG developed as a first-stage procedure before duodenal switch or gastric bypass in high-risk patients [45, 46]. Studies have shown that LSG used in this manner reduces weight, comorbidities, and operative risk (ASA score) at the time of a second bariatric procedure [47–49]. There is increasing application of LSG as a primary weight loss operation [45, 46, 50, 51]. Evolving data demonstrate LSG provides substantial weight loss and resolution of comorbidities to 3–5 years follow-up [45, 47, 52–54]. Early comparative data demonstrate percent EBWL at 1 year superior to AGB and approaching that of RGB and BPD [55]. There are other minimally invasive weight loss procedures in developmental stages. Gastric pacing, which has been in development in Europe for over 10 years, has shown acceptable safety and early efficacy (<15 months), though its use is appropriately limited to clinical trials until more mature data become available [56].

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 comorbidities 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/m^2 or ≥ 35 kg/m^2 with comorbidities), have failed attempts at diet and exercise, are motivated and well informed, and are free of significant psychological disease [57]. In addition, the expected benefits of operation must outweigh the risks. Surgery for morbid obesity has a low failure rate, with a mean EBWL of 61.2% [22]. Adverse events vary between procedures, but may reach 20% in high risk patients. Mortality rates approximate 0.1% for gastric banding, 0.5% for RGB, and 1.1% for BPD [22]. There are no absolute contraindications to bariatric surgery. 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 dependency, and severely impaired intellectual capacity. Crohn’s disease may be a relative contraindication to RGB [58] and BPD [59], and is listed by the manufacturer as a contraindication to the LAP-BAND® system.

Laparoscopic surgery may be difficult or impossible in patients with giant ventral hernias, severe intra-abdominal adhesions, large liver, high BMI with central obesity or physiological intolerance of pneumoperitoneum. Surgeons performing bariatric surgery should possess the necessary skills to perform open bariatric surgery in the event it becomes necessary to convert to an open procedure [32].

Weight loss surgery for individuals with BMI ≤ 30–35 kg/m^2 and comorbidities merits consideration given the poor results of nonoperative weight loss regimens [60]. 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 [61]. Another report of 37 patients undergoing RGB showed excellent weight loss and near-complete resolution of comorbidities [62]. Further data are necessary before surgery for BMI < 35 kg/m^2 becomes standard practice.

Early in the laparoscopic bariatric era, many traditional programs declined super-obese (BMI > 50 kg/m^2) or supersuper-obese patients (BMI > 60 kg/m^2) because of perceived high risk and technical challenge. However, as endosurgical techniques and equipment have improved, laparoscopic RGB and AGB have been more liberally applied at extreme BMIs, with consequent health and quality-of-life benefits, acceptable rates of morbidity and mortality, but lower EBWL [63–71]. Laparoscopic BPD+DS may also be appropriate for super-obese patients given the superior weight loss over laparoscopic RGB [72].

Age restrictions are less rigidly employed in the current era of refined anesthesiology, effective critical care, and high quality surgical outcomes. Laparoscopic bariatric surgery has been performed in patients older than 55–60 years [73–75], but with comparatively less weight loss, longer length of stay, higher morbidity and mortality, and less complete resolution of comorbidities compared with younger patients. Still, the reduction in comorbidities supports use of laparoscopic RGB or laparoscopic AGB in well-selected older patients [76–83].

At the time of the NIH consensus conference in 1991, bariatric surgery for morbidly obese children and adolescents was not advised because of insufficient data. However, with pediatric obesity increasing in prevalence and severity, interest in adolescent bariatric surgery is growing [84]. RGB is well tolerated and produces excellent weight loss in patients younger than 18 years with 10-year follow-up [85–91]. Advocates believe weight reduction at an early age will prevent or minimize emotional and physical consequences of obesity [92]. Well-designed prospective studies are just emerging to better define the place for adolescent bariatric surgery [93].

Guidelines for patient selection

- 1991 NIH consensus guidelines provide valid but incomplete patient selection criteria for contemporary bariatric procedures including laparoscopic BPD ± DS, RGB, VGB and AGB (level II, grade A).
- Other well-selected patients may benefit from laparoscopic bariatric surgery by experienced surgeons:
  –BMI > 60 kg/m^2 (level II, grade A).
  –Patients > 60 years (level II, grade B).
- Adolescent 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).
- Individuals with BMI 30–35 kg/m^2 may benefit from laparoscopic bariatric surgery (level I, grade B).

Bariatric program and facility

The etiology of morbid obesity seems to involve genetic, environmental, metabolic, and psychosocial factors [94]. Therefore, treatment of the bariatric patient lends itself to a team approach for systematic evaluation and management [95]. Although a multidisciplinary team is seen as an important component of a bariatric surgery practice [32, 56, 96, 97], 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 as per the SAGES Guidelines 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, gastroenterologists, etc.) to help evaluate and optimize patients preoperatively and to provide care postoperatively if necessary [32, 96, 97].

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 supermorbid obesity. In the operating room, specially rated tables and attachments, extra-long instruments, and appropriate staplers and retractors are necessary [97]. Healthcare providers and staff must be experienced with and sensitive to the special needs of bariatric patients, and protected against ergonomic and lifting injuries.

Postoperative support groups are also an important aspect of a bariatric program and may improve postoperative results and limit relapse [32, 97, 98, 99]. Two nonrandomized studies have shown that patients attending support groups achieve greater weight loss than those who do not [100, 101].

Hospital annual case volume above 100 may be associated with reduced morbidity and mortality and improved costs [102]. Higher surgeon volume has been associated with reduced mortality [103]. Center of Excellence designation programs have gained traction [95] and are maintained by the American College of Surgeons [104] and the American Society for Metabolic and Bariatric Surgery [105].

Guidelines for bariatric programs

- 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).

Preoperative workup

The preoperative evaluation is similar for all bariatric procedures. 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 comorbid diseases. Typical assessment includes psychological testing, nutrition evaluation, and medical assessment [97, 106].

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 [107]. Patients with psychiatric disorders may have a suboptimal outcome after bariatric surgery [107]. However, no consensus recommendations exist regarding preoperative psychological evaluation [106, 108]. A recent survey reported that 88% of US bariatric programs utilize some psychological evaluation, with half requiring a formal standardized assessment [106]. Many insurance companies require such psychological evaluation prior to granting precertification 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 [106, 109, 110]. It is not certain which psychosocial factors predict success following bariatric surgery [108], 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 [106].

Nutrition consult

The nutrition professional is an integral part of multidisciplinary bariatric care [111, 112]. He or she is charged with nutritional assessment, diet education regarding postoperative eating behaviors, and preoperative weight loss efforts [113]. Preoperative very-low-calorie diet for 6 weeks has been shown to reduce liver volume by 20% and to improve access to the upper stomach during laparoscopic surgery [114, 115], with 80% of the volume change occurring in the first 2 weeks [114]. Furthermore, patients who are able to achieve 10% EBWL preoperatively have shorter hospitalization and more rapid weight loss [116].

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 [117, 118]. 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. Outcome studies and clinical trials are necessary to help define the role of the nutrition professional in the bariatric team.

Preoperative medical evaluation

Medical assessment prior to bariatric surgery is similar to abdominal operations of the same magnitude. Thorough history and physical examination with systematic review is used to identify comorbidities that may complicate the surgery. Consultation with a medical subspecialist is often necessary to optimize medical conditions to reduce perioperative risk.

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 [119]. 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 [98, 120].

Guidelines for preoperative preparation

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

Surgical techniques and outcomes (presented in order of introduction above)

Laparoscopic biliopancreatic diversion

Introduction

After jejunoileal bypass was abandoned [121], most of the bariatric community focused on restrictive operations [122]. However, Scopinaro revisited the value of malabsorption in his description of the BPD in the late 1970s

[28]. Since then, modifications have included the duodenal switch [123], the sleeve gastrectomy [29], and the laparoscopic approach [124]. DS diminishes the most severe complications of BPD, including dumping syndrome and peptic ulceration of the anastomosis [125]. 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 [125, 126]. The laparoscopic approach decreases wound complications, pain and hospital length of stay [127].

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 transection to a point 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 approximately 100 cm^3. The duodenum is divided 3 cm distal to the pylorus, and duodenoileostomy establishes continuity of the alimentary limb. Limb lengths determine weight loss and complications. 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 [128]. Scopinaro, in his original animal study [129], 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 [28], he noted that ‘‘the exact length of the common ileal segment and the length of the jejunum in the biliopancreatic tract required to achieve maximum weight reduction with minimum complications have yet to be determined.’’ Hess [130] 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 200–360 cm [131, 132].

A US study suggests common channels longer than 100 cm result in inferior results [132]. In a comparative study of outcomes and complications, 100 cm common channel was superior to 50 cm, and sleeve gastrectomy was superior to distal gastrectomy [125]. 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 [133, 134]. Laparoscopic BPD has reduced hospital stay and complications, mainly due to a lower rate of wound infections and dehiscence [127]. Laparoscopic BPD is an advanced, complex and feasible technique in bariatric surgery, and one which has a steep learning curve [135].

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/m^2, and 70% of those with BMI>50 kg/ m^2, achieve greater than 50% excess body weight loss [29, 136, 137]. Weight may be regained over time [138], highlighting the importance of long-term follow-up.

BPD dramatically impacts comorbidities. At least 90% of patients with type 2 diabetes will cease diabetic medications by 12–36 months [127, 128, 139]. Of hypertensive patients 50–80% will be cured, with another 10% experiencing improvement [140–142]. Up to 98% of patients with obstructive sleep apnea symptoms will have resolution [143, 144].

Although BPD, RGB, 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 [143, 145]. Likewise, BPD may be superior to RGB in patients with BMI ≥50 kg/m^2 [71].

Percent EBWL after bariatric procedures [145]

Operation		Mean follow-up (years)							
		[redacted]							
BPD	% EBWL	71.8	75.1	76.3	75.5	73.3	69	75.8	77.0
	Aggregate N	896	1623	410	410	174	89	405	122
	# studies	4	3	4	3	3	1	2	1
RGB (proximal)	% EBWL	67.3	67.5	62.5	58.0	58.2	55.0		52.5
	Aggregate *N*	1627	385	285	509	176	2		194
	# studies	7	5	4	4	3	1		2
AGB	% EBWL	42	57.2	54.8	54.5	55.2	51.0	59.3*	
	Aggregate N	4456	3383	3104	1435	640	29	100	
	# studies	11	11	12	9	5	2	1	

* 42 patients with 8-year follow-up and band not removed [146]

A meta-analysis examining studies published between 1990 and 2003 found BPD resulted in more weight loss and improvement of diabetes, hyperlipidemia, hypercholesterolemia, hypertriglyceridemia, and obstructive sleep apnea than any other type of bariatric procedure [22].

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 [29].

Postoperative

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

Close follow-up is recommended in the postoperative period. 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 [126, 131]. 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% [134, 147]. 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 [29, 147–150], or later bowel obstruction, incarceration or stricture [151].

The performance of a sleeve gastrectomy as part of the BPD+DS allows patients two-thirds of their preoperative dietary volume without specific food intolerances. Between 70 and 98% maintain normal serum albumin 3 years after surgery [29, 126]. Diarrhea is a frequent chronic complication of BPD. Common channel length of 50 cm is associated with reports of diarrhea in most patients [126], whereas length of 100 cm is not [29]. Iron deficiency is common, with serious iron deficiency anemia (hemoglobin <10 mg/dl) occurring in 6% of patients [152]. Surveillance of biochemical and hematological markers of iron deficiency should drive replacement. Calcium and vitamin D malabsorption are also common, manifesting as secondary hyperparathyroidism [153]. 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 [154]. Due to fat malabsorption resulting from BPD, supplementation of fat-soluble vitamins is recommended. Deficiency of these vitamins is more likely with a shorter common channel.

Cholelithiasis postoperatively occurs in 6% [155] to 25% [28]. 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 [156].

Guidelines for laparoscopic BPD ± DS

- In BPD, the common channel should be 60–100 cm, and the alimentary limb 200–360 cm (level II, grade C).
- DS diminishes the most severe complications of BPD, including dumping syndrome and peptic ulceration of the anastomosis (level II, grade C).
- BPD is effective in all BMI>35 kg/m^2 subgroups, with durable weight loss and control of co-morbidities beyond 5 years (level II, grade A).
- Laparoscopic BPD provides equivalent weight loss, shorter hospital stay, and fewer complications than open BPD (level III, 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).
- After BPD ± DS, close nutritional surveillance and supplementation are needed (level III, grade C).

Laparoscopic Roux-en-Y gastric bypass

Introduction

Gastric bypass was first developed in the 1960s as a means to combine restrictive, malabsorptive, and behavioral components to achieve weight loss. 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 transection, Roux-en-Y reconstruction, and variations in length of the alimentary limb [157, 158]. Feasibility of the laparoscopic approach to RGB was first shown in the early 1990s [33].

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. Although accurate measurement of pouch volume is difficult and prospective data are lacking, a retrospective study has suggested that smaller pouches may be associated with greater weight loss [159]. Most surgeons choose the transection point by measuring from the esophagogastric junction or by counting vascular arcades.

When creating the Roux en-Y bypass, the jejunum is typically divided below the ligament of Treitz, 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 anastomosis. The proximal bowel segment, also called the biliopancreatic 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 [157].

Several authors have addressed the issue of limb length during RGB. In BMI ≤ 50 kg/m^2 patients, both retrospective [160] and prospective [161, 162] data fail to show a benefit for alimentary limbs longer than 150 cm. However, BMI >50 kg/m^2 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 [162]. Other studies have examined the use of alimentary limbs longer than 300 cm for BMI > 50 kg/m^2 patients, and have found improved weight loss over standard RGB, but with increased nutritional deficiencies and need for reoperation [163, 164].

Laparoscopic RGB is a technically demanding procedure; the available literature suggests an experience of 50–150 cases is required for surgeons to become safe and proficient [34, 36, 165–168].

Outcomes

The literature comparing laparoscopic RGB to open RGB and to contemporary medical and surgical treatments for obesity includes several prospective randomized controlled trials [161, 169–175], a large prospective case-controlled cohort study [19], numerous case series, and four metaanalyses [2, 21, 22, 176].

Surgical therapy is clearly more effective than medical therapy in terms of weight loss and resolution of comorbidities. Morbidly obese patients employing behavioral and medical therapies alone actually gain weight in the long term [2, 19]. Surgical patients have lower 5 year mortality versus nonsurgical patients (0.68% versus 6.17%), despite 0.4% perioperative mortality [177].

Patients who undergo laparoscopic RGB typically experience 60–70% EBWL, with >75% control of comorbidities [2, 19, 21, 22]. In general, these outcomes are better than banding procedures, which have 45–50% EBWL and less predictable improvement of comorbidities, but are less than BPD ± DS which has 70–80% EBWL with excellent control of comorbidities [22].

Improvement of comorbidities after bariatric procedures [22]

Operation	Diabetes resolved	Hypercholesterolemia improved	Hypertension resolved	Sleep apnea resolved
Banding	47.8%	71.1%	38.4%	94.6%
RGB	83.8%	93.6%	75.4%	86.6%
BPD	97.9%	99.5%	81.3%	95.2%

Open and laparoscopic RGB have similar efficacy. In prospective randomized trials [169–171, 174], there are no significant differences in weight loss up to 3 years follow-up. Similar results have been reported in cases series [176].

Postoperative

Close, long-term follow-up is recommended for patients after bariatric surgery [57]. 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 comorbidities, 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 [178, 179].

Complications

The mortality rate after RGB ranges from 0.3% in case series to 1.0% in controlled trials, and the rate of preventable and nonpreventable adverse surgical events is 18.7% [21]. The mortality rate in a review of selected laparoscopic RGB series ranged from 0.5% to 1.1% [180]. Safety of laparoscopic RGB has been compared to open RGB, with laparoscopic patients having reduced incidence of iatrogenic splenectomy, wound infection, incisional hernia and perioperative mortality, but higher rates of bowel obstruction, intestinal hemorrhage, and stomal stenoses [181].

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%) [181].

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).
- 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).
- Long-term follow-up is recommended and may improve weight-loss outcomes (level III, grade C).

Laparoscopic adjustable gastric banding

Introduction

In the 1980s, gastroplasty was the most common restrictive bariatric procedure, with the most commonly performed iteration being the vertical banded gastroplasty. However, due to poor long-term weight loss [182, 183] and a high rate of late complications, alternatives to this operation were sought [184].

Open gastric banding procedures inspired laparoscopic AGB, first described in 1993 [43], 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. Saline injected into the port will cause balloon inflation 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 Endosurgery, 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 [185], 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) [186–188]. 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 [71, 189]. However, potential disadvantages of laparoscopic AGB compared to laparoscopic RGB include the ongoing need for band adjustments, delayed or unsatisfactory weight loss [190], and unique indications for reoperation such as pouch dilation, esophageal dilation, band slippage, band erosion, port-site complications, or leaks from the device [185].

Outcomes

Laparoscopic AGB has been compared to intensive pharmacotherapy, behavioral modification, diet modification, and exercise in patients with BMI 30–35 kg/m^2. In this population, laparoscopic AGB was seen to be more effective in reducing weight, resolving metabolic derangements, and improving quality of life [61].

Laparoscopic AGB is very effective at producing weight loss, with patients losing approximately 50% of their excess body weight [22, 191]. 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 3–8 years based on the few studies providing this length of follow-up [145, 192–194]. However, as many as 25% of laparoscopic AGB patients fail to lose 50% of their excess body weight by 5 years [22, 190].

Laparoscopic AGB has positive effects on the comorbidities of obesity. Type 2 diabetes is improved in about

90% of patients, due to increased insulin sensitivity and increased pancreatic beta-cell function [195], and diabetic medications are eliminated in 64% [196, 197]. 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 [196, 198].

Symptoms of gastroesophageal reflux disease may be eliminated in at least 89% at 12 months, even in patients with large hiatal hernias [199, 200], but with the side-effect of impaired lower esophageal sphincter relaxation and possible altered esophageal motility [201]. Rate of obstructive sleep apnea drops from 33% to 2% in laparoscopic AGB patients [202]. 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 [203–205].

The short-term (< 12 months) weight loss of laparoscopic AGB is inferior to RGB [206]. This discrepancy is seen to continue, with a randomized controlled trial illustrating that EBWL at 5 years was 47.5% for AGB versus 66.6% for RGB [207]. 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. Immediately after operation, oral intake is restricted to liquids and soft foods to prevent vomiting and dislodgment of the band. After a recovery period, the diet is transitioned to solid foods that induce satiety and no-calorie liquids between meals. Eventually, a wide range of foods is tolerated, though whole meats and heavy breads may always cause dysphagia or regurgitation. To avoid protein–calorie malnutrition and loss of lean body mass, diets should focus on protein and complex carbohydrate intake, with a limited quantity of simple sugars and fats. Physical activity is recommended to maintain lean body mass and to improve cardiovascular fitness and total weight loss.

In the initial postoperative period, most advocate leaving the band unfilled. The first adjustment usually occurs about 6 weeks after placement with initial and subsequent fill volumes determined by band type and patient factors. Fluid should be added if weight loss falls below expectations, or if meal volumes increase with loss 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 solid food intolerance. Bands may be adjusted with or without radiographic guidance with acceptable results [208].

Complications

Case series and systematic reviews put early mortality rates after laparoscopic AGB at 0.05–0.4% [21, 209], compared with laparoscopic RGB at 0.5–1.1% [180], open RGB at 0.5–1.0% [21, 22], open BPD at 1.1% [21], and laparoscopic BPD at 2.5–7.6% [134, 147, 148].

Regarding relative morbidity rates, comparative data are few. Overall complications and major complications are less common in laparoscopic AGB than laparoscopic RGB or laparoscopic BPD, in a single-center experience [151].

Mortality/morbidity after laparoscopic bariatric procedures

[redacted]			
Lap AGB	0.05–0.4%	9%	0.2%
Lap RGB	0.5–1.1%	23%	2%
Lap BPD	2.5–7.6%	25%	5%

Recent review of a multicenter, prospective US trial of laparoscopic AGB placement by the perigastric approach [205] 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 33%.

In contrast, parallel review of a subsequent trial which implemented the pars flaccida technique [205] found reduced slippage/pouch dilatation (7%), esophageal dilatation (1%), and stomal obstruction (2%) at 1-year. Non-US surgeons have also championed the pars flaccida method [186–188, 210, 211] 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% [211].

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 (level II, grade A).
- 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).

Revisional surgery

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

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 employed and have since fallen out of favor [212]. A number of pure restrictive procedures that involved gastric partitioning with staples have been limited by stomal dilation or recanalization of nondivided staple lines [213, 214]. Even procedures acceptable by today's standards, such as VBG [215], RGB

[216], and AGB are at risk for anatomic derangement that may be amenable to surgical revision [217, 218, 219]. 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 [220]. For all these reasons, it is vital the surgeon makes every effort to define the prior procedure(s) performed by medical record review and preoperative radiographic and endoscopic assessment [221, 222].

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 [223]. Endoscopy will assess for ulcers and internalized foreign bodies, and may allow for therapeutic dilatation 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 [224, 225], or an inappropriate operation. Those who regain weight after years may have suffered staple line recanalization or behavioral failure [226]. Reoperation 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 [227–230]. However, BPD, AGB, and other operations have also been employed in this setting [231–233]. Likewise, most authors advocate RGB for revision of AGB because of complications or insufficient weight loss [217–219], although other operations have been applied [234, 235]. Finally, in cases of failed BPD+DS some have advocated use of a pouch reduction procedure [236], and in failed RGB use of either AGB to improve the restrictive component [237] or lengthening to improve the malabsorptive component [238]. Comparative data are lacking.

Secondary complications

In some cases, bariatric procedures require revision when unexpected complications emerge over time. For example, the jejunoileal bypass resulted in dramatic weight loss, but became marred by the occurrence of malabsorptive complications including renal and hepatic failure [122, 239]. 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 gastroesophageal reflux (GER), bile reflux, complicated ulcers, or obstruction [240]. Severe GER may occur after gastroplasty or VBG in the absence of outflow obstruction [229], whereas bile reflux may occur in procedures that utilize Bilroth II gastrojejunostomy [220]. In either case, conversion to RGB is therapeutic [241]. Easily treated marginal ulcers are common in the healing phase [242], but later should raise concern for salicylate or NSAID abuse [243], or gastrogastric fistula [224]. Late gastrogastric fistula closure may be a difficult procedure requiring laparotomy, sometimes with resection [225], whereas marginal ulcer perforation is more easily managed with a laparoscopic approach [244]. Obstruction due to internal herniation may require major resection and intestinal reconstruction [245].

Excessive weight loss, steatorrhea, 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 [164]. One option is to relocate the junction of the biliary and alimentary limbs more proximally, with a 50 cm distance being suggested by Hamoui [246]. An alternative, and a technically easier operation is to leave the original anastomosis intact and to create another enteroenterostomy 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 [246]. However, complication rates are high even in this simple procedure, presumably due to the poor physiological state of the malnourished patient.

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 [210, 211]. 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 [246, 247].

Role of laparoscopy in revisional procedures

Revisional bariatric operations may be performed laparoscopically [248–250] or via open technique [251, 252]. Complications are more common after reoperations than after primary bariatric procedures [253]. 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 [230]. Foreign-body removal and partial gastric resection may also be required [216]. Drain placement is often performed in response to a recognized increased possibility of leak [254].

Guidelines for revisional 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. BMI and age-based candidacy guidelines should not limit access for patients suffering with progressive or poorly controlled obesity-related comorbidities if the risk-versus-benefit analysis favors surgery. 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.

Relative strengths of laparoscopic bariatric surgical procedures

	[redacted]				
[redacted]					
Lowest perioperative risk	+++	++	+	[22, 208]	[21, 36, 134, 147, 165, 166, 210]
Most effective durable weight loss	+	++	+++	[72, 143, 145, 206, 207]	[2, 19, 21, 29, 136, 137, 145, 193–195]
Best comorbidity resolution	+	++	+++	[22, 208]	[126, 128, 139–141, 195, 199, 200]
Most reversible	+++	+	+		[210, 211, 246, 247]
Best procedure to avoid reoperation due to:					
" Technical complication – early	+++	++	+		[21, 181, 205]
" Technical complication – late	+	++	+++		[181, 210, 211]
" Metabolic complication – late	+++	++	+		[29, 126, 152–154]
" Inadequate weight loss	+	++	+++	[22, 207]	[190]
[redacted]					
Lowest need for outpatient visits	+	+++	++		[57, 138, 178, 179]
Fewest metabolic consequences of poor follow-up	+++	++	+		
Durable weight loss with poor patient compliance	+	++	+++		[138]

Relative scale +++ > ++ > +

Acknowledgement Printing costs of this guideline were supported by Karl Storz.

Appendix A: Levels of evidence

Level I	Evidence from properly conducted randomized, controlled trials
Level II	Evidence from controlled trials without randomization
	Or
	Cohort or case-control studies
	Or

Level I	Evidence from properly conducted randomized, controlled trials
	Multiple time series, dramatic uncontrolled experiments
Level III	Descriptive case series, opinions of expert panels

Appendix B: Scale used for recommendation grading

Grade A	Based on high-level (level I or II), well-performed studies with uniform interpretation and conclusions by the expert panel
Grade B	Based on high-level, well-performed studies with varying interpretation and conclusions by the expert panel
Grade C	Based on lower-level evidence (level II or less) with inconsistent findings and/or varying interpretations or conclusions by the expert panel

Appendix C: Summary of guidelines

Justification for surgical treatment of obesity

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

Guidelines for selecting validated bariatric procedures

- Laparoscopic RGB, gastric banding by VBG or AGB, and BPD ± DS are established and validated bariatric procedures that provide effective long-term weight loss and resolution of co-morbid conditions (level II, grade A).
- LSG is validated as providing effective weight loss and resolution of comorbidities to 3-5 years (level II, grade C).

Guidelines for patient selection

- 1991 NIH consensus guidelines provide valid but incomplete patient selection criteria for contemporary bariatric procedures including laparoscopic BPD ± DS, RGB, VBG and AGB (level II, grade A).
- Other well-selected patients may benefit from laparoscopic bariatric surgery by experienced surgeons:
  – BMI > 60 kg/m^2 (level II, grade A).
  – Patients > 60 years (level II, grade B).
- Adolescent bariatric surgery (age < 18 years) has been proven effective but should be performed in an experienced center (level II, grade B). Patient selection criteria should be the same as used for adult bariatric surgery (level II, grade C).
- Individuals with BMI 30–35 kg/m^2 may benefit from laparoscopic bariatric surgery (level I, grade B).

Guidelines for bariatric programs

- 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).

Guidelines for preoperative preparation

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

Guidelines for laparoscopic BPD ± DS

- In BPD, the common channel should be 60–100 cm, and the alimentary limb 200–360 cm (level II, grade C).
- DS diminishes the most severe complications of BPD, including dumping syndrome and peptic ulceration of the anastomosis (level II, grade C).
- BPD is effective in all BMI >35 kg/m^2 subgroups, with durable weight loss and control of comorbidities beyond 5 years (level II, grade A).
- Laparoscopic BPD provides equivalent weight loss, shorter hospital stay, and fewer complications than open BPD (level III, 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).
- After BPD ± DS, close nutritional surveillance and supplementation are needed (level III, grade C).

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 >150 cm may improve intermediate-term weight loss but also may increase nutritional complications (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).
- Long-term follow-up is recommended and may improve weight-loss outcomes (level III, grade C).

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 (level II, grade A).
- 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).

Guidelines for revisional 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).

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