Chapter 5
Duodenal Switch and Its Derivatives in Bariatric and Metabolic Surgery

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5.1 Introduction

Duodenal switch is a procedure that has been performed since the early 1980s but is estimated to only make up approximately 1% of all bariatric procedures performed in the United States. On the other hand, sleeve gastrectomy (SG) and Roux En Y Gastric Bypass (RYGB) make up 60% and 18%, respectively [1]. The first biliopancreatic diversion with duodenal switch (BPD/DS) was performed in 1988 by Hess et al. and Marceau et al. published their results and techniques later in 1993 [2, 3]. Later, both a laparoscopic as well as robotic approaches were reported on in 2000 [4, 5]. The benefits of BPD/DS are that it is the most effective operation for excess weight loss and resolution of diabetes and hyperlipidemia. However, it is not as effective as RYGB in controlling gastroesophageal reflux [6]. With these improved outcomes, the reason for slower uptake is thought to be due to the procedure being technically challenging, longer to perform, having more possible technical complications, and various nutritional deficiencies [7]. In this chapter, we will briefly review preoperative workup, operative techniques, postoperative care, and complications.

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5.2 Preoperative Workup

Indications for BPD/DS are similar to other bariatric operations but may be most appropriate for those with a high BMI, more severe diabetes, or hypercholesterolemia. Initially it was thought that patients with a BMI above 50 kg/m^3 would benefit most from a BPD/DS. However, there is evidence that a cutoff BMI does not affect excess weight loss or lead to increased malnutrition complications when either above or below a BMI of 50 kg/m^3 [6]. Therefore more typical criteria for bariatric surgery, BMI > 40 kg/m^3 or >35 with significant medical comorbidities, may be applied to patients proposed for BPD/DS.

Contraindications to BPD/DS include unresolved psychiatric conditions including substance abuse, overwhelming medical risk, noncompliance, or dense small bowel adhesions preventing appropriate mobilization. All proposed bariatric patients should undergo multidisciplinary evaluation including a mental health worker and a dietitian. In addition to multidisciplinary evaluation, careful assessment of the patient's vitamin levels should be performed and corrected preoperatively as they are more difficult to correct post-operatively.

An additional consideration when assessing patients for BPD/DS it is the possibility of performing a staged procedure for the super-obese. The BMI considered to be super-obese varies by study with some considering it 60 and others over 80. In those patients where one stage BPD/DS may be prohibitive either due to patient size or medical comorbidities, an SG followed later by BPD/DS may be considered. However, the data about the efficacy and complication profile for this strategy is the subject of some debate [8–10]. The rationale for a staged procedure is to lessen the morbidity associated with the super-obese by allowing for weight loss similar to weight loss prior to a hernia repair leading to less recurrence [11]. Some have suggested that patients should not have their hernia repaired until their BMI is <33 [12].

5.3 Techniques and Derivatives of BPD/DS

For some time BPD/DS has been described as utilizing a laparotomy but now it can be performed in a minimally invasive fashion. Generally speaking, the operation requires a sleeve gastrectomy with creation of a gastric pouch larger than a standard sleeve, approximately 150–250 mL. Next, the pylorus is preserved and the first portion of duodenum is divided over the adherent portion of the pancreas. A post-pyloric anastomosis is then created, which can be done either stapled or sewn. Differing limb lengths have been described but most commonly a 250 cm alimentary limb is created with a 100 cm common channel. It is important to keep in mind that these measurements are in relation to the ileocecal valve unlike an RYGB which is in relation to the ligament of Treitz. The two most common configurations of BPD/DS include a standard Roux configuration or as a loop duodeno-ileostomy. Proposed benefits from a loop duodeno-ileostomy are a decreased risk of internal

hernias and less technical complications due to one less anastomosis. However, in the more standard Roux configuration leaks are not complicated by bile spillage and there is less of a risk of bile acid reflux and its associated long-term complications [13].

Prior to starting the BPD/DS, it is important to properly pad and position patients. The average duration of a BPD/DS tends to be longer than an RYGB or sleeve gastrectomy and therefore patients are at a higher risk of injury from improper padding or positioning. Depending on the approach, patients are placed in either the supine or split leg position. After entry in the abdomen, either with a Veress needle or optical trocar, ports are placed in addition to a liver retractor. Next the greater curvature of the stomach is mobilized from the left crus to the first portion of the duodenum. Key areas to take extra care is the more cephalad short gastric near the spleen which can easily avulse and lead to bleeding. Another key area is dissection of stomach off the pancreas near the pylorus. Distal dissection should end near the gastroduodenal artery (GDA) and care must also be taken to avoid damage to the portal structures. Great care should be taken in both areas to avoid bleeding or thermal spread to surrounding organs. Typically, a 50–60 French bougie is used to size the stomach, which is larger than a more typical sleeve gastrectomy, and stapling is begun approximately 5 cm from the pylorus along the bougie [13]. Some surgeons will utilize buttress material including sutures, buttress material, or clips however there is no standardized approach and data is somewhat mixed on outcomes with each buttress strategy [14–17]. More importantly is to not make the sleeve too small and to avoid spiraling the staple line.

After creation of the gastric pouch, attention is turned to the duodeno-ileostomy. The small bowel at the premarked site (around 250 cm) is brought up to be anastomosed to the stapled end of the duodenum. This can be performed either antecolic or retrocolic. The omentum can be either divided or a window created. It is important to maintain appropriate orientation of the small bowel to prevent kinking, internal hernia, or a closed loop obstruction. Creation of the duodeno-ileostomy can be done in a variety of ways. The first we will discuss is the use of an EEA stapler. Typically, a size 21 anvil is utilized and passed orally through the pylorus and docked at the proximal duodenum. Next the stapler is passed through the small bowel and engaged with the anvil. The small bowel enterotomy is then closed. Due to the need to traverse the pylorus, anvil passage can be more difficult than in an RYGB. An alternative to the EEA includes a linear stapling configuration of hand-sewn anastomosis. However, it is recommended to avoid linear stapling across the pylorus as this can disrupt its function. Part of a successful BPD/DS is ensuring pyloric function post-operatively.

After completion of the proximal anastomosis the distal anastomosis is created. With the creation of a standard Roux approach, the common channel is created 100 cm from the ileocecal valve with a 250 cm alimentary limb. However, in a loop the typical limb used is longer, around 300 cm. Creation of the common channel can be done in either a stapled or hand-sewn fashion depending on surgeon preference. Most often a 60 mm stapler is used for anastomotic creation [13]. The key is to create a common channel that is at least 100 cm to avoid symptoms of short gut syndrome.

To prevent internal hernias, closure of the mesenteric defects between the alimentary limb and the biliary limb is performed using a running nonabsorbable suture. If the anastomosis is placed antecolic, closure of Peterson's defect may be performed but some debate whether this is necessary. Those who feel it should be closed is due to the risk of internal hernia, however those who do not close it state that a large defect is less likely to obstruct. There is no conclusive evidence either way at this time and the decision to close Peterson's defect is left up to the surgeon's preference. The final step of the BPD/DS is a leak test with methylene blue or intraoperative endoscopy. The method preferred is at the discretion of the surgeon.

Another consideration of BPD/DS is whether or not to perform a simultaneous cholecystectomy at the time of bypass. Reasons to perform a cholecystectomy include difficulty in accessing the common bile duct due to lack of remnant stomach and a possible higher rate of gallstone formation in the BPD/DS patient. The rationale is similar to evaluating patients who are having RYGB for gallstones to avoid the need for advanced intervention strategies for choledocholithiasis. Not only is access to the biliary tree more difficult but it also may be more technically difficult to perform a cholecystectomy after BPD/DS secondary to scarring from the duodeno-ileostomy. Reasons not to perform a cholecystectomy is not wanting to add additional length to the operation or increase potential morbidity from another surgical site intra-abdominally. Again, there is no consensus on simultaneous cholecystectomy and it is up to surgeon discretion on whether or not to perform it.

5.4 Post-operative Care

Monitoring on a bariatric floor, or other floor with bariatric trained support staff, should be utilized after BPD/DS the same way an SG or RYGB would be. BPD/DS patients have similar post-operative complaints to patients with an SG. There is some component of gastroparesis or pylorospasm which can predispose these patients to post-operative nausea and vomiting. Unlike RYGB, patients with a BPD/DS have a larger pouch and therefore can have high volume emesis. They are at risk for aspiration pneumonia. Post-operative nausea and vomiting should be managed with PRN anti-emetics and other adjuncts such as a scopolamine patch. Despite this BPD/DS patients are started on small volumes of liquids like SG and RYGB and do not have a significantly longer length of stay. If an intraoperative leak test was performed, it is unnecessary to get a upper gastro intestinal (UGI) post-operatively. Patients should also have their vitamins replaced in the usual way [7].

5.5 Complications

Generally, complications after BPD/DS fall into similar categories compared to SG and RYGB including technical, surgical, and nutritional. However, the rate of complications tends to be higher at 30 days and 1 year post-operatively [6]. Some of the more

common complications include bleeding and leaks. Bleeding is typically managed conservatively with monitoring including intravenous fluid, holding deep venous thrombosis (DVT) prophylaxis, serial hemoglobin levels, and blood replacement. If these are unsuccessful, more invasive methods such as endoscopy, including epinephrine injections and clipping, or re-operation can be attempted. In the setting of a post-operative leak re-operation, stenting, drain placement, nothing per oral (NPO), and total parenteral nutrition (TPN) are all options that can be used in combination to treat leaks.

Longer term complications include oxalate kidney stones, stricture of the sleeve, intractable GERD, and bowel obstruction. In the setting of a sleeve stricture strituroplasty can be attempted [18]. Oxalate kidney stones form due to a lack of oxalate binding in the gut by calcium and can be prevented by oral replacement of calcium. If stone do form, adequate hydration and making the urine more acidic helps dissolve these stones. Patients with intractable GERD may need conversion to an RYGB which is a technically challenging revision given the history of BPD/DS. Finally, bowel obstruction can have disastrous complications if not corrected in a timely fashion. Namely, dilation of the biliary limb will lead to duodenum blow out. If there is any suggestion of abdominal pain or dilation of the biliary limb on imaging, exploration with evaluation of the entire length of small bowel is indicated. In addition patients are at risk for intussusception and internal hernia like with an RYGB. Unlike RYGB, BPD/DS patients are at a low risk for marginal ulcer formation [19].

Nutritional complications are some of the most feared complications when performing a BPD/DS. Typically, patients do not absorb fat soluble vitamins (A, D, E, K) well and are often more pre-disposed to vitamin D deficiencies. If deficiency in these vitamins occurs, they must be replaced in their water-soluble analogue forms. Mineral deficiencies include iron, copper, zinc, and magnesium. As discussed earlier, evaluating these pre-operatively to correct for deficiencies is of the utmost importance. Vitamin and mineral deficiencies should be evaluated annually and replaced as needed. It is also important to keep in mind that normally self-resolving, chronic nausea and vomiting can lead to vitamin B deficiency and should also be evaluated [20]. Protein deficiencies are another major concern in this patient population. There is some literature to suggested that a longer common channel may correct this but no definitive strategies other than vigilant monitoring of the patient's protein intake are routinely utilized [21].

5.6 Outcomes

Many retrospective single center studies have been performed examining BPD/DS outcomes. Less commonly multicenter or randomized controlled trials have been performed. Some of the pertinent studies will be reviewed here. Sudan et al. conducted a multi-institutional analysis comparing bariatric operations with 130,767 patients. While BPD/DS made up a small part of this cohort it did include 1436 patients. BPD/DS was compared to SG, RYGB, and adjustable gastric band (AGB). The study was supportive of BPD/DS efficacy in comparison to the other methods

of bariatric surgery with a larger BMI reduction (10.6 units vs 9.3 units in RYGB and 5.7 units in SG) and greater remission of type 2 diabetes mellitus and hypertension. However, GERD was still best treated with RYGB and they found a higher rate of adverse events at 30 days and 1 year in patients who underwent BPD/DS. This included higher rates of bleeding, leaks, and pulmonary embolism [6].

Longer term single center retrospective studies do exist that corroborate the findings of Sudan et al. One study compared BPD and RYGB with findings of faster resolution of co-morbidities and weight loss in the BPD/DS patients. They however did not see an increase in morbidity and mortality [22]. Another study looked at 810 BPD/DS patients with BMI < 50 kg/m^2 and again showed similar findings with improved weight loss and rapid resolution of co-morbid symptoms. This study is of interest because it suggests that BPD/DS is appropriate for patients even if their BMI is not >50 kg/m^2 [23]. Studies looking at longer term outcomes show consistent excess body weight loss and resolution of medical co-morbidities [24, 25].

Single anastomosis duodeno-ileal bypass, with or without sleeve gastrectomy (also referred to as a loop), is a newer method of BPD/DS and its outcomes are still being defined. One small study found that patients who underwent single anastomosis duodeno-ileal bypass had a different hormone profile in comparison to traditional BPD/DS. Patients with a single anastomosis had higher glucose, GLP-1, insulin secretion, and glucagon. This suggests that while both are duodeno-ileal bypasses, they may have different endocrine mechanisms for weight loss [26]. One systematic review by Shoar et al. examined 12 studies and found that single anastomosis duodeno-ileal bypass was utilized most as a primary procedure (508 of 581 patients, 87.4%) with varying common channel lengths. The lengths include 300 cm (54.2%), 250 cm (23%), and 200 cm (13.4%). Percent excess weight loss (%EWL) was 85% at 2 years with co-morbidity resolution of 74.1% of DM, 68.3% HLD, and 96.3% for HTN. The most common reported complication was diarrhea (1.2%) with Vitamin A, selenium, iron, and protein deficiencies being the most common nutritional deficiencies [27].

Another systematic review by Spinos et al. reviewed 14 studies with similar findings. They found that at 12 months single anastomosis duodeno-ileal bypass had a mean total body weight loss between 21.5% and 41.2%. There was no weight regain after 24 months and co-morbidity resolution was 72.6% for DM, 77.2% HLD, and 59.0% for HTN. The most common post-operative complication was a need for reoperation with additional mentioned complications including nutrient deficiencies [28]. The most recent statement on single anastomosis duodeno-ileal bypass by the ASMBS states that it has “similar outcomes those reported after classic DS and should therefore be endorsed” with the “currently available peer-reviewed literature does not suggest outcomes differ substantially from those seen with classic DS” [29].

5.7 Conclusion

BPD/DS as either a staged procedure, primary procedure (either as a classic BPD/DS or a loop), or revisional strategy is important to have as an option for the bariatric surgeon. Increasing familiarity with the procedure and its performance in resolving EWL and medical co-morbidities should be weighed carefully when evaluating patients for bariatric surgery.

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