Biliopancreatic Diversion with Duodenal Switch

Surgical Technique and Perioperative Care

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KEYWORDS

• Biliopancreatic diversion • Duodenal switch • Surgical technique
• Malabsorptive surgery • Management

KEY POINTS

- Patient selection is key to obtaining good clinical outcomes.
- Sleeve gastrectomy (SG) alone can be used as a staged approach in selected cases or to assess patient compliance with follow-up and supplementation.
- Long-term nutritional follow-up with vitamins and minerals supplements is mandatory.

Video content accompanies this article at http://www.surgical.theclinics.com

INTRODUCTION

The duodenal switch technique, without gastric resection, was originally described for the treatment of bile gastritis, by DeMeester and colleagues in 1987.[1] In addition, Dr Scopinaro and colleagues[2] described in 1979 a technique of biliopancreatic diversion. This procedure combined a distal gastrectomy, a gastrojejunostomy, and a jejunojejunostomy to create a 50-cm common channel and a 250-cm alimentary channel. This technique resulted in excellent outcomes, but the resection of the pyloric valve and the short, 50-cm, common channel resulted in postgastrectomy syndrome, significant risks of marginal ulcer, and increased gastrointestinal side effects.[3] The technique was thus modified in the late 1980s, to perform a longitudinal gastrectomy instead of a distal gastrectomy and to increase the common channel to 100 cm.[4,5] By preserving the pyloric valve and first duodenum, the normal emptying of the stomach is preserved, the risk of marginal ulcer is decreased, and gastrointestinal side effects are reduced.[3] In short, biliopancreatic diversion with duodenal switch (BPD-DS) includes

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3 specific components: (1) a longitudinal gastrectomy (SG) to provide some caloric restriction while decreasing acid production and maintaining a normal gastric emptying; (2) a 250-cm total alimentary limb whose role is to decrease caloric absorption; and (3) a 100-cm common channel where food bolus mixes with biliopancreatic juices, resulting in decreased protein and fat absorption (Fig. 1). The malabsorptive and hormonal effects of BPD-DS result from separating the flow of food from the flow of bile and pancreatic juices. This results in a reduction of caloric and food absorption, in particular lipids, and metabolic changes through modifications in incretin levels.

In 2001, Dr Gagner[6] performed the first BPD-DS by laparoscopy, but the procedure has long been long been considered the most challenging bariatric procedure. Improvements in patient selection and preparation, surgical instrumentation, and 2-stage surgery, however, have now made laparoscopic approach standard, even for patients with very high body mass index (BMI).

SURGICAL TECHNIQUE

Preoperative Planning

The goal in modern bariatric surgery should be to select the right procedure for the right patient. This can significantly improve patient compliance with vitamin

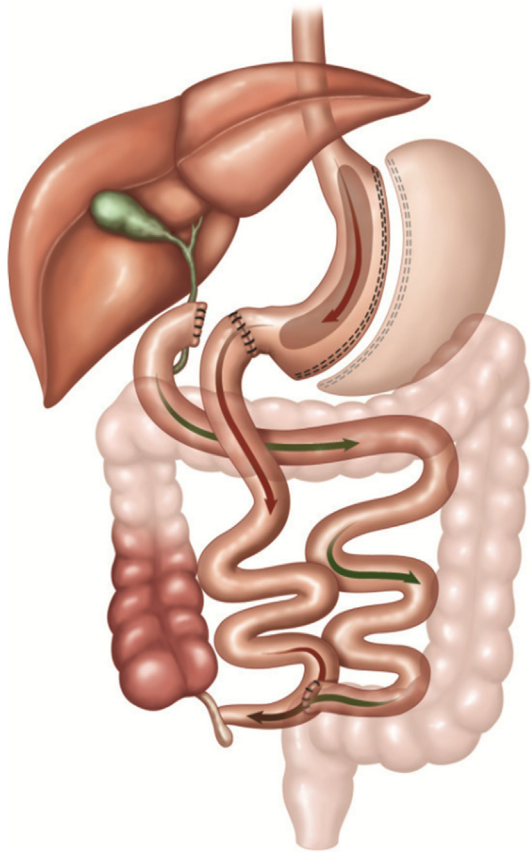

Fig. 1. BPD-DS. SG is performed and the first duodenum is anastomosed to the last 250 cm of small bowel. A 100-cm common channel is created.

supplementations, decrease dissatisfaction with side effects, and set reasonable goal expectations. The selection criteria for BPD-DS follows the standard recommendations for bariatric surgery, described in 1991 by the National Institutes of Health.[7] In addition, with the increased popularity of SG, it has become of increasing importance to be knowledgeable of laparoscopic BPD-DS for the management of weight regain. A duodenal switch allows staying away from scarred tissue at the level of the stomach, which can potentially reduce the risk of leak at the level of a gastrojejunostomy. Also, the safety and effectiveness of redo SG or conversion to Roux-en-Y gastric bypass for patients who have failed an SG can be questionable. On the other hand, adding a malabsorptive component (duodenal switch) represents an effective way to offer a successful weight loss to those patients.[8]

Contraindications for malabsorptive surgery follow the standard recommendations for bariatric surgery. In addition, the presence of Barrett esophagus is usually seen as a relative contraindication to an SG. Compliance with long-term follow-up, regular blood work, and lifelong vitamin and mineral supplementation are also of utmost importance to obtaining successful outcomes. A history of substance abuse in the prior 6 months, poorly controlled mental disease, and questionable long-term compliance represent the authors' main reasons to refuse patients for BPD-DS. Patients should quit smoking before any bariatric surgery. Slow-release medications should be converted to normal release, due to the unknown absorption after malabsorptive surgery (ie, long-acting antidepressants).

Preoperative Work-up

All bariatric patients are assessed by a multidisciplinary team, including a bariatric surgeon, specialized bariatric nurse, and dietician. Consultation with a dietician experienced with BPD-DS is of utmost importance, to correct eating disorders before surgery and for patient education of the recommended diet after BPD-DS (high-protein and low-fat diet). A psychiatric evaluation is requested for patients with a history of mental disease or when clinically indicated. Patients are screened for sleep apnea and, if needed, noninvasive positive pressure ventilation is initiated by a pneumologist before surgery. Preoperative blood work consists of a complete blood cell count, liver enzymes, albumin, calcium, parathyroid hormone, vitamin D, vitamin A, vitamin B_{12}, and folic acid. Patients also have a lipid panel and are screened for diabetes. All patients receive a multivitamin complex (Centrum Forte) before surgery (usually 3 months in advance) and vitamin D supplementation (10,000U for 1 month followed by 1000 U until surgery). Other vitamins and minerals deficiencies are corrected before surgery.

Preparation and Patient Positioning

Patients are placed under general anesthesia in a bariatric operating room table. Intravenous antibiotics (cefazolin, 2 g) and thromboprophylaxis (heparin, 5000 U, subcutaneously 2 hours before surgery, or low-molecular-weight heparin at a prophylactic dose, 12 hours before surgery) are given before the procedure starts. Pneumatic compression devices are used during the procedure and until patients are ambulatory.

The following laparoscopic instruments set is used during the surgery:

- A 5-mm or 10-mm 30° endoscope
- Nontraumatic bowel graspers, including extralong (45-cm) instruments
- Articulating linear stapler-cutter, 60 mm in length, with cartridges ranging from white to black loads (Echelon Flex long 60, Ethicon, Cincinnati, OH)
- Ace ultrasonic device (Ethicon)

- Laparoscopic curved needle holder with DeBakey forceps, with a bariatric needle holder
- 5-mm and 10-mm disposable trocars, 10 cm in length (Endopath Xcel, Ethicon), with 15-cm length trocars available
- 15-cm Veress needle
- V-Loc absorbable 3-0 suture (Covidien, Mansfield, Massachusetts)
- Long clip applier
- Fascia closure device

The basic principles of a BPD-DS are to start with the gastric mobilization and SG. The duodenum is transected 3 cm to 4 cm distal to the pylorus. The small bowel is then transected 250 cm from the ileocecal valve. A handsewn duodenoileostomy is then created. The biliary limb is anastomosed side to side to the alimentary limb, 100 cm from the ileocecal valve.

Positioning

Patients are placed in a split-legs position, with both arms open. The surgeon stands between a patient's legs, a camera operator to the right, and an assistant to the left. A 15-cm Veress needle is introduced in the left subcostal area to create a 15-mm Hg pneumoperitoneum. A 5-mm or 10-mm optical trocar is placed under direct vision, 2 handbreadths under the xyphoid, for the camera. A 12-mm port is placed at the same level in the left and right flanks. A 5-mm port is placed in the epigastrium for the liver retractor, in the left upper quadrant for the assistant, and in the left flank for the submesocolic part of the procedure (**Fig. 2**).

Surgical Approach

Step 1: gastric mobilization

The first step of the procedure is similar to a standard SG (Video 1). The gastrocolic ligament is opened starting at the level of the gastric body, using an ultrasonic scalpel (**Fig. 3**). The greater curvature of the stomach is fully mobilized from the antrum to the

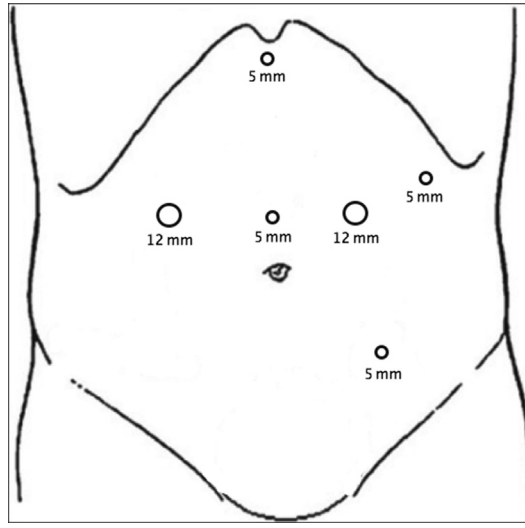

Fig. 2. Trocars position for a laparoscopic BPD-DS.

Fig. 3. Transection of the gastrocolic ligament.

angle of His. The feasibility of the duodenal switch is appraised at that point. In certain cases (ie, super-super obese man with a short mesentery, dense adhesions at the level of the duodenum or pelvis, or patients with high intra-abdominal pressure with limited working space), the surgery can be converted to SG alone, as a first-stage surgery.

Step 2: duodenal dissection

The duodenal dissection represents the main specificity of a duodenal switch and the learning curve with this dissection should be done under supervision, due to the proximity of several major anatomic structures, such as the pancreatic head, the common bile duct, and the gastroduodenal artery (Videos 2 and 3). The pylorus is identified and the peritoneum is opened at the inferior and superior edges of the duodenum. Pulling the antrum to the patient's left, from the left upper quadrant trocar, provides a good retraction of the duodenum. The common bile duct is often visualized at the superior aspect of the duodenum and can be used as a landmark for the duodenal dissection. Two different techniques exist for the mobilization of the first duodenum: a complete mobilization of the inferior and posterior attachments of the duodenum (inferior approach) and a direct approach of the duodenum to create a tunnel under the posterior aspect of the duodenum (posterior approach).

Inferior approach The gastrocolic ligament is transected using ultrasonic energy (see Video 2). The pyloric artery is controlled and dissection is continued on the first duodenum. A posterior dissection is performed to mobilize the first 3 cm to 4 cm of duodenum. The gastroduodenal artery is often used as the limit for the posterior dissection of the first 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 with a blue cartridge is introduced through the 12-mm port in the left flank. The duodenum is then transected.

Posterior approach A window is created at the inferior part of the duodenum, 3 cm to 4 cm distal to the pylorus (see Video 3). Blunt dissection is used to identify the plane between the posterior duodenal wall and the pancreas. That dissection has to be done carefully, to avoid bleedings from the small venous branches draining the duodenum to the pancreatic head, from the gastroduodenal artery, and to prevent an injury to the back wall of the duodenum. If any difficulties are encountered, the dissection can be converted to an Inferior approach to better identify the anatomy. When the window

below the duodenum is created, a 15-cm Penrose drain is used to retract the duodenum (Fig. 4). The window is slightly enlarged to accommodate the anvil of a 60-mm linear stapler and the duodenum is transected (Fig. 5).

Step 3: sleeve gastrectomy

Gastric transection is started 5 cm to 7 cm from the pylorus (Fig. 6, Video 4). A 60-mm Echelon Flex is used with black or green cartridges for the first 2 to 3 firings. The length of the staples is decreased (from green to blue cartridges) as the gastric transection progresses towards the fundus. A 34-French esophagogastric bougie is usually placed for guidance. Care is taken not to create the sleeve too tight along that bougie. The goal of gastric resection in BPD-DS patients is to reduce acid production and to be mildly restrictive. This is in stark contrast with SG as a stand-alone procedure, in which the sleeve has to be much more restrictive due to the absence of associated small bowel bypass. The hemostasis on the staple line must be controlled, either with clips, oversewing with a 3-0 absorbable suture or with buttressing materials. The gastrectomy specimen is then placed in a plastic bag and removed through the 12-mm trocar in the right flank.

Step 4: small bowel transection

Patients are placed in a head-down position with the left side down (Video 5). The surgeon moves to the left side of the patient and uses the 2 lower trocars in the left flank. The ileocecal junction is first identified and adhesions between the ascending colon and the omentum are released. The authors use the length of the metallic part of our bowel graspers (5 cm) to measure the alimentary limb. The small bowel is first marked at 100 cm from the ileocecal junction, using a large clip on each side of the mesentery. 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 alimentary limb should be on the patient's right side and is directly marked using a metallic clip on the mesentery. The small bowel mesentery is usually opened a few centimeters to decrease tension on the duodenal anastomosis. Resection of the last few centimeters of small bowel can be done if there is any ischemia detected at that time.

Step 5: duodenoileal anastomosis

The duodenoileal anastomosis is usually performed first, to decrease tension on that anastomosis as much as possible (Videos 6 and 7). In smaller patients, however, the distal anastomosis (see step 6) can be performed before the duodenoileal

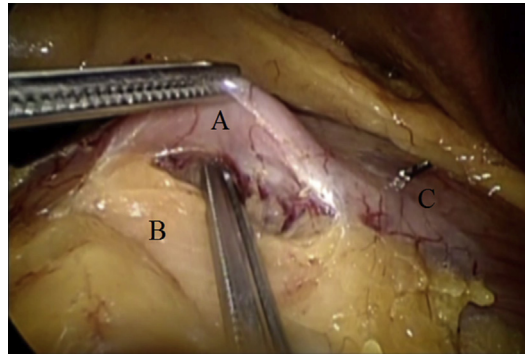

Fig. 4. (A) The duodenum is lifted up with a Penrose drain and the retroduodenal window is enlarged (B) pancreatic head and (C) pylorus.

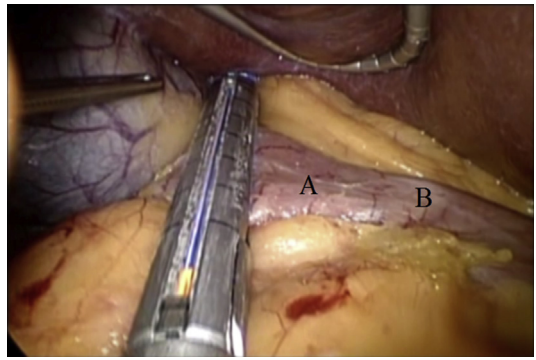

Fig. 5. Transection of the (A) duodenum using a 60-mm stapler with a blue load, 3 cm from (B) the pylorus.

anastomosis, to avoid one position change. For the duodenal anastomosis, the patient is placed in a slight head-up position and the surgeon goes between the patient's legs. The alimentary limb is brought to the right upper quadrant in an antecolic fashion and approximated to the transected duodenum. The omentum can be mobilized from its attachments to the ascending colon if there is any tension on the anastomosis. A handsewn end-to-side anastomosis is then created. A 23-cm 3-0 absorbable V-Loc suture is used for the first anastomotic layer (see Video 6). The antimesenteric side of the small bowel is anastomosed to the duodenum (**Fig. 7**). The intestinal lumens are opened and another 23-cm 3-0 V-Loc suture is used to create the back wall of the anastomosis, starting from the top of the intestinal opening. A 15-cm V-Loc suture is then used to create the anterior wall of the anastomosis, starting from the top of the anastomosis (**Fig. 8**, see Video 7). The 2 running sutures are crossed or attached together on the inferior aspect of the anastomosis. The anastomosis can be tested by insufflating air through a nasogastric tube. This also allows testing the patency of the anastomosis. The authors do not routinely test the anastomosis but rather perform an intraoperative gastroscopy in selected cases.

Step 5: ileoileal anastomosis

The ileoileal anastomosis is then created at 100 cm from the ileocecal valve (see Video 5). The patient is place head-down and the surgeon moves back to the patient's

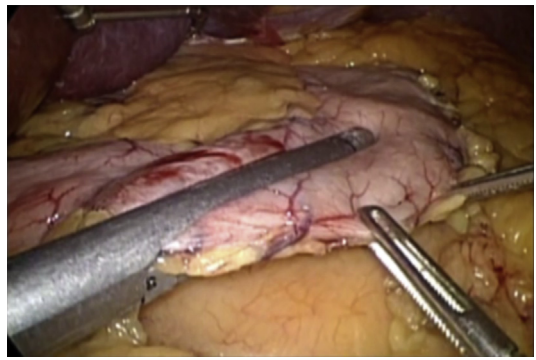

Fig. 6. The SG is started 5 cm to 7 cm from the pylorus.

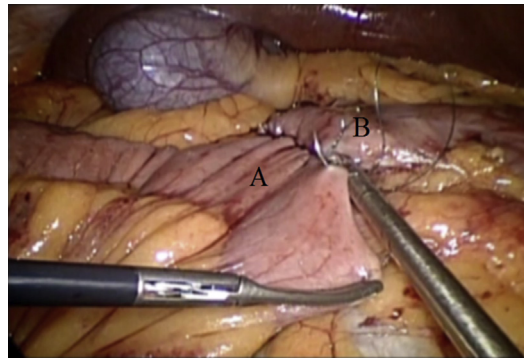

Fig. 7. The first posterior layer is created using 3-0 absorbable suture, to approximate (A) the alimentary limb to (B) the duodenum.

left side. The biliary limb is attached to the ileon using a 2-0 Vicryl in an antiperistaltic technique (Fig. 9). This stitch is used to provide an adequate exposure for the anastomosis. A side-to-side anastomosis is then created using another white load of a 60-mm linear stapler-cutter. The intestinal opening is closed using a single layer of 3-0 V-Loc suture, starting from the mesenteric side (Fig. 10). The small bowel is then retracted to the right upper quadrant using the 2-0 Vicryl stay suture. The mesenteric window is closed using a nonabsorbable 2-0 Prolene suture. The Petersen window is also closed as much as possible. The transverse colon is lifted up through the left upper quadrant trocar. A 2-0 Prolene suture is then used to close the Petersen defect.

A routine cholecystectomy and liver biopsy are usually performed at the end of the surgery; 12-mm trocars are closed with 2-0 Vicryl using a fascia closure device and the pneumoperitoneum is exsufflated under direct vision.

Postoperative Period

Regular or low-molecular-weight subcutaneous heparin is given the day of surgery. All patients are switched to a low-molecular-weight heparin on postoperative day 1. Patients are allowed to drink water the day of surgery. A liquid diet is started on postoperative day 1 and a soft diet on postoperative day 2. Patients are usually discharged on

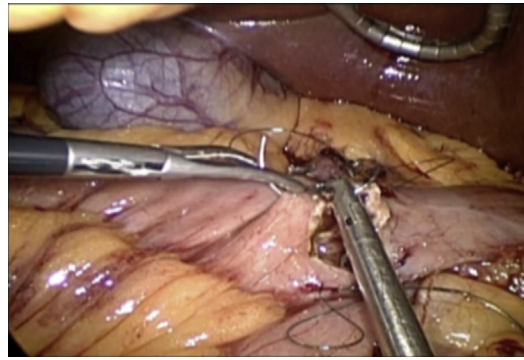

Fig. 8. The anterior wall of the anastomosis is created, using an absorbable 3-0 running suture, starting from the top of the anastomosis.

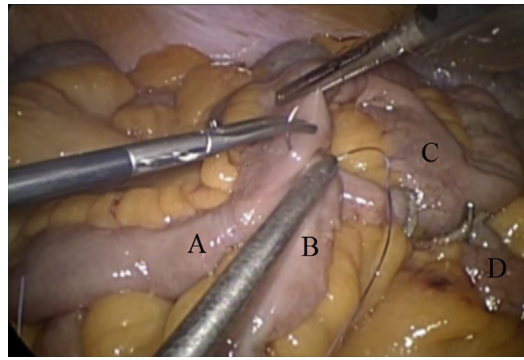

Fig. 9. A 2-0 Vicryl suture is placed to approximate (A) the common channel and (B) the biliary limb. (C) The alimentary limb is located in the patient's right flank and (D) proximal Ileon.

postoperative day 3, when tolerating a soft diet. 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. A nutritionist monitors patient intakes before discharge and instructs patients to progress to a minced diet after 2 weeks and to a regular diet after 1 month. Daily vitamins and mineral supplementations are started within the first month after surgery (ferrous sulfate, 300 mg; vitamin D, 50,000 IU; vitamin A, 20,000 IU; calcium carbonate, 1000 mg; and a multivitamin complex). These supplements are adjusted over the years, and education in consuming a high-protein diet is reinforced. The patient is followed with a blood work (similar to the blood work done in the preoperative period) after 4, 8, and 12 months and annually thereafter.

SUMMARY OF CLINICAL OUTCOMES

A recent survey of the International Federation for the Surgery of Obesity and Metabolic Disorders member national societies reported that the proportions of BPD-DS were 4.9% in 2008, 2.1% in 2011, and 1.5% in 2013.[9] Even though the absolute number of BPD-DS procedures increased from 2008 to 2013, this suggests that other surgeries are performed preferentially (ie, SG, which has now become the predominant surgery in North America). This decrease in the percentage of duodenal switch can

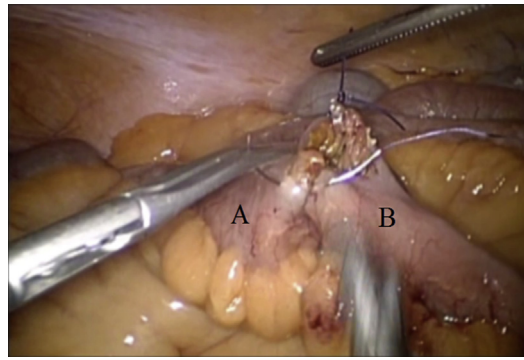

Fig. 10. The intestinal opening of the anastomosis is closed with a 3-0 absorbable suture. (A) The common channel is on the left and (B) the biliary limb is on the right.

be related to the lack of exposure of many surgical teams to the BPD-DS technique, its greater complexity, and greater concerns about gastrointestinal side effects and vitamins and protein deficiencies. In addition, BPD-DS can only be offered to super–morbidly obese patients (BMI above 50 kg/m^2) in some countries.

Long-Term Outcomes After Biliopancreatic Diversion with Duodenal Switch

Even though an exhaustive discussion of BPD-DS outcomes is beyond the goal of this article, the authors want to place long-term outcomes of BPD-DS in perspective. Only a few investigators[10–13] reported their outcomes beyond 5 years in a significant number of patients (>100 patients). These studies are summarized in **Table 1**. Overall, long-term outcomes are excellent and BPD-DS has a marked effect on obesity-related diseases, specifically type 2 diabetes mellitus (T2DM) (remission in >90% for T2D on oral medications). Similarly, Buchwald and colleagues,[14] in a meta-analysis of 32 studies with 4035 patients who underwent a biliopancreatic diversion or BPD-DS, reported a mean excess weight loss (EWL) of 70%, improvement or remission of T2DM in 98%, resolution of hypertension in 81%, resolution of sleep apnea in 95%, and improvement of hyperlipidemia in 99%.

Perioperative Morbidity and Mortality

In a meta-analysis of 361 studies, including 85,048 patients published in 2007, the mean 30-day mortality after bariatric surgery was 0.28%.[15] Perioperative mortality for BPD-DS was the highest, with a rate between 0% and 2.7% for laparoscopic procedures. More recently, global mortality after bariatric surgery has been consistently reported to be approximately 0.1%. The authors reported a complication rate in a series of 1000 consecutive BPD-DS, including the initial experience with laparoscopic BPD-DS[16]; the 90-day mortality rate was 1/1000, from pulmonary embolism. In that series, major complications occurred in 7.2%, including 1.5% leak from the SG and 1.5% leak from the duodenal anastomosis. The complication rate after BPD-DS is usually higher compared with restrictive or mixed procedure, such as gastric bypass.[17] This is partly due to the complexity of the technique but also to BPD-DS being specifically offered in superobese patients with a higher rate of metabolic

Table 1
Clinical outcomes in large series of biliopancreatic diversion with duodenal switch (>100 cases) with a minimal follow-up of 5 years

Authors	Follow-up (y)	n	Weight Loss (%)	Type 2 Diabetes Mellitus (Remission)	Hypertension	Dyslipidemia
Bolckmans & Himpens,[10] 2016	10.8 ± 4.6	153	Total body weight loss: 40.7 ± 10	87.5%	81% Improved	>90%
Marceau et al,[11] 2015	8 (5–20)	2615	EWL: 71 (55.3 kg)	93.4%	60% Cured 91% Improved	80%
Biertho et al,[12] 2010	8.6 ± 4	810	EWL: 76 ± 22	92%	60% Cured	—
Pata et al,[13] 2013	11.9 ± 3.1	874	21 points of BMI lost	67% to 97%[a]	>96%	>96%

[a] Remission was 67% for patients initially on Insulin and 97% when initially on oral medications.
Data from Refs.[10–13]

complications. Even though there has been a significant decrease in both major and minor complications with laparoscopic approach in recent years, this rate is likely to remain slightly higher compared with other surgeries with shorter operative times or lower complexity.

SUMMARY

Malabsorptive bariatric procedures, such as BPD-DS, offer sustained weight loss and marked effect on comorbidities. Offering these procedures laparoscopically can improve the complication rate and accelerate patients' return to normal activities. This should be the approach of choice in this high-risk population. Intraoperative strategies can be used to minimize surgical complications, including the use of SG as a bridge to BPD-DS. Postoperative management involves active patient participation with follow-up and adherence to dietary recommendations, including lifelong vitamin supplements. The excellent long-term medical benefits and improvement in quality of life come at the expense of some gastrointestinal side effects and vitamin supplementation.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.suc.2016.03.012.

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