Surgical Management of Obesity: A Broad Overview of Bariatric and Metabolic Surgery

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ABSTRACT

Obesity is the second leading preventable cause of death globally. India has the dubious distinction of housing the third-highest number of obese people in the world. Obesity leads to several comorbid conditions that practically affect every organ of the body. Long-term results of medical therapy and lifestyle interventions for morbid obesity are dismal. Bariatric surgery has proven to be superior to medical therapy in terms of weight loss and resolution of comorbidities. Bariatric metabolic surgery may be offered to patients with body mass index (BMI) ≥37.5 kg/m², with or without any obesity-related comorbidity, or BMI ≥32.5 kg/m² with two or more obesity-related comorbidities. Surgery for morbid obesity would not be indicated if patients do not show a desire to adhere to long-term dietary advice or take nutritional supplements. Bariatric procedures can be classified into three types: mainly restrictive [vertical banded gastroplasty (historical), adjustable gastric banding, sleeve gastrectomy], mainly malabsorptive (duodenal switch, biliopancreatic diversion), and a combination of the two (gastric bypass). With advances in technology and the demand for less invasive weight loss therapy, all the above-mentioned procedures can be performed laparoscopically or with a robot. Endoscopic procedures and devices including intragastric balloons, endoluminal suturing, aspiration systems, and many other experimental therapies are also being tried. Post-bariatric surgery, patients have to follow a strict dietary regimen and take supplements lifelong. This review article provides a broad overview of surgical treatment of obesity and metabolic syndrome.

Keywords: Bariatric surgery, Metabolic surgery, Obesity, Sleeve gastrectomy.

INTRODUCTION

Obesity is truly a worldwide epidemic, accounting for 5% of all deaths in a year, with an annual economic impact of roughly $2 trillion. It is the second leading preventable cause of death worldwide, second only to smoking. India has the third-largest number of obese people in the world, after the USA and China.3 The number of obese and overweight people in India has been rising steadily. It is the need of the hour to find effective and lasting ways to tackle this “silent” pandemic.

OBESITY AND ITS RELATED PROBLEMS

Obesity is defined as an abnormal or excessive accumulation of fat that may impair health. As per the World Health Organization (WHO) criteria, any individual with a body mass index (BMI) ≥30 kg/m² is obese. Severe or class III obesity is defined as a BMI ≥40 kg/m² or a BMI between 30 and 39.9 kg/m² with significant comorbidities. In Indian populations, overweight is regarded as BMI >23 kg/m², obesity is defined as BMI 27.5 kg/m² and individuals with BMI ≥37.5 kg/m² are regarded as severely obese.2 Obesity is attended with a host of other comorbid conditions, which may impact nearly every organ system of the body. Table 1 provides a list of medical conditions associated with severe obesity.

MEDICAL VS SURGICAL TREATMENT

Medical therapy for obesity essentially consists of restricted caloric intake via hypocaloric diets, along with increased energy expenditure by graded exercise. Diet, exercise, and behavior modification therapy are important components of patients who are overweight (BMI <30 kg/m²) and highly recommended for patients with a BMI of 30–35 kg/m². Calorie restriction under medical supervision with clearly defined weight targets is the most important part of medical management.5 No diet is particularly useful.4 Another option available for obese patients is a pharmacologic intervention, which may be primary therapy alone or in conjunction with simultaneous diet and exercise. Orlistat is a selective inhibitor of pancreatic lipase, which thereby moderates the intestinal digestion and absorption of fat, with a reported mean weight loss of around 3 kg. Phentermine is another sympathomimetic drug that stimulates noradrenaline release suppressing appetite, while topiramate has also been used for weight loss along with phentermine use. Lorcaserin helps in weight loss by suppressing appetite through activation of hypothalamic 5-HT2C receptors. Naltrexone is an opiate antagonist,
while bupropion is a weak dopamine and noradrenaline reuptake inhibitor. These drugs can be used in combination to promote satiety via enhancement of hypothalamic release of melanocyte-stimulating hormone (MSH) leading to reduced food intake and increased energy expenditure.

Glucagon-like peptide 1 (GLP-1) agonists like exenatide, liraglutide, semaglutide, and dulaglutide are effective in reducing weight by enhancing satiety via hypothalamic stimulation and delayed gastric emptying, thereby reducing food intake. Recently, multi-agonist drugs have been introduced which are active at two or more different receptors like GLP-1/glucagon receptor dual agonists, GLP-1/gastric inhibitory polypeptide (GIP) dual agonists, and GLP-1/GIP/glucagon receptor triple agonists. Other new drugs used for obesity include SGLT-2 inhibitors like dapagliflozin, canagliflozin, and empagliflozin, and amylin mimetics like pramlintide.

Unfortunately, the long-term results of medical therapy and lifestyle interventions for morbid obesity are suboptimal. Sustained weight loss is inadequate with a meta-analysis showing weight loss of 4.5–7.5 kg at 1 year and 3–4 kg at 4 years. However, it is important to consider that these patients once reach the point of morbidly obese, the chances of an individual reaching and maintaining BMI $<$ 35 kg/m$^2$ by diet and exercise alone are as low as 3%. The long-term efficacy of bariatric and metabolic surgery (BMS) has been proved by the Swedish Obese Subjects (SOS) study. Two thousand and ten subjects who were prospectively followed and underwent surgery were compared with 2,037 matched controls who received standard medical treatment. The mean weight loss after 2, 10, 15, and 20 years were $−23, −17, −16$, and $−18\%$, respectively, in the surgery group while in the control group it was $0, 1, −1$, and $−1\%$, respectively. Bariatric and metabolic surgery was associated with long-term decrease in overall mortality by 29% ($p = 0.01$), significantly decreased incidences of diabetes ($p < 0.001$), myocardial infarction ($p = 0.02$), stroke ($p = 0.008$), and cancer ($p = 0.0008$). In our own experience, we have reported that bariatric surgery was superior to intensive medical therapy in terms of weight loss, resolution of comorbidities, and quality of life (QOL) score. Similar results have also been reported in multiple randomized controlled trials as well as meta-analyses. International Diabetes Federation has released a consensus statement which states that BMS is a safe and effective treatment for obese type II diabetics who could not achieve recommended targets with medical therapy. Although diet and exercise are not effective in the long run, however, it allows weight loss through the safest means. Second, it is important preparation for the adoption of healthier habits into the patient’s lifestyle.
postoperatively. Third, it can be used to augment weight loss after bariatric surgery, as shown by our own experience with liraglutide supplementation after sleeve gastrectomy.17

**Indications and Contraindications for Bariatric and Metabolic Surgery**

As per recent guidelines issued by the Obesity Surgery Society of India,18 BMS may be offered to:

- **Patients with a BMI ≥35 kg/m²,** with or without any obesity-related comorbidity.
- **Patients with BMI ≥30 kg/m²,** with two or more obesity-related comorbidities.
- **Central obesity with waist circumference ≥80 cm in females and ≥90 cm in males along with obesity-related comorbidities like type II diabetes.**
- **Patients are motivated to enter a long-term weight control program and motivated to life-long follow-up.**
- **Patients with BMI ≥27.5 kg/m² with uncontrolled type II diabetes can be offered BMS as a non-primary treatment option not responding to optimal medical management.**

Bariatric and metabolic surgery is generally offered to patients between 18 years and 65 years. Though BMS can be offered to younger age groups (<18 years), however, OSS guidelines18 state that weight loss surgery should only be offered under special circumstances after approval of a multidisciplinary team of a pediatrician, endocrinologist, dietician, psychologist, and bariatric surgeon. One has to also consider the attainment of puberty and completion of skeletal maturity for this patient population.19 Similarly, BMS can be prescribed to patients aged ≥65 years, if the benefits of surgery outweigh the risks.20

**Contraindications to Bariatric Surgery**

- **Inability to come for long-term follow-up or reluctance to take nutritional supplements.**
- **Medically unfit patients.**
- **Uncontrolled or non-stabilized psychiatric disorders.**
- **Chronic smokers, alcohol abusers, or patients with drug dependence unless they have undergone deaddiction successfully.**
- **Patients with short life expectancy or are suffering from a terminal illness.**
- **Pregnant women or those women who wish to conceive within 1 year after surgery.**

**Preoperative Evaluation**

Thorough patient evaluation is the first step following referral for BMS. A detailed analysis of all complaints, comorbidities, medications, as well as expectations from the surgery, is performed. A structured bariatric proforma is a useful tool to ensure that all areas are covered. Complete patient history and physical examination are performed. Blood investigations including complete hemogram, coagulogram, and blood indices, liver, kidney, and thyroid function tests, electrolytes, lipid profile, mineral and vitamin levels (iron, calcium, magnesium, vitamin B12, vitamin D), blood glucose profile, and glycosylated hemoglobin (HbA1c) are done. Deficiencies if any are corrected before surgery.

Cardiorespiratory evaluation is a vital part of preoperative evaluation. An electrocardiogram (ECG) and chest X-ray are basic essential investigations. Preoperative ECG has been shown to pick up abnormalities in up to 62% of patients.21 Additional investigations like echocardiography and stress test (exercise or pharmacologic) may be necessary for selected patients. Respiratory evaluation with pulmonary function tests and chest X-ray is done. Patients often have obstructive sleep apnea or hypoventilation syndrome, which has been associated with poorer outcomes after BMS. Screening tools like the STOP-BANG questionnaire or Epworth sleepiness scale can help select patients for polysomnography.22 Use of CPAP machine, smoking cessation, and respiratory physiotherapy is commenced 3–4 weeks before surgery.

Screening upper gastrointestinal (GI) endoscopy is recommended, especially in patients who have symptoms.23 The endoscopist looks for reflux esophagitis, hiatus hernia, Barrett’s esophagus, peptic ulcer disease, *Helicobacter pylori* infection, and malignancy. In presence of any of these abnormalities, gastric bypass is generally preferred over sleeve gastrectomy. Ultrasound of the abdomen is done to assess liver size and composition. An excessively large or fatty left lobe of the liver can increase technical difficulty in liver retraction and exposure. Prior knowledge allows the patient to follow a very low-calorie diet for at least 2 weeks before surgery to shrink the liver size. If the gallbladder is intact the presence of gallstones and sludge is assessed. Some surgeons, including our team, prefer to perform simultaneous cholecystectomy if stones are discovered.

A significant proportion of obese patients have type 2 diabetes mellitus (T2DM). Baseline glycemic status should be measured, and diabetic control should be optimized before surgery. A specialist endocrinologist evaluation is invaluable in this regard. Similarly, other endocrine dysfunction needs to be ruled out by doing thyroid function, vitamin D, and parathyroid hormone levels.

**Types of Bariatric Surgical Procedures, their Results, and Complications**

Surgical weight loss is brought about either by decreasing the quantity of nutrient intake or artificially inducing a state of malabsorption of nutrients. Accordingly, BMS procedures can be classified into three types: mainly restrictive (vertical banded gastroplasty (historical), adjustable gastric banding, sleeve gastrectomy), mainly malabsorptive (duodenal switch (DS), biliopancreatic (BP) diversion), and a combination of the two (gastric bypass). Laparoscopic and robotic techniques have become the standard of care in performing BMS. Minimally invasive techniques have been shown to have similar efficacy with reduced pain, fewer wound complications, incisional hernia, leading to earlier hospital discharge and lower 30-day complication rates.24 A recent significant increase in the number of bariatric procedures has been driven by improved patient compliance and willingness to undergo these procedures, especially with a minimally invasive approach. This section will focus on various weight loss procedures in detail.

**Adjustable Gastric Banding**

Laparoscopic adjustable gastric banding (LAGB) is a purely restrictive procedure. In this, a circumferential adjustable silicone band is placed around the stomach just below the gastroesophageal junction. The restrictive ability of the band can
be changed by filling it with saline through a subcutaneous port similar to a chemotherapy port.

The efficacy of LAGB in producing weight loss is comparable to other procedures. In a previous study of 1,140 patients, authors reported excess BMI loss of 43.7 and 58.9% at 24 and 36 months, respectively. O’Brien et al. reported a mean of 47% excess weight loss (EWL) for all patients who were at or beyond 10-year follow-up. Advantages of LAGB include its technical simplicity and potential for adjustability and reversibility. However, band-related problems (erosion, migration, pouch dilatation, and intolerance) remain the Achilles heel of this procedure. Band erosion may occur into the stomach, which may necessitate endoscopic removal. Likewise, prolapse of the stomach over the band may occur, which may need reoperation. Band slippage is another bothersome complication. Lastly, tubing problems like kinking, occlusion, and detachment may occur in a few patients. For these reasons, LAGB has not performed frequently anymore, accounting for only 7.4% of bariatric procedures worldwide.

**Sleeve Gastrectomy (Fig. 1)**

Laparoscopic sleeve gastrectomy (LSG) is the most commonly performed procedure today. Gagner reported the first LSG in 1994. It was initially performed as the first stage of the DS procedure. However, due to good results with LSG alone, it became popular as a stand-alone primary procedure. Laparoscopic sleeve gastrectomy involves a drastic reduction in gastric volume (from 1,500 to 2,000 mL to around 100 mL) by forming a narrow gastric tube along the lesser curvature. The first step involves taking down omentum from greater curvature, i.e., 2 cm from pylorus down to the angle of His and the left crus of the diaphragm. Using a large bougie (usually 36 Fr) oriented along the lesser curvature, the stomach is divided along the bougie from antrum to fundus. The blood supply of the sleeve comes from the lesser curvature arteries, i.e., left and right gastric arteries.

There are many advantages of LSG, including technical simplicity. There is no need for intestinal anastomosis, and the procedure maintains physiologic gastrointestinal (GI) continuity. There are minimal nutritional and metabolic complications and no risk of internal herniation and marginal ulcer. Although LSG is designed to be a primarily restrictive operation, now there is evidence to point toward a metabolic effect also. This results from hormonal changes secondary to the effects of rapid gastric emptying and intestinal transit. Laparoscopic sleeve gastrectomy results in markedly reduced ghrelin levels due to complete excision of the fundus of the stomach. Ghrelin is predominantly secreted by endocrine X/A-like cells of the fundus mucosa. Ghrelin is responsible for appetite modulation and is also involved in glucose homeostasis. Rapid intestinal transit after LSG leads to rapid emptying, a shorter contact time of food with proximal gut, and rapid delivery of nutrients into terminal ileum (hindgut theory).

This results in an exaggerated release of GLP-1, leading to improved carbohydrate metabolism and improvement of T2DM.

Results after LSG are quite encouraging. A review with a large number of patients demonstrated an EWL of 55.4% with comparable morbidity and mortality rate to other bariatric procedures. Misra et al. reported long-term results of LSG in 284 Indian patients with a mean BMI of 44.9 ± 7.9 kg/m². The authors reported a mean %EWL at 5 years of 26.0 ± 9.9%. Authors reported a remission rate of diabetes at 1, 3, and 5 years in 78.5, 71.4, and 66.6%, respectively. In a systematic review with a mean follow-up of 13.1 months, diabetes mellitus was reported to resolve in 66.2% of patients, improve in 26.9%, and remained stable in 13.1% of patients. Other comorbidities like obstructive sleep apnea (88%), hypertension (75%), hyperlipidemia (83%), stress incontinence (90%), and musculoskeletal disorders also resolve after LSG. Another study in superobese patients with 5-year follow-up also showed excellent resolution of comorbidities after LSG, which included hypertension (95%), T2DM (100%), hyperlipidemia (100%), and obstructive sleep apnea (100%).

One of the disadvantages of LSG is irreversibility. However, early complications after LSG include bleeding and/or leakage from the staple line while late complications include delayed leaks, gastric stenosis, twisting or kinking of the sleeve. A notable contraindication to LSG is patients with long-standing or severe gastroesophageal reflux disease (GERD) who may experience accentuation of reflux symptoms after LSG. Another contraindication is Barrett’s esophagus where intact stomach would be required in case esophagectomy is needed later on. However, the sleeve reservoir may dilate with time in patients who increase the portion size of the meal, resulting in weight regain and recurrence of comorbidities. Therefore, this surgery is recommended only in those patients who demonstrate long-term compliance with dietary and exercise regimen.
ROUX-EN-Y GASTRIC BYPASS (FIG. 2)

Roux-en-Y Gastric Bypass (RYGB) is the classic example of a combined restrictive–malabsorptive operation. The procedure consists of creating a small proximal gastric pouch of 3-cm long and wide (around 20–30 mL capacity) which is separated from the distal stomach. An orogastric tube with an Ewald balloon is used to size the pouch. A long Roux limb of the jejunum is anastomosed to this pouch with a narrow anastomosis of around 1.5 cm width. A leak test with 50–100 mL of methylene blue dye is routinely performed. This procedure creates three areas of mesenteric defects between the mesentery of the bowel loops that need to be closed to prevent potential internal herniation.

Several variations to the basic technique have been described and popularized.37 Three main areas of variation include gastroenterostomy anastomosis technique (linear stapled, circular stapled, hand-sewn), alimentary limb configuration (antecolic or retrocolic, antegastric or retrogastric), and length of both BP and alimentary limbs. The length of the BP and alimentary limbs vary depending upon the BMI of the patient and the extent of malabsorption intended. Biliopancreatic limb length may be 25 cm/50 cm/100 cm (longer lengths are preferred for patients with T2DM) and the alimentary limb can be 100 cm/150 cm.

Buchwald et al. reported an EWL loss of 62% and 30-day mortality of 0.5% after RYGB, and these results were superior in comparison to other procedures.38 Roux-en-Y Gastric Bypass results in significant early weight loss, which is reported to be maintained even in long term. In the SOS study,8 results showed the superiority of RYGB in terms of weight loss over vertical banded gastroplasty surgery (VBG) and LAGB throughout the study period. Comorbidity resolution after RYGB was reported as impressive, with diabetes resolution in 80%, hypertension in 67.5%, shortness of breath in 94%, sleep apnea in 92%, and dyslipidemia in 49%.

In another Swedish randomized trial comparing LSG and RYGB (SMBOSS),39 results showed similar efficacy of weight loss, but less incidence of reintervention after LSG. Similar findings were reported by Yaghoubian et al.40

Relative contraindications to LRYGB include previous gastric and antireflux surgery, severe iron deficiency anemia, distal gastric or duodenal lesions requiring continuous future surveillance, and Barrett’s esophagus with severe dysplasia. Complications related to RYGB can be categorized into early and late complications, some of which can be life-threatening. Early complications include bleeding, anastomotic leak, and deep venous thrombosis/pulmonary embolism. Late complications include anastomotic strictures, gastrogastric fistulae, intestinal obstruction, marginal ulceration at the gastrojejunostomy anastomosis, internal herniation through mesenteric defects, and nutritional as well as metabolic complications due to malabsorption.41

Due to a higher risk of complications and procedures being technically more demanding and long-term metabolic deficiencies, many centers have switched to more patient-friendly procedures.

ONE-ANASTOMOSIS GASTRIC BYPASS/MINI-GASTRIC BYPASS

One-anastomosis gastric bypass (OAGB), also called mini-gastric bypass (MBG) was first reported in 1997 by Robert Rutledge. It comprises a long tubular gastric pouch made on the lesser curvature, anastomosed to a wide, non-restrictive anastomosis to a loop of jejunum 150–250 cm in length in from the ligament of Treitz inBillroth II fashion.

Anatomically, it is different from RYGB because of the absence of the Roux-en-Y configuration, as well as the different anatomy of the gastric pouch compared to RYGB. Whereas the gastric pouch is intended to be small and “tight”, the MBG gastric pouch eliminates the reservoir function of the stomach and converts it into a non-obstructive extension of the esophagus. Mean EWL after MBG reported at 12 months is between 55 and 91%.40 In a study from Punjab,41 the average EWL at 2 years was 91% and was well maintained for over 5 years. The authors reported that a mean EWL of 85% was maintained over a 6-year follow-up period. Authors reported remission of T2DM in 93%, hyperlipidemia in 91%, shortness of breath in 94%, sleep apnea in 92%, and hypertension in 74% of their patients. Lee et al.42 also reported a higher resolution of T2DM with MBG compared to RYGB and also a higher postoperative rise of GLP-1, whereas Disse et al.43 reported greater excess BMI loss percent (EBL%) at 6 months and 1 year with MGB (76.3 vs 60.0%, p = 0.001, and 89.0 vs 71.0%, p = 0.002) compared to RYGB. However, MGB has significant bile reflux, reported in up to 40% of patients postoperatively.

BILIOPANCREATIC DIVERSION (FIG. 3)

Nicola Scopinaro was the first person from Italy to describe a radical operation for morbid obesity. Biliopancreatic diversion (BPD) operation involves distal subtotal gastrectomy and construction of residual gastric pouch of 200–mL capacity for superobese, while a slightly larger pouch for patients with BMI <50 kg/m². The procedure involves dividing the terminal ileum 250 cm proximal to the ileocecal valve. The distal end of the divided ileum is then anastomosed to the stomach, creating a 2- to 3-cm stoma. The proximal end of the ileum is then anastomosed side-to-side to the terminal ileum approximately 100 cm proximal to the ileocecal valve. Prophylactic cholecystectomy is added due to the high incidence of gallstone formation. Biliopancreatic diversion results in exceptional weight loss and permanent resolution of most comorbidities. Buchwald et al.38 reported EWL of 70.1% with a mortality of 1.1 and 27–33% morbidity. The incidence of nutritional complications reported in this procedure goes up to 40–77%. This procedure has...
not received wide acceptance because of technical difficulty and the high incidence of postoperative nutritional complications. It is performed in a limited number of patients, approximately 4,000/year, which account for <3.0% of the estimated bariatric procedures performed annually worldwide.

Duodenal Switch (Fig. 4)

This procedure is a modification of BPD introduced by Hess and Marceau called DS which was designed to reduce complications of BPD including vomiting, marginal ulceration, micronutrient deficiency, and dumping syndrome. The DS procedure differs from the BPD in the stomach portion of the operation. Duodenal switch is different from BPD as instead of distal gastrectomy, sleeve resection of the stomach is performed. The diameter of this tube is calibrated with a dilator. The duodenum is divided approximately 2 cm from the pylorus in the D1 region. The proximal duodenal end is anastomosed to the distal 250 cm of ileum. Results of DS are comparable to that of BPD. In a randomized controlled trial of super obese patients, weight loss after DS compared favorably to RYGB, with a percentage excess weight loss after 12 months of 75 vs 54%, respectively.44 However, DS is reported to have a higher incidence of early complications including incisional hernias (21.1%), wound infection (15.7%), anastomotic leak (5.2%), intra-abdominal infection (5.2%), and intestinal obstruction (5.2%). Nutritional complications are also frequent, especially protein-energy malnutrition, in addition to low ferritin, fat-soluble vitamin deficiency, zinc, and copper deficiencies.45

Endoscopic Bariatric Procedures (Fig. 5)

With advances in technology and demand for less invasive weight loss therapy, the armamentarium of endoscopic bariatric procedures has increased over the last ten years. Endoscopic procedures can be stand-alone or adjunct, and primary or revisional. Endoscopic devices include intragastric balloons, endoluminal suturing, aspiration systems, and many other experimental therapies.46 Intragastric balloon therapy consists of placing an inert, nontoxic silicon balloon within the stomach. The Orbera balloon is the most well-known among these. It is introduced in the collapsed state and can be filled up to 400–700 mL of saline under endoscopic guidance.47 It can remain in the stomach for up to 6 months. Common side effects were nausea and vomiting, and occasionally premature deflation, gastric ulceration, and erosion. In a large series, %EWL was 33.9 ± 18.7, with improvement or resolution of diabetes and hypertension in 86.9 and 93.7% of patients, respectively.48

A novel technique called endoscopic sleeve gastroplasty utilizes a full-thickness endoscopic suturing system called Apollo Overstitch (Apollo Endosurgery, Austin, TX, USA). This device can apply interrupted and running sutures with real-time suture reloading.49 Abu Dayyeh et al.50 reported 53 ± 17, 54 ± 40, and 45 ± 41% EWL at 6, 12, and 20 months, respectively (p < 0.05). In another randomized study, the endoscopic group reported 31.5 ± 26.7% EWL compared to 9.8 ± 15.5% in patients who had lifestyle counseling alone (p < 0.001).51

Although still largely in the developmental phase, endoscopic modalities may become more attractive in the future. These may be indicated in patients who desire temporary weight loss (intragastric balloon), who do not wish to undergo surgery (endoscopic sleeve gastroplasty), or need revision surgery (gastrojejunal anastomosis narrowing). However, currently, surgical procedures remain the mainstay of morbid obesity with metabolic syndrome.

Postoperative Nutritional Care and Supplementation

Diet after bariatric surgery is progressed gradually in phases, each phase lasting approximately 2 weeks. In phase 1, patients are asked to take free fluids only, up to 2 L/day, progressing to purée or blended food about 2 to 3 tablespoons/meal in the second phase after 2 weeks of surgery. In phase 3, soft foods and some solid foods are allowed. After 6 weeks, stage 4 consists of low fat, low sugar balanced diet—increasing to small tea plate size over time. Patients are also advised to follow certain behaviors while eating, such as having a regular meal pattern, eating slowly, having small bites of food, chewing them well, using smaller plates or bowls to control portion sizes.
Post BMS, patients are at risk of developing nutritional deficiencies, which may be due to non-compliance with dietary advice, inability to tolerate some foods, reduced intake, or malabsorption. In the case of malabsorptive procedures, the length of an intestinal bypass is directly related to the risk of nutritional deficiencies. Routine postoperative screening includes full blood count (FBC), renal and liver function tests, ferritin, folate, vitamin B12, calcium, and vitamin D levels. Guidelines for nutritional supplementation are shown in Table 2. Table 3 shows folate, vitamin B12, calcium, and vitamin D levels. Guidelines for nutritional supplementation are shown in Table 2. Table 3 shows the mortality, complication rate, and incidence of reoperation for commonly performed BMS procedures.

PGIMER, CHANDIGARH EXPERIENCE

We did our first case of LSG on June 9, 2011, and have so far performed close to 180 such procedures with zero operative mortality. We analyzed our data of the first 94 patients which included data of 3 M.S. thesis and 2 D.M. dissertations. The mean BMI of the patients was 43.4 kg/m² while the mean BMI loss at 6 months was 11.3 kg/m². The overall mean percentage of excess body weight loss (%EWL) at 6 months of follow-up was 49.8%. We have observed that most patients continued to lose weight up to 2 years though it was steep in the first year.

There was a direct correlation between the decrease of mean BMI and improvement in metabolic parameters after surgery. The mean fasting glucose, postprandial glucose, HbA1c levels, and insulin levels declined from preoperative levels of 119.84 mg/dL, 171.93 mg/dL, and 7.1% to 6 months postoperative level of 107.54 mg/dL (10.3% decrease), 136.35 mg/dL (20.7% decrease), and 5.89% (25.28% decrease), respectively.

There was complete resolution of T2DM in 59.5% and improvement in the remaining 40.5% of patients. There was 80.9% complete resolution in hypertension status and improvement in the remaining 19.1% of patients. Dyslipidemia resolved in 70.6% of patients at 6 months postoperative. We also noted a decrease in 10-year coronary heart disease risk of 5.1% at 6 months.

In addition to resolution in metabolic syndrome, 88.3% of patients had symptoms of sleep apnea at baseline and a complete resolution was observed in 89.2% of patients at 6 months of surgery. We observed that 48.9% had symptoms of arthritis before surgery which resolved in 45.7%, improved in 39.1%, and 15.2% of patients did not show improvement. One patient in this series leaked a gastric sleeve which was managed conservatively while two patients in initial experience had esophageal perforation related to a balloon of the bougie.

CONCLUSION

With advances in surgical technique, bariatric surgery has become the treatment of choice for difficult problems of obesity, diabetes, and metabolic syndrome. Among the variety of procedures available, LSG is preferred due to its technical simplicity with durable results and minimal risk of nutritional deficiencies.

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