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SURGICAL ENDOSCOPY
and Other Interventional Techniques

A comparison of 399 open and 568 laparoscopic gastric bypasses performed during a 4-year period

N. Sekhar, A. Torquati, Y. Youssef, J. K. Wright, W. O. Richards

Department of Surgery, Vanderbilt University Medical Center, D-5219 MCN Nashville, TN 37232, USA

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Abstract
Background: Laparoscopic Roux-en-Y gastric bypass surgery (RYGB) was introduced at the authors' institution 5 years ago. The authors analyzed the short- and long-term results of this procedure compared with those for the same procedure using the laparotomy approach over the same period.
Methods: Retrospective analysis of a prospectively collected bariatric database used the outcome end points used by the American Society of Bariatric Surgery (ASBS) and the American College of Surgeons (ACS) in their center of excellence programs.
Results: From January 2001 to July 2005, 568 laparoscopic and 399 open gastric bypasses were performed at Vanderbilt University. The patients were from the same bariatric surgery program and therefore received the same pre- and postoperative care. The hospital length of stay in the laparoscopic group was significantly shorter (2.5 ± 2.4 days) than in the open group (3.7 ± 3.7 days; $p = 0.001$). The procedure time was significantly shorter in the laparoscopic group (164 ± 50 min) than in the open group (195 ± 50 min; $p = 0.0001$). The follow-up assessment response at 2 years was 76.6%. At 2 years, the excess weight loss (EWL) was significantly greater in the laparoscopic group (71.3% ± 18.4%) than in the open group (67.3% ± 15.3%; $p = 0.03$). The wound infection rate was significantly higher in open group (9.2%) than in the laparoscopic group (1.7%; $p = 0.001$). There was no significant difference in 30-day mortality: open (0.50%) versus laparoscopic (0.17%; $p = 0.371$). There was no significant difference in the 30-day reoperation rate between the open (2.4%) and laparoscopic (2.6%; $p = 0.705$) groups. The 30-day readmission rate was similar in the open (5.0%) and laparoscopic (5.2%; $p = 0.852$) groups, as was the rate of leakage from the gastrojejunostomy in the open (0.50%) and laparoscopic (0.35%; $p = 0.127$) groups. The conversion rate from laparoscopic procedure to laparotomy was 1.7%.
Conclusion: In the authors' institution, a laparoscopic bariatric surgery program with a very low rate of morbidity and mortality has been introduced. Operative time, hospital stay, and wound complications are reduced with the laparoscopic approach. The laparoscopic and open procedures are equally safe, with equivalent 30-day mortality, readmission, reoperation, and gastrojejunostomy leakage rates.

Key words: Bariatric surgery — Gastric bypass — Laparoscopic Roux-en-Y gastric bypass — Open versus laparoscopic gastric bypass

Laparoscopic bariatric surgery is a complex procedure with limitations observed in decreased freedom of motion and less tactile sensation to the surgeon. However, the laparoscopic approach has many benefits for the patient compared with the open procedure, including decreased perioperative complications and faster return to function [7].

The prevalence of morbid obesity has increased markedly over the past two decades and is gaining attention as a significant public health concern [3]. This development is leading to increased awareness of this problem in society and causing more patients to seek operative treatment for their condition. As more and more surgeons are trained in the laparoscopic approach, the surgery for morbid obesity has become the fastest growing surgical procedure in the United States [4].

Open gastric bypass procedures still are performed in large numbers across the country despite a randomized trial showing that the laparoscopic approach has clear advantages over the open approach, including shorter hospital stay, faster recovery, and a quicker ascent to a higher quality of life [7]. A 3-year follow-up evaluation

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Correspondence to: W. O. Richards

of this randomized trial has reaffirmed these advantages, and notably has shown that randomized patients have a significantly lower rate of incisional hernia [13].

This large single-center retrospective study aims to add to the body of evidence supporting the superiority of the laparoscopic approach for the treatment of morbid obesity using end points applied to attain center of excellence status by the ASBS and the ACS. In addition, this study aims to challenge some of the supposed disadvantages of the laparoscopic approach (i.e., increased leakage rate and operative time).

Materials and methods

The study was conducted at Vanderbilt University Medical Center, where data of patients undergoing surgery for morbid obesity are prospectively collected and maintained in an institutional review board–approved clinical database.

Laparoscopic Roux-en-y gastric bypass surgery (RYGB) was performed for 568 patients from January 2001 to July 2005. The first 91 cases were managed using a circular 21-mm stapler to create the anastomosis with a retrocolic 100-cm Roux limb. In the 477 subsequent cases, the gastrojejunostomy was created by placing the Roux limb in a retrocolic, retrogastric position and suturing it to the posterior aspect of the gastric pouch using two 2-0 Vicryl sutures. A 45-mm linear stapler with a 3.5-mm blue cartridge then was inserted halfway to create a 22-mm stapled anastomosis between the posterior aspect of the gastric pouch and the antimesenteric border of the Roux limb. A 34-Fr gastric lavage tube next was advanced across the anastomosis and the opening, which then was closed in two layers using a running 2-0 Vicryl. The Roux limb next was occluded distally with a 10-mm Debakey bowel clamp. The anastomosis was submerged in saline, and endoscopy was performed under air insufflation to check for air leaks, bleeding, and the caliber of the stoma and pouch. After suture repair of any air leaks, the patients were re-endoscoped to ensure success of the repair.

During the same period, 399 open gastric bypasses were performed. A surgeon in the same program and with clinical experience similar to that of the surgeon performing the laparoscopic procedure performed the open procedure. At the beginning of the bariatric surgery experience, the surgeon performing gastric bypass laparoscopically referred patients to the surgeon performing the open procedure if the body mass index (BMI) was greater than 60 in men and 70 in women. The BMI cutoff for open versus laparoscopic surgery was lower for men because of their tendency toward significant abdominal adiposity. Patients who had undergone significant or multiple previous abdominal surgeries, especially Nissen fundoplication, were referred to the surgeon performing the procedure in the open fashion.

The laparotomy technique involved an open incision from xiphoid to umbilicus. A TA-45 stapler with a green cartridge was used to fashion a 30-ml proximal gastric pouch. The open procedure also created a divided stomach. The staple lines were oversewn with 3-0 seromuscular silk stitches and the remnant with 3-0 Vicryl lamberts. The gastrojejunostomy was constructed with the Roux limb in a retrocolic retrogastric position using a hand-sewn anastomosis over a nasogastric tube using a 3-0 seromuscular running prolene and running 3-0 Vicryl. After construction, a leak test was undertaken with pressurized methylene blue–tinted saline.

Patient demographics, operative time, incidence of postoperative leaks, length of stay, percentage of follow-up assessment, 12- and 24-month excess weight loss (EWL), readmission and reoperation rates, and mortality rate were collected and analyzed for the two groups. Excess weight loss was defined as the excess weight over the ideal body weight calculated according to the Metropolitan Life Weight Tables available from the Metropolitan Life Insurance Company.

Statistical analysis

The data are presented as mean ± standard deviation for continuous variables, and as counts or proportions (%) for categorical variables.

Table 1. ASA class stratified by laparoscopic or open surgery

ASA class	Laparoscopic RYGB (%)	Open RYGB (%)
2	15.2	7.6
3	79.9	82.6
4	4.9	9.8

ASA, American Society of Anesthesiology classification; RYGB, Roux-en-Y gastric bypass surgery

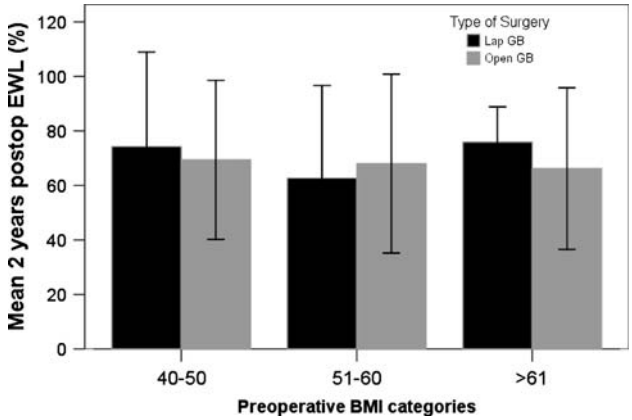

Fig. 1. Mean 2-year excess weight loss (EWL) stratified according to preoperative body mass index (BMI) class.

Continuous outcomes were evaluated by unpaired *t*-tests. Discrete variables were analyzed with Pearson's chi-square test or Fisher's exact test. The SPSS statistical software program (version 13.0; SPSS, Chicago, USA) was used for all analyses. Statistical significance was set at a p value less than 0.05.

Results

The mean age was 42.9 years for both groups. The gender distribution was unbalanced between the two groups, with 489 females (86%) in the laparoscopic group and 305 females (76%) in the laparotomy group ($p = 0.001$). The mean preoperative BMI was higher in the laparotomy group (58.9 ± 10.6 vs 49.1 ± 7.6 kg/m^2; $p = 0.001$). As shown in Table 1, the American Society of Anesthesiologists' class distribution also was significantly different between the two groups ($p = 0.001$).

The surgical procedure time was significantly shorter in the laparoscopic group (164 ± 50 min) than in the open group (195 ± 50 min; $p = 0.0001$). The hospital length of stay in the laparoscopic group was significantly shorter (2.5 ± 2.4 days) than in the open group (3.7 ± 3.7 days; $p = 0.001$), and the wound infection rate was significantly higher in open group (9.2%) than in the laparoscopic group (1.7%; $p = 0.001$). There was no significant difference in the 30-day mortality rate between the open (0.50%) and laparoscopic (0.17%) groups ($p = 0.37$) nor in the 30-day reoperation rate between the open (2.4%) and laparoscopic (2.6%) groups ($p = 0.71$). The 30-day readmission rate was similar in the open (5.0%) and laparoscopic (5.2%) groups ($p = 0.85$). The rate of leakage from the gastrojejunostomy was similar in the open (0.50%) and

laparoscopic (0.35%) groups ($p = 0.12$). There were no leakages from the jejunojejunostomy in either group. The conversion rate from laparoscopic procedure to laparotomy was 1.7%.

The follow-up response at 2 years was 79% for the laparotomy group and 84% for the laparoscopic group ($p = 0.26$). The 1-year EWL was significantly greater in the laparoscopic group (66.9% ± 16%) than in the open group (57% ± 13.5%; $p = 0.01$). Similarly, the 2-year EWL was significantly greater in the laparoscopic group (71.3% ± 18.4%) than in the open group (67.3% ± 15.3%; $p = 0.03$). However, the EWL was similar between the two groups when stratified according to preoperative BMI class (Fig. 1).

Discussion

A recent randomized study has clearly demonstrated the advantages of the laparoscopic approach for the surgical treatment of morbid obesity. These include less postoperative pain, shorter hospital stay, improved pulmonary function, and a faster return to perioperative function [7]. The follow-up findings of this study show that weight loss and improvement of obesity-related comorbidities were similar [13]. In addition, the rate of incisional hernia was significantly lower [13].

Our study is the first to compare the open and laparoscopic approaches to RYGB according to outcome end points used by the ACS and ASBS in their center of excellence programs. In our study, we found a number of results that agreed with earlier findings and some original findings. The laparoscopic approach had a significant advantage in length of hospital stay, wound infection rate, and 1- and 2-year EWL. The finding of increased EWL with the laparoscopic approach is likely attributable to the higher preoperative BMI in the subset of patients undergoing open gastric bypass. In fact, this difference disappears when the data are stratified according to preoperative BMI classes.

A number of outcomes were statistically similar in the two groups. There were no significant differences in 30-day readmission, reoperation, or mortality rates. There was a trend, although not statistically significant, toward a lower rate of anastomotic leakage in the laparoscopic group. This differs from previous studies, which showed the same leakage rate for the two techniques [7].

Increased operative time and the greater cost of surgical instruments have been cited previously as a disadvantage of the laparoscopic approach for morbid obesity. Marema et al. [5] quantified the extra cost for specialized laparoscopic equipment at $2,600 for the laparoscopic procedure, as compared with $790 for the open procedure. Nguyen and Wolfe [11] found that the operative cost for laparoscopic RYGB was higher than the cost for open RYGB, but that hospital costs were significantly lower for laparoscopic surgery.

In our series, the average hospital costs for the laparoscopic procedure are likely to be lower because of two factors: shorter operating time and decreased hospital stay. Our finding of significantly lower operative time required for the laparoscopic approach contradicts data from earlier studies. Our average operating room time for the laparoscopic bypass was 30 min shorter than the operating room time required for the open bypass (164 vs 195 min). Previous studies have found procedure times ranging from 10 to 30 min longer for the laparoscopic procedure than for the open procedure [5–7, 9–11, 14].

Our study found the length of hospital stay to be 1.2 days shorter for the laparoscopic procedure than for the open procedure (2.4 vs 3.7 days). Previous authors have echoed this finding [1, 2, 5, 7, 9, 11, 14, 15]. In our series, the significantly shorter operating time and hospital stay outweighed the increased cost of surgical supplies for the laparoscopic procedure and should lead to a lower overall hospital cost for the laparoscopic procedure.

Previous authors have reported a higher mortality rate with the open procedure than with the laparoscopic procedure [7, 12]. In our series, we found no significant difference in 30-day mortality rates between the two procedures (open 0.5% vs laparoscopic 0.17%). However, previous studies have noted increased bleeding, time spent in the intensive care unit, and suppression of pulmonary function with the open procedure [7, 10]. The open procedure also is associated with a significantly higher production of stress hormones than the laparoscopic procedure, which suggests greater operative trauma [8]. These all are likely etiologies for the increased frequency of complications found with the open procedure by other authors [7, 10].

Although not a prospective randomized investigation, this study involved a large consecutive series of patients at a single center whose data have been contained within a prospectively maintained database. In this large series comparing open and laparoscopic gastric bypass at our institution, we found several advantages for the laparoscopic approach with a safety profile similar to that for the open approach. The shorter operating time and length of hospital stay have the potential to decrease hospital costs. In addition, the quicker return to function observed among patients undergoing the laparoscopic approach will lead to lower societal costs for this approach compared with the open approach. Therefore, the laparoscopic approach should be considered as the procedure of choice for the surgical treatment of morbid obesity.

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