

Original article

# Duodenal switch versus Roux-en-Y gastric bypass: a perioperative risk comparative analysis of the MBSAQIP Database (2015–2019)

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## Abstract

**Background:** Biliopancreatic diversion with duodenal switch (BPD/DS) is a procedure that has long been considered to have a higher early postoperative morbidity than Roux-En-Y gastric bypass (RYGB). However, patients who undergo BPD/DS have more baseline co-morbidities that may affect the reported early postoperative morbidity.

**Objective:** To compare 30-day postoperative morbidity and mortality between BPD/DS and RYGB propensity score–matched cohorts obtained from the MBSAQIP database.

**Setting:** Analysis of data obtained from the Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program (MBSAQIP) database.

**Methods:** Retrospective analysis of 21-variable propensity score–matched patients in the BPD/DS and RYGB groups obtained from the MBSAQIP database between 2015 and 2019. Variables included age, sex, body mass index, American Society of Anesthesiologists (ASA) class, and pertinent medical co-morbidities. Data were analyzed for 30-day postoperative morbidity, mortality, reoperation, re-intervention, and readmissions.

**Results:** Before matching, RYGB and BPD/DS cohorts contained 134 188 and 5079 patients, respectively. After multivariable propensity score matching, each cohort contained 5050 patients. The RYGB group had a higher rate of surgical-site infections than the BPD/DS group (1% versus .5%,  $P = .007$ ) and a higher rate of blood product transfusions (1.1% versus .6%,  $P = .018$ ). The rate of other early postoperative complications was similar between the 2 groups ( $P > .05$ ). There was no statistically significant difference in the 30-day mortality, readmission rate, reoperation rate, or reintervention rate between the 2 groups ( $P > .05$ ).

**Conclusion:** When matched for baseline body mass index and co-morbidities, BPD/DS does not lead to a higher 30-day postoperative morbidity and mortality than RYGB. Patients can be counseled that in the short term, BPD/DS is as safe as RYGB. (Surg Obes Relat Dis 2022;18:253–259.) © 2021 American Society for Bariatric Surgery. Published by Elsevier Inc. All rights reserved.

**Keywords:** Biliopancreatic diversion (BPD); Duodenal switch (DS); Roux-en-y gastric bypass (RYGP); Comparison; MBSAQIP database

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Biliopancreatic diversion with duodenal switch (BPD/DS) was first introduced in 1979 by Scopinaro et al. [1]. Various refinements to the approach were incorporated

over time while keeping in mind preservation of the pyloric sphincter as a way to reduce the high rate of postgastrectomy syndrome. These refinements resulted in the current

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BPD/DS procedure, described in 1998 by Hess and Hess [2]. Multiple reports have demonstrated superior outcomes associated with BPD/DS over the sleeve gastrectomy and Roux-en-Y gastric bypass (RYGB) in terms of weight loss and diabetes resolution [3,4]. However, persistent fears about severe malabsorption, malnutrition, and a higher rate of complications have led to a lower rate of adoption of the procedure, specifically in the United States [5]. Currently, BPD/DS constitutes less than 1% of the primary bariatric surgeries performed nationwide [6]. It remains noteworthy to mention that the data supporting the aforementioned reservations stem mostly from single-institutional cohort studies [7]. There are published studies using national databases showing higher complications in BPD/DS than in RYGB, but most of the surgeries in the BPD/DS group were performed in an open rather than a minimally invasive fashion (75% in the BPD/DS group versus 9% in the RYGB group) [8]. When these 2 surgeries were compared in matched patients at a single institution, perioperative complications and mortality were shown to be equivalent [9]. While a randomized, controlled study has compared the 2 surgeries, it had a remarkably low number of patients and was only confined to patients with body mass indexes of  $>50 \text{ kg/m}^2$  [10].

The Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program (MBSAQIP) Participant Use File (PUF) is a valuable resource to study postoperative complications following major bariatric surgery because all bariatric centers accredited by the American College of Surgeons report their data, which amount to more than 200 000 cases per year. In this report, we aim to evaluate 30-day safety and complication outcomes for BPD/DS and RYGB using the MBSAQIP PUF [5].

## Methods

### *Patients and study design*

The MBSAQIP PUF was searched for patients who had undergone BPD/DS or RYGB between the years 2015 and 2019. Inclusion criteria consisted of patients who underwent a primary bariatric operation in the form of RYGB identified by Current Procedural Terminology (CPT) code 43644 or BPD/DS (CPT code 43485). We excluded the patients  $<18$  years of age, those who underwent RYGB or BPD/DS as a revisional operation, and those who underwent combined additional procedures during the index operation with the exception of upper endoscopy.

After meeting appropriate inclusion and exclusion criteria, patients in these 2 cohorts were then matched based on their propensity score, controlling for patient body mass index (BMI), age, sex, American Society of Anesthesiology status, and multiple other co-morbidities. A total of 21 variables were matched between the 2 groups. A retrospective analysis of these propensity score–matched (PSM) cohorts

was performed to study and compare the baseline patient characteristics and 30-day postoperative clinical outcomes. We divided the reported complications into a Clavien–Dindo classification. This was done manually using the listed complications as follows: Grade 1 was “DEHYD\_TRTMT\_OUT,” “POST OP SUPERFICIAL INCISIONAL SSI”; grade 2 was “TRANSFINTOPSTOP,” “BLEEDING\_UNITS,” “POSTOPUTI,” “CDIFF,” “ANTI-COAGULATION\_INITIATED\_BAR,” “POSTOPPNEUMONIA,” “VEINTHROMBREQTER”; grade 3a was “POSTOPDEEPINCISIONALSSI”; grade 3b was “PULMONARYEMBOLISM”; grade 4a was “ACTERENALFAILURE,” “CARDIACARRESTCPR,” “MYOCARDIALINFR,” “PROGRSRENALINSUF”; grade 4b was “POSTOPVENTILATOR,” “POSTOPORGANSPACESSI,” “POSTOPSEPSIS,” “POSTOPSEPTICSHOCK,” “UNPLANNEDADMISSIONICU30.” We used the following for grade 5: “DEATH30,” “DEATH\_CAUSE\_BAR, DEATH\_RELATED\_BAR.”

Our institutional review board deemed this project exempt because it is a deidentified national database. The MBSAQIP and associated participating centers participating 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.

### *Statistical analysis*

Quantitative variables were described using mean and standard deviation. Categorical variables were described using frequencies and proportions. Two-tailed Student *t* test,  $\chi^2$  test, and Fisher exact test as indicated were used to assess differences across databases. Propensity-matched analysis was completed to control for differences in cohorts across databases. *P* values less than 5% were considered statistically significant. All analyses were completed in R version 4.1.0, which is reachable at <https://www.r-project.org/> (R Foundation, Vienna, Austria).

## Results

### *Patient characteristics*

Prior to matching, the aggregate cohorts contained 134 188 patients in the RYGB group and 5079 patients in the BPD/DS group (Fig. 1). The difference in the baseline characteristics of these 2 cohorts was statistically significant for various parameters, including age, sex, co-morbidities including diabetes mellitus, deep vein thrombosis, chronic obstructive pulmonary disease, hyperlipidemia, and sleep apnea ( $P < .05$ ). Also of note, the mean BMI of the RYGB group was lower than that of the DS group (46.1 versus  $52 \text{ kg/m}^2$ ,  $P < .05$ ; see Table 1).

After the multivariable propensity score matching, the RYGB and BPD/DS cohorts contained 5050 patients each. All the above-mentioned baseline patient characteristics

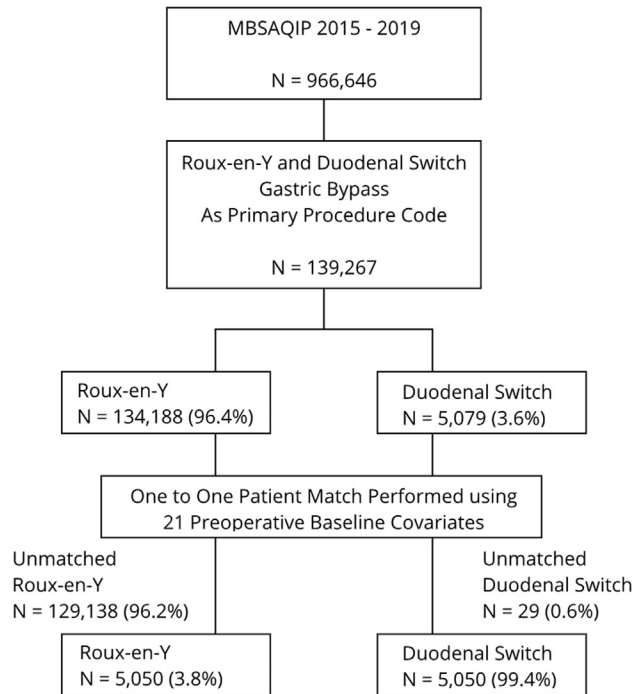


Fig. 1. Flowchart portraying surgery types and numbers before and after propensity score matching.

were matched, and the compositions of both cohorts were similar ( $P > .05$ ). Fig. 2 shows the standardized differences between the 2 groups before and after propensity score matching. The mean age of the patients in both cohorts was comparable (43 and 43.1 yr for RYGB and BPD/DS, respectively,  $P = .68$ ). Most patients in both cohorts were women (69.7% and 71.5%,  $P = .055$ ). The mean BMIs of both cohorts were 52.0 and 52.1 kg/m<sup>2</sup> ( $P = .41$ ). As shown in Table 1, all other co-morbidities were similar between the 2 cohorts. The most common co-morbidities were hypertension (49.8% and 49.5%,  $P = .83$ ), sleep apnea (44.7% and 44%,  $P = .51$ ), diabetes mellitus (31.6% and 32%,  $P = .48$ ), and gastroesophageal reflux disease (31.6% and 32.5%,  $P = .35$ ).

### 30-Day postoperative outcomes

Overall, Clavien–Dindo complications were similar between these 2 PSM cohorts with the exception of grade 1 complications, which were found to be higher for the RYGB group at 1% versus .5% for the BPD/DS group. A multivariate subgroup analysis was further performed, and the postoperative outcomes revealed that there was a twice as high incidence of superficial surgical-site infection in the RYGB cohort (1%) versus the DS cohort (.5%). The RYGB group also was found to have a statistically significant higher need for postoperative transfusion at 1.1% versus .6% in the BPD/DS group. There was no statistically significant difference identified between the 2 groups

(Table 2) in terms of other complications, including grade 2 (urinary tract infection, pneumonia, deep vein thrombosis, need for anticoagulation), grade 3 (deep surgical-site infection, pulmonary embolism), and grade 4 (acute or progressive renal failure, cardiac arrest, myocardial infarction, need for ventilator, organ space surgical-site infection, sepsis, septic shock, unplanned ICU admissions) or death.

The readmission rate was found to be similar (6.1% versus 6.1%,  $P = 1.0$ ) for both groups. Prior to the propensity score matching, the reoperation rate was significantly higher in the BPD/DS group (2.9% versus 2.1%,  $P = .00$ ). However, in the matched cohorts, this difference was not statistically significant (2.9% versus 2.4%,  $P = .107$ ). The reintervention rate was similar for both the cohorts (2.1% versus 2.1%,  $P = .835$ ). There was also no statistical difference noted in the 30-day postoperative mortality between the 2 cohorts (.3% versus .3%,  $P = 1.0$ ) (Table 3).

## Discussion

In this study, a higher risk of surgical-site infection was encountered in the RYGB group compared with the BPD/DS group. Additionally, patients undergoing RYGB had a higher rate of postoperative transfusions. The Clavien–Dindo grade 1 complication rate was higher in the RYGB group, and no significant difference was found in the complication rates of grades 2–5 between the 2 cohorts. Finally, hospital readmission and overall mortality rates were similar between the 2 groups.

Mason [11] compared short-term morbidity and mortality rates of RYGB and BPD/DS patients using the National Surgical Quality Improvement Project (NSQIP) database. Propensity score matching was used, and subjects were matched for all the NSQIP preoperative risk factors. Additional stratification was employed to differentiate between open and laparoscopic approaches. This study demonstrated an increased incidence of serious morbidity (7.3% versus 3.1%,  $P = .01$ ) in the BPD/DS group (serious morbidity was defined as organ surgical-site infection, wound disruption, pulmonary embolism, acute renal failure, cardiac arrest, stroke, myocardial infarction, and sepsis/septic shock by the author). Additionally, a higher rate of reoperation (4.9% versus 1.5%,  $P = .024$ ) was found in the BPD/DS group. When the author evaluated the laparoscopic approach, a higher rate of overall morbidity was found in the BPD/DS group versus the RYGB group (8.6% versus 1%,  $P = .019$ ), but no statistically significant difference in mortality was found.

Our study did not show similar outcomes because we found no difference in complication rates. The report by Mason [11] also only included 326 and 105 patients in the open and laparoscopic arms, respectively. This relatively small sample size may have decreased the power of the study. Another report by Topart et al. [12] showed an increase in overall morbidity following BPD/DS versus

Table 1  
Patient characteristics for pre- and postmatched Roux-en-Y and duodenal switch procedures

Characteristics	All cohorts (prematch)		P value*	Matched cohorts		P value	d
	Roux-en-Y	Duodenal switch		Roux-en-Y	Duodenal switch		
No.	134 188	5079	—	5050	5050	—	—
Age, yr	44.3 ± 11.7	43.1 ± 11.4	.000	43.0 ± 11.6	43.1 ± 11.4	.680	.019
Sex (female)	106 737 (79.5%)	3682 (71.5%)	.000	3592 (69.7%)	3682 (71.5%)	.055	.036
Body mass index, kg/m <sup>2</sup>	46.1 ± 8.1	52.0 ± 9.4	.000	52.0 ± 9.4	52.1 ± 9.2	.410	.009
ASA 1	338 (.3%)	17 (.3%)	.312	15 (.3%)	17 (.3%)	.730	-.013
ASA 2	22 940 (17.1%)	535 (10.6%)	.000	451 (8.8%)	532 (10.5%)	.010	.025
ASA 3	104 436 (77.9%)	4202 (82.9%)	.000	4172 (82.6%)	4189 (83.0%)	.670	-.016
ASA 4	6306 (4.7%)	315 (6.2%)	.000	296 (5.8%)	315 (6.2%)	.380	-.016
History of myocardial infarction	1899 (1.4%)	73 (1.4%)	.940	92 (1.8%)	73 (1.5%)	.210	-.005
Previous cardiac stent	2781 (2.1%)	92 (1.8%)	.220	101 (2.0%)	92 (1.8%)	.660	-.010
Diabetes	46 294 (34.5%)	1630 (32.1%)	.000	1594 (31.6%)	1628 (32.2)	.480	.030
Hypertension	67 875 (50.6%)	2562 (50.4%)	.857	2514 (49.8%)	2502 (49.5%)	.830	-.002
Hyperlipidemia	36 865 (27.5%)	1222 (24.1%)	.000	1244 (24.2%)	1222 (24.2%)	.870	.000
Mobility device use	2189 (1.6%)	152 (3.0%)	.000	135 (2.6%)	152 (3.0%)	.280	.015
Deep vein thrombosis	2285 (1.7%)	116 (2.3%)	.002	109 (2.2%)	116 (2.3%)	.690	.003
Pulmonary embolism	1531 (1.1%)	86 (1.7%)	.000	77 (1.5%)	86 (1.7%)	.340	.008
Therapeutic anticoagulation	3558 (2.7%)	175 (3.4%)	.001	183 (3.6%)	174 (3.5%)	.670	.044
COPD	2252 (1.7%)	118 (2.3%)	.001	94 (1.4%)	118 (2.3%)	.110	-.001
Current smoker	10 582 (7.9%)	525 (10.3%)	.000	508 (10.1%)	523 (10.4%)	.650	-.006
Renal insufficiency	824 (.6%)	33 (.6%)	.820	38 (.8%)	33 (.7%)	.630	-.000
Dialysis	256 (.2%)	16 (.3%)	.380	11 (.2%)	13 (.3%)	.840	-.031
Sleep apnea	57 499 (42.8%)	2231 (43.9%)	.130	2258 (44.7%)	2224 (44.0%)	.510	-.017
GERD	48 483 (36.1%)	1643 (32.3%)	.000	1594 (31.6%)	1639 (32.5%)	.350	-.002
Steroid immunosuppressive use	2074 (1.5%)	78 (1.5%)	1.000	74 (1.5%)	76 (1.5%)	.930	-.000
Functional status (nondependent)	132 906 (99.6%)	4971 (97.9%)	.000	4945 (97.9%)	4950 (98.0%)	.780	-.017

ASA = American Society of Anesthesiologists; COPD = chronic obstructive pulmonary disease; GERD = gastroesophageal reflux disease.

RYGB (20.4% versus 7.5%,  $P = .0017$ ). However, in this study, patients in the BPD/DS group had a higher mean pre-operative BMI (54.9 versus 44.3 kg/m<sup>2</sup>,  $P = .001$ ) and a higher rate of co-morbidities (66.1% versus 50%,  $P = .0217$ ). Our study compared patients with similar clinical profiles and did not find these results. Despite these critical baseline characteristic differences, no difference was found in the intergroup overall 30-day mortality rate. In a similar manner, Oviedo et al. [13] reported a significantly higher

30-day morbidity rate in their BPD/DS group when compared with their RYGB group (31% versus 13%,  $P = .004$ ). Likewise, the patients in the BPD/DS group were found to have higher mean BMI (51.7 versus 46.8 kg/m<sup>2</sup>,  $P = .00001$ ) and a higher rate of co-morbidities, most notably type 2 diabetes (64% versus 38%,  $P = .0004$ ) and obstructive sleep apnea (55% versus 49%,  $P = .012$ ). When the cohort was stratified based on preoperative BMI, no statistically significant difference was found

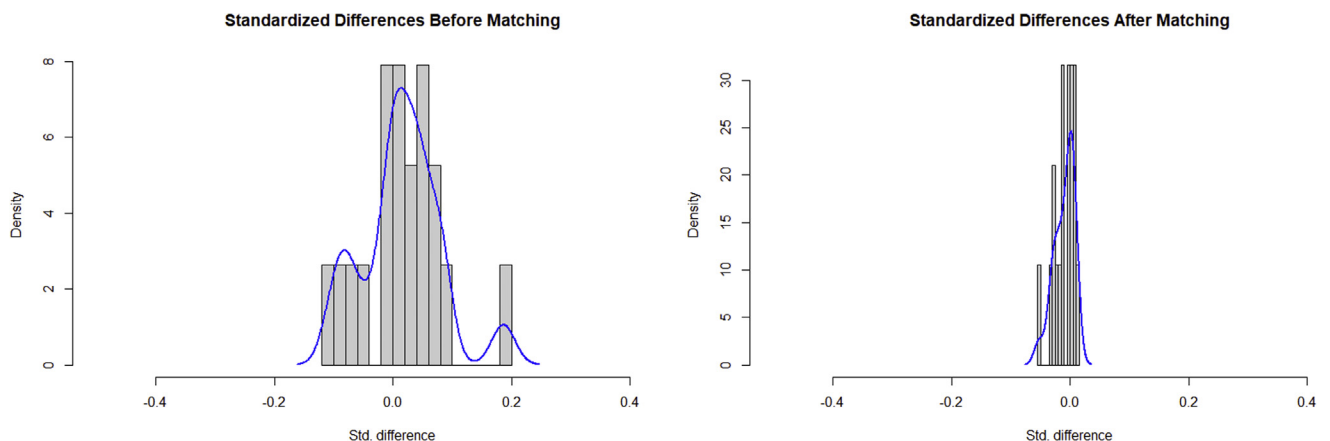


Fig. 2. Standardized differences between BPD/DS and RYGB groups before and after propensity score matching.

Table 2  
30-day complications with associated Clavien–Dindo classification for pre- and postmatched Roux-en-Y and duodenal switch procedures

Clavien-Dindo class	All cohorts (prematched)			Matched cohorts		
	Roux-en-Y n = 134 188	Duodenal switch n = 5079	P value	Roux-en-Y n = 5050	Duodenal switch n = 5050	P value
Grade 1	1072 (.8%)	25 (.5%)	.001	49 (1%)	25 (.5%)	.007
Superficial incisional SSI	1072 (.8%)	25 (.5%)	.001	49 (1%)	25 (.5%)	.007
Grade 2	3224 (2.4%)	129 (2.5%)	.590	133 (2.6%)	128 (2.5%)	.800
UTI	603 (.4%)	24 (.5%)	.810	22 (.4%)	23 (.5%)	1.000
Pneumonia	432 (.3%)	20 (.4%)	.420	21 (.4%)	20 (.4%)	1.000
Venous thrombosis	209 (.2%)	17 (.3%)	.003	7 (.1%)	17 (.3%)	.066
Anticoagulation initiated	590 (.4%)	36 (.7%)	.006	28 (.6%)	36 (.7%)	.380
Transfusion	1390 (1.0%)	32 (.6%)	.006	55 (1.1%)	32 (.6%)	.018
Grade 3a	171 (.1%)	3 (0%)	.050	8 (.2%)	3 (0%)	.230
Deep incisional SSI	171 (.1%)	3 (0%)	.050	8 (.2%)	3 (0%)	.230
Grade 3b	177 (.1%)	19 (.4%)	.000	14 (.3%)	19 (.4%)	.490
Pulmonary embolism	177 (.1%)	19 (.4%)	.000	14 (.3%)	19 (.4%)	.490
Grade 4a	379 (.3%)	26 (.5%)	.740	27 (.5%)	26 (.5%)	1.000
Acute renal failure	140 (.1%)	12 (.2%)	.009	11 (.2%)	12 (.2%)	1.000
Cardiac arrest	65 (0%)	3 (0%)	.740	5 (0%)	3 (0%)	.730
Myocardial infarction	51 (0%)	3 (0%)	.450	1 (0%)	3 (0%)	.620
Progressive renal failure	123 (0%)	8 (.2%)	.150	10 (.2%)	8 (.2%)	.810
Grade 4b	2277 (1.7%)	196 (3.9%)	.000	183 (3.6%)	196 (3.9%)	.530
Ventilator	164 (.1%)	11 (.2%)	.100	11 (.2%)	11 (.2%)	1.000
Organ space SSI	434 (.3%)	56 (1.1%)	.000	56 (1.1%)	56 (1.1%)	1.000
Sepsis	205 (.2%)	21 (.4%)	.000	17 (.3%)	21 (.4%)	.630
Septic shock	140 (.1%)	16 (.3%)	.000	11 (.2%)	16 (.3%)	.440
Unplanned ICU admission	1334 (1.0%)	92 (1.8%)	.000	88 (1.7%)	92 (1.8%)	.760
Grade 5	174 (.1%)	15 (.3%)	.003	15 (.3%)	15 (.3%)	1.000
Death	174 (.1%)	15 (.3%)	.003	15 (.3%)	15 (.3%)	1.000

SSI = surgical-site infection; UTI = urinary tract infection; ICU = intensive care unit.

between the 2 groups. Nonetheless, it is significant to mention that a higher incidence of morbidity was noted in the DS group than in the group with BMIs in the range of 50–60 kg/m<sup>2</sup>.

In this report, and following propensity score matching of the above-mentioned baseline characteristics, an almost equivalent rate of 30-day morbidity in the 2 groups was noted. Furthermore, a higher rate of surgical-site infections and a higher need for postoperative transfusions were found unexpectedly in the RYGB group. The higher rate of surgical-site infections might be explained by the use of the circular stapler technique in the RYGB group because use of circular staplers is linked to a higher incidence of infection [14,15]. The circular stapler technique

is used in the United States to perform the gastrojejunostomy in RYGB patients, but this method is not feasible in BPD/DS surgery because the duodenoileostomy can only be performed either with handsewn or linear stapler technique. This also may help to explain the higher rate of bleeding in the RYGB group [16]. Additionally, by design, the chance of ulcers is lower in the BPD/DS group than in RYGB group [13,17]. It may be that early ulcers presenting as bleeding also contributed to this significant bleeding difference.

Overall, the similar 30-day postoperative outcomes between the 2 groups can be explained by the fact that many of the complications that occur in patients with obesity are most likely related to their preoperative

Table 3  
30-day outcomes for pre- and postmatched Roux-en-Y and duodenal switch procedures based on readmissions, reoperations, and reinterventions

30-Day outcome	All cohorts (prematched)		P value	Matched cohorts		P value
	Roux-en-Y	Duodenal switch		Roux-en-Y	Duodenal switch	
No.	134 188	5079	—	5050	5050	—
Readmissions	7357 (5.5%)	308 (6.1%)	.080	308 (6.1%)	308 (6.1%)	1.000
Reoperations	2755 (2.1%)	147 (2.9%)	.000	120 (2.4%)	147 (2.9%)	.110
Reinterventions	2758 (2.1%)	108 (2.1%)	.760	104 (2.1%)	108 (2.1%)	.840



characteristics such as higher BMIs and other weight-related co-morbidities such as diabetes. These variables are known to impair wound healing and to increase the rate of complications. This is specifically true for anastomotic leak. Our results showed no difference in the anastomotic leak rate between the matched groups. This contradicts many of the previously reported nonmatched data [4]. Thus BPD/DS probably has been wrongfully judged as an on operation with a higher rate of complications than its peers because it is reserved for patients with superobesity who at baseline are sicker and more complex. That said, our findings can be interpreted alternatively by proposing that the vast majority of BPD/DS procedures are performed by experienced surgeons at high-volume bariatric centers. These surgeons have passed their learning curve and exhibit mastery of the technical aspects of the procedure, which could theoretically lead to fewer complications. Conversely, RYGB, one of the most common bariatric procedures, is performed by a wide array of surgeons scattered across the learning curve. Finally, our study focused only on the short-term complications and did not touch on the longer-term complications, which may yield different results.

Our report has specific limitations. First, use of the MBSAQIP database to look at a 5-year bracket of patients can lead to bias pertaining to the inclusion of multiple operations using the same CPT code: the BPD/DS procedure has evolved recently to include the single-anastomosis duodenal ileal bypass (SADI), especially after the American Society for Metabolic and Bariatric Surgery (ASMBS) endorsed SADI [18]. In principle, SADI should not be coded as the traditional BPD/DS, but some surgeons may be using the same CPT code for both surgeries. One of the other limitations of our report is the lack of long-term follow-up with regard to the analysis of long-term complications. Additionally, BPD/DS remains a relatively uncommon procedure mainly performed in highly specialized bariatric centers by experienced surgeons, which can introduce bias to our findings. Also, the experience of the surgeon is not accounted for because surgeons past their learning curve are likely performing the procedure safely with low complications rates, but less experienced surgeons may have poorer results.

## Conclusions

Our analysis of the MBSAQIP database showed that BPD/DS can be considered as safe as RYGB in terms of short-term complications. This conclusion probably reflects the outcomes of experienced bariatric surgeons performing BPD/DS who are practicing in high-volume specialized centers. These data can be used to help bariatric surgeons counsel patients about the short-term safety of each procedure. Additional investigations about the long-term complications of BPD/DS are warranted.

## Disclosure

*None of the authors have any conflicts of interest to disclose, either financial or otherwise.*

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