Biliopancreatic Diversion with Duodenal Switch

Ranjan Sudan, MD\textsuperscript{a,*}, Danny O. Jacobs, MD, MPH\textsuperscript{b}

HISTORY

The biliopancreatic diversion with duodenal switch (BPD-DS) is often referred to as the duodenal switch operation and is a modification of the original biliopancreatic diversion described by Scopinaro in 1979.\textsuperscript{1} The essential difference between these two operations is that in the BPD-DS version, a sleeve gastrectomy is performed and the pylorus is preserved, whereas in the original Scopinaro operation, a distal gastrectomy sacrifices the pylorus. In both operations, the stomach pouch has a capacity of 250 mL and malabsorption results from a distal Roux-en-Y reconstruction of the bowel, with a common channel of 50 to 100 cm and an alimentary limb of 250 cm.\textsuperscript{2,3} The Scopinaro BPD has excellent long-term weight loss\textsuperscript{4} but, unlike the BPD-DS, has a greater risk of postgastrectomy symptoms that are related to the distal gastrectomy, including diarrhea, dumping, and marginal ulceration.

Postgastrectomy syndrome, which includes anastomotic ulceration, early and late dumping, bowel disturbance, and nutritional deficiencies, has been a problem with other general surgical operations, such as the Billroth hemigastrectomy or the radical pancreatoduodenectomy (Whipple procedure). To avoid these symptoms, several surgeons considered preserving the pylorus. Longmire and Traverso described the pylorus-preserving Whipple procedure in 1978.\textsuperscript{5} Critchlow, in 1985, bypassed the duodenum beyond the pylorus to reduce mortality associated with a duodenal diverticulectomy.\textsuperscript{6} In 1987, DeMeester, when conducting experiments for reflux disease in dogs, demonstrated that preserving the pylorus prevented marginal ulceration.\textsuperscript{7} In bariatric surgery, Marceau and colleagues\textsuperscript{8} were the first to describe a reduction in postgastrectomy symptoms associated with the BPD by preserving the pylorus in

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\textsuperscript{a} Department of Surgery, Duke University Medical Center, Box 2834, Durham, NC 27710, USA
\textsuperscript{b} Department of Surgery, Duke University Medical Center, Duke University School of Medicine, Box 3704, Suite 7690 HAFS 7th floor, Durham, NC 27710, USA
* Corresponding author.
E-mail address: ranjan.sudan@duke.edu

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They modified the Scopinaro BPD by making a tube along the lesser curvature of the stomach, preserving the pylorus, and stapling the duodenum shut proximal to the ampulla of Vater. The first part of the duodenum was then anastomosed to the alimentary limb enabling gastric contents to bypass the pancreatic and biliary secretions. This operation was successful in reducing postgastrectomy symptoms; but the duodenal staple line broke down, and the continuity with the rest of the duodenum was reestablished in several patients. Hess and Hess, in 1988, preserved the pylorus and completely divided the first part of the duodenum by cutting across it in a patient with a failed horizontal stapled gastroplasty and, later that year, performed the same operation as a primary bariatric procedure but they did not publish their results until 10 years later, in 1998. That year, Marceau and colleagues also published their results of the BPD-DS with a divided duodenum and demonstrated that weight loss was equivalent but the postgastrectomy symptoms were significantly reduced compared with the BPD. These findings contributed to the BPD-DS becoming the preferred version of the operation in North America.

The BPD-DS has traditionally been performed by midline laparotomy, and although the first laparoscopic Roux-en-Y gastric bypass was described by Wittgrove and colleagues in 1994, it was not until 2000 that the results of the first human laparoscopic BPD-DS series were reported by Ren and colleagues. The first robotically assisted BPD-DS was also performed in 2000 by a totally intracorporeal approach. Currently, several methods of performing the laparoscopic BPD-DS have been described and differ primarily in the manner that the duodenoeileostomy is created. These methods include the hand-assist technique using a linear stapler and totally intracorporeal techniques using the circular stapler, linear stapler, robotically hand sewn, and a conventional laparoscopic hand-sewn approach.

Despite several good descriptions of the technique and its excellent weight-loss results, the BPD-DS is an infrequently performed procedure. A recent review of the patient registry of the American Society for Bariatric and Metabolic Surgery showed that over a 23-month period immediately before May of 2009, only 517 (0.87%) of the 57,918 registered patients underwent either a BPD or a BPD-DS and most of them were performed by laparotomy.

The possible reasons for the slow adoption of the BPD-DS in the United States include an apprehension about its malabsorptive side effects and its technical complexity. Apprehension about severe malabsorption is a carryover from the jejunoileal bypass (JIB) era. However, there are major differences between the JIB and the BPD-DS. In the JIB, the stomach was not resected and weight loss resulted from severe malabsorption by connecting the proximal 35 cm of jejunum to the distal 10 cm of the terminal ileum. The rest of the small bowel was a blind intestinal limb. The side effects associated with the JIB included severe diarrhea, nephropathy, and cirrhosis. Therefore, the procedure was largely abandoned by the 1980s. In contrast, the BPD-DS has no blind limb, stomach resection provides a restrictive component, and the 250-cm alimentary limb has not been associated with nephropathy or liver disease since the BPD-DS was first performed in 1988.

**PHYSIOLOGIC BASIS**

The clinical benefits and side effects of the BPD-DS have become known through observational studies. However, the underlying mechanisms of actions are not very well understood. It is thought that restriction from the sleeve gastrectomy provides early weight loss but fat malabsorption provides long-term weight loss. This explanation may be simplistic because significant gut hormonal changes have also been
demonstrated in patients after a BPD-DS. These changes include reduced ghrelin and increased peptide YY levels.\textsuperscript{18,19} Ghrelin is produced by the D cells of the stomach and by epsilon cells in the pancreas. Low levels of this hormone are associated with satiety. Peptide YY is released from the ileum and colon in response to feeding and also increases the sense of satiety. The sleeve component of the BPD-DS is most likely responsible for the changes in ghrelin because levels of this gut hormone have been shown to decline after isolated sleeve gastrectomy.\textsuperscript{20} The rapid entry of nutrients in the distal gut is likely responsible for the increase in peptide YY levels seen after a distal bypass. Hence, not only mechanical but potent gut hormonal factors may be responsible for the weight loss associated with the BPD-DS.

The mechanism of action for reducing marginal ulceration is thought to be the result of a reduced parietal cell mass from the sleeve gastrectomy, which leads to lower acid production. The Brunner’s glands in the duodenum may also play a role by producing mucus that serves to protect the ileal mucosa from marginal ulceration. Experimental animal models with the first part of the duodenum and the pylorus preserved have confirmed these findings,\textsuperscript{7} and observational studies with the BPD-DS have shown a reduced incidence of marginal ulceration. In a follow-up study of more than 1000 patients over 15 years, Marceau and colleagues\textsuperscript{21} had only 1 confirmed case of marginal ulceration, and Hess and colleagues\textsuperscript{22} reported a 0.3% marginal ulceration rate after more than 10 years of follow-up.

Besides reducing the incidence of marginal ulceration and other postgastrectomy symptoms, such as dumping, the ability to tolerate larger quantities and wider varieties of food have led many patients and surgeons to think that the quality of life is better after a BPD-DS than the Roux-en-Y gastric bypass or other restrictive bariatric operations. Although the evidence does favor fewer dumping symptoms, the evidence for improved quality of life is equivocal in patients undergoing the BPD-DS versus other bariatric operations. A technetium-labeled omelet study in 20 patients after a BPD-DS demonstrated that half-time for emptying the remaining stomach was 28 ± 16 minutes, which was faster than the intact stomach (91 ± 20 minutes), but self-reported dumping symptoms in these patients were rare and minor.\textsuperscript{18} Nevertheless, a survey of patients comparing food tolerance or quality of eating after 4 different bariatric operations failed to show a benefit for the BPD-DS patients.\textsuperscript{23} Further, a health-related quality-of-life survey failed to show significant differences between patients undergoing the BPD-DS, laparoscopic adjustable gastric band, and Roux-en-Y gastric bypass. Another interpretation of these studies could be that the quality of life of patients undergoing a BPD-DS is not impaired by malabsorption. However, the proportion of BPD-DS patients in both these studies was relatively small and larger studies are needed.\textsuperscript{24}

A bias also exists regarding the bowel habits of patients undergoing a BPD-DS. Patients are thought to have frequent malodorous stool and flatus. However, a study comparing the bowel habits of patients after a BPD-DS ($n = 28$) or a Roux-en-Y gastric bypass ($n = 18$) using a self-reported questionnaire showed no statistical difference in urgency, incontinence, episodes of waking from sleep, or stool consistency even though the BPD-DS patients reported more bowel movements (23.5 vs 16.5 over a 14-day period).\textsuperscript{25} A greater amount of flatus is attributed to carbohydrate malabsorption and some of the bowel disturbance in BPD-DS patients is related to an increased incidence of lactose intolerance. Lactase is a brush border enzyme in the mammalian small bowel that digests dietary lactose and its levels decrease with age. The reduced length of the alimentary limb after a BPD-DS further decreases the ability of the bowel to tolerate a lactose load. Supplemental intake of the oral enzyme can mitigate some of these effects. Steatorrhea would also be expected in
BPD-DS patients because of fat malabsorption. Marceau and colleagues demonstrated that patients with the BPD-DS had an average of 2.7 soft bowel movements a day, but this frequency was less than that reported by patients who had undergone a BPD with a distal gastrectomy. These studies suggest that bowel habits alone should not be a reason to withhold the BPD-DS operation from patients as long as they are well informed about the effects of their dietary choices.

The effects of steatorrhea are not entirely negative. Absorption of dietary fat depends on emulsification by bile salts and can only take place in the common channel. The malabsorption of fat and the excretion of bile acids with a BPD-DS or a BPD cause a significant reduction in cholesterol and have been proposed for familial hypercholesterolemia even in the nonobese. However, fat malabsorption also predisposes patients to deficiencies of vitamins, such as A, D, E, and K. A study comparing the vitamin status of patients after a BPD-DS or a Roux-en-Y gastric bypass found that patients undergoing a BPD-DS were at greater risk for vitamin A, D, and thiamine deficiency in the first year. Another study found that patients undergoing either a BPD or a BPD-DS were at a higher risk for vitamin A, D, K, and calcium deficiency with concomitant elevation of parathormone levels, but did not differentiate between the BPD-DS and the BPD patients, and preoperative vitamin levels were not measured. Based on the results of published studies, it is fair to say that the patients undergoing BPD-DS are at an increased risk for deficiency of fat-soluble vitamins. Therefore, supplementation with the water-soluble analogues of vitamins A, D, E, and K is recommended in addition to supplementation of other vitamins and minerals, including B12, iron, and calcium.

On the other hand, BPD-DS patients do not seem to suffer from as much protein-calorie malnutrition as is commonly thought. The remaining stomach after a BPD-DS produces acid and pepsinogen and should enhance protein digestion. The absorption of peptides and carbohydrates is also preserved along the length of the alimentary limb because of the presence of brush border enzymes. The BPD-DS has in fact been shown to be associated with less protein malnutrition compared with the BPD while facilitating excellent weight loss. By preserving the pylorus and making the common channel 100 cm in length in the BPD-DS in contrast to the 50 cm for the BPD with distal gastrectomy, Marceau and colleagues have been able to reduce the incidence of revisions from 18% in BPD with distal gastrectomy patients to 2% in the BPD-DS group over an observation period of 10 years. The percentage of patients needing reversals for excessive diarrhea and malnutrition also decreased from 2.7% for the BPD to 0.5% for the BPD-DS over this period. Anthone and colleagues have reported a higher reversal rate of 5.8% caused by protein malnutrition or diarrhea but they created a smaller stomach tube with a capacity of 100 mL, which may have predisposed their patients to more malnutrition. Protein malabsorption has not been a major issue in the authors’ personal series of more than 400 BPD-DS patients, and they have not had to reverse any operation for malnutrition over the last 10 years.

INDICATIONS FOR PROCEDURE

In the American Society for Metabolic and Bariatric Surgery’s 2005 consensus conference, the BPD-DS was recognized as an established bariatric operation. The Centers for Medicare and Medicaid Services also reimburses for BPD-DS if a patient meets medical necessity for any bariatric operation (body mass index [BMI] ≥35 kg/m², has one major comorbidity, and has failed previous medical weight-loss attempts). Other third-party payers variably cover the procedure and may have stipulations, such as BMI criteria (>50 kg/m²), that must be met for preauthorization of a BPD-DS.
operation. Although it has been shown that patients with a BMI greater than 50 kg/m² will lose more weight³⁴ and have faster resolution of diabetes and hypertension³⁵ with a BPD-DS than after a Roux-en-Y gastric bypass, a recent review of 810 BPD-DS patients with a BMI less than 50 kg/m² also demonstrated excellent weight loss and resolution of other comorbid conditions. Patient satisfaction was also excellent, with acceptable complication rates.³⁶ Therefore, the authors think it is reasonable to offer the BPD-DS to patients who desire the operation as a primary bariatric operation even if their BMI is less than 50 kg/m² and are well informed of their choices as long as they meet criteria for a bariatric operation. Although rare, patients who have malrotation of the gut may also be good candidates for either an open or a laparoscopic BPD-DS because the small bowel lays on the patients’ right side and a duodenileostomy created in the right upper quadrant places less stretch on the mesentery of the alimentary limb.³⁷

The BPD-DS may also be performed as a revision operation for other failed bariatric operations. Previously, these operations were performed by laparotomy.³⁸ More recently, laparoscopic revision of the laparoscopic adjustable gastric band³⁹–⁴² and the Roux-en-Y gastric bypass⁴³,⁴⁴ to the BPD-DS have been described. Laparoscopic revision surgery to BPD-DS carries a higher morbidity.⁴⁰–⁴² Therefore, it is suggested that surgeons should only undertake revisions after they have surpassed the learning curve for primary laparoscopic BPD-DS procedure.

CURRENT PROCEDURE

The BPD-DS can be performed by either an open or laparoscopic approach. The operation has 3 main components: the creation of the stomach tube with pylorus preservation, the distal ileoileal anastomosis, and the proximal duodenal-ileal anastomosis. The sleeve gastrectomy is performed by mobilizing the greater curvature of the stomach distally to about 4 cm past the pylorus and proximally to the angle of His, using a thermal sealing and cutting device (Fig. 1). This dissection preserves the lesser curvature blood supply and vagal innervations. Traction on the stomach should be gentle to avoid avulsing the short gastric vessels. The stomach reservoir should also be protected from thermal injury to prevent a delayed leak. To create the stomach tube, resection is typically begun along the greater curvature about 5 cm proximal to

Fig. 1. Mobilization of the proximal 4 cm of duodenum and the greater curvature of stomach is followed by transection of the duodenum and resection of the greater curvature of the stomach to result in a gastric remnant with a capacity of 150 mL. (From Sudan R, Puri V, Sudan D. Robotically assisted biliary pancreatic diversion with a duodenal switch: a new technique. Surg Endosc 2007;21(5):729–33; with permission.)
the pylorus. In this location, the stomach wall is thick and, therefore, longer leg-length staples (4.5 mm) are used. A gentle curve is then created using additional stapler loads to complete the resection at the angle of His. The staple line may be further secured by either oversewing or the use of buttress material at the surgeon’s discretion. Care is taken to ensure that the stomach is not narrowed, such as in an hourglass deformity, because this may cause functional obstruction and predispose to leaks and reflux. The goal is to create a stomach tube with a capacity of 150 to 250 mL. A variety of bougie sizes have been used to determine the volume of the stomach tube. However, no difference in weight loss was found at 6 months when the stomach was sized using a 40F or a 60F bougie. Another study measured gastric volume after surgery using computerized tomography and also found no correlation between the stomach tube volume and weight loss. Because the BPD-DS is conceptualized as a combined restrictive and malabsorptive operation, there is probably a range of stomach volumes within which the operation is effective.

To perform the bypass, the bowel is divided 250 cm proximal to the ileocecal valve and the biliary limb is anastomosed to the common channel 100 cm proximal to the ileocecal valve (Fig. 2). The resulting enterotomy created by the stapler can be closed by staplers or by suturing, ensuring that the lumen of the bowel is not narrowed. Many investigators use these standard limb lengths for bypass; however, others have proposed making the common channel 10% and the alimentary limb 40% of the total length of the small bowel. The duodenal-ileal anastomosis can be performed using several techniques, including either the circular stapler, the linear cutter, the hand-sewn laparoscopic technique, or the robot. A study comparing the circular stapler, linear stapler, and hand-sewn technique found that the leak rates and local wound complications rate were higher with the circular stapler compared with the other two methods.

Fig. 2. The distal entero-enteric anastomosis is performed using a 60-mm vascular load endoscopic stapler. The 100-cm long common channel (CC) is shown. (AL, eventual alimentary limb; BPL, eventual biliopancreatic limb.) (From Sudan R, Puri V, Sudan D. Robotically assisted biliary pancreatic diversion with a duodenal switch: a new technique. Surg Endosc 2007;21(5):729–33; with permission.)
Typically, the mesenteric defects between the biliary limb, the common channel, and the mesentery of the alimentary limb are closed using a running permanent suture, and the completed procedure is demonstrated in Fig. 3.

Many surgeons also perform an appendectomy, cholecystectomy, and a liver biopsy. To evaluate the need for incidental cholecystectomy, a recent publication described performing a cholecystectomy selectively in patients with gallstones. The remaining patients did not undergo a cholecystectomy and were placed on ursodeoxycholic acid for 6 months. Only 8.7% of these patients required a cholecystectomy subsequently and, therefore, the investigators concluded that routine cholecystectomy was not necessary. When making the decision to perform a cholecystectomy selectively, it is important to remember that the chances of gallstone formation after a BPD-DS may be higher than the Roux-en-Y gastric bypass or other purely restrictive operations because of the greater loss of bile salts from interruption of their enterohepatic recirculation. Also, if patients develop choledocholithiasis, access to the bile duct by endoscopic retrograde cholangiopancreatography is more challenging after a BPD-DS because of the absence of a remnant stomach pouch and a very long biliopancreatic limb. A subsequent cholecystectomy may also be more difficult in the presence of an inflamed gallbladder and adhesions in the area of the duodenal-ileal anastomosis.

In the postoperative period, many surgeons tend to be conservative with diet advancement after a BPD-DS and usually wait for ileus to resolve before initiating oral feeding. This practice usually results in a longer average length of hospital stay.

Fig. 3. The final configuration results in a 100-cm long common channel (CC). The alimentary limb (AL) and the biliopancreatic limb (BPL) are demonstrated. The length of the AL is 150 cm. (From Sudan R, Puri V, Sudan D. Robotically assisted biliary pancreatic diversion with a duodenal switch: a new technique. Surg Endosc 2007;21(5):729–33; with permission.)
of about 4 days for the BPD-DS patients compared with 2 days after a Roux-en-Y gastric bypass. A well-balanced meal with 200% of the daily value of vitamin and mineral supplementation is required, and patients are advised to take 10,000 units of vitamin A, 2000 units of vitamin D, and 300 micrograms of vitamin K in the form of water-soluble analogues of these vitamins. Daily supplementation should include 1800 to 2400 mg/d of calcium citrate in 3 to 4 divided dosages. Guidelines for nutritional evaluation and vitamin supplementation for bariatric patients have been published. Laboratory testing to detect nutritional deficiencies, including serum fat-soluble vitamin levels, should be performed at least annually.

RESULTS

The operative mortality for large BPD-DS series by laparotomy is approximately 1% with a range of 0.57% to 1.9%. These series have also reported a leak rate of 2.7% to 3.75%. The operative mortality rate in the first reported laparoscopic BPD-DS series was 2.5%, and for patients with a BMI more than 60 kg/m², a rate as high as 6.5% has been reported. This finding has been the basis for offering a staged approach for performing a BPD-DS in high-risk patients (Table 1). However, other investigators have safely performed the operation in patients with a BMI greater than 50 kg/m² as a single-stage procedure with no significant increase in mortality. Others have shown that patients’ BMI becomes less predictive of complications after the learning curve for laparoscopic BPD-DS is overcome.

In long-term studies with a follow-up greater than 10 years, Marceau and colleagues have shown that BPD-DS patients continue to have 25% greater mean weight loss than those who underwent the BPD with a distal gastrectomy. Also, there were few patients (1.3%) who failed to lose less than 25% of their excess weight. Serum calcium, iron, and hemoglobin levels were higher and parathormone levels were lower in patients with the BPD-DS. The need for revisions was also dramatically lowered from 18.5% in the BPD with distal gastrectomy to 2.7% in the BPD-DS group. Comorbidity resolution with the BPD-DS was excellent for diabetes (92% were off medication), sleep apnea (90% were off continuous positive airway pressure machines), and asthma (88% were on a reduced dosage of medications). The incidence of long-term bone fractures (17%) and urolithiasis (14%) were similar in both groups, but they did not compare these results to either the nonbariatric surgery population or those with other bariatric operations. Therefore, the significance of this incidence of fractures is not known. Although 20% of their patients had lower serum calcium and 50% had a mild to moderate increase of parathormone levels, overall their serum vitamin D levels were higher after surgery than their preoperative levels. Compliance with medical instructions to take supplemental vitamins may have been responsible for the higher vitamin D levels. In patients with low serum vitamin D or calcium levels or high parathormone levels, bone density can be measured with dual-emission x-ray absorptiometry scans. Severe bone damage or vitamin deficiency and anemia were rare in their series.

A randomized clinical trial comparing BPD-DS to Roux-en-Y gastric bypass in superobese patients (BMI >50 kg/m²) demonstrated better weight loss at 1 year, longer hospital length of stay, and longer operating time but no significant increase in morbidity or mortality in the BPD-DS group. The BPD-DS patients decreased their BMI from a mean of 55.2 kg/m² to 32.5 kg/m², whereas the Roux en Y gastric bypass patients decreased their BMI from 54.8 kg/m² to 38.5 kg/m².49

Another study compared the results of the BPD-DS with the Roux-en-Y gastric bypass for patients with a BMI greater than 50 kg/m² and found that the weight loss
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Abbreviations: EBL, estimated blood loss; EWL, excess weight loss; L, laparoscopy; NR, not reported; O, laparotomy; R, robot assisted.

<sup>a</sup> Mean.
<sup>b</sup> Range.
<sup>c</sup> N = 1300 patients.
<sup>d</sup> N = 182 patients with more than 10 years postsurgery, with 92% follow-up.
<sup>e</sup> N = 1356 patients.²¹
<sup>f</sup> Median follow-up of 9 months.
<sup>g</sup> Median.
following a BPD-DS was superior. In the same weight category, patients who under-
went the BPD-DS were more likely to resolve type II diabetes (100% vs 60%), hyper-
tension (68.0% vs 38.6%), and dyslipidemia (72.0% vs 26.3%) but the Roux en Y
gastric bypass was superior for the resolution of gastroesophageal reflux disease
(76.9% vs 48.57%). In the future, based on patients' BMI and medical comorbidities,
factors such as these may be used to inform the choice of procedure for patients.

SUMMARY

From mostly retrospective literature and one randomized study, some conclusions
regarding the BPD-DS can be made. Compared with the BPD, patients who undergo
BPD-DS are less likely to suffer adverse postgastrectomy symptoms, especially
marginal ulcer and dumping. Furthermore, some patients may lose more weight
than they would after a Roux-en-Y gastric bypass and have better resolution of dia-
etes, hypercholesterolemia, and hypertension. The Roux-en-Y gastric bypass may
be more effective for the treatment of reflux disease. In any event, outcomes after
the BPD-DS for patients with a BMI either greater than or less than 50 kg/m² are excep-
tent. The reported operative mortality of the BPD-DS is currently higher than the
Roux-en-Y bypass but this may decrease as surgeons gain more experience with
the technical aspects of the procedure. Vitamin supplementation and monitoring are
crucial for preventing postoperative nutritional deficiencies.

REFERENCES

5. Longmire WP Jr, Traverso LW. The Whipple procedure and other standard oper-
6. Critchlow JF, Shapiro ME, Silen W. Duodenojejunostomy for the pancreaticobiliary
7. DeMeester TR, Fuchs KH, Ball CS, et al. Experimental and clinical results with
   proximal end-to-end duodenojejunostomy for pathologic duodenogastric reflux.
10. Wittgrove AC, Clark GW, Tremblay LJ. Laparoscopic gastric bypass, Roux-en-Y:
11. Ren CJ, Patterson E, Gagner M. Early results of laparoscopic biliopancreatic
    diversion with duodenal switch: a case series of 40 consecutive patients. Obes
12. Sudan R, Sudan D. Development of a totally intracorporeal robotic assisted biliary


34. Prachand VN, Davee RT, Alverdy JC. Duodenal switch provides superior weight loss in the super-obese (BMI > or = 50 kg/m²) compared with gastric bypass. Ann Surg 2006;244(4):611–9.


