Chapter 24
Laparoscopic Biliopancreatic Diversion with Duodenal Switch: Surgical Technique

Laurent Biertho, Léonie Bouvet-Bouchard, and Phil Vourtzoumis

24.1 Introduction

Obesity is known as a multi-factorial, complex, chronic, and relapsing disease [1]. Although lifestyle changes remain a key factor in the treatment of obesity, bariatric surgery is considered as the only approach leading to significant, long-term, beneficial impact in patients with severe obesity. Several weight loss procedures are endorsed by medical and surgical societies, including "biliopancreatic diversion with duodenal switch" (BPD-DS), which is the subject of this chapter. The surgical principle of a biliary bypass goes back to 1923, as described by Mann and Williamson [2]. In 1973, Nicola Scopinaro adapted the technique to decrease caloric absorption by adding a distal gastrectomy and performed the first biliopancreatic diversion [3]. The distal gastrectomy was necessary to decrease the risks of ulcers, but protein malabsorption, gastrointestinal side effects, and dumping syndrome were common. The technique was then modified in the late 1980s, to remove as much parietal cell located in the fundus and to increase the common channel length from 50 cm to 100 cm [4, 5]. This led to the creation of the BPD-DS, as we still know it (Fig. 24.1). It was later adapted to the laparoscopic approach in 1999 [6] which led to dramatic reduction in peri-operative complication rates [7].

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L. Biertho (✉) · L. Bouvet-Bouchard · P. Vourtzoumis
Department of Surgery, Institut Universitaire de cardiologie et pneumologie de Québec—Université Laval, Laval University, Quebec City, QC, Canada
e-mail: Laurent.biertho@criucpq.ulaval.ca; leonie.bouvet-bouchard.med@ssss.gouv.qc.ca; phil.vourtzoumis@mail.mcgill.ca

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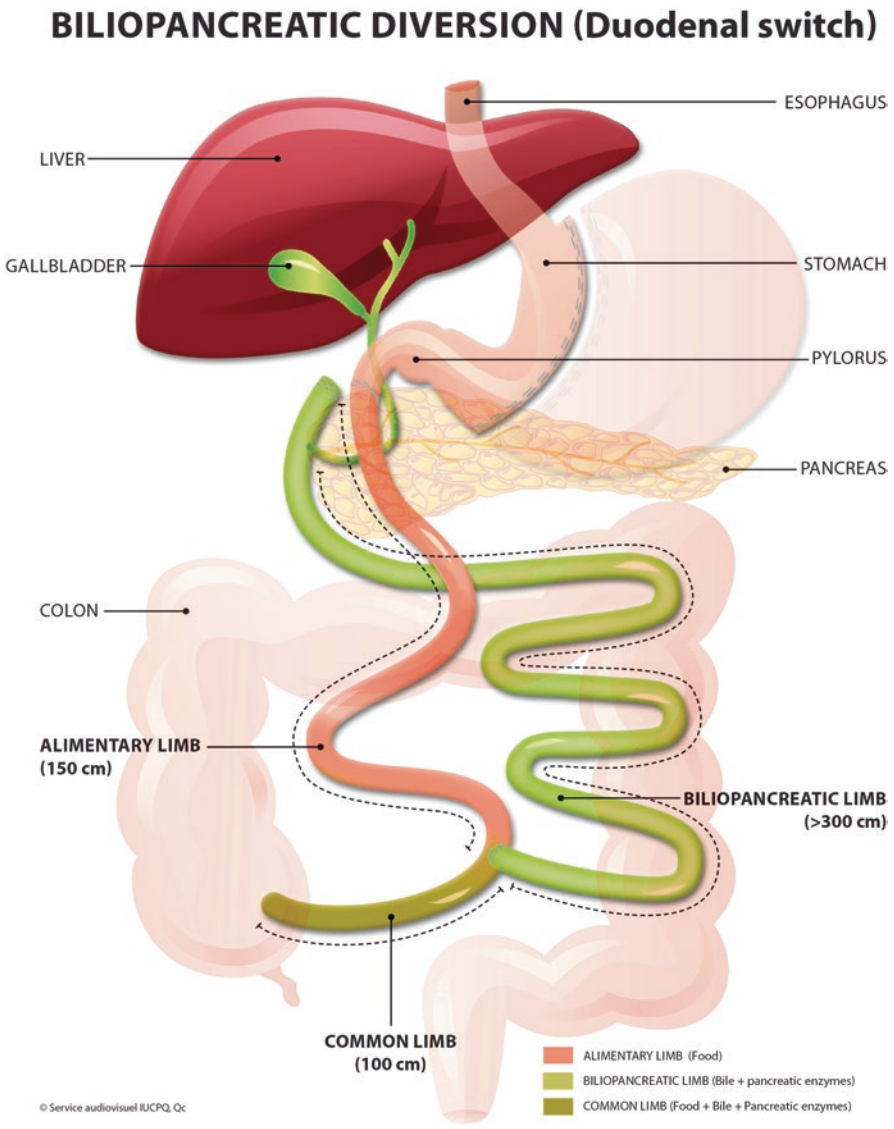

Fig. 24.1 Biliopancreatic diversion with duodenal switch

In short, the current BPD-DS technique we described in the present article includes three specific components. First, the sleeve gastrectomy provides some caloric restriction while decreasing acid production and accelerating gastric emptying. A 250-cm total alimentary limb is created to decrease caloric absorption. Finally, a 100-cm common channel is formed, where food bolus mixes with biliopancreatic

juices, resulting in decreased protein and fat absorption and in a strong metabolic effect. Long-term outcomes, side effects, and complications have been described extensively in the literature [7–11], and we will focus this chapter on surgical technique and peri-operative management.

24.2 Surgical Technique (Video 24.1)

24.2.1 Preoperative Evaluation

All bariatric patients are evaluated by a multidisciplinary team, including a bariatric surgeon, bariatric nurse, and dietician. Consultation with a dietician qualified in BPD-DS is of utmost importance to correct eating disorders and to educate patients on the recommended diet after BPD-DS (high-protein, very low-fat diet). Before surgery, a low-calorie, high-protein diet can also be used to decrease the size of the liver and the amount of intraperitoneal fat. A psychiatric or psychological evaluation is requested for patients with a history of mental health or when clinically indicated. Screening for diabetes, dyslipidemia, and obstructive sleep apnea is performed. These comorbidities are controlled prior to surgery, especially when moderate to severe sleep apnea is detected, and noninvasive positive pressure ventilation should be initiated before surgery.

Preoperative blood work consists of a complete blood cell count, liver enzymes, albumin, calcium, parathyroid hormone, vitamin D, vitamin A, vitamin B12, and iron panel. Preoperative nutritional deficiencies should be detected and treatment initiated *before* surgery, to decrease the risks of poorly controlled deficiencies in the postoperative period. In our practice, all patients receive a multivitamin complex that contains vitamin B1 (Centrum Forte©) and vitamin D3 supplementation (10,000 U per day for 1 month followed by 1000 U per day until surgery) at least 3 months before surgery.

24.2.2 Preparation and Patient Positioning

The patient is placed under general anesthesia and placed in the supine, split-leg position with both arms open (Fig. 24.2). The surgeon stands between the patient's legs, and the assistant to the left side, except for the sub-mesocolic part of the procedure where they both are on the patient's left side. Before the beginning of the surgery, appropriate antibiotic (cefazolin 2 g IV for patients weighing ≤120 kg and 3 g for patients weighing >120 kg) and deep venous thrombosis prophylaxis (heparin 5000 U SC 2 hours before surgery) are given.

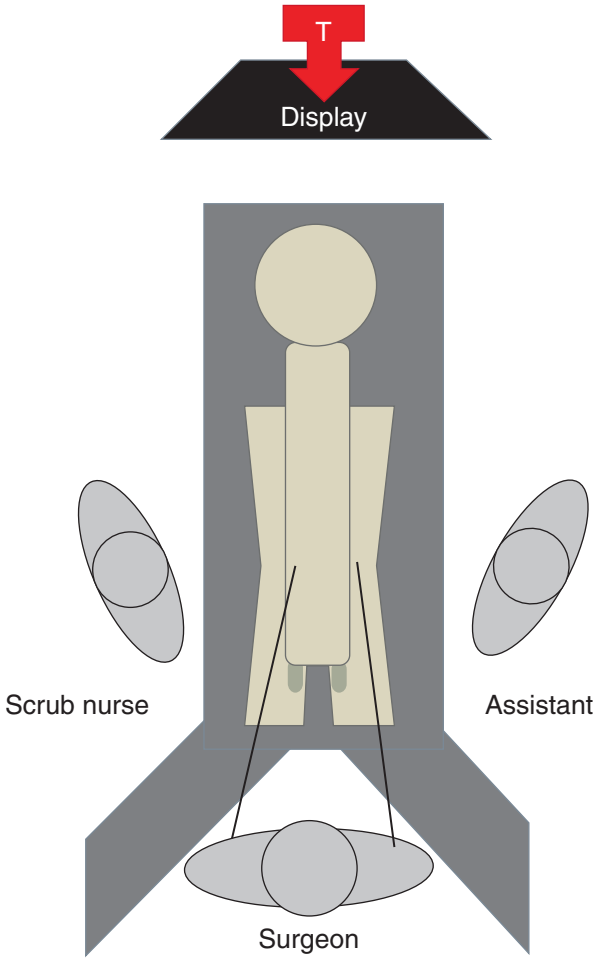

Fig. 24.2 Patient positioning

24.2.3 Peritoneal Access and Ports Positioning

A 15-cm Veress needle introduced in the left subcostal area is used to establish a 15-mm Hg pneumoperitoneum. The first 5- or 12-mm optical trocar is then placed, 2 handbreaths under the xiphoid, for a 30° endoscope. Two 12-mm ports are placed at the same level in the left and right upper flanks. Three more 5-mm ports are placed, one subxiphoid for the liver retractor, one in the left upper quadrant for the assistant, and one in the left lower quadrant for the sub-mesocolic part of the procedure (Fig. 24.3).

24.2.4 Gastric Mobilization

The patient is placed in a reverse Trendelenburg position. The gastrocolic ligament is divided off the greater curvature, using an ultrasonic scalpel (Fig. 24.4). This dissection is carried from 4 cm proximal to the pylorus up to the angle of His. The left

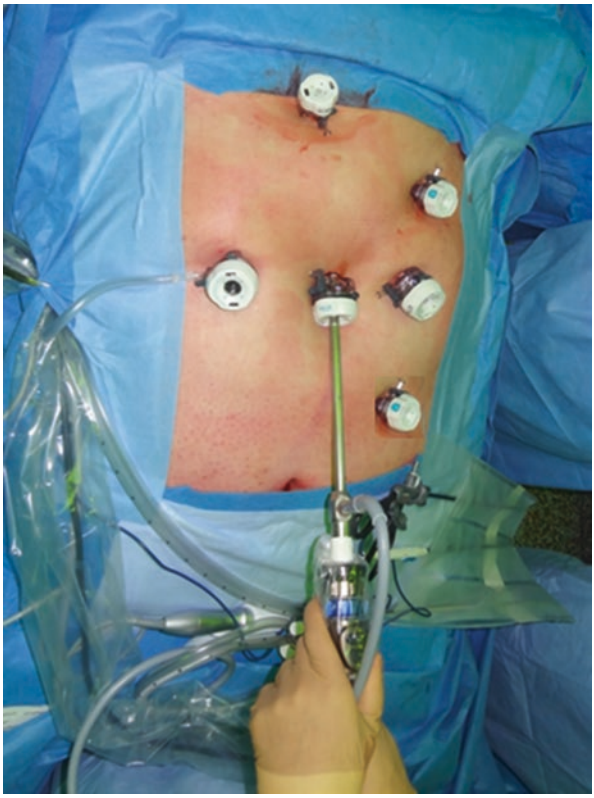

Fig. 24.3 Trocar placement for laparoscopic BPD-DS

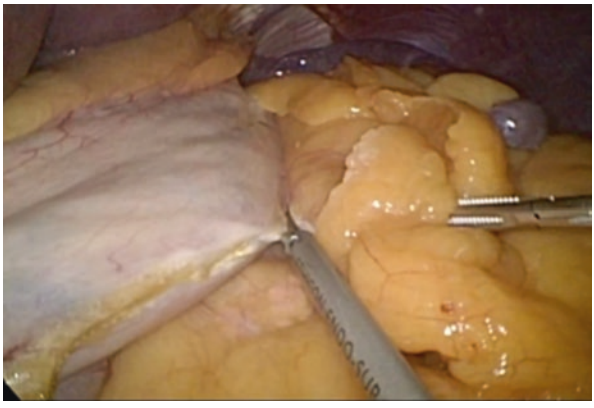

Fig. 24.4 Transection of the gastrocolic ligament

crux is exposed to assess that mobilization of the fundus is complete and to avoid leaving a gastric pouch at that level. At the same time, the presence of a hiatal hernia is ruled out. When a hiatal hernia is detected intraoperatively, it should ideally be repaired at the same time.

The feasibility of the duodenal switch is then assessed. If anatomic concerns are encountered (i.e., limited working space due to high intra-abdominal pressure, super obese man with a short mesentery, dense adhesions at the level of the duodenum or in the pelvis), a staged approach can be considered by doing a sleeve gastrectomy as a first-stage surgery.

24.2.5 Duodenal Dissection

The assistant grasper is placed on the antrum from the left subcostal port, applying a left horizontal traction, essential for a good duodenal exposition. The pylorus is identified, and the peritoneum at the inferior and superior edge of the duodenum is opened. The common bile duct is often visualized at the superior aspect of the duodenum and can be used as a landmark. A perfect knowledge of the position of major anatomical structures (pancreatic head, common bile duct, gastroduodenal artery) is essential for duodenal dissection. Two different approaches exist for the mobilization of the first duodenum.

The posterior approach consists in a complete mobilization of the inferior and posterior attachments of the duodenum. The gastrocolic ligament transection is carried down to the duodenum, and the pyloric artery is controlled using ultrasonic energy or clips. A posterior dissection is performed using the gastroduodenal artery as a landmark for distal mobilization of the duodenum. A window is then created on the upper aspect of the duodenum, and a 15-cm Penrose drain is used for retraction. The window is slightly enlarged to accommodate the anvil of a 60-mm linear stapler. An Echelon Flex™ (Johnson and Johnson, USA) with a blue cartridge is introduced through the 12-mm left upper quadrant trocar for a transverse duodenal transection. Stapler line reinforcement (Gore Seamguard™, WL Gore and Associates, USA) can be used on the anvil side, avoiding clip placement on the staple line for control of bleeds.

The inferior approach is a direct duodenal approach to create a retroduodenal tunnel. A window is created at the inferior part of the duodenum, 3–4 cm distal to the pylorus. Careful blunt dissection is used to identify the plane between the posterior duodenal wall and the pancreas, avoiding small venous branches, the gastroduodenal artery, and injury to the back wall of the duodenum. If difficulties are encountered, the dissection can be converted to a posterior approach. When the retroduodenal dissection reaches the upper part of the duodenum and the window is completed, the duodenum is transected 2–4 cm distal to the pylorus (Fig. 24.5).

24.2.6 Sleeve Gastrectomy

The goal of gastrectomy in BPD-DS is to reduce acid production and to be only mildly restrictive. It is of utmost importance not to create the sleeve too tight along the bougie (in opposition to a stand-alone sleeve gastrectomy) as this would increase the risk of protein malnutrition. A bougie is used to calibrate the sleeve, performed along the vessels on the lesser curvature, and the transection is started 5–7 cm from the pylorus using a 60-mm stapler (Fig. 24.6). Black or green cartridges are used for the first two to three firings. As the transection progresses toward the fundus, the length of the staples is decreased from green to blue cartridges. Either clips, oversewing sutures, or buttressing materials are used to control hemostasis on the staple line. The gastrectomy specimen is then placed in a bag and removed through the 12-mm trocar in the right flank after slight enlargement of the aponeurosis.

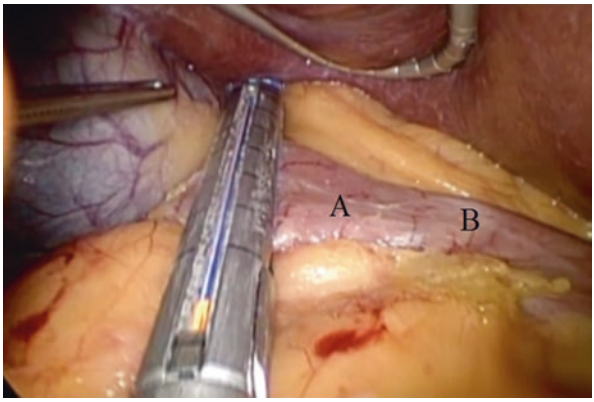

Fig. 24.5 Transection of the duodenum (**a**) using a 60-mm stapler with a blue load, 3 cm from the pylorus (**b**)

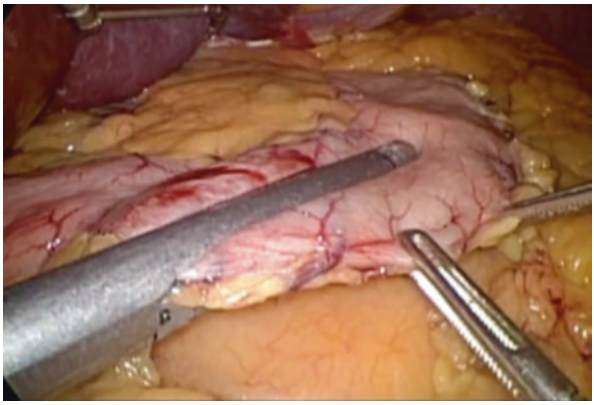

Fig. 24.6 The sleeve gastrectomy is started 5–7 cm from the pylorus

24.3 Small Bowel Measurement and Transection

The patient is placed in a Trendelenburg position with the left side down. The surgeon uses the two left flank trocars. Starting at the ileocecal junction, a common channel of 100 cm is measured, and the future site of the ileoileostomy is marked, using a large clip on each side of the mesentery. The length of the metallic part of our bowel graspers is 5 cm, and we use it to measure the small bowel. The small bowel is then run another 150 cm and transected at that level (250 cm from the ileocecal valve), using a 60-mm linear stapler with a white cartridge. The corresponding mesentery is opened a few centimeters to decrease tension on the duodenal anastomosis. The alimentary limb is immediately marked using a metallic clip and should be placed in the right upper quadrant. Our technique of choice, especially in patients with high BMIs, is to place a Penrose drain below the small bowel at 250 cm to help bring the small bowel to the duodenum and to reduce the tension on the duodenal anastomosis. The duodenal anastomosis is done before transecting the ileum (similar to a single-anastomosis BPD-DS).

24.3.1 Duodenoileostomy

This anastomosis is usually performed first, to reduce tension on the small bowel mesentery. The patient is placed in a slight head-up position. The proximal alimentary limb is brought to the transected first duodenum in an antecolic fashion. If there is tension on the anastomosis, the omentum can be mobilized from its attachments to the ascending colon. A hand-sewn end-to-side anastomosis is then created. The first anastomotic layer is made, joining the anti-mesenteric side of the small bowel to the duodenum (Fig. 24.7). A 2-cm enterotomy is made on each intestinal side, and another running suture is used to create the back wall of the anastomosis, starting from the top of the intestinal opening. The anastomosis is completed by creating

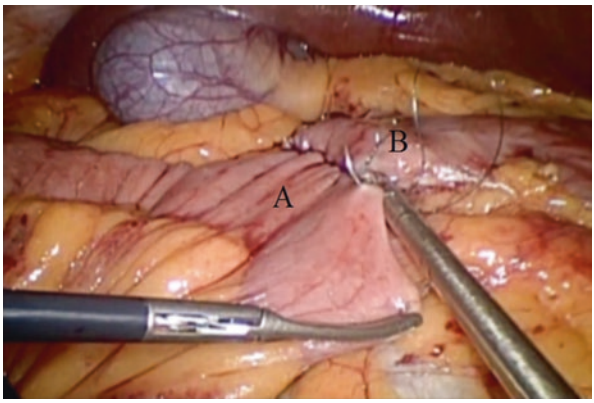

Fig. 24.7 The first posterior layer is created using 3.0 V-Loc™ suture, to approximate the alimentary limb (**a**) to the proximal duodenum (**b**)

the anterior part of the anastomosis, starting from the top and going down to the posterior wall suture located on the inferior aspect of the anastomosis (Fig. 24.8). A 23-cm, 3.0 absorbable V-Loc suture or 3.0 PDS suture is used for all anastomosis layers.

24.3.2 Ileoileostomy

The patient is placed in head-down position with the left side down for the creation of the ileoileostomy, 100 cm from the ileocecal valve. The stump of the biliary limb is first attached to the common channel in an anti-peristaltic configuration, using 2.0 Vicryl™ suture (Fig. 24.9). A side-to-side anastomosis is created using a white load of a 60-mm linear stapler-cutter. The bowel opening is closed using a single layer of 3.0 V-Loc™ suture, starting from the mesenteric side (Fig. 24.10).

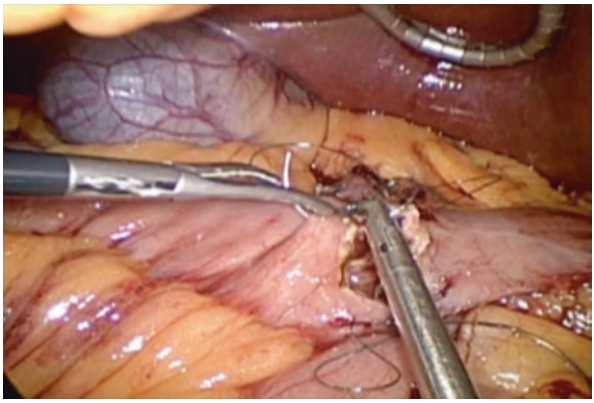

Fig. 24.8 The anterior wall of the anastomosis is created, using a 3.0 V-Loc™ running suture, starting from the top of the anastomosis

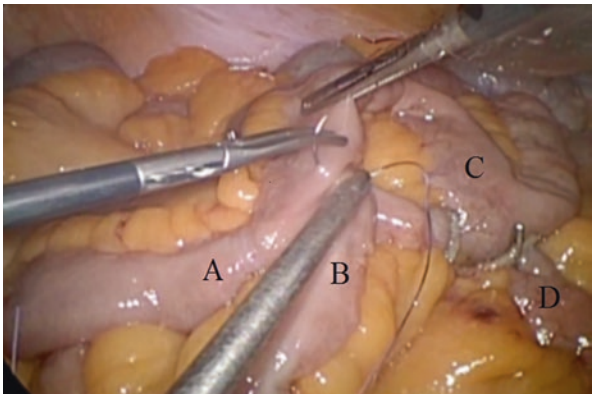

Fig. 24.9 A 2.0 Vicryl suture is placed to approximate the common channel (**a**) and the biliary limb (**b**). The alimentary limb (**c**) is located in the patient's right flank. The disconnected alimentary limb can be seen on the right side of the picture (**d**)

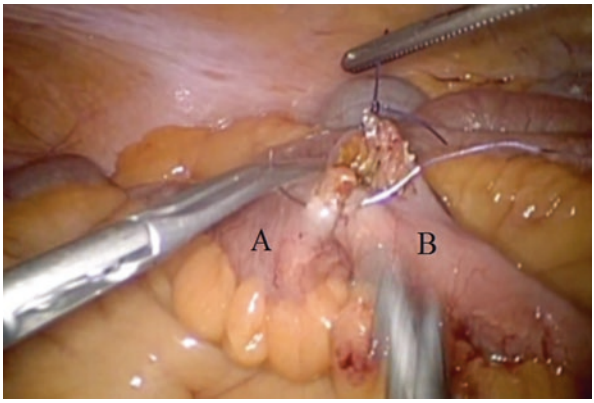

Fig. 24.10 The intestinal opening of the anastomosis is closed with a 3.0 absorbable suture. The common channel (**a**) is on the left and the biliary limb (**b**) on the right of the picture

24.4 Closure of Mesenteric Window and Petersen Window

The ileoileostomy is retracted to the right upper quadrant with the 2–0 Vicryl™ stay suture, allowing good exposure for the mesenteric window closure. The window is closed from the left using a 23-cm 2.0 Prolene suture.

The patient is then placed head up with the left side up, and the transverse colon is lifted up using the right upper quadrant trocar. Petersen's defect is then closed using the same type of suture. A routine cholecystectomy and liver biopsy are then performed.

The dilated 12-mm trocars in the right flank are closed with 2.0 Vicryl™ using a fascia closure device. Trocars are removed, and the pneumoperitoneum is exsufflated under direct vision.

24.5 Postoperative Care

Regular subcutaneous heparin is given the evening of surgery (heparin 5000 U SC). All patients are started on a low-molecular-weight heparin on postoperative day 1 for 3 weeks post-op. Pneumatic compression devices, incentive spirometry, and noninvasive airway support (C-PAP or Bi-PAP) are also used. Patients are allowed water the day of surgery, followed by clear liquids on the first postoperative day and a full liquid diet on postoperative day 2. Patients are usually discharged on the second postoperative day on a full liquid diet for 2 weeks. The diet progressed to pureed diet, minced diet, and then regular diet every 2 weeks. Patients who still have their gallbladder are placed on ursodiol (Actigall, Ciba-Geigy, Summit, New Jersey), 250 mg orally, twice a day, for 6 months. Daily vitamins and mineral supplementations are started within the first month after surgery (ferrous sulfate, 300 mg;

Table 24.1 Clinical outcomes in large series of BPD-DS (>100 cases) with a minimal follow-up of 5 years

Authors	Follow-up (yrs)	N	Weight loss (%)	T2DM (% remission)	HTN (%)	DLP (%)
Himpens [8]	11 ± 5	153	TBWL: 41 ± 10%	88%	81% improved	>90%
Marceau [9]	8 (5–20)	2615	EWL: 71% (55 kg)	93%	60% cured 91% improved	80%
Biertho [10]	9 ± 4	810	EWL: 76 ± 22%	92%	60% cured	–
Pata [11]	12 ± 3	874	21 points of BMI lost	67% to 97%[a]	>96%	>96%

Legend: *yrs.* years, *N* number of patients, *TBWL* total body weight loss, *EWL* excess weight loss, *T2DM* type 2 diabetes, *HTN* hypertension, *DLP* dyslipidemia

[a]Remission rate was 67% for patients initially on insulin and 97% when initially on oral medications

vitamin D2, 50,000 IU; vitamin A, 30,000 IU; calcium carbonate, 1000 mg; and a multivitamin complex). These supplements are adjusted over time, and education in consuming a high-protein diet is reinforced. The patient is followed with blood analysis (similar to preoperative blood work) at 4, 8, and 12 months and annually thereafter. Fasting glucose, hemoglobin A1C, and lipid panel are performed every year. Table 24.1 summarizes the medium- and long-term outcomes after BPD-DS in series with more than 100 subjects. As expected, the overall metabolic outcomes for BPD-DS are excellent, with remission rate for T2D above 90% for patients on non-insulin therapy and resolution of HTN above 60% and dyslipidemia above 80% on the long term.

24.6 Conclusion

BPD-DS offers one of the best long-term controls of obesity-related diseases and is associated with one of the lowest risks of weight gain. It should be part of surgeons' armamentarium, particularly for the management of weight regain following sleeve gastrectomy. Like any advanced surgical procedure, there is a learning curve associated with laparoscopic BPD-DS, but standardization of the different surgical steps allows keeping complication rates low. The use of a hand-sewn anastomosis, particularly, is associated with some of the lowest risk of anastomotic leak. In case of intraoperative difficulties, the procedure can be converted to a stand-alone sleeve gastrectomy, and a duodenal switch can be performed, typically 18 to 24 months after the initial surgery.

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