

Duodenal switch in revisional bariatric surgery: conclusions from an expert consensus panel.

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I. Abstract

BACKGROUND: Duodenal switch (BPD/DS) is gaining popularity as a secondary procedure for inadequate weight loss following an initial operation. **OBJECTIVES:** We aim to generate expert consensus points on the appropriate use of BPD/DS in the revisional bariatric surgical setting. **SETTING:** Data was gathered at an international conference with attendees from a variety of different institutions and settings. **METHODS:** 16 lines of questioning regarding revisional BPD/DS were presented to an expert panel of 29 bariatric surgeons. Current available literature was reviewed extensively for each topic and proposed to the panel prior to polling. Responses were collected and topics defined as achieving consensus ($\geq 70\%$ agreement) or no consensus ($< 70\%$ agreement). **RESULTS:** Consensus was present in 10 of 16 lines of questioning, with several key points most prominent. **CONCLUSIONS:** As a second stage procedure, BPD/DS is most appropriate following sleeve gastrectomy (SG) for the treatment of super morbid obesity (96.7% agree), or as a subsequent operation for a reliable patient with insufficient weight loss following SG (88.5%). In a patient with weight regain and reflux and/or enlarged fundus after SG, Roux-en-Y gastric bypass (RYGB) is preferable and BPD/DS should be avoided (90%). BPD/DS should not be used prophylactically in patients with a history of jejunoileal (JI) bypass who are otherwise doing well (80.8%). Applicability of BPD/DS is limited by technical difficulty; 86.2% of experts would routinely recommend or consider the procedure if it were more technically feasible following failed bypass. No consensus was found on approaches to revision of BPD/DS for protein malnutrition.

KEY WORDS: obesity, duodenal switch, revisional bariatric surgery, expert consensus

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HIGHLIGHTS:

1. As a revisional procedure, duodenal switch (BPD/DS) is most appropriate as a second-stage surgery following sleeve gastrectomy (SG) for the treatment of super morbid obesity, or as a subsequent operation for a reliable patient with insufficient weight loss following SG
2. In a patient with weight regain and documented reflux and/or enlarged fundus after SG, Roux-en-Y gastric bypass (RYGB) is preferable and BPD/DS should be avoided
3. BPD/DS should not be used prophylactically in patients with a history of jejunioileal (JI) bypass who are otherwise doing well
4. As a revisional procedure for failed RYGB, applicability of BPD/DS is limited by technical difficulty; most experts would routinely recommend or consider the procedure if it were more technically feasible following failed bypass

II. Introduction

Biliopancreatic diversion (BPD) was first described in 1979 as an alternative to jejunioileal (JI) bypass for patients with morbid obesity⁽¹⁾. The procedure entails gastric antrectomy and gastroileal anastomoses, with a separate biliopancreatic limb joining the alimentary tract at the distal ileum. Duodenal switch (DS) was later added to BPD to minimize complications associated with the stand-alone procedure. With the DS modification, gastroileostomy is exchanged for duodenoileostomy, preserving the gastric antrum and pylorus. Although BPD alone is now rarely performed, BPD/DS has persisted as an effective surgical

intervention for patients requiring maximal weight loss or treatment of uncontrolled type 2 diabetes mellitus (T2D).

BPD/DS includes sleeve gastrectomy (SG), division of the first portion of the duodenum, duodenoileostomy, and ileoileostomy approximately 100 cm from the ileocecal valve. Variations in the length of the common channel are prevalent, as there is no consensus on the ideal measurement that limits malnutrition while maximizing weight loss. While first performed through a standard midline incision, laparoscopic BPD/DS introduced in 1999 by Gagner is now the standard of care⁽²⁾. Some debate has ensued in recent years over the relative appropriateness of BPD/DS and RYGB in the surgical management of super morbid obesity (BMI \geq 50)⁽³⁾. While RYGB is plagued by high failure rates in populations with super morbid obesity – indeed, 55% of patients are unable to reach target weight loss goals at 5 years – several factors, including variability in surgeon skill, limited experience with the procedure, insurance coverage, and higher rates of postoperative complications, have limited general applicability of the BPD/DS procedure⁽⁴⁾.

BPD/DS is increasingly performed as a revisional procedure for inadequate weight loss following an initial operation. An impressive 114% increase was observed in the number of revisional BPD/DS cases performed in the United States between 2015 and 2017, from 199 cases annually to 426⁽⁵⁾. This trend outpaced growth in primary BPD/DS procedures (1,264 to 2,069 cases annually, 54.3% growth) and total bariatric procedures (168,093 to 200,374 in 2017, 19.2% growth) during the same time period (Table 1). As a technically challenging procedure with a higher postoperative complication profile, particularly in patients with super morbid obesity, BPD/DS is increasingly utilized only in patients who have failed traditional procedures. Longer operations are higher risk for patients with super morbid obesity, and increased demand for

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bariatric procedures and longer operating room times required for BPD/DS – 206 minutes, on average, versus 91 minutes for a laparoscopic RYGB – makes BPD/DS a less practical initial choice^(6,7).

BPD/DS is well-documented as the most effective bariatric operation for sustained weight loss in patients with morbid and super morbid obesity. In a systematic review of 48 studies and 1,565 patients undergoing bariatric procedures, BPD/DS was associated with 73% excess body weight loss (EBWL) at 2 years, ahead of RYGB (63%), gastroplasty (56%), and laparoscopic adjustable gastric banding (LAGB) (49%)^(8,a). These results have been replicated in patients with BMI \geq 50, where BPD/DS was superior to RYGB in maximizing weight loss up to 9 years following surgery^(4,9,10,11).

BPD/DS appears superior to other bariatric procedures in producing remission of obesity-related diseases, particularly T2D, hyperlipidemia (HLD), and hypertension (HTN)^(8,12,13-15). With special regards to long-term remission of T2D, experience with BPD suggests superiority of BPD/DS over RYGB. A recent 5-year, randomized prospective study found a 53% relapse rate in T2D in patients with morbid obesity undergoing RYGB initially in remission 2 years postoperatively. Patients randomized to BPD/DS had a 37% relapse rate of T2D during this period. Within the same study, only 42% of RYGB patients had an HgbA1C% \leq 6.5 at 5 years, compared with 68% of BPD/DS patients⁽¹⁶⁾.

Despite its effectiveness as a bariatric procedure, the risk profile of BPD/DS is significant. A recent meta-analysis found BPD/DS was associated with the highest early mortality (0.29 - 1.23% for open, 0.0% - 2.7% for laparoscopic) of all procedures, with pulmonary embolism, respiratory failure, and anastomotic leak most commonly causing death. Although results were not adjusted for patient size, complications reported at 1 year were highest

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for BPD/DS (25.7%) when compared with other bariatric procedures (4.6% for LABG, 10.8% for SG, and 14.9% for RYGB)⁽¹⁷⁾. Overall rates of reoperation following BPD/DS can exceed 40%, with malnutrition prompting up to 24.9% of additional surgery^(4,18). Significant micronutrient deficiencies are common following BPD/DS, particularly when compared to other contemporary bariatric procedures^(19,20).

As experience with BPD/DS accumulates, high rates of postoperative complications and micronutrient deficiencies may be mitigated. In defense of the procedure, contemporary authors have suggested the learning curve of the operation is such that many reoperations contributing to available data are secondary to lack of equipoise and technical error⁽³⁾. Many of the surgeons contributing to the above cited studies had limited experience with the procedure and used operative techniques that have since been discouraged – for example, using a 34 french bougie to craft the gastric sleeve, rather than a 60 french^(3,18). With regards to malnutrition, these authors also contend patients in earlier studies were not supplemented or monitored adequately in the postoperative period.

Existing evidence suggests BPD/DS is safe and effective in the revisional setting. A recent study comparing revisional BPD/DS following sleeve gastrectomy with primary laparoscopic BPD/DS found no significant differences in global outcomes between the 2 procedures at 3 years. Patients who underwent conversion to BPD/DS from sleeve gastrectomy experienced an additional 41% of excess weight loss (EWL) and 35% remission rate for T2D⁽²¹⁾. Other authors have published success with revisional BPD/DS following RYGB, vertical banded gastroplasty, and laparoscopic adjustable gastric banding (LAGB)^(22,23). A small study of 9 patients who underwent BPD/DS following RYGB found an additional mean EWL of $31 \pm 23.1\%$ (4%-76.6%) at 1 year, with no leaks, morbidities, or reoperations within 30 days observed⁽²³⁾.

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Single-anastomosis duodenoileal bypass (SADI) represents a modification of the traditional BPD/DS procedure that may play a significant role in the revisional setting in years to come. SADI exchanges the Roux-en-Y configuration for a single duodenoileal anastomosis, combining the common channel and alimentary limb⁽²⁴⁾. Several authors have demonstrated SADI is safe and effective as a revisional bariatric operation, particularly following LAGB and SG. In these respective studies, mean EWLs of $81.57 \pm 11.12\%$ and $78.93 \pm 35.5\%$ were observed at 2 years^(25,26).

Further validation of BPD/DS as a primary bariatric procedure is beyond the scope of this paper. In lieu of long-term published data, we present expert consensus data on the role of BPD/DS as a revisional operation. We aim to stimulate interest and discussion of BPD/DS within the bariatric surgical community for selected patients who fail their initial weight loss procedure. In our discussion of expert consensus points, we outline areas of further research to better delineate the role of revisional BPD/DS and investigate mechanisms by which the operation could be more easily performed after RYGB.

III. Methods

Three chairpersons with extensive experience in revisional bariatric and metabolic procedures developed the agenda and panel inclusion criteria for this study. A pre-meeting review of published data was conducted to assist with the selection of relevant lines of questioning. Questions designed for the study focused on patient selection, indications, contraindications, surgical technique, and re-operative and postoperative management of revisional BPD/DS. Panelists were presented with several answer options for each question in

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multiple-choice format, with only one answer selection permitted per panelist per question. Free-format answers were not permitted.

29 bariatric surgeons were ultimately chosen for the panel, based on surgical experience and prominence within the international community (see Appendix). Internal review board (IRB) approval for this study was not obtained, as data gathered was based on previously published literature.

An interactive, evidence-based approach was used to collect data and generate consensus points. With the entire panel in attendance, a published data review and open discussion was conducted for each line of questioning. All questions were then presented individually and viewed using a large monitor. Panelist responses were collected using an anonymous electronic voting system (Polleverywhere.com – a web-based service that allows live, interactive polling). Between 90 and 100% of panelists responded to each question, and 100% of questions were answered. The entire panel immediately reviewed the distribution of the group's responses after each individual question. Based the group's responses, lines of questioning were divided into 2 categories based on the presence or absence of expert panelist consensus, defined as $\geq 70\%$ or $<70\%$ in agreement, respectively.

IV. Results

10 lines of questioning were identified with $\geq 70\%$ consensus: 1. BPD/DS can be considered as a second-stage of a 2-stage operation, i.e. SG to BPD/DS (96.7%). 2. BPD/DS is more preferable to consider following SG than RYGB for a highly motivated patient with insufficient weight loss after their index bariatric operation (88.5% vs 60%); BPD/DS is superior Duodenal switch in revisional bariatric surgery.

to RYGB following SG in terms of weight loss (92.9%). 3. BPD/DS is limited in its general application by “other concerns” although it remains superior to other procedures in terms of overall weight loss and comorbidity resolution (88.9%). 4. BPD/DS is a poor option for revision of SG with reflux, weight regain, and enlarged fundus, and RYGB is preferred (90%); RYGB superior to BPD/DS in patients with GERD and failed SG (96.4%). 5. If technical modifications were developed to facilitate RYGB to BPD/DS conversion, surgeons would be more inclined to offer the procedure to selected patients (72.4%). 6. The length of the common channel is an important aspect of a malabsorptive procedure (92.9%). 7. The length of the alimentary channel is an important aspect of a malabsorptive procedure (90%). 8. SADI is a reasonable option to treat failed SG (72.4%). 9. Leak at the duodenoileal anastomosis following SADI requires Roux-en-Y for biliary diversion (78.3%). 10. BPD/DS should not be performed in asymptomatic JI bypass patients without complications (80.8%); 71.4% of surgeons would avoid prophylactically converting JI bypass patients who are otherwise doing well.

Remaining topics without consensus were as follows: 1. BPD/DS should not be considered after RYGB because of poor long-term data and high complication rate (45.2% disagree, 38.7% agree, 16.1% undecided). 2. For weight regain after SG with a normal upper gastrointestinal (UGI) series, the best option is: BPD/DS (43.3%), RYGB (33.3%), SADI (13.3%), other (10%). 3. The most suitable role for BPD/DS, given its rarity as a primary procedure: conversion from another procedure in a suitable patient (60.7%), after failed SG (21.4%), other (10.7%), never indicated (7.1%). 4. The best surgery to offer a patient after LABG removal: RYGB (53.6%), whatever surgery (SG, RYGB, BPD/DS) is indicated based on BMI, assuming esophageal function is preserved (39.3%), SG if esophageal function is preserved (7.1%). 5. Protein malnutrition following BPD/DS can be solved by lengthening the common

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channel at the expense of the biliary limb (41.4% agree, 48.3% disagree, 10.3% undecided). 6. Insufficient weight loss following BPD/DS can be treated by: a. re-sleeve (50% disagree, 23.3% agree, 26.7% undecided), b. shortening the common channel (50% disagree, 20% agree, 30% undecided).

V. Discussion

Expert responses indicate revisional BPD/DS is most appropriate as a planned second-stage operation following SG for the treatment of super morbid obesity (96.7% agree), or for a reliable patient with insufficient weight loss following SG (88.5%). In a patient with weight regain with reflux and/or enlarged fundus after SG, panelists favored RYGB and felt BPD/DS should be avoided (90%). In light of this, it is important for clinicians to note the presence of reflux symptoms and quantify esophageal function before recommending conversion.

BPD/DS (or any other revisional bariatric procedure) should not be used prophylactically in patients with a history of JI bypass who are otherwise doing well (80.8% agree). Historically, up to 31% of patients who underwent JI bypass developed significant postoperative hepatic failure, renal failure, postoperative protein malnutrition, or intractable dumping symptoms necessitating reoperation^(27,28). Surgical reversal is the only accepted treatment for these complications.

There is no clear consensus on the suitability for BPD/DS following failed RYGB, or failed LAGB with preserved esophageal function. While the expert community slightly favors avoiding BPD/DS for failed RYGB (54.8% would avoid the procedure or were undecided versus 45.2% who would consider the procedure), panelists were fairly evenly divided on this subject.

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As discussed below, technical feasibility and lack of experience in using DS after RYGB may account for a large component of this divide. For BPD/DS after failed LAGB with preserved esophageal function, RYGB was slightly favored (53.6%) over whatever procedure was most indicated based on BMI (39.3%), including BPD/DS. Only 7.1% of expert panelists would avoid BPD/DS entirely in this scenario.

The applicability of BPD/DS is unquestionably limited by technical difficulty. This may account for a substantial component of expert hesitancy. With regards to conversion following RYGB, 86.2% of surgeons surveyed would routinely recommend or consider the procedure if it were more technically feasible. This is certainly an area of research to pursue in the future.

Surgical reversal with proximal side-to-side enteroenterostomy is a published treatment for intractable malnutrition and dumping symptoms following BPD/DS⁽²⁹⁾. In reflection of this practice, the majority of experts surveyed agreed that the lengths of the alimentary and common channels were important aspects of malabsorptive procedures (92.9% and 90%, respectively). Despite these agreements, no consensus was reached on alternative effective surgical solutions for protein malnutrition or insufficient weight loss following BPD/DS. Experts were divided on the assertion that protein malnutrition following BPD/DS could be solved by lengthening the common channel at the expense of the biliary limb (41.1% agree vs 58.6% disagree or undecided). Subsequent revisions to BPD/DS are rare, so adequate evidence regarding the efficacy of various interventions is lacking. Reliable comparisons between common channel lengths are further hindered by the inaccuracy of intraoperative small bowel measurement. As clinical experience with BPD/DS revisions improves and new technologies to better standardize intraoperative small bowel measurement are developed, answers to these questions may be better provided.

In reflection of recent trends, a combined 82.1% of surgeons felt that the most suitable role for BPD/DS was as a conversion from another procedure in a suitable patient (60.7%), or more specifically after failed SG (21.4%). Only 7.1% of surgeons felt the procedure was never indicated, reaffirming a perceived need for the procedure within the bariatric surgical community.

72.4% of experts felt SADI was a reasonable revisional option following failed SG. Discussion of this procedure represents a subfocus of revisional BPD/DS. Although available data lacks long-term follow-up and sample sizes remain small, SADI offers a somewhat simplified approach to duodenoileal bypass, and may offer technical advantages over traditional BPD/DS. The presence of consensus on the applicability of this procedure following SG suggests SADI may play a prominent role in the revisional bariatric setting in the years to come.

Study limitations include the relatively small number of experts surveyed and the subjective nature of data collected. Whether all experts included actually performed BPD/DS or were simply familiar with the procedure is also unknown. Given the relative rarity of bariatric surgeons who routinely perform the procedure, these limitations are somewhat unavoidable. While overall consensus regarding the role for the procedure appears clear, a small portion of study subjects appeared to change their minds on certain topics, leading to minor inconsistencies in reported data. While 96.7% of experts felt BPD/DS could be considered as a second-stage of a 2-stage operation, i.e. SG to BPD/DS, 7.1% of responders later indicated BPD/DS should never be considered. Out of a total 82.1% of experts who indicated the most suitable role for BPD/DS was conversion from another procedure (including 21.4% who limited their response to following SG), 38.7% also contended BPD/DS should not be considered after RYGB because of poor long-term data and high complication rate. While questions may not have adequately

captured nuanced opinion within the expert community, such inconsistencies may also signify some degree of indecisiveness in panelists or ambiguity within questions asked. These inconsistencies may be better understood and elucidated as more data becomes available.

VI. Conclusions

Based on a formalized survey of experts in the bariatric surgery community, the following key consensus points regarding revisional BPD/DS are apparent: 1. BPD/DS is most validated as a planned second-stage operation following SG for the treatment of super morbid obesity, or a second operation for a reliable patient with insufficient weight loss following SG. 2. BPD/DS should be avoided in SG patients with weight gain and reflux, and/or enlarged fundus. 3. BPD/DS is not indicated prophylactically in asymptomatic patients with a history of JI bypass. 4. BPD/DS would be more applicable to the general bariatric surgical community, particularly following inadequate weight loss with RYGB, if the procedure were more technically feasible.

VII. Disclosures

The Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program (MBSAQIP) and the hospitals participating in the MBSAQIP are the source of the data used herein; they have not verified and are not responsible for the statistical validity of the data analysis or the conclusions derived by the authors. Conflicts of interest among the manuscripts' authors are as follows: honorariums for speaking and consulting with Ethicon, Medtronic, Gore,

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Valeant, and Lexington Medical, as well as honorariums for consulting, training, and advisory board membership with Intuitive Surgical and Johnson & Johnson.

VIII. Figure Legend

Table 1: Frequencies of primary and revisional duodenal switch procedures in the United States, 2015-2017.

IX. Notes

^a Total body weight loss (TBWL) is now the preferred measurement of the American Society for Metabolic and Bariatric Surgery (ASMBS). As this is a relatively recent change, many of the references discussed use excess body weight loss (EBWL), excess weight loss (EWL) or total reduction in body mass index (BMI) to quantify results. Results of each study are presented as reported in the original manuscript.

X. References

1. Scopinaro N, Gianetta E, Civalleri D, Bonalumi U, Bachi V. Biliopancreatic by-pass for obesity. II. Initial experience in man.” *British J Surg* 1979;66(9):618-20.
2. Ren CJ, Patterson E, Gagner M. Early results of laparoscopic biliopancreatic diversion with a duodenal switch: a case series of 40 consecutive patients. *Obes Surg* 2000;10(6):514-23.

3. Gagner M. Bariatric surgery: to bypass or switch? That is the question in obesity surgery. *Nat Rev Gastroenterol* 2015;12(5):255-6.
4. Risstad H, Sovik T, Engstrom M, et al. Five-year outcomes after laparoscopic gastric bypass and laparoscopic duodenal switch in patients with body mass index of 50 to 60: a randomized clinical trial. *JAMA Surg* 2015;150(4): 352-61.
5. Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program (2015-2017). *Participant use data file* [Database]. Retrieved from <https://reports.nsqip.facs.org/acsMbsaqip>.
6. Sovik TT, Taha O, Aasheim ET, et al. Randomized clinical trial of laparoscopic gastric bypass versus laparoscopic duodenal switch for superobesity. *British J Surg* 2010;97(2):160-6.
7. Chakravartty S, Sarma DR, Patel AG. Rhabdomyolysis in bariatric surgery: a systematic review. *Obes Surg* 2013;23(8):1333-40.
8. Buchwald H, Estok R, Fahrback, et al. Weight and type 2 diabetes after bariatric surgery: systematic review and meta-analysis. *Am J Medicine* 2009;122(3):248-56.
9. Prachand VN, DaVee RT, Alverdy JC. Duodenal switch provides superior weight loss in the super obese (BMI \geq 50) compared with gastric bypass. *Ann Surg* 2006;244(4):611-19.
10. Skogar M, Sundbom M. Duodenal switch is superior to gastric bypass in patients with super morbid obesity when evaluated with the bariatric analysis and reporting outcome system (BAROS). *Obes Surg* 2017;27:2308-16.
11. Strain GW, Torghabeh MH, Gagner M, et al. Nutrient status 9 years after biliopancreatic diversion with duodenal switch (BPD/DS): an observational study. *Obes Surg* 2017;27:1709-18.

12. Tsoli M, Chronaiou A, Kehagias I, Kalfarentzos F, Alexandrides TK. Hormone changes and diabetic resolution after biliopancreatic diversion and laparoscopic sleeve gastrectomy: a comparative prospective study. *Surg Obes Relat Dis* 2013;9(5):667-77.
13. Dorman RB, Rasmus NF, al-Haddad BJ, et al. Benefits and complications of the duodenal switch/biliopancreatic diversion compared to the Roux-en-Y gastric bypass. *Surg* 2012;152(4):758-65.
14. Prachand VN, Ward M, Alverdy JC. Duodenal switch provides superior resolution of metabolic comorbidities independent of weight loss in the super-obese (BMI \geq 50 kg/m²) compared with gastric bypass. *J Gastrointest Surg* 2012;14(2):211-20.
15. Anderson B, Gill RS, de Gara CJ, Karmali S, Gagner M. Biliopancreatic diversion: the effectiveness of duodenal switch and its limitations. *Gastroenterol Res Pract* 2013;2013:974762.
16. Mingrone G, Panunzi S, De Gaetano A, et al. Bariatric-metabolic surgery versus conventional medical treatment in obese patients with type 2 diabetes: 5 year follow-up of an open-label, single-centre, randomized controlled trial. *Lancet* 2015;386(9997):964-73.
17. Demaria EJ, Winegar DA, Pate VW, Hutcher NE, Ponce J, Pories WJ. Postoperative outcomes of metabolic surgery to treat diabetes participating in the ASMBS bariatric surgery center of excellence program as reported in the bariatric outcomes longitudinal database. *Ann Surg* 2010;252(3):559-66.
18. Bolckmans R, Himpens J. Long-term (>10 years) outcome of the laparoscopic biliopancreatic diversion with duodenal switch. *Ann Surg* 2016;264(6):1029-37.
19. Strain GW, Torghabeh MH, Gagner M, et al. The impact of biliopancreatic diversion with duodenal switch (BPD/DS) over 9 years. *Obes Surg* 2017;27:787-94.

20. Aasheim ET, Bjorkman, Sovik TT, et al. Vitamin status after bariatric surgery: a randomized study of gastric bypass and duodenal switch. *Am J Clin Nutr* 2009;90(1):15-22.
21. Biertho L, Theriault C, Bouvet L, et al. Second-stage duodenal switch for sleeve gastrectomy failure: a matched controlled trial. *Surg Obes Relat Dis* 2018 Oct;14(10):1570-9.
22. Greenbaum DF, Wasser SH, Riley T, Juengert T, Hubler J, Angel K. Duodenal switch with omentopexy and feeding jejunostomy – a safe and effective revisional operation for failed previous weight loss surgery. *Surg Obes Relat Dis* 2011 Mar-Apr;7(2):213-8.
23. Halawani HM, Bonanni F, Betancourt A, Antanavicius G. Conversion of failed Roux-en-Y gastric bypass to biliopancreatic diversion with duodenal switch: outcomes of 9 case series. *Surg Obes Relat Dis* 2017 Aug;13(8):1272-7.
24. Topart P, Becouarn G. The single anastomosis duodenal switch modifications: a review of the current literature on outcomes. *Surg Obes Relat Dis* 2017 Aug;13(8):1306-12.
25. Wu A, Tian J, Cao L, Gong F, Wu A, Dong G. *Surg Obes Relat Dis* 2018 Nov;14(11):1686-90.
26. Balibrea JM, Vilallonga R, Hidalgo M, et al. Mid-term results and responsiveness predictors after two-step single-anastomosis duodeno-ileal bypass with sleeve gastrectomy. *Obes Surg* 2017 May;27(5):1302-8.
27. Requarth JA, Burchard KW, Colacchio TA, et al. Long term morbidity following jejunoileal bypass: the continuing potential need for surgical reversal. *Arch Surg* 1995;130:318–25.

28. Soyer MT, Ceballos R, Aldrete JS. Reversibility of severe hepatic damage caused by jejunoileal bypass after re-establishment of normal intestinal continuity. *Surgery* 1976;79:601-4.
29. Hamouli N, Chock B, Anthone GJ, Crookes PF. Revision of the duodenal switch: indications, technique, and outcomes. *J Am Coll Surg* 2007;204(4):603-8.

XI. Appendix

List of revisional bariatric surgery experts surveyed.

Dr. Helmuth Billy

Dr. Robin Blackstone

Dr. Camilo Boza

Dr. Stacy Brethauer

Dr. Robin Brolin

Dr. Guilherme Campos

Dr. David Cummings

Dr. Eric DeMaria

Dr. Mathias Fobi

Dr. Manoel Galvao

Dr. Jan Willem Greve

Dr. Miguel Herrera

Dr. Jacques Himpens

Dr. Matt Hutter

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Dr. Kanzunori Kasama

Dr. Keith Kim

Dr. Jean Marc Chevallier

Dr. Samer Matter

Dr. Michel Murr

Dr. Aurora Pryor

Dr. Almino Ramos

Dr. Raul Rosenthal

Dr. Phil Schauer

Dr. Michel Suter

Dr. Antonio Torres

Dr. Rudolf Weiner

Dr. Alan Wittgrove

Dr. Bruce Wolfe

Dr. Natan Zundel

XII. Figures and Tables

	2015	2016	2017	% growth, 2015 to 2017 (%)
<i>Total bariatric cases</i>	168,093	186,772	200,374	19.2
<i>Total BPD/DS</i>	1,264	1,588	2,069	63.7
<i>% of total cases</i>	0.75%	0.85%	1.03%	37.3
<i>Primary</i>	1,065	1,268	1,643	54.3
<i>Revision</i>	199	320	426	114.1
<i>Robotic-Assisted</i>	271	279	369	36.2
<i>Laparoscopic</i>	818	1,089	1,473	80.1
<i>Open</i>	82	117	131	59.8
<i>Other</i>	93	103	96	3.2

Table 1. Frequencies of primary and revisional duodenal switch (BPD/DS) procedures in the United States, 2015-2017. Relative to a 19% increase in total bariatric cases performed, a 63.7% increase in the number of BPD/DS cases performed was observed between 2015 and 2017. Notably, a marked and disproportionate increase was seen in the number of revisional cases during this period, relative to primary BPD/DS and total number of bariatric cases (114.1% vs 54.3% and 25.6%, respectively)⁵.