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Original article

Perioperative complications in a consecutive series of 1000 duodenal switches

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Abstract

Background: In the past 10 years, most bariatric surgeries have seen an important reduction in the early complication rate, partly associated with the development of the laparoscopic approach. Our objective was to assess the current early complication rate associated with biliopancreatic diversion with duodenal switch (BPD-DS) since the introduction of a laparoscopic approach in our institution, a university-affiliated tertiary care center.

Methods: A consecutive series of 1000 patients who had undergone BPD-DS from November 2006 to January 2010 was surveyed. The primary endpoint was the mortality rate. The secondary endpoints were the major 30-day complication rate and hospital stay >10 days. The data are reported as a mean ± SD, comparing the laparoscopic (n = 228) and open (n = 772) groups.

Results: The mean age of the patients was 43 ± 10 years (40 ± 10 years in the laparoscopy group versus 44 ± 10 years in the open group, $P < .01$). The preoperative body mass index was 51 ± 8 kg/m^2 (47 ± 7 laparoscopy versus 52 ± 8 kg/m^2 open, $P < .01$). The conversion rate in the laparoscopy group was 2.6%. There was 1 postoperative death (.1%) from a pulmonary embolism in the laparoscopy group. The mean hospital stay was shorter after laparoscopic surgery (6 ± 6 d versus 7 ± 9 d, $P = .01$), and a hospital stay >10 days was more frequent in the open group (4.4% versus 7%, $P = .04$). Major complications occurred in 7% of the patients, with no significant differences between the 2 groups (7% versus 7.4%, $P = .1$). No differences were found in the overall leak or intra-abdominal abscess rate (3.5% versus 4%, $P = .1$); however, gastric leaks were more frequent after open surgery (0% versus 2%, $P = .02$). During a mean 2-year follow-up, 1 additional death occurred from myocardial infarction, 2 years after open BPD-DS.

Conclusion: The early and late mortality rate of BPD-DS is low and comparable to that of other bariatric surgeries. (Surg Obes Relat Dis 2013;9:63–68.)

Keywords: Bariatric surgery; Biliopancreatic diversion; Duodenal switch; Complications; Laparoscopy

Biliopancreatic diversion with duodenal switch (BPD-DS) is still considered 1 of the most challenging bariatric procedure, associated with some of the greatest perioperative complications and mortality rate [1,2]. However, because BPD-DS is often only considered in superobese patients (body mass index [BMI] ≥50 kg/m^2) makes the comparison with patients who undergo laparoscopic adjustable gastric banding or gastric bypass (Roux-en-Y gastric bypass [RYGB]) difficult. Also, although the first laparoscopic BPD-DS has been performed >10 years previously [3], this type of surgery remains uncommon, with BPD-DS representing <1% of the 344,000 bariatric surgeries performed worldwide in 2008 [4]. This is possibly related to the learning curve of this technique and the greater compli-

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cation rate reported in early series of laparoscopic BPD-DS performed in superobese patients [2]. These early reports advocated laparoscopic sleeve gastrectomy, the restrictive and "acid-reducing" part of BPD-DS, as a first-stage bariatric surgery to decrease the complication rate in high-risk patients. However, the long-term results of sleeve gastrectomy are uncertain [5], and the theoretical benefits of a 2-stage approach are still unclear [6].

In our institution, open BPD-DS has been the procedure of choice for the treatment of morbid obesity since the early 1990s [7], with the introduction of laparoscopic BPD-DS in 2006. The present study hypothesized that the introduction of laparoscopy in our milieu had a positive effect on the outcomes of the whole bariatric surgery population. We assessed the morbidity and mortality rate of BPD-DS since the introduction of the laparoscopic approach in a consecutive series of 1000 patients.

Methods

The present study was performed at a University-affiliated tertiary care center. Laparoscopic BPD-DS was introduced in our institution in November 2006. The first 1000 patients who underwent primary BPD-DS (either laparoscopic or open) since that date were included in the present study. Five surgeons performed the procedures during the study period. The data were obtained retrospectively from our prospectively maintained electronic database. Ethical review board approval was obtained for the publication of these data. The indications for surgery followed the National Institutes of Health guidelines [8], and the decision was taken with the collaboration of a multidisciplinary team (i.e., nutritionist, social worker, bariatric nurse, and bariatric surgeon). Patients underwent a mandatory preoperative course regarding the requirements for BPD-DS. All patients were tested for sleep apnea and, if sleep apnea was present, were seen by a pneumologist and treated with noninvasive positive pressure ventilation before surgery. The patients were required to see a cardiologist only if they had a cardiac history, symptoms, high risk factors for cardiac disease, or abnormal electrocardiographic findings were present. All patients with endocrine disease (i.e., diabetes) or abnormal laboratory results (hemoglobin A1c) were assessed by an endocrinologist or specialist in internal medicine to initiate treatment, if required, and for follow-up. Psychiatric evaluation was required only when a history of psychiatric disease was present or when clinically indicated. The patients were well informed about the risks and benefits of the surgery, and they usually participated in a support group before surgery.

At the beginning of the introduction of laparoscopic BPD-DS, we selected patients with peripheral obesity, a BMI <50 kg/m^2, and no exceptional associated diseases (e.g., severe cardiac or pulmonary dysfunction). The indication to a laparoscopic approach was progressively extended to all patients. Only patients who underwent primary BPD-DS with standard intestinal measures (250-cm alimentary limb and 100-cm common channel) were included in the present study.

Surgical technique

Patients received intravenous antibiotics and subcutaneous heparin or low-molecular-weight heparin 2 hours before surgery. Pneumatic compression devices were used during surgery and until ambulation. The laparoscopic technique was adapted from our open approach. Sleeve gastrectomy was created first, the duodenum was transected about 4 cm distal to the pylorus and anastomosed to a 250-cm alimentary limb with a 100-cm common channel. Routine cholecystectomy was also performed. Appendectomy was only performed in the open BPD-DS group. Duodenal anastomosis in the open group was performed using the biofragmentable absorbable device from Covidien (Dublin, Ireland); and a 21-mm circular stapler from Ethicon Endosurgery (Cincinnati, OH) was used in the laparoscopic group. Sleeve gastrectomy was performed using a 60-mm linear stapler cutter in the laparoscopic group (Ethicon Endosurgery) and the open equivalent (75 or 100 mm) in the open group. An esophagogastric bougie was not routinely used.

Postoperative period

Regular subcutaneous heparin was given for the first postoperative day and then switched to low-molecular-weight heparin. The patients were discharged with the same regimen for 3 weeks, when tolerating a soft diet. Vitamin and mineral supplementation were started within the first month after surgery (ferrous sulfate 300 mg, vitamin D 50,000 IU, vitamin A 20,000 IU, calcium carbonate 500–1000 mg, and a multivitamin complex). These supplements were adjusted over the years, and education in consuming a high-protein diet was reinforced.

Follow-up

The patients were usually seen at 3, 6, 9, and 12 months postoperatively and annually thereafter. The blood work consisted of complete blood count, liver enzymes, albumin, transferrin, iron, ferritin, calcium, parathyroid hormone, vitamin A, vitamin B_{12}, and folic acid. A team of nurses remained in contact with these patients and their family doctor, making a yearly average of 6 telephone calls per patient. Information regarding complications and hospitalizations were recorded. We have constantly made great effort to reach each and everyone.

The primary endpoint for the present study was the mortality rate within 30 days. The secondary endpoints were major perioperative complications and a hospital stay >10 days.

The data are reported as the mean $\pm$ standard deviation for continuous data or as percentages for categorical variables. Statistical analysis was performed using a Student's *t*

test for continuous variables, and the chi-square test for categorical variables, except when a low number of observations required Fisher's exact test. An analysis of variance corrected for preoperative weight was used to assess the difference of weight loss between the 2 groups. $P < .05$ was considered statistically significant.

Results

The demographic data for the 2 groups is detailed in Table 1. Patients in the open group were significantly older, had a greater preoperative BMI (47 ± 7 versus 52 ± 8 kg/m^2, $P = .01$) and more co-morbidities. Type 2 diabetes mellitus was present in 44.5% of the whole group (with 26% requiring insulin), 65.7% had sleep apnea, 67.5% had high blood pressure, 36.2% had dyslipidemia, and 12% had a coronary artery disease.

Laparoscopic BPD-DS took a mean of 37 minutes longer to perform but was associated with less intraoperative blood loss (Table 2). Six patients (2.6%) required conversion to laparotomy for technical difficulties. These patients remained in the laparoscopy group on an intention to treat basis. Cholecystectomy was performed in 696 patients (554 in the open group and 142 in the laparoscopic group), and appendectomy in 546 (540 in the open group and 6 in the laparoscopic group).

During the study period, 14 patients (6%) who were scheduled for laparoscopic BPD-DS underwent conversion to laparoscopic sleeve gastrectomy for various reasons (e.g., technical difficulties, difficulty with exposure, intraoperative findings). Because these patients were informed in advance that they were at "high risk" to undergo 2-stage surgery, they were not included in the present study. The mean postoperative stay after laparoscopic BPD-DS was shorter (5.9 versus 7.3 d, $P = .006$), and a postoperative stay >10 days was more frequently required in the open group (4.4% versus 7%, $P = .04$).

Table 1
Demographic data

Variable	All	Laparoscopy	Laparotomy
Patients (n)	1000	228	772
Age (y)	43.1 ± 10.4	40.3 ± 10.6	43.9 ± 10.1*
Gender ratio (M/F)	47.7	21.3	57.9*
BMI (kg/m^2)	51.1 ± 8.3	46.8 ± 6.4	52.4 ± 8.4*
Weight (kg)	141.6 ± 28.4	127.6 ± 21.7	145.7 ± 28.8*
Patients with BMI ≥50 kg/m^2 (%)	49.6	25.0	56.8*
Mean number of co-morbidities	4.5 ± 1.8	4.0 ± 1.9	4.6 ± 1.8*

M = male; F = female; BMI = body mass index.

Student's *t* test used for analysis of BMI, weight, and number of co-morbidities; chi-square test used for analysis of age, gender ratio, and percentage of patients with BMI ≥50 kg/m^2.

* Statistically significant difference between laparoscopic and open groups.

Table 2
Perioperative data

Variable	All	Laparoscopy	Laparotomy
Operative time (min)	187.0 ± 48.7	224.2	176 ± 39.7*
Blood loss (mL)	361.1 ± 312.0	87.5 ± 129.4	443.1 ± 303.9*
Conversion rate (%)	NA	2.6	0
Hospital stay (d)	6.9 ± 8.3	5.9 ± 5.9	7.3 ± 8.9*

NA = not applicable.

Student's *t* test used for analysis of operative time, blood loss, and hospital stay.

* Statistically significant difference between laparoscopic and open groups.

Mortality

One death occurred within 30 day (.1%) in the laparoscopic group. A 58-year-old patient, with a BMI of 47 kg/m^2 with a history of deep venous thrombosis, had an unremarkable laparoscopic BPD-DS but developed a massive pulmonary embolism on the first postoperative day. He died a few hours later despite maximal medical management. No other patient had died by 90 days of follow-up.

Early complications (≤30 d)

The complications or readmissions that occurred during the first 30 postoperative days are listed in Table 3. Major complications occurred in 7% of the patients (7.4% of the

Table 3
Complications in first 30 postoperative days

Complications	All (n = 1000)	Laparoscopy (n = 228)	Laparotomy (n = 772)
Major			
Gastric leak	1.5	0	1.9 (15)*
Duodenal leak	1.5	2.6 (6)	1.2 (9)
Ileoileal anastomosis leak	.1	0	.1 (1)
Intra-abdominal abscess	.6	.9 (2)	.8 (6)
Pancreatitis	.3	.4 (1)	.3 (2)
Pancreatic leak	.2	0	.3 (2)
Biliary leak	.3	0	.4 (3)
Pneumonia	.6	.9 (2)	.5 (4)
Gastrointestinal abdominal hemorrhage	.5	.4 (1)	.5 (4)
Pulmonary embolism	.8	.4 (1)†	.9 (7)
Anastomotic stenosis/small bowel obstruction	.9	2.2 (5)	.5 (4)*
Total	7.2	7.0	7.4
Minor			
Wound infection/hematoma	3.0	1.3 (3)	3.5 (27)*
Food intolerance	3.4	3.0 (7)	3.5 (27)
Urinary complications	.8	.4 (1)	.9 (7)
Phlebitis	.8	.4 (1)	.9 (7)
Other	1.1	1.7 (4)	.9 (7)
Total	9.1	7.5	9.7

Data presented as percentages, with numbers in parentheses.

* Statistically significant difference between laparoscopic and open groups using Fischer's exact test.

† Patient died of pulmonary embolism.

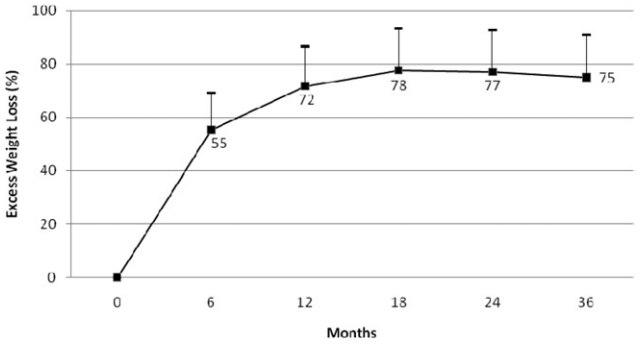


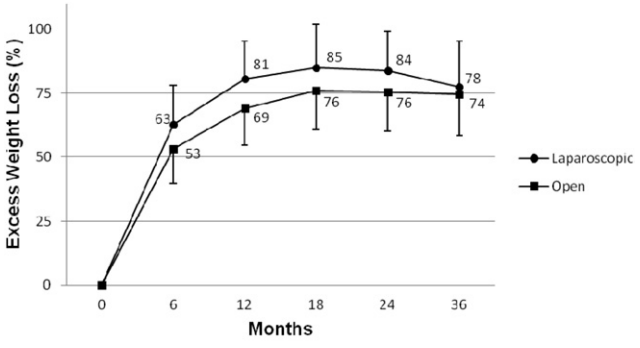
Fig. 1. Mean percentage of excess weight loss (EWL) ± standard deviation for whole population.

open group and 7% of the laparoscopy group, $P = .1$). The rate of digestive leak or intra-abdominal abscess was similar in both groups (3.5% versus 4%, $P = .1$), but gastric leaks were more frequent in the open group (0% versus 2%, $P = .02$). The term "intra-abdominal abscess" refers to patients who required drainage of an intra-abdominal abscess in whom a leak could not be demonstrated. The minor complication rate was greater after open surgery (9.7% versus 7.5%, $P = .3$) mostly related to a greater rate of wound complications. Readmission (≤30 d) was required to treat 1 of the complications mentioned in 5.7% of the patients in the laparoscopy group and 8.9% in the open group ($P = .1$).

Follow-up and late complications (>30 d)

The mean follow-up period was 23 ± 11 months. Of the patients, 90% (n = 906) visited the clinic or their family doctor with at least partial blood work during the past 12 months preceding our review and 84% (n = 843) of the patients had physically attended our clinic.

The excess weight loss for the whole group is detailed in Figure 1. The EWL for the 2 groups is shown in Figure 2. The difference in the percentage of EWL between the 2 groups



The difference in percentage of EWL between the two groups was statistically significant up to 24 months (Analysis of Variance corrected for per-operative weight). The difference was not significant at 36 months.

Fig. 2. Mean percentage of excess weight loss (EWL) ± standard deviation after laparoscopic and open biliopancreatic diversion with duodenal switch (BPD-DS).

was significant for ≤2 years but not at 3 years (78% ± 18% versus 74% ± 16%).

During the study period, rehospitalization for something related to bariatric surgery was required in 12.7% of the patients (Table 4). No significant difference was found in the readmission rate (13.5% versus 10.1%, $P = .2$) and reoperation rate (6.3% versus 5.2%, $P = .5$) between the 2 groups. Small bowel obstruction required surgery in 2.8% versus 1.3% of the patients after open and laparoscopic surgery, respectively ($P = .2$). This included lysis of adhesions in 18 patients, repair of an internal hernia in 4, and small bowel resection in 3 patients.

Revisional surgery was also required in 5 patients. A lengthening of the common channel (from 100 to 200 cm) was performed in 3 patients, and a feeding jejunostomy tube was installed in 2 patients. One additional patient required lengthening of the common channel for diarrhea.

An additional death occurred during the follow-up period. A 61-year-old man died of a myocardial infarction, 2 years after open DS, for a 2-year mortality rate of .2% in the present series.

Discussion

The excellent long-term weight loss and correction of obesity-related diseases after BPD-DS have never been really challenged. In 2004, in a meta-analysis of the bariatric data, Buchwald et al. [9] reported that BPD was the surgery offering the best long-term EWL (70.1%) and improvement in type 2 diabetes (98%). However, it was also the surgery associated with the greatest mortality rate (1.1% compared with .28% for all procedures). These results and other studies reporting a perioperative mortality rate of 5.6% for BPD-DS [2] led to the advocacy of 2-stage surgery.

In the present survey, we considered our current perioperative complication rate associated with BPD-DS since the introduction of laparoscopic surgery in our institution. We hypothesized that it could result in a decrease in perioperative complications, such as was seen for laparoscopic RYGB [10].

First, the perioperative mortality rate in the present series was low (.1%). These results are consistent with those from other reports. Buchwald et al. [11], in a series of 190 BPD-DS procedures (168 open and 32 laparoscopic) did not experience any 30-day mortality. Prachand et al. [12] experienced 1 death in a series of 198 laparoscopic BPD-DS procedures in superobese patients. Rabkin et al. [13], in a series of 345 BPD-DS procedures (27 laparoscopic and 318 hand-assisted) did not experience any mortality. In a recent meta-analysis of published mortality data after bariatric surgery [14], the mortality rate at ≤30 days for all restrictive procedures was .3% for the open and .07% for the laparoscopic procedures. The mortality rate for RYGB was .41% for the open and .16% for the laparoscopic procedures. Large single-institution series of laparoscopic RYGB have

Table 4
Rehospitalizations related to bariatric surgery (mean follow-up 23 ± 11 mo)

Variable	All	Laparoscopy (n = 227)		Laparotomy (n = 772)	
		Patients (n)	Required surgery	Patients (n)	Required surgery
Food intolerance	26	6	—	20	—
Small bowel obstruction	28	3	3	25	22
Abdominal pain	12	2	1	10	—
Persistent fistula	12	—	—	12	10
Abscess	5	1	—	4	—
Stenosis	10	6	6	4	1
Denutrition	12	3	1	9	4
Biliary colic	2	2	1		
Sepsis	1	—	—	1	—
Incisional hernia	11	—	—	11	11
Anastomotic ulcer	2	—	—	2	—
Diarrhea	3	—	—	3	1
Pulmonary embolism	1	—	—	1	—
Gastrointestinal bleeding	2	—	—	2	—
Total	127 (12.7)	23 (10.1)	12 (5.2)	104 (13.5)	49 (6.3)

Data in parentheses are percentages.
No significant difference found between 2 groups, using Student's *t* test.

also reported the same level of mortality, at .14% [15]. The results of the present study suggest that BPD-DS can obtain similar mortality rates.

The reasons for the amelioration of the mortality rate associated with BPD-DS in the past few years are probably multifactorial. First, it has been previously demonstrated, for other types of surgeries, that the overall morbidity and mortality rate can be decreased in "high-volume" centers [16], especially for higher risk patients. Also, a general trend has occurred in the improvement of mortality and morbidity rate over the years, with overall improvement of preoperative preparation of the patients and medical, surgical, and nursing care. From 1991 to 2006, our mortality rate was 1% (22 of 2068). In the present survey, it decreased to .1%, with no other mortality in our whole bariatric population during the study period (1 of 1450).

Second, this improvement in mortality rate corresponds to the introduction of laparoscopic bariatric surgery in our institution. Before November 2006, all bariatric surgery candidates were offered open BPD-DS, including patients with a high perioperative risk of complications. These patients are now often offered laparoscopic sleeve gastrectomy either as a stand-alone procedure or as a staged approach, which could be associated with a lower mortality rate. During the study period, we performed 166 sleeve gastrectomy procedures. Among these, 49 (29.5%) were done for patients with a perioperative risk that was judged to be prohibitive for malabsorptive surgery. None of these patients died.

Although the mortality rate of DS seems to have decreased with time, major complications still occur. However, the rate of major early complications was similar in the laparoscopic and open groups (7%). Also, even if a comparison between the techniques is difficult, the rate is similar to that of perioperative complications reported in large series of laparoscopic RYGB [17]. In the present series, the patients in the laparoscopic group usually weighed less and had fewer co-morbidities than in the open group, at least at the beginning of our experience, which led to a selection bias. In contrast, patients in the laparoscopy group went through the standardization process of our technique, which can be associated with increased perioperative complications, including leaks.

That the duodenal anastomosis remains the demanding part in laparoscopic BPD-DS is expressed by a 2.6% leak rate at that level versus no leak at the level of the sleeve gastrectomy. We developed some modifications of our technique to correct that problem and now use a hand-sewn technique. With these modifications, our leak rate has decreased to 1% (1 of 92).

One of the concerns that remains with BPD-DS is the long-term risk of nutritional deficiencies. However, other reports with longer follow-up have shown that severe nutritional deficiencies are rare with good long-term follow-up and adjustment of vitamin supplements [18]. This risk, as well as the long-term results with weight loss and the correction of obesity-related diseases, should not be influenced by the technique (laparoscopic or open), as long as the surgical principals are preserved. The present study, however, does not have the long-term follow-up required to assess correctly this question.

The limitations of the present study were that, even if the data were collected prospectively, the survey was still retrospective. The patients at the beginning of the laparoscopic series were carefully selected, resulting in an open group consisting of older, heavier, and sicker patients. Also, some of the heaviest and sickest patients were oriented toward laparoscopic sleeve gastrectomy as a bridging procedure to

BPD-DS. In contrast, most of the surgeons in the present study had better experience with open DS, explaining the good results in the open group. Also, some patients who were scheduled to undergo laparoscopic DS underwent laparoscopic sleeve gastrectomy instead because of the intraoperative findings and were excluded from the present study. However, no leak or mortality occurred in this group, but it could still represent a bias.

Conclusion

The early and late mortality rate of BPD-DS is low and comparable to that of other bariatric surgeries.

Disclosures

L. Biertho is a consultant for Ethicon Endosurgery.

References

[1] Buchwald H, Estok R, Fahrbach K, Banel D, Sledge I. Trends in mortality in bariatric surgery: a systematic review and meta-analysis. Surgery 2007;142:621–35.
[2] Kim WW, Gagner M, Kini S, et al. Laparoscopic vs. open biliopancreatic diversion with duodenal switch: a comparative study. J Gastrointest Surg 2003;7:552–7.
[3] Gagner M, Ren C. Laparoscopic biliopancreatic diversion with duodenal switch for morbid obesity: early results. Obes Surg 2000;10:333–4.
[4] Buchwald H, Oien DM. Metabolic/bariatric surgery worldwide. Obes Surg 2009;19:1605–11.
[5] Himpens J, Dobbeleir J, Peeters G. Long-term results of laparoscopic sleeve gastrectomy for obesity. Ann Surg 2010;252:319–42.
[6] Regan JP, Inabnet WB, Gagner M, Pomp A. Early experience with two-stage laparoscopic Roux-en-Y gastric bypass as an alternative in the super-super obese patient. Obes Surg 2003;13:861–4.
[7] Marceau P, Biron S, Bourque RA, Potvin M, Hould FS, Simard S. Biliopancreatic diversion with a new type of gastrectomy. Obes Surg 1993;3:29–35.
[8] National Institutes of Health Consensus Development Conference Statement: gastrointestinal surgery for severe obesity. Am J Clin Nutr 1991;55:615S–9S.
[9] Buchwald H, Avidor Y, Braunwald E, et al. Bariatric surgery: a systematic review and meta-analysis. JAMA 2004;292:1724–8.
[10] Nguyen NT, Goldman C, Rosenquist CJ, et al. Laparoscopic versus open gastric bypass: a randomized study of outcomes, quality of life, and costs. Ann Surg 2001;234:279–91.
[11] Buchwald H, Kellogg TA, Leslie DB, Ikramuddin S. Duodenal switch operative mortality and morbidity are not impacted by body mass index. Ann Surg 2008;248:541–8.
[12] Prachand VN, Davee RT, Alverdy JC. Duodenal switch provides superior weight loss in the super-obese (BMI $>$ or $=$ 50 kg/m^2) compared with gastric bypass. Ann Surg 2006;244:611–9.
[13] Rabkin RA, Rabkin JM, Metcalf B, Lazo M, Rossi M, Lehmanbecker LB. Laparoscopic technique for performing duodenal switch with gastric reduction. Obes Surg 2003;13:263–8.
[14] Buchwald H, Estok R, Fahrbach K, Banel D, Sledge I. Trends in mortality in bariatric surgery: a systematic review and meta-analysis. Surgery 2007;142:621–35.
[15] Ballantyne GH, Belsley S, Stephens D, et al. Bariatric surgery: low mortality at a high-volume center. Obes Surg 2008;18:660–7.
[16] Nguyen NT, Paya P, Stevens CM, Mavandadi S, Zainabadi K, Wilson SE. The relationship between hospital volume and outcome in bariatric surgery at academic medical centers. Ann Surg 2004;240:586–94.
[17] Tice JA, Karliner L, Walsh J, Petersen AJ, Feldman MD. Gastric banding or bypass? A systematic review comparing the two most popular bariatric procedures. Am J Med 2008;121:885–93.
[18] Biertho L, Biron S, Hould FS, Lebel S, Marceau S, Marceau P. Is biliopancreatic diversion with duodenal switch indicated for patients with body mass index $<$50 kg/m^2? Surg Obes Relat Dis 2010;6:508–14.