PAPER

# Analysis of Obesity-Related Outcomes and Bariatric Failure Rates With the Duodenal Switch vs Gastric Bypass for Morbid Obesity

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**Objective:** To compare the outcomes of a large cohort undergoing biliopancreatic diversion/duodenal switch (DS) vs gastric bypass (GB).

**Design:** Retrospective review of the Bariatric Outcomes Longitudinal Database from 2007 to 2010. All inpatient and outpatient follow-up data were analyzed.

**Setting:** Multicenter database.

**Patients:** Patients undergoing primary DS were compared with a concurrent cohort undergoing GB.

**Main Outcome Measures:** The main outcome measures were (1) weight loss; (2) control of comorbidities including diabetes mellitus, hypertension, and sleep apnea; and (3) failure to achieve at least 50% excess body weight loss.

**Results:** One thousand five hundred forty-five patients underwent DS and 77 406 underwent GB, with a mean preoperative body mass index (BMI; calculated as weight in kilograms divided by height in meters squared) of 52 and 48, respectively ($P<.01$). The DS was associated with longer operative times, greater blood loss, and longer lengths of hospital stay (all $P<.05$). Early reoperation rates were higher in the DS group (3.3% vs 1.5%). Percentage of change in BMI was significantly greater in the DS group at all follow-up intervals ($P<.05$). Subgroup analysis of the superobese population (BMI >50) revealed significantly greater percentage of excess body weight loss in the DS group at 2 years (79% vs 67%; $P<.01$). Comorbidity control of diabetes, hypertension, and sleep apnea were all superior with the DS (all $P<.05$). The risk of weight loss failure was significantly reduced with DS vs GB for all patients, with a greater reduction in the BMI more than 50 subgroup.

**Conclusions:** The DS is a less commonly used bariatric operation, with higher early risks compared with GB. However, the DS achieved better weight and comorbidity control, with even more pronounced benefits among the superobese.

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BARIATRIC SURGERY IS WELL established as the most effective means of treating morbid obesity and weight-related comorbidities.[1,2] Although the traditional Roux-en-Y gastric bypass (GB) is widely considered the gold standard bariatric procedure, a growing body of evidence suggests that weight loss failure and weight regain may be more prevalent than originally believed, particularly in the superobese population (body mass index [BMI] >50 [calculated as weight in kilograms divided by height in meters squared]).[3-5] In an attempt to find the ideal bariatric operation, a multitude of surgical options have been developed, each with their own profiles of efficacy, technical difficulties, and risk.[6] Rather than use a one-size-fits-all mentality, surgical algorithms have evolved to better tailor the procedure to the specific patient circumstances and goals.[7]

*See Invited Critique at end of article*

The majority of currently performed bariatric operations are either entirely restrictive (gastric band, sleeve gastrectomy) or combine major restriction with a mild degree of malabsorption (gastric bypass). The jejunoileal bypass represented the first attempt at a primarily malabsorptive procedure but was eventually abandoned because of often devastating nutritional consequences and hepatic failure.[8] In 1979, Scopinaro et al[9] introduced the biliopancreatic diversion, combining a distal gastrectomy with a long enteric bypass. This was later modified by Hess and Hess[10] by the addition of a DeMeester duodenal switch to create the modern biliopancreatic diversion with duodenal switch (DS). Despite several groups reporting on the ex-

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cellent early to long-term efficacy, durability, and safety associated with both the open and laparoscopic DS,[11-16] the procedure has generally been slow to gain acceptance in the United States. This is likely because of persistent concerns about technical difficulty, particularly for a laparoscopic approach, and potential long-term nutritional complications. The purpose of this study was to analyze a large and multicenter cohort of patients undergoing the DS for morbid obesity to evaluate early outcomes including complications, weight loss, and comorbidity control and compare these results with a concurrent control population undergoing GB. In addition, we sought to evaluate the rates of weight loss failure associated with each of these procedures, specifically in the superobese population.

## METHODS

This study was performed using the Bariatric Outcomes Longitudinal Database (BOLD) developed and maintained by Surgical Review Corporation. The BOLD database was established in 2007 as a key component of tracking surgical outcomes for centers that have received certification as a bariatric center of excellence. It is a large, multicenter database that represents the world's most comprehensive clinical bariatric surgery database with more than 400 000 patients currently enrolled. All data are prospectively collected and maintained and include preoperative, inpatient, and long-term postoperative follow-up data.[17] In addition to detailed data related to the surgery and initial hospital stay, the BOLD contains detailed information collected at each follow-up visit including weight, BMI, and the presence and severity of each obesity-related comorbidity such as diabetes mellitus, hypertension, and sleep apnea.

All adult patients undergoing laparoscopic or open DS and GB procedures for the purpose of weight loss were included. Patients undergoing these operations for reasons other than for weight loss were excluded. All revisional operations were excluded. Exploratory analysis of the entire sample was performed to establish baseline demographics, operative and perioperative profiles, complication rates, and weight loss. The primary analysis compared demographics, complications, weight loss, and postoperative control of comorbid diseases between patients undergoing DS vs GB. Subgroup analysis was then performed to compare these variables of interest by operative approach (laparoscopic vs open), both within and between the 2 primary procedures. Additional subgroup analysis was performed for patients with a BMI more than 50 (superobese) to determine rates of weight loss failure associated with each procedure. Patients were designated as a "weight loss failure" if they failed to lose at least 50% of their calculated excess body weight.[3,18-20]

Categorical variables were compared using the $\chi^2$ or Fisher exact test. Continuous variables were compared using the *t* test and paired *t* test for repeated variables where appropriate. Significance was set at a *P* value of less than .05. All statistics were performed using SPSS version 11.1 (SPSS Inc). This study was reviewed and approved by the local institutional review board as well as the data use committee of the Surgical Review Corporation.

## RESULTS

From the BOLD database, 78 951 patients were identified as having undergone either GB or DS between 2007 and 2010. Of these patients, 77 406 (98%) underwent GB and 1545 (2%) underwent DS. Mean (SD) age of the entire cohort was 45 (11.5) years and 78% of the patients were female, with no significant differences in age or sex identified between the 2 cohorts. Mean (SD) follow-up was 8.8 (6.3) months among GB patients and 8.9 (6.2) months for DS patients ($P = .39$). One-year follow-up data were accrued for 21 028 GB patients (27%) and 437 DS patients (28%). At 2 or more years, follow-up data had been collected for 2688 GB patients (3%) and 45 DS patients (3%). Preoperative BMI was significantly greater in the DS group compared with the GB group (52 vs 48) ($P = .001$). In general, DS patients had a higher prevalence of preexisting underlying disease at baseline. The DS patients were noted to have worse overall congestive heart failure and functional status classifications compared with GB patients ($P < .001$). In addition, a greater proportion of DS patients had associated obesity-related comorbidities including glucose abnormalities, hypertension, hyperlipidemia, gastroesophageal reflux, and obstructive sleep apnea. The severity of these comorbidities also appeared to be worse among DS patients as illustrated by the greater percentage of patients requiring multidrug regimens to control disease (**Table 1**).

Laparoscopy was the primary surgical approach used among GB patients (92%), whereas only 50% of DS patients underwent a laparoscopic surgery ($P < .001$). Conversion rates from laparoscopic to open surgery for both groups were similar at 0.8% for GB and 0.9% for DS. Common concurrent procedures included cholecystectomy, upper endoscopy, liver biopsy, and lysis of adhesions. The DS patients more frequently underwent concurrent cholecystectomy (45% vs 5%) and liver biopsy (47% vs 8%), whereas GB was more frequently associated with concurrent upper endoscopy (21% vs 12%). The DS was associated with significantly greater operative times (191 vs 114 minutes) and estimated blood loss (132 vs 54 $mL^3$) as well as increased need for intraoperative transfusion (1.6% vs 0.8%) (all $P < .001$). Intraoperative complication rates were similar between GB and DS, although DS was associated with a significantly greater rate of solid organ injury (0.5% vs 0.2%) (**Table 2**).

Postoperatively, GB was associated with shorter lengths of initial hospital stay compared with DS (2.4 vs 4.4 days). The DS more frequently required early reoperation (3.3% vs 1.5%) compared with GB; however, no differences in late reoperation rates were noted between the 2 groups. Rates of anastomotic complications such as anastomotic stricture (3.3% vs 1.9%) and marginal ulcer (1.2% vs 0.3%) were significantly higher in the GB cohort. However, postoperative infections including surgical site infection, pneumonia, urinary tract infection, and systemic infection rates were more prevalent among patients undergoing DS. Furthermore, anastomotic leaks were twice as likely to occur following DS compared with GB (1.6% vs 0.8%). Overall mortality was significantly greater for DS, with a mortality rate of 1.2% compared with 0.3% for GB. Although the development of major nutritional deficiencies was relatively uncommon, it more frequently occurred with the DS procedure compared with GB (4.1% vs 2.1%) (**Table 3**). Similar trends in complication rates were seen when controlling only for superobese patients (BMI >50) (**Table 4**).

Additional subgroup analysis was performed to compare intraoperative and postoperative variables between laparoscopic GB and laparoscopic DS (**Table 5**) as well as between open GB and open DS (**Table 6**). In both cases,

**Table 1. Preoperative Demographics From Bariatric Outcomes Longitudinal Database for All Gastric Bypass and Duodenal Switch Patients**

| | % | | | |
|---|---|---|---|---|
| | Gastric Bypass (n = 77 406) | Duodenal Switch (n = 1545) | All Patients (n = 78 951) | *P* Value |
| Age, y, mean (SD) | 45.4 (11.5) | 45.3 (11.3) | 45.4 (11.5) | .86 |
| Sex, No. (%) | | | | |
| M | 16 748 (21.6) | 401 (26) | 17 149 (21.7) | <.001 |
| F | 60 658 (78.4) | 1144 (74.0) | 61 802 (78.3) | |
| Preoperative BMI, mean (SD) | 48.1 (8.3) | 51.8 (9.7) | 48.1 (8.3) | <.001 |
| Comorbidities | | | | |
| CHF class | | | | |
| Class 1 | 1.4 | 2.3 | 1.5 | <.001 |
| Class 2 | 0.6 | 1.4 | 0.6 | |
| Class 3 | 0.3 | 0.5 | 0.3 | |
| Class 4 | 0.1 | | 0.1 | |
| Functional status | | | | |
| Class 1 | 2.4 | 4.9 | 2.5 | <.001 |
| Class 2 | 0.8 | 0.8 | 0.8 | |
| Class 3 | 0.5 | 1.7 | 0.5 | |
| Class 4 | 0 | 0 | 0 | |
| History of GERD | 49.1 | 51.5 | 49.1 | .06 |
| Glucose metabolism abnormality | 38.7 | 41.0 | 38.7 | .06 |
| Severity of glucose metabolism abnormality | | | | |
| Oral agents | 19.1 | 19.3 | 19.1 | <.001 |
| Insulin | 3.4 | 6.3 | 3.5 | |
| Insulin and oral agents | 7.5 | 7.6 | 7.5 | |
| History of hypertension | 60.2 | 63.4 | 60.3 | .01 |
| Severity of hypertension | | | | |
| No agents | 4.8 | 5.6 | 4.8 | .04 |
| Single agent | 28.2 | 28.5 | 28.2 | |
| Multiple agents | 22.4 | 23.8 | 22.5 | |
| Severely poorly controlled | 0.4 | 0.2 | 0.4 | |
| Lipid abnormality | 42.6 | 44.1 | 42.6 | .24 |
| Obstructive sleep apnea | 47.8 | 60.5 | 48.1 | <.001 |
| History of abdominal surgery | 32.9 | 36.2 | 32.9 | .01 |

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); CHF, congestive heart failure; GERD, gastroesophageal reflux disease.

laparoscopic and open GB were associated with shorter operative times, less intraoperative blood loss, and shorter hospital stays compared with their DS counterparts (all $P<.001$). Subgroup analysis was also performed to compare intraoperative and postoperative characteristics between laparoscopic and open DS (**Table 7**). In this case, the laparoscopic approach was associated with significantly longer operative times (234 vs 150 minutes) compared with the open approach. However, the laparoscopic approach was associated with significantly less intraoperative blood loss (76 vs 184 $mL^3$) and patients were discharged home an average of 2 days earlier compared with those who underwent open surgery (3.4 vs 5.4 days).

Both GB and DS operations achieved significant weight loss during the follow-up period. Among patients with up to 2 or more years' follow-up, mean BMI was 31 in the GB group compared with 30 in the DS group. To critically analyze weight loss outcomes, trends in both percentage of excess BMI lost and percentage of change in BMI were examined. As illustrated in **Figure 1**, the mean percentage of excess BMI lost at 6 months was significantly greater for GB patients compared with DS patients (58% vs 56%). However, by 2 years' follow-up, DS patients had achieved superior maximum weight loss with 85% excess BMI lost, compared with 79% for those undergoing GB ($P<.001$). When looking at the percentage of change in BMI, the DS was associated with significantly greater percentage of change in BMI at all follow-up intervals compared with GB. In addition, the magnitude of the difference in percentage of change in BMI between the 2 groups increased at each follow-up interval. At 2 or more years' follow-up, the DS group had attained 43% change in BMI compared with just 36% in the GB group (**Figure 2**). In subgroup analysis, these weight loss trends remained consistent, with laparoscopic and open DS consistently achieving a significantly greater percentage of excess BMI lost at 2 years' follow-up compared with their GB counterpart.

Subgroup analysis was then performed to specifically evaluate and compare weight loss obtained for GB and DS in the superobese (BMI >50) population. Interestingly, the DS was associated with significantly greater reduction in BMI compared with GB at both the 1- and 2-year follow-ups with a mean percentage of excess BMI lost of 79% for DS and 67% for GB at 2 years. The superobese population was further analyzed to determine any differences in rates of weight loss failure between the 2 operations. Weight loss failure was defined as the failure to lose at least 50% of excess body weight for patients with at least 1 year of fol-

**Table 2. Intraoperative Variables for All Gastric Bypass and Duodenal Switch Patients**

| | % | | | |
|---|---|---|---|---|
| | Gastric Bypass (n = 77 406) | Duodenal Switch (n = 1545) | All Patients (n = 78 951) | *P* Value |
| Planned surgical approach | | | | |
| Open | 7.7 | 50.5 | 8.6 | <.001 |
| Laparoscopic | 92.3 | 49.5 | 91.4 | |
| Final surgical approach | | | | |
| Open | 8.6 | 51.4 | 9.4 | |
| Laparoscopic | 91.4 | 48.6 | 90.6 | <.001 |
| Laparoscopic converted to open surgery | 0.8 | 0.9 | 0.8 | |
| Resident participation | 12.1 | 12.4 | 12.1 | .67 |
| Fellow participation | 10.1 | 10.2 | 10.1 | .97 |
| Concurrent procedures | | | | |
| Cholecystectomy | 4.9 | 45.1 | 5.7 | <.001 |
| Endoscopy examination | 20.5 | 11.5 | 20.3 | <.001 |
| Hiatal hernia repair | 6.8 | 3.7 | 6.8 | <.001 |
| Liver biopsy | 8.4 | 46.7 | 9.2 | <.001 |
| Lysis of adhesions | 9.0 | 17.5 | 9.2 | <.001 |
| Ventral hernia repair | 1.2 | 3.7 | 1.2 | <.001 |
| Operative time, min, mean (SD) | 113.8 (53.8) | 191.2 (87.6) | 115.4 (55.7) | <.001 |
| Estimated blood loss, $mL^3$, mean (SD) | 54.0 (89.2) | 131.7 (170.9) | 55.6 (92.1) | <.001 |
| Transfusion | 0.8 | 1.6 | 0.8 | <.001 |
| Intraoperative complications | | | | |
| Cardiac event | 0.1 | 0.1 | 0.1 | .97 |
| Bleeding event | 0.3 | 0.2 | 0.3 | .65 |
| Hollow viscus injury | 0.2 | 0.1 | 0.2 | .53 |
| Solid organ injury | 0.2 | 0.5 | 0.2 | .01 |

**Table 3. Postoperative Complications for All Gastric Bypass and Duodenal Switch Patients**

| | % | | | |
|---|---|---|---|---|
| | Gastric Bypass (n = 77 406) | Duodenal Switch (n = 1545) | All Patients (n = 78 951) | *P* Value |
| Initial length of hospital stay, d, mean (SD) | 2.4 (3.1) | 4.4 (4.7) | 2.5 (3.1) | <.001 |
| Any reoperation | 7.2 | 11.5 | 7.3 | <.001 |
| Early | 1.5 | 3.3 | 1.6 | <.001 |
| Late | 1.3 | 1.1 | 1.3 | .42 |
| Complications | | | | |
| Anastomotic stricture | 3.3 | 1.9 | 3.3 | .002 |
| Marginal ulcer | 1.2 | 0.3 | 1.2 | .001 |
| Any infection | 1.9 | 4.5 | 1.9 | <.001 |
| Surgical site infection | 1.1 | 2.1 | 1.1 | <.001 |
| Pneumonia | 0.4 | 0.9 | 0.4 | .001 |
| Urinary tract infection | 0.3 | 0.8 | 0.3 | <.001 |
| Systemic infection | 0.2 | 0.9 | 0.2 | <.001 |
| Leak | 0.8 | 1.6 | 0.8 | .001 |
| Death | 0.3 | 1.2 | 0.3 | <.001 |
| Any nutritional deficiency | 2.1 | 4.1 | 2.1 | <.001 |
| Required TPN or tube feeds | 0.3 | 2.7 | 0.3 | <.001 |

Abbreviation: TPN, total parenteral nutrition.

low-up data. Results showed that nearly 20% of GB patients failed to lose at least 50% of their excess BMI by both the 1- and 2-year follow-ups. Conversely, the weight loss failure rates for DS patients were markedly lower, with 9% and 6% failing to lose at least 50% of their excess weight at 1 and 2 years, respectively (**Figure 3**).

Finally, in regard to postoperative comorbidity control, the DS group saw significantly greater resolution or improvement in most of the well-recognized obesity-related comorbidities, including diabetes, hypertension, hyperlipidemia, and obstructive sleep apnea (all $P<.01$) (**Table 8**).

## COMMENT

The field of bariatric surgery has been evolving for more than 50 years.[21] Still, no ideal operation currently exists that is suitable for all patients. The Roux-en-Y gastric bypass remains the gold standard of bariatric surgery in

**Table 4. Postoperative Complications for All Superobese (BMI >50) Gastric Bypass and Duodenal Switch Patients**

| | % | | | |
|---|---|---|---|---|
| | Gastric Bypass (n = 25 724) | Duodenal Switch (n = 786) | All Superobese (n = 26 510) | *P* Value |
| Any reoperation | 7.2 | 12.7 | 7.4 | <.001 |
| Early | 1.5 | 3.9 | 1.6 | <.001 |
| Late | 1.1 | 1.3 | 1.1 | .60 |
| Complications | | | | |
| Anastomotic stricture | 3.4 | 2.3 | 3.4 | .10 |
| Marginal ulcer | 1.2 | 0.1 | 1.1 | .002 |
| Any infection | 2.3 | 5.2 | 2.4 | <.001 |
| Surgical site infection | 1.3 | 2.2 | 1.4 | .60 |
| Pneumonia | 0.4 | 1.3 | 0.5 | .003 |
| Urinary tract infection | 0.4 | 1.0 | 0.4 | .02 |
| Systemic infection | 0.3 | 1.1 | 0.3 | <.001 |
| Leak | 0.9 | 2.4 | 0.9 | <.001 |
| Death | 0.4 | 1.8 | 0.5 | <.001 |
| Any nutritional deficiency | 2.3 | 5.5 | 2.4 | <.001 |
| Required TPN or tube feeds | 0.3 | 3.4 | 0.4 | <.001 |

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); TPN, total parenteral nutrition.

**Table 5. Intraoperative and Postoperative Subgroup Analysis of Laparoscopic Gastric Bypass and Laparoscopic Duodenal Switch**

| | % | | |
|---|---|---|---|
| | Gastric Bypass (n = 70787) | Duodenal Switch (n = 751) | *P* Value |
| Operative time, min, mean (SD) | 113.1 (52) | 234.3 (86.6) | <.001 |
| Estimated blood loss, $mL^3$, mean (SD) | 47 (66.3) | 76 (100.2) | <.001 |
| Intraoperative complications | | | |
| Cardiac event | 0.1 | 0 | .49 |
| Bleeding event | 0.2 | 0.3 | .88 |
| Hollow viscus injury | 0.2 | 0.1 | .76 |
| Solid organ injury | 0.1 | 0 | .32 |
| Any reoperation | 7.0 | 6.3 | .44 |
| Early | 1.5 | 3.1 | <.001 |
| Late | 1.3 | 0.8 | .21 |
| Complications | | | |
| Anastomotic stricture | 3.2 | 1.6 | .01 |
| Marginal ulcer | 1.2 | 0.3 | .02 |
| Any infection | 1.7 | 3.7 | <.001 |
| Surgical site infection | 0.9 | 1.3 | .23 |
| Pneumonia | 0.4 | 0.9 | .01 |
| Urinary tract infection | 0.3 | 0.9 | .001 |
| Systemic infection | 0.2 | 0.5 | .03 |
| Leak | 0.7 | 1.1 | .29 |
| Death | 0.2 | 0.8 | .003 |
| Initial length of hospital stay, d, mean (SD) | 2.3 (2.9) | 3.4 (3.4) | <.001 |

**Table 6. Intraoperative and Postoperative Subgroup Analysis of Open Gastric Bypass and Open Duodenal Switch**

| | % | | |
|---|---|---|---|
| | Gastric Bypass (n = 6619) | Duodenal Switch (n = 794) | *P* Value |
| Operative time, min, mean (SD) | 121.5 (69.5) | 150.4 (66.6) | <.001 |
| Estimated blood loss, $mL^3$, mean (SD) | 129.8 (199.2) | 184.4 (204.1) | <.001 |
| Intraoperative complications | | | |
| Cardiac event | 0.1 | 0.1 | .50 |
| Bleeding event | 0.4 | 0.1 | .24 |
| Hollow viscus injury | 0.4 | 0.1 | .21 |
| Solid organ injury | 0.5 | 0.9 | .19 |
| Any reoperation | 9.4 | 16.4 | <.001 |
| Early | 2.0 | 3.5 | .004 |
| Late | 1.5 | 1.4 | .78 |
| Complications | | | |
| Anastomotic stricture | 4.4 | 2.3 | .004 |
| Marginal ulcer | 1.6 | 0.3 | .003 |
| Any infection | 4.0 | 5.3 | .09 |
| Surgical site infection | 2.6 | 2.8 | .73 |
| Pneumonia | 0.6 | 0.9 | .29 |
| Urinary tract infection | 0.6 | 0.8 | .49 |
| Systemic infection | 0.6 | 1.3 | .03 |
| Leak | 1.7 | 2.1 | .33 |
| Death | 0.5 | 1.5 | <.001 |
| Initial length of hospital stay, d, mean (SD) | 3.5 (4.3) | 5.4 (5.5) | <.001 |

terms of the degree and durability of weight loss and comorbidity control. It is by far the most frequently performed operation for the treatment of morbid obesity. Between 2007 and 2010, more than 77 000 GB operations were logged into BOLD and its use had increased over the 3-year period by nearly 137%. However, as longer-term follow-up data have been obtained and reported, there is an increasing awareness that even the gastric bypass has a significant incidence of weight loss failure. This has been particularly appreciated among the population of superobese patients (BMI >50). With reports of failure rates as high as 20.4% in morbidly

**Table 7. Intraoperative and Postoperative Subgroup Analysis of Laparoscopic Duodenal Switch and Open Duodenal Switch**

| | % | | |
|---|---|---|---|
| | Laparoscopic Duodenal Switch (n = 751) | Open Duodenal Switch (n = 794) | *P* Value |
| Operative time, min, mean (SD) | 234.3 (86.6) | 150.4 (66.6) | <.001 |
| Estimated blood loss, mL[3], mean (SD) | 76 (100.2) | 184.4 (204.1) | <.001 |
| Intraoperative complications | | | |
| Cardiac event | 0 | 0.1 | .33 |
| Bleeding event | 0.3 | 0.1 | .53 |
| Hollow viscus injury | 0.1 | 0.1 | .97 |
| Solid organ injury | 0 | 0.9 | .01 |
| Any reoperation | 6.3 | 16.4 | <.001 |
| Early | 3.1 | 3.5 | .61 |
| Late | 0.8 | 1.4 | .27 |
| Complications | | | |
| Anastomotic stricture | 1.6 | 2.3 | .34 |
| Marginal ulcer | 0.3 | 0.3 | .96 |
| Any infection | 3.7 | 5.3 | .14 |
| Surgical site infection | 1.3 | 2.8 | .05 |
| Pneumonia | 0.9 | 0.9 | .92 |
| Urinary tract infection | 0.9 | 0.8 | .70 |
| Systemic infection | 0.5 | 1.3 | .13 |
| Leak | 1.1 | 2.1 | .09 |
| Death | 0.8 | 1.5 | .19 |
| Initial length of hospital stay, d, mean (SD) | 3.4 (3.4) | 5.4 (5.5) | <.001 |

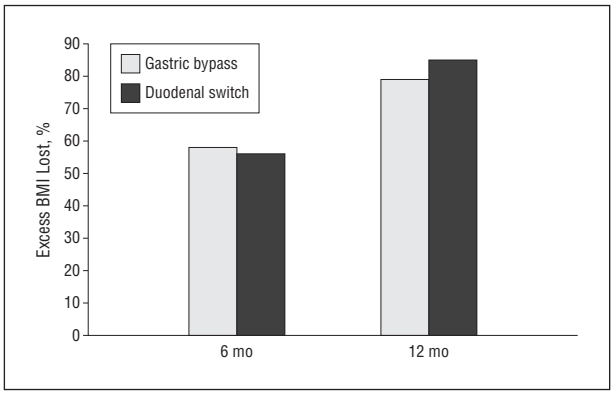


**Figure 1.** Percentage of excess body mass index (BMI) lost at 6 and 12 months for gastric bypass and duodenal switch patients.

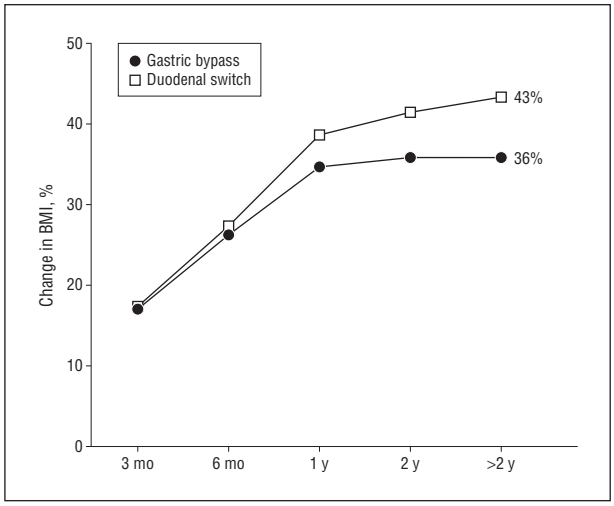


**Figure 2.** Weight loss as percentage of change in body mass index (BMI) for gastric bypass and duodenal switch patients.

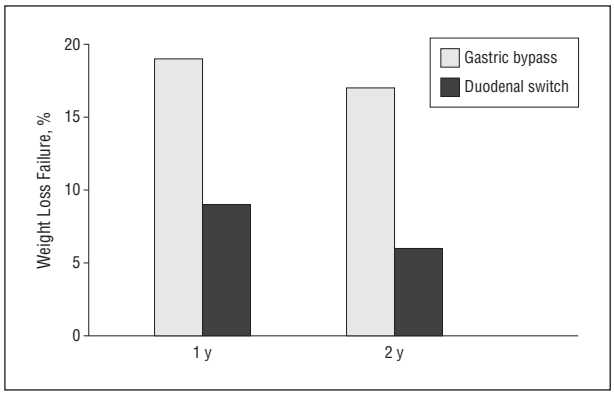


**Figure 3.** Comparison of weight loss failure rates between gastric bypass and duodenal switch patients at 1 and 2 years.

obese patients and 34.9% in superobese patients at mid- to long-term follow-up,[3] the durability of the GB, particularly in the superobese population, is in need of critical reevaluation.

Recent evidence has demonstrated that the DS is capable of producing superior sustained weight reduction as well as improved control of comorbidities in direct comparisons with the GB.[22-24] Although our data from the multicenter BOLD demonstrate a significant relative increase (150%) in the use of the DS for morbid obesity, it remains a much less used option in the United States compared with gastric bypass. This is likely because of multiple factors, including the technical difficulty of the procedure, the higher reported rates of short-term complications, and concerns about the longer-term nutritional consequences of a primarily malabsorptive procedure. Although these remain valid issues and concerns, we believe that the issues of longer-term failures of weight loss and comorbidity control must also be factored heavily into the preoperative decision-making process. Among patients at higher risk of weight loss failure or with more severe obesity-related comorbidity, the risk-benefit analysis may support the performance of the DS over other bariatric options.

This large, multicenter database review highlights the fact that DS patients on average tend to be more obese and have more severe underlying disease at baseline than their GB counterparts, which we believe indicates appropriate patient selection and use. Despite starting with significantly greater mean preoperative BMIs, patients undergoing DS consistently lose more weight as measured by percentage of excess BMI lost and show a greater rate and magnitudes of percentage of change in BMI at all follow-up intervals compared with GB patients. Most importantly, this weight loss appears to be sustained for greater than 2 years of follow-up. The efficacy of the DS for weight loss and comorbidity control appears to be most striking among the superobese population, who are well

**Table 8. Comorbidities at Last Follow-up for All Gastric Bypass and Duodenal Switch Patients**

| | % | | | |
|---|---|---|---|---|
| | Gastric Bypass (n = 77 406) | Duodenal Switch (n = 1545) | All Patients (n = 78 951) | *P* Value |
| Follow-up, mo, mean (SD) | 13.4 (5.2) | 13.2 (5.1) | 13.4 (5.2) | .51 |
| Comorbidities at last follow-up | | | | |
| GERD improved | 28.1 | 24.6 | 28.1 | <.001 |
| Glucose metabolism abnormality resolved | 63.2 | 76.2 | 63.5 | <.001 |
| Glucose metabolism abnormality improved | 75.5 | 82.7 | 75.6 | .003 |
| Hypertension resolved | 46.6 | 58.4 | 46.9 | <.001 |
| Hypertension improved | 62.6 | 69.9 | 62.8 | .001 |
| Lipid abnormality resolved | 43.7 | 67.9 | 44.3 | <.001 |
| Obesity hypoventilation syndrome resolved | 49.3 | 78.9 | 50.0 | .01 |

Abbreviation: GERD, gastroesophageal reflux disease.

known to have poorer outcomes compared with those with lesser degrees of obesity. Our data demonstrate the superior weight-loss outcomes among the subgroup of superobese patients undergoing DS compared with those undergoing GB. Of particular importance is the fact that weight loss failure was seen among approximately 20% of superobese patients undergoing GB and that this was decreased to 9% and 6% at the 1- and 2-year follow-ups with the DS procedure. In addition, and arguably more importantly, the DS was also associated with greater resolution and improvement in obesity-related comorbidities including diabetes, hypertension, hyperlipidemia, and obstructive sleep apnea.

Although DS was associated with superior weight loss and comorbidity control, there was a greater early risk profile including higher rates of early reoperation, postoperative infection, and anastomotic leak. This likely reflects both the differences in the baseline condition and comorbidities of the 2 patient populations, as well as the more exacting technical issues encountered with the DS procedure. Interestingly, several of the more common anastomotic problems such as stricture and marginal ulceration were more common in the GB cohort and likely reflect the improved profile of a duodenoileal anastomosis vs a gastrojejunostomy. One of the major criticisms of the DS often expressed is the concern for long-term nutritional complications due to the increased malabsorption associated with this operation. Although this study noted higher rates of nutritional abnormalities and need for supplemental nutrition among patients undergoing DS compared with GB, the overall rate of nutrition-related complications was low at less than 5%. Additional long-term multi-institutional follow-up data are needed to fully elucidate the long-term effects of the DS, but large single-institution series reporting low rates of nutritional deficiencies and need for reversal are reassuring.[13] Finally, although the overall mortality rate was low, there was a significant difference (1.2% vs 0.3%) in favor of the GB. However, experience with this operation, particularly in the United States, is still early. In 2004, Flum and Dellinger[25] documented that early 30-day mortality rates for laparoscopic GB were as high as 1.9% and closely related to surgeon experience level and learning curve. As surgeons become more familiar with the DS operation, it is not unreasonable to expect these morbidity and mortality rates to decline as has occurred with groups that perform this operation regularly.[12,26]

To our knowledge, this represents the first large, multicenter study of the DS procedure in the United States. Although the DS carries a higher relative risk profile than GB, the absolute risk is low. Among morbidly obese patients, the DS results in superior sustained weight reduction and improved comorbidity control compared with GB, which may outweigh early perioperative risk. The benefits of the DS, including a significant decrease in the bariatric failure rates, appear to be greatest in the superobese population. Further studies of this procedure to determine the optimal patient selection, operative technique, and longer-term risks vs outcomes are warranted.

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## INVITED CRITIQUE

# Gastric Bypass

## *Time for a Change?*

The data from Nelson and colleagues[1] challenge the notion that GB is the "Cadillac" of bariatric operations, noting a near 20% weight loss failure rate in superobese patients at 1 and 2 years postoperation compared with only 9% and 6% after DS. In a 2006 study specifically looking at follow-up after 10 years, Christou and colleagues[2] also noted rates of weight loss failure after GB of 20.4% and 34.9% at mid- and long-term follow-up. Perhaps more importantly, Nelson and colleagues demonstrated that the rates of resolution of diabetes mellitus, hypertension, hyperlipidemia, and obstructive sleep apnea were higher after DS than GB.

In some ways, the remaining comparisons between GB and DS are a little unfair, in that (at least in the United States) DS has been performed an order of magnitude less frequently than GB, was performed with open technique about half the time, and has not been researched, presented, dissected, and discussed anywhere near as exhaustively as the GB operation has. Nelson and colleagues note that the overall complication rate for DS is still low, and if one compares the rates of leak, reoperations, and death with some of the earlier studies on GB patients, the risk profiles are comparable (and in some cases better!).[3]

Nelson and colleagues surmise that complication rates may fall as experience with DS grows and that the apparent benefits of DS in terms of reduced dumping syndrome, reduced anastomotic ulceration and stricture, overall weight loss, and control of weight-related health conditions (particularly in the superobese population) may outweigh the higher perioperative risks. Nelson and colleagues conclude (appropriately and conservatively) that DS for morbid obesity requires more study with regard to appropriate patient selection, operative technique, and longer-term risk vs outcomes.

This note of caution against full-throated endorsement of DS arises from the maturity of the data available to Nelson et al. Only 3% of patients in either the GB or DS cohorts had follow-up data at 2 years postoperatively, a point at which the percentage of change in the BMI curve still seems to be slowly rising for DS patients. Nutritionally deficient patients post–bariatric surgery can be extraordi-