Chapter 63
Staged Duodenal Switch for High-Risk Patients

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63.1 Introduction

In the USA, since the year 2000, the adult obesity rate has increased from 30.5 to 42.4% in 2018, with the subset of severely obese patients increasing rapidly. Hispanic and non-Hispanic Black adults had the highest age-adjusted prevalence of obesity [1]. This presents as a public health crisis, as the prevalence of obesity mirrors the prevalence and burden of many comorbid diseases, affecting several organ systems. Despite several pharmaceutical, lifestyle, and public health measures aimed to address the disease, the obesity epidemic in the USA continues to grow [2]. In patients suffering from morbid obesity refractory to lifestyle change, bariatric surgery has demonstrated effective long-term treatment. Given the procedural efficacy, safety, and utilization of laparoscopic methods, procedures such as the sleeve gastrectomy, Roux-en-Y gastric bypass (RYGB), and biliopancreatic diversion with duodenal switch (BPD/DS) have been increasingly utilized in the USA.

LAGB and RYGB are the most common bariatric procedures aimed for weight reduction; however, the BPD/DS is the most effective procedure, resulting in the greatest excess weight loss (EWL) among the various surgical options. Patients undergoing BPD/DS often experience decreased hunger due to the reduction in gastric volume and further EWL through diminished nutrient absorption within the

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A. Teixeira et al. (eds.), *Duodenal Switch and Its Derivatives in Bariatric and Metabolic Surgery*, https://doi.org/10.1007/978-3-031-25828-2_63

alimentary limb. The procedure is technically intensive, requiring a skilled surgeon with clinical expertise for choosing appropriate patients. As a result, BPD/DS accounts for <1% of bariatric surgery, despite the powerful impact on weight and improved resolution of obesity-related comorbidities, such as type II diabetes. Increased perioperative morbidity and long-term nutritional adverse effects related to the nature of the technique add to the disinclination of its use. However, BPD/DS still maintains a critical role in the treatment of super obese patients (BMI >50 kg/m^2), due to the effective management of their disease. In high-risk or super-super obese patient groups (BMI >60 kg/m^2), a two-stage procedure may be utilized to limit procedure time, leading to a reduction in the perioperative morbidity and mortality. The first stage consists of a sleeve gastrectomy, followed by duodenoileostomy and ileoileostomy approximately 6–18 months after [3, 4]. The objectives of this chapter will be to (1) provide an overview of the procedure, (2) describe indications and contraindications, (3) briefly describe the surgical technique, and (4) outline surgical outcomes and complications related to staged BPD/DS.

63.2 Procedure

By staging the BPD/DS into two stages, (1) sleeve gastrectomy and (2) duodenoileostomy and ileoileostomy, operation duration is decreased, and complications related to increased time under anesthesia are reduced [4, 5]. Staging of procedures may be planned preoperatively, or the decision can be made during the sleeve gastrectomy portion. Indications for intraoperative decision for procedure staging include physiologic compromise of the patient or questionable technical feasibility of the remaining maneuvers. The SG and BPD portions of the procedure have also been reported using a robotic-assisted technique, with similar outcome to purely laparoscopic procedures [6]. In other bariatric procedures, such as the RYGB, a comparison of robotic-assisted surgery to laparoscopy demonstrated a potentially increased leak rate at the gastric pouch or remnant stomach level [7].

63.2.1 Stage 1: Sleeve Gastrectomy

Commonly a stand-alone procedure, the sleeve gastrectomy is conducted laparoscopically and is the first portion of the staged BPD/DS for high-risk or super-super obese patients. In this procedure, approximately 75–80% of the stomach is removed in a vertical fashion to limit food volume intake (Fig. 63.1). The stomach volume will be reduced from 2 L to 100–150 mL, and due to the removal of the fundus, the new stomach is largely resistant to stretch and accommodation of large ingested volumes. With the patient in supine position and surgeon standing on the patient's right and working ports in the right subcostal and mid-abdomen, the camera is in the

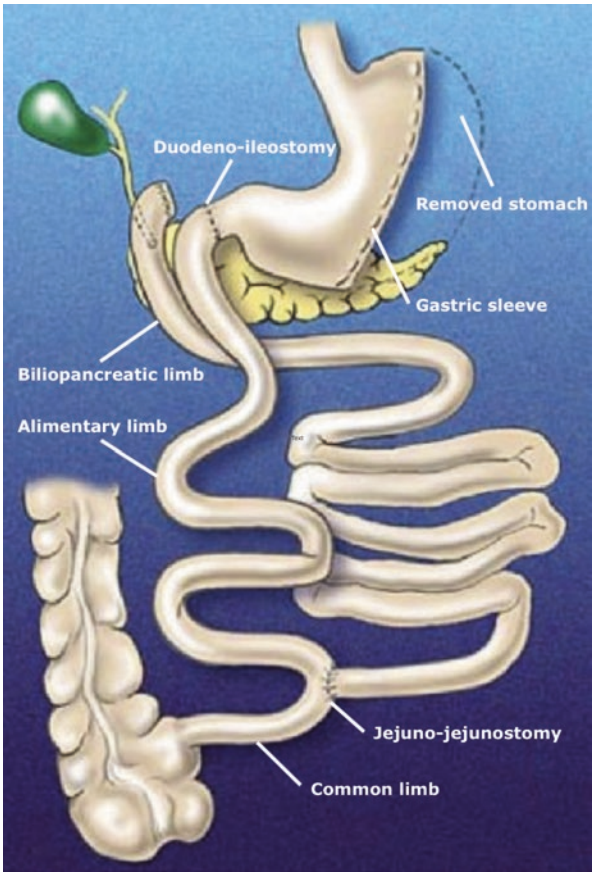

Fig. 63.1 Illustration of the BPD with DS procedure [5]

left mid-abdomen. A liver retractor is added to provide exposure. Using an ultrasonic or bipolar energy device, the greater curvature of the stomach is devascularized and mobilized approximately 4–6 cm from pylorus superiorly to the left crus of the diaphragm. After mobilization, a bougie typically 40–60 Fr in diameter is passed to guide the gastric division. If a hiatal hernia is noted during the procedure, repair is indicated to reduce postoperative gastroesophageal reflux and retained elements of the stomach leading to impaired weight loss. Creation of the gastric sleeve utilizes a thick tissue cartridge with a linear stapler. Stapling must be conducted in the same horizontal plane to avoid functional obstruction caused by a spiral-sleeve contour. Stapling along the bougie should not be overly tight, as improper staple firing may occur. The stapling will begin 4–6 cm above the pylorus to spare much of the antrum. In a two-staged procedure, the gastric specimen can now be removed, and the procedure is terminated. The weight loss goal for this first stage in high-risk patients is a 100–150 pound weight loss (or until weight plateau), often reached within 6–18 months after the sleeve gastrectomy.

63.2.2 Stage 2: Duodenoileostomy and Ileoileostomy

63.2.2.1 Duodenal Transection

Excessive visceral fat may complicate the dissection, and bleeding can blur the tissue planes. Due to this, the duodenal transection can be technically demanding; however it is critical to minimize excessive duodenal devascularization and injury to the duodenum and pancreas. With lateral retraction of the antrum to linearize the first portion of the duodenum, free the peritoneum on the inferior and superior portions of the duodenum, until the duodenum fuses posteriorly with the pancreas. Either a curved or right-angle dissector can be used to create this retroduodenal tunnel. A Penrose can be passed around the duodenum to help continue the dissection. Once 2 cm of duodenum are freely dissected, the duodenum can be transected with a stapler. Following transection, perfusion of the cuff can be assessed using indocyanine green (ICG) fluorescence to visualize limb microcirculation prior to anastomosis.

63.2.2.2 Alimentary Limb Creation

The greater omentum is opened toward the patient's right, allowing the ileum to be connected with the duodenum. Moving to the patient's left side, working through the LUQ subcostal and lateral mid-abdominal ports, identify the terminal ileum at the ileocecal junction. If the patient has a past abdominal surgery history, examine the region for intra-abdominal adhesions before duodenal transection. Measuring 125 cm from the cecum, mark the ileum at the site of later ileoileostomy. Another 125 cm past this point, transect the ileum using a stapler. Mark this distal end of the biliopancreatic limb to distinguish from the alimentary limb. The alimentary limb is carried through the omental window toward the duodenal cuff. If excessive tension is present, a second sagittal vascular stapling can be applied. If significant tension still remains on the alimentary limb, it can be brought through a mesocolic window opposed to the omental window.

63.2.2.3 Duodenoileostomy

The duodenoileostomy anastomosis may be implemented with many techniques. Understanding each technique allows for surgical flexibility depending on differing anatomy. The techniques include (1) hand-sewn technique, (2) circular stapler technique, and (3) linear stapler technique.

The hand-sewn technique avoids enlarging port sites for stapler accommodation and anvil manipulation. The method constructs more consistent sizing of anastomosis than either technique involving stapler use. The previously placed duodenal suture is tied to the previously placed ileal suture placed 125 cm from the cecum, to create the posterior outer row of the anastomosis. Enterotomies are made along the

entire length of the ileum and duodenum, and the inner layer of the anastomosis is made with two sutures with anterior closure. A permanent running suture is placed as the outer layer conjoining the anastomosis.

The circular stapler technique creates the duodenoileostomy using an EEA stapler. The EEA anvil can be inserted directly to the duodenal cuff staple line or passed transgastrically, transabdominally, or transorally. Opening the proximal end of the alimentary limb and aligning it with the duodenal cuff bring the stapler through the antimesenteric border of the proximal alimentary limb and staple the join the segments at the anvil.

In the linear staple technique, the alimentary limb is brought to the duodenal cuff, and an enterotomy is made in the ileum and duodenum. A stapler is inserted, but due to difficult alignment of the stapler to form the anastomosis, two firings are often necessary. Due to these angulation challenges, there is inconsistency in the size and shape of anastomosis with this method. Lastly, the common enterotomy is hand-sewn closed.

63.2.2.4 Ileoileostomy

Following the alimentary limb distal from the duodenoileostomy to the marking 125 cm proximal to the ileocecal valve, identify the distal biliopancreatic limb. Approximate the alimentary limb and the distal biliopancreatic limb using a suture. With small enterotomies in either limb, create an anastomosis using a 2.5 mm stapler, then hand suture to join the remaining enterotomies using a single-layer stitch to avoid narrowing of the anastomosis.

63.2.2.5 Robotic-Assisted Laparoscopic BPD/DS

With the patient in Trendelenburg position, running the small intestine approximately 250 cm from the ileocecal valve, the surgeon will mark with a silk stich proximally and a Vicryl stitch distally. Prior to docking the robot, the patient is placed in reverse Trendelenburg position. Once docked, the duodenal switch is conducted by creating a window behind the duodenum, 2.5 cm distal to the pylorus (Fig. 63.2). The sleeve gastrectomy is begun by exposing the left crus by creating a window in the greater omentum from 6 cm proximal to the pylorus, up to the angle of His. A 34 French bougie is passed into the antrum. Using a linear stapler, the stomach is transected. Upon completing the gastric sleeve, the linear stapler is used to transect the duodenum through the same omental window. The duodenoileostomy is created by anastomosing the proximal portion of the duodenum to the ileal stitches 250 cm from the cecum, made earlier. Ileoileostomy is begun through a window around the ileum, proximal to the duodenoileostomy. Using a linear stapler, transect the biliary limb, and 125 cm distally on the small intestine from the cecum, anastomose the biliary limb and ileum. The duodenoileostomy and staple are both

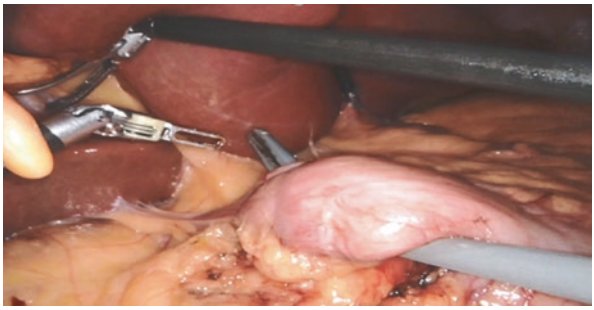

Fig. 63.2 Intraoperative image of robotic-assisted duodenal dissection

tested with saline and methylene blue submersion. The gastric remnant can be removed through the right lower quadrant port. Drains may be placed next to the sleeve gastrectomy staple line and anastomoses [8].

63.3 High-Risk Classification Leading to Staging

Preoperative

- Super-super obese patients (BMI >60 kg/m^2) [4]
- Patients unlikely to tolerate prolonged general anesthesia [9]
- High-risk classification according to the obesity surgery mortality risk score (OS-MRS)
  - Risk factors: BMI >50 kg/m^2, male gender, hypertension, pulmonary embolism risk, age >44 [10]

Intra-operative decision

- Physiological compromise in the patient
- Presence of adhesions
- Hepatomegaly
- Torque on instruments [9]

63.3.1 Postoperative Care

Telemetry and the use of continuous pulse oximetry can aid in the detection of early postoperative complications. Patients are NPO with IV fluid administration until the following morning. Variable methods for pain management may be utilized; common protocols include Dilaudid PCA with ketorolac [11]. Patients should be placed

on chemoprophylaxis for venothromboembolism and should ambulate within 6 h of the surgery. Patients with obstructive sleep apnea should utilize their at-home airway device to maintain patency. Spirometry and other respiratory therapy may be utilized to decrease incidence of pneumonia and atelectasis following surgery [12]. To assess for early postoperative anastomotic leak, fistula, or stricture, an upper gastrointestinal endoscopy may be ordered [13]. Many patients may be discharged on the second postoperative day, while others, especially those classified as super-super obese, may require an extended stay and have less predictable comorbidities. For 2 weeks following the operation, patients will stay on a puree diet and transition to solid foods over the course of 1 month.

For 1 month after surgery, patients are instructed to take

- Proton pump inhibitor
- Multivitamin with iron
- Vitamin D
- Calcium citrate
- B complex vitamin
- 80–90 g of protein daily (as a liquid)
- Vitamin A (indefinitely)

63.3.2 Indications

- For BPD/DS, it is recommended that patient BMI exceeds 50 kg/m^2, while other weight loss surgeries may be indicated for less severe obesity [14]
- Staged BPD/DS is often indicated with super-super obesity (BMI >60 kg/m^2)
- Obesity with severe type II diabetes [5]
- Suboptimal outcomes of previous bariatric surgery (e.g., sleeve gastrectomy) [15]

63.3.3 Contraindications

- Non-correctable coagulopathy
- Large abdominal wall hernia
- Preexisting malabsorptive disorder (celiac disease, inflammatory bowel disease, malignancy)
- Severe gastroesophageal reflux disease (sleeve gastrectomy may worsen reflux)
- Other: inability to maintain follow-up, inadequate support, active substance or alcohol abuse, smoking, patient financial standing to afford postoperative supplements and medications [16]

63.3.4 Complications

63.3.4.1 Surgical

The laparoscopic BPD/DS is the most technically demanding bariatric surgery and, not surprisingly, has high surgical complication rates up to 15–38% in the proceeding weeks to months. However, it is important to note that this procedure is conducted in the most severely obese patients with comorbid diseases, increasing morbidity and mortality. More recently, the use of a staged BPD/DS has led to a reduction of related morbidity and mortality [17, 18].

Major surgical complications of BPD/DS

- Anastomosis leaks (at any staple or suture line, commonly duodenal or gastric leaks)
- Features: tachycardia, elevated white blood cell count, fever
- Intra-abdominal abscess
- Pulmonary embolism (manage with aggressive perioperative prophylaxis)
- Congestive heart failure or pulmonary hypertension exacerbation (use perioperative fluids conservatively)
- Myocardial infarction
- Obstruction and stricturing
- Digestive bleeding
- Intraperitoneal hemorrhage
- Internal hernia

Minor surgical complications of BPD/DS

- Pneumonia and atelectasis
- Stenosis
- Food intolerance
- *C. difficile* colitis
- Pancreatitis
- Wound infection

63.3.4.2 Nutritional

There is a reasonable likelihood for nutritional deficiencies to develop from vitamin and mineral and protein malabsorption. The long-term nutritional risks can be minimized with careful patient selection, nutritional supplementation, education, and follow-up [19, 20]. Protein deficiencies can result from reduced intake (due to decreased gastric volume), obligate loss, and malabsorption. However, the amount of protein loss to malabsorption is uncertain, as studies have demonstrated that 50 cm duodenal segments are sufficient in absorbing protein loads [21]. This study highlights the importance of the surgeon's choice of limb-length measurements during the DS as it impacts both protein and fat absorption. Mild-moderate protein

deficiencies can be managed with dietary supplementation and patient education. In the instance of severe protein deficiencies, treatment with hyperalimentation and diuresis is indicated, and refractory surgery to lengthen the common channel may be required. Despite prophylactic vitamin and mineral supplementation, there is a high prevalence of micronutrient deficiencies or insufficiencies in DS patients [22]. The subsequent malabsorption of micronutrients in these patients may cause their deficiency status to be refractory to supplementation.

Compared to RYGB, DS switch patients categorized as super-obese were more likely to experience lower levels of vitamins A and D and had a larger decrease in thiamine levels after surgery. These super-obese patients may require more intense supplementation or frequent alimentation and regular nutritional status monitoring [23].

Long-term (15–20 years) metabolic outcomes result from nutritional deficiencies [20]

- Albumin and hemoglobin deficiency
- Vitamin A, B9, B12, and D deficiency
- Iron deficiency
- Calcium deficiency
- Hyperparathyroidism

63.3.5 Outcomes

BPD/DS has demonstrated superior weight loss to all other bariatric procedures, resulting in over 70% EWL, compared to 61.2% for gastric bypass and 68.2% for gastroplasty [24]. The efficacy of the procedure is highest among super obese patients, resulting in the highest percent EWL and percent BMI reduction compared to other bariatric surgeries [25]. As a secondary or staged procedure, BPD/DS is gaining popularity. From 2015 to 2017, the total bariatric case load increased 19.2%, BPD/DS increased 63.7%, and revision procedures increased 114.1% [26]. Expert consensus points to the use of BPD/DS in the case of revisional bariatric surgery or for planned staged surgery in super obese and high-risk patients [19]. BPD/DS has also shown a more powerful effect in treating obesity-related diseases, such as type II diabetes, hypertension, and hyperlipidemia, when compared to RYGB [27].

63.4 Conclusions

While bariatric surgery is the only proven lasting method for weight loss in morbidly obese patients, BPD/DS is the most effective method to maximize EWL. However, this procedure comes with potential surgical risks and long-term metabolic deficits due to nutrient malabsorption. In super-obese or other high-risk patients, the procedure can be implemented in a staged fashion, with the

duodenoileostomy and ileoileostomy following 6–18 months after gastric sleeve placement. Revision duodenal switch surgery may also be indicated in the setting of revisional bariatric surgery and is gaining popularity for this use.

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