Published in final edited form as:

J Pediatr Surg. 2013 October ; 48(10): 2092–2098. doi:10.1016/j.jpedsurg.2013.05.019.

Perioperative outcome of Laparoscopic Roux-en-Y gastric bypass: A children's hospital experience

Go Miyano^a, Todd M. Jenkins^b, Stavra A. Xanthakos^c, Victor F. Garcia^b, and Thomas H. Inge^{b,*}

^aDivision of Pediatric Surgery, Juntendo University, Tokyo, Japan

^bDivision of Pediatric General and Thoracic Surgery, Cincinnati Children's Hospital, Medical Center, Cincinnati, OH, USA

^cDivision of Gastroenterology, Hepatology and Nutrition, Cincinnati Children's, Hospital Medical Center, Cincinnati, OH, USA

Abstract

Background/Purpose—To evaluate the perioperative safety of laparoscopic Roux-en-Y gastric bypass (LRYGB) in a freestanding children's hospital setting.

Patients and Methods—Perioperative (<90 days) clinical complications of 77 consecutive patients (mean age 16.8 ± 2.1 years; mean BMI 59.4 kg/m^2 , 68% female), who underwent LRYGB at Cincinnati Children's Hospital from 2002 to 2007 were examined, using standardized data collection forms that were created specifically for use in this study.

Results—No mortality or conversion to open surgery was observed. Intraoperative complications were uncommon (3%). No anesthetic complications or transfusion requirements were observed. Median hospital stay was 3 days. Twenty-two percent of subjects had a complication from discharge to 30 days, while 13% experienced a complication between 31 and 90 days. The common types of postoperative complications included gastrojejunal anastomotic stricture (17%), leak (7%), dehydration (7%), and small bowel obstruction (SBO; 5%). Reoperation was required in 9 subjects. Operating time significantly decreased as the number of cases performed increased.

Conclusions—LRYGB in this case series of adolescents was associated with a low rate of intraoperative complications, with an increased rate over the ensuing 90 days. These events can be successfully managed, even in super obese adolescents.

Keywords

Laparoscopy; Roux-en-Y gastric bypass; Adolescent; Complication

Similar to the adult obesity epidemic, an adolescent obesity epidemic is unfolding; approximately one-third of adolescents are overweight (BMI for age 85th percentile), 17% are obese (BMI for age 95th percentile) [1], and 4%–6% are extremely obese (BMI 35

kg/m² or BMI for age 120% of the 95th percentile) [2]. Weight loss surgery has proven to be an effective and durable solution in morbidly obese adults, but there are still a number of unknowns regarding use of bariatric procedures in adolescents.

The most common bariatric procedure performed in the United States is laparoscopic Roux-en-Y gastric bypass (LRYGB) [3]. Use of laparoscopy for this procedure significantly reduces perioperative morbidity associated with the open (laparotomy) approach. Thus, improved outcomes as well as patient demand for minimally invasive procedures have driven surgeons to adopt the laparoscopic approach [4,5]. Few studies have evaluated the outcomes of LRYGB in adolescents [6–10]. In particular, there are few reports of perioperative safety of bariatric surgery performed in a pediatric medical center.

The purpose of this study was to characterize the perioperative complications observed during treatment of a large single pediatric cohort. We hypothesized that the types of complications would be similar to those reported in the adult bariatric literature. The data were derived from an initial and consecutive institutional experience using LRYGB, including the first laparoscopic case done. Particular attention was given to use of a standardized data collection strategy with a low threshold to capture events to accurately reflect the possible complications that may be encountered while treating extremely high BMI adolescents with a complex minimally invasive procedure.

1. Materials and methods

1.1. Human subjects

The Follow-up of Adolescent Bariatric Surgery (FABS) study was approved by the Cincinnati Children's Hospital Medical Center Institutional Review Board in 2004. The study group included consecutive patients from August 2002 through May 2007. FABS data were retrospectively collected (with waiver of consent) for cases performed from 2002 until 2004, and subjects were consented for prospective data collection beyond 2004.

From 2002 until 2006, patients had been selected for surgery based on having BMI of 40 kg/m² with serious obesity-related comorbidities (type 2 diabetes mellitus, severe sleep apnea, pseudotumor cerebri), or BMI of 50 kg/m² with other comorbidities (eg., hypertension, insulin resistance, dyslipidemia, impaired quality of life or activities of daily living, gastroesophageal reflux disease, obesity-related psychosocial distress). From 2006 to 2007, this center used the clinical selection criteria of BMI of 35 kg/m² with serious obesity-related comorbidities (see above), or BMI of 40 kg/m² with other comorbidities (see above). During the entire period (2002–2007), a multidisciplinary team approach was used during patient assessment and management and contraindications for surgery remained the same during this entire series [11].

1.2. Preoperative evaluation

Each patient had an extensive preoperative evaluation, including cardiac, pulmonary, endocrinologic evaluation, dietary education, and psychosocial assessment. Patients with symptoms of obstructive sleep apnea were studied with overnight polysomnogram. All patients were also evaluated by an attending anesthesiologist before surgery. All patients

received a third generation cephalosporin preoperatively and at 3 h intraoperatively if applicable. Low molecular weight heparin (40 mg enoxaparin injected subcutaneously and continued twice daily postoperatively while in the hospital) was administered and sequential compression boots were also used intraoperatively and postoperatively until ambulatory.

1.3. Laparoscopic Roux-en-Y gastric bypass

LRYGB was performed with a surgical team consisting of 2 attending pediatric surgeons for each procedure; procedures had the following common elements: 1) use of a transparent, bladeless, direct viewing trocar technique for initial abdominal access (Ethicon Endosurgery, Cincinnati, OH); 2) transection of jejunum at 15–30 cm from Treitz ligament; 3) biliopancreatic limb-length of 75 cm for patients with BMI less than 50 kg/m² and 100 or 150 cm for patients with BMI greater than or equal to 50 kg/m²; 4) Side-to-side, functional end-to-end jejunojejunostomy with one application of a 45 mm stapler; 5) retrocolic and retrogastric passage of Roux limb; 6) 30–45 ml gastric pouch creation with stapler; 7) 2-layered, hand-sewn, gastrojejunostomy anastomosis with 3-0 polyglactin sutures, sized with 10–15 mm diameter using 34–40F orogastric tube as a stent, tested with air insufflation technique intraoperatively; 8) Roux limb construction with counter-clockwise rotation of the Roux limb after jejunal transection resulting in the jejunojejunostomy on the left side of the axis of the mesentery; 9) running closure of the transverse mesocolic and Petersen's mesenteric defects with nonabsorbable sutures; 10) placement of a Jackson–Pratt drain posterior to the gastrojejunal anastomosis site.

1.4. Postoperative management

Postoperatively, patients were routinely cared for on a regular pediatric surgical floor. On the morning of postoperative day 1, patients were routinely studied with upper gastrointestinal (UGI) contrast studies. If no leak was identified, they were given liquids and subsequently advanced to a high protein liquid diet for 2 weeks, then subsequently to a mechanically soft diet for 2 more weeks. Patients were scheduled for postoperative visits with the surgeon, psychologist, and dietician every week for 1 month, every other week for the subsequent 2 months, then monthly for the remaining first 6 months.

1.4.1. Research methods and definitions—A manual of research procedures and data dictionary was created to provide uniformity in conduct of the study over time. Data collected included: demographics, BMI, obesity-related comorbidities, operative procedure, length of hospital stay, and complications. Data were collected by trained research coordinators using Teleform® data collection forms created specifically for this study. Data were uploaded electronically into the database with numerous range and quality checks performed automatically. Postoperative complications were defined as events that led to unplanned pharmacologic therapy (eg., anticoagulation or antibiotic therapy beyond routine prophylaxis), an unplanned emergency department visit, any readmission to the hospital, need for endoscopy, or abdominal re-operation.

1.5. Statistical analysis

We created a composite end-point of any of the following complications occurring within 90 days after surgery: mortality, pulmonary embolism, deep vein thrombosis, gastro-

jejunostomy stricture, leak, small bowel obstruction, dehydration, marginal ulcer, wound infection, or reoperation. A log-binomial regression model was used to evaluate predictors of this composite outcome (SAS, Cary, NC). Gender, race, age, surgical order, and pre-operative BMI were all considered for inclusion into the final model. We also evaluated operating time as a function of the number of cases performed. Operating time was not found to be normally distributed and was log-transformed for analyses. Linear regression was used to assess the association of predictors and log-operating time. For all tests, an α significance level of 0.05 was used to determine statistical significance.

2. Results

2.1. Demographics

Seventy-seven consecutive patients who underwent surgery over a 5-year period were included in this analysis (Table 1). Patient characteristics revealed an average BMI of 59.4 kg/m² with a range from 41.4 to 95.5 kg/m². Fifty-two females and 25 males were included, and the mean age was 16.8 years with a range from 13 to 23 years. Patients presented with a variety of comorbid conditions, with prevalence enumerated in Table 1. Median length of hospital stay was 3 days (range: 2–14 days).

2.2. Complications

2.2.1. Intraoperative events—In this series, no mortality, conversion to open surgery, or transfusions were observed. Indeed, only 2 (2.6%) intraoperative complications were noted: 1) a liver laceration, which was controlled with direct pressure, without hemodynamic effect or transfusion requirement and 2) severe ischemia of the stapled blind end of a Roux-limb identified intraoperatively which was resected with a stapler (Table 2). Neither of these intraoperative complications affected postoperative management plan or outcome. There were no anesthetic complications. None of the patients in this series required parenteral nutrition postoperatively.

2.2.2. Postoperative events—The incidence of perioperative complications within 90 days (defined as events leading to unplanned procedures, endoscopy, or readmission from the time of surgery to 90 days after surgery) is summarized in Table 2. Overall, 17 subjects (22.1%) had an event within 30 days, while 10 subjects (13.0%) had an event between 31 and 90 days. The most common types of postoperative complications included gastrojejunal anastomotic stricture ($n = 13$, 16.9%), reoperation ($n = 10$, 13.0%), and leak and dehydration (each $n = 5$, 6.5%). All 13 patients with anastomotic stricture at the gastrojejunostomy underwent esophagogastroscope and successful balloon dilatation. Dilations were performed by an attending pediatric gastroenterologist, typically as an outpatient intervention under general anesthesia. Dilatation was performed using graduated balloons to the maximum diameter of 8–12 mm at first treatment. For patients who required 2 dilation episodes, the goal diameter was 15 mm. A single dilatation episode led to complete symptom resolution in nearly half of patients, while a mean of 1.7 (range, 1–3) dilatations was needed overall. There were no perforations or other complications of dilation.

Exploratory laparoscopy was performed in 4 of 6 subjects with gastrointestinal leaks. Details of these cases are described as follows. In one patient, a small penetration on the anterior wall of the gastric remnant was identified by bilious leakage from the abdominal drain in 1 case on post-operative day 2. This complication was readily managed by laparoscopic gastrostomy tube placement with simple closure at the site of penetration. Leak at the gastrojejunal anastomotic site was found in one case on postoperative day 9, and peritoneal irrigation and placement of an additional intra-abdominal drain were performed with no attempt to primarily repair the site of leakage. No definite leak site was identified at the time of exploratory laparoscopy in two other cases, which were managed by irrigation, gastrostomy tube, and JP drain placement. None of these cases required conversion to open surgery. Conservative treatment with broad spectrum antibiotics was used in one case of a contained leak, due largely to mild symptoms and only modest objective signs of inflammatory response. None of the instances of anastomotic leak were identified by routine UGI study on postoperative day 1.

One late leak presentation occurred at 3 weeks in a patient who had an initially uneventful course. After discharge, the patient stayed in Cincinnati for 2 weeks prior to travelling home approximately 600 miles from Cincinnati. When the leak occurred, the patient was treated with washout and drainage by open laparotomy performed by a local bariatric surgeon.

Exploratory laparoscopy was performed in all 4 small bowel obstruction cases. There was one stricture at the level of the passage of the retrocolic roux limb through the transverse mesocolon. Obstruction at the site of the jejunojejunostomy was identified in another case, which was managed by stapled, side-to-side bypass of the obstructed anastomosis with good result. A specific cause of obstruction was not identified at the time of exploratory laparoscopy in another 2 cases, in which mechanical obstruction could not be discriminated from ileus based on imaging before the reexploration. Immediate improvement of clinical symptoms was observed postoperatively in all 4 cases.

There was one case of deep vein thrombosis which occurred on postoperative day 8. The right common femoral and popliteal veins were involved, and managed by low-molecular-weight-heparin and warfarin therapy, with full recovery. There were 5 cases of dehydration requiring readmission; one case was related to marginal ulcer, and one case to repeated vomiting which was not associated with other diagnosis. Importantly, none of the adverse clinical events noted intraoperatively, or within the first 90 days following operation led to permanent disability or recurrent medical or surgical complications beyond the 90 day period.

Regression modeling was used to test the hypothesis that preoperative factors may predict development of complications within 90 days. One-third of subjects (26 of 77) had at least one 90 day event. When gender, race, age, surgical order, and pre-operative BMI were examined, neither crude nor adjusted analyses revealed that any of these were significantly associated with the composite 90 day complications outcome in this small cohort study.

2.3. Correlation with Learning Curve

Median operating time, defined as time taken from the initial incision made to the final dressing placed, was 249 min (range: 120–575 min). Adjusted analyses indicated that case order in this series ($p < 0.01$) and gender ($p < 0.01$) were significant predictors of log-operating time. Specifically, for each 10 additional cases performed, operating time decreased by 5.7%. Also, operating time for males was 28% greater than that for females. BMI, race, and age were not found to be significant predictors in this series.

3. Discussion

This report represents the first to focus strictly on perioperative complications during treatment of adolescents undergoing laparoscopic RYGB in a single pediatric center. We believe that we have described all clinically important complications observed during and beyond the “learning curve” of our institutional experience with a complex minimally invasive procedure, performed by 2 pediatric surgeons in a group of individuals at high risk for complications if for no other reason due to extreme obesity. This is a very unique cohort since in the adult and adolescent bariatric literature, details of the perioperative outcome of a cohort with a mean BMI of 59 kg/m² are rarely ever seen.

The presentation of all events that were captured from this unique population using a rigorous and objective evaluation for inclusion provides a large number of events for review. In the broader general surgical literature, lack of uniform reporting of negative outcomes makes comparison and interpretation of postoperative adverse clinical events challenging. In the bariatric literature pertaining to adults, most of the series that describe complications of LRYGB do not follow strict reporting guidelines and indeed the majority of the reports do not provide sufficient methodological details to discern what events qualified for inclusion and what events did not reach a level of significance to “trigger” inclusion in the data reported. In contrast, we have used a conservative trigger, including all events that led to a deviation in the expected postoperative course. By including events triggered by conservative thresholds, this report includes many events that are not routinely captured in bariatric outcome reports, which can result in higher estimates of adverse events when compared to other complication data in the literature. To illustrate this point, in one recently published retrospective series of 78 laparoscopic RYGB cases, 2 patients experienced “minor postoperative complications” (2.5%), however no details were provided addressing how these data were collected, during what period of time, or what types of events qualified for inclusion. In another prospective study of adolescents undergoing laparoscopic RYGB, authors reported 3 of 81 (3.7%) had complications within 30 days of operation; however, there was no indication of how broadly or narrowly complications were defined, nor what types qualified for inclusion/exclusion from the analysis and reporting. Postoperative complications in adolescents undergoing vertical sleeve gastrectomy have been reported in 1 of 23 (4%) and 5 of 108 (4.6%), while in both series complication ascertainment details are sparse [12]. Postoperative complications were reported in none of 41 and 11 of 73 (15%) for LAGB [13,14]. Notably, the 15% rate was reported from a prospective, FDA monitored LAGB study in contrast to the retrospective study, which reported no complications. Neither study clearly described data definitions nor methodology for detection/collection of such

data. One LAGB prospective randomized trial (n = 25 surgical subjects) conducted with considerable methodological rigor and with clear definitions of adverse events reported no operative complications in 30 days, but 23% with operative complications over 2 years [15]. Thus, in summary, there is variability in reporting of complication rates by procedure, and higher rates have been reported from studies that more rigorously describe complication ascertainment methodology.

One of the most common complications associated with LRYGB is the development of postoperative gastrojejunostomy anastomotic stricture, occurring between 4.7% and 27% of the time [16–20]. Although the relationships between anastomotic features (diameter, method of creating anastomosis) and incidence of stricture formation has not been clearly elucidated, several published series have reported a higher incidence of gastrojejunostomy anastomotic stricture formation when techniques are used that aim to create initially smaller diameter stomas. For instance, the literature suggests that the stricture rate for an anastomosis created by a 21 mm circular stapler (internal diameter = 8.4 mm) is higher than that created by a 25 mm circular stapler (internal diameter = 12.4 mm) [21,22]. In our series, a 34F orogastric tube (11 mm diameter) was used to calibrate the anastomotic site based on the technique of Higa et al. [5]. The 34F calibration tube and handsewn technique would predictably lead to an anastomotic diameter of 11 mm, slightly smaller than the internal diameter achieved with a 25 mm circular stapler. However, with the handsewn technique, fewer leaks have been reported, justifying the choice of this technique as an initial approach to the adolescent patient. However, following this initial experience which resulted in numerous strictures, we carefully evaluated other techniques whereby we could standardize and optimize the performance of this critical anastomosis. After a period of use of the linear stapled technique in 2007–2008, we further evaluated use of the 25 mm circularly stapled technique and adopted this method due to time savings and greater technical satisfaction with the approach. We have since been impressed with this technique with elimination of stricture complications and without increased rates of leakage.

Extraluminal leak is the most common serious early complication of LRYGB, and the reported incidence is between 1.4% and 5.1% [4,23–26]. Clinical symptoms are often nonspecific and physical examination is difficult owing to the large size of the patient [24,27], and if not recognized early, postoperative leak is a potentially lethal complication of RYGB [28]. In our series, leak originated from the gastric remnant in one case, and no definite leak site was identified even at the time of exploratory laparoscopy in 2 cases; none of our leaks were identified by the routine UGI study performed on postoperative day 1 surgery. While these findings would question the usefulness of early routine UGI for detection of leak, the UGI does also provide reassurance that there is satisfactory performance of the jejunojunction and excludes obstruction at this level. Development of leak is possible for several weeks after surgery and careful attention to symptoms and clinical signs of leak within the first month after operation may be more important than imaging, a concept that has also been promoted in the adult bariatric literature [23,26].

Patients with a BMI ≥ 60 kg/m², who comprised a large proportion of the study cohort, may experience a higher rate of complications and mortality when compared to less obese patients following bariatric surgery, particularly when the approach is laparoscopic [29], and

some surgeons may even consider such patients “inoperable.” Adolescents with this extreme degree of obesity tend to have a thick abdominal wall, large amounts of perivisceral fat in the abdominal cavity as well as in the retroperitoneum, and fatty infiltration of the liver, which increase the risks and technical difficulty when performing laparoscopy. Due in part to the nulliparous status of these in general, the intra-abdominal domain is a smaller and more challenging environment in which to work operatively than an otherwise comparable adult patient in her 5th or 6th decade of life. Nonetheless, high-risk “super obese” patients ($\text{BMI} > 50 \text{ kg/m}^2$) may in particular benefit from a less invasive approach because they are more vulnerable to cardiopulmonary and wound-related complications of open surgery.

This study has several important limitations. The relatively small numbers of patients with a relatively high and narrow BMI range limited the analyses that could be done. Clearly, correlations between perioperative safety and BMI, as well as other covariates that pertain to perioperative safety and learning curve effect should be assessed with a much larger sample size in adolescents with a broader BMI range. The excessive number of gastrojejunal anastomotic strictures reported here following use of a laparoscopic, handsewn gastrojejunostomy limits the generalizability of the data and leads to an overestimate of the risk of this particular complication when one considers that stricture rates of $<3\%$ are routinely achieved by surgeons utilizing the more commonly used stapled techniques. Indeed, were it not for the high rate of stricture requiring endoscopic treatment, the 30 and 90 day complication rates in this series would be 17% and 4% rather than 22% and 13%, respectively. Ninety-day complication rates of 34% are consistent with those reported in the adult RYGB literature.

In summary, these data suggest that the variety of complications of LRYGB that we observed in adolescents are similar to those reported in adult series but the rates are higher than expected, owing to the extreme BMI values, the technical difficulty of the cases, and to reporting of every complication observed during the initial institutional experience with this procedure. Aside from the surgical complications, it is notable that there were very few perioperative *medical* complications following surgery, despite the extraordinarily high BMI values and risks. It is certainly possible that procedures other than RYGB will demonstrate more favorable short and long term complication rates for adolescents. However, only when clinical investigators use rigorous methods for adverse event data collection and unambiguous descriptions of such methods in outcome reporting will we be able to make informed comparisons and decisions about optimal procedures and care paradigms for adolescent bariatric treatment.

Acknowledgments

This publication was supported in part by NIH grant 5R03DK68228 (THI), an Institutional Clinical and Translational Science Award, NIH/NCRR Grant Number 5UL1RR026314-02, and an investigator initiated grant from Ethicon Endosurgery. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the NIH or Ethicon Endosurgery.

The authors would like to acknowledge the superb work of the following clinical research coordinators and data management staff in the conduct of this study: Kimberly Wilson, Kimberly Gamm, Cynthia Spikes, April Carr, Renee Jeffreys, Rachel Akers, and Jennifer Andringa. The authors would also like to express gratitude to Dr. Kelvin Higa who proctored the first 4 operative procedures.

References

1. Ogden CL, Carroll MD, Curtin LR, et al. Prevalence of overweight and obesity in the United States, 1999–2004. *JAMA*. 2006; 295:1549–1555. [PubMed: 16595758]
2. Koebnick C, Smith N, Coleman KJ, et al. Prevalence of extreme obesity in a multiethnic cohort of children and adolescents. *J Pediatr*. 2010; 157:26–31. e22. [PubMed: 20303506]
3. Santry HP, Gillen DL, Lauderdale DS. Trends in bariatric surgical procedures. *JAMA*. 2005; 294:1909–1917. [PubMed: 16234497]
4. Schauer PR, Ikramuddin S, Gourash W, et al. Outcomes after laparoscopic Roux-en-Y gastric bypass for morbid obesity. *Ann Surg*. 2000; 232:515–529. [PubMed: 10998650]
5. Higa KD, Boone KB, Ho T, et al. Laparoscopic Roux-en-Y gastric bypass for morbid obesity: technique and preliminary results of our first 400 patients. *Arch Surg*. 2000; 135:1029–1033. [discussion 1033–1024]. [PubMed: 10982506]
6. Lawson ML, Kirk S, Mitchell T, et al. One-year outcomes of Roux-en-Y gastric bypass for morbidly obese adolescents: a multicenter study from the Pediatric Bariatric Study Group. *J Pediatr Surg*. 2006; 41:137–143. [discussion 137–143]. [PubMed: 16410123]
7. Collins J, Mattar S, Qureshi F, et al. Initial outcomes of laparoscopic Roux-en-Y gastric bypass in morbidly obese adolescents. *Surg Obes Relat Dis*. 2007; 3:147–152. [PubMed: 17324636]
8. Stanford A, Glascock JM, Eid GM, et al. Laparoscopic Roux-en-Y gastric bypass in morbidly obese adolescents. *J Pediatr Surg*. 2003; 38:430–433. [PubMed: 12632362]
9. Varela JE, Hinojosa MW, Nguyen NT. Perioperative outcomes of bariatric surgery in adolescents compared with adults at academic medical centers. *Surg Obes Relat Dis*. 2007; 3:537–540. [discussion 541–532]. [PubMed: 17903775]
10. Jen HC, Rickard DG, Shew SB, et al. Trends and outcomes of adolescent bariatric surgery in California, 2005–2007. *Pediatrics*. 2010; 126:e746–e753. [PubMed: 20855388]
11. Inge TH, Garcia V, Daniels S, et al. A multidisciplinary approach to the adolescent bariatric surgical patient. *J Pediatr Surg*. 2004; 39:442–447. [PubMed: 15017567]
12. Nadler EP, Barefoot LC, Qureshi FG. Early results after laparoscopic sleeve gastrectomy in adolescents with morbid obesity. *Surgery*. 2012; 152:212–217. [PubMed: 22828142]
13. Fielding GA, Duncombe JE. Laparoscopic adjustable gastric banding in severely obese adolescents. *Surg Obes Relat Dis*. 2005; 1:399–405. [PubMed: 16925257]
14. Nadler EP, Youn HA, Ren CJ, et al. An update on 73 US obese pediatric patients treated with laparoscopic adjustable gastric banding: comorbidity resolution and compliance data. *J Pediatr Surg*. 2008; 43:141–146. [PubMed: 18206472]
15. O'Brien PE, Sawyer SM, Laurie C, et al. Laparoscopic adjustable gastric banding in severely obese adolescents: a randomized trial. *JAMA*. 2010; 303:519–526. [PubMed: 20145228]
16. Bell RL, Reinhardt KE, Flowers JL. Surgeon-performed endoscopic dilatation of symptomatic gastrojejunal anastomotic strictures following laparoscopic Roux-en-Y gastric bypass. *Obes Surg*. 2003; 13:728–733. [PubMed: 14627467]
17. Perugini RA, Mason R, Czerniach DR, et al. Predictors of complication and suboptimal weight loss after laparoscopic Roux-en-Y gastric bypass: a series of 188 patients. *Arch Surg*. 2003; 138:541–545. [discussion 545–546]. [PubMed: 12742960]
18. Csendes A, Burgos AM, Burdiles P. Incidence of anastomotic strictures after gastric bypass: a prospective consecutive routine endoscopic study 1 month and 17 months after surgery in 441 patients with morbid obesity. *Obes Surg*. 2009; 19:269–273. [PubMed: 18696171]
19. Bendewald FP, Choi JN, Blythe LS, et al. Comparison of hand-sewn, linear-stapled, and circular-stapled gastrojejunostomy in laparoscopic Roux-en-Y gastric bypass. *Obes Surg*. 2011; 21:1671–1675. [PubMed: 21739350]
20. Kravetz AJ, Reddy S, Murtaza G, et al. A comparative study of handsewn versus stapled gastrojejunal anastomosis in laparoscopic Roux-en-Y gastric bypass. *Surg Endosc*. 2011; 25:1287–1292. [PubMed: 20927539]

21. Takata MC, Ciofica R, Cello JP, et al. Predictors, treatment, and outcomes of gastrojejunostomy stricture after gastric bypass for morbid obesity. *Obes Surg.* 2007; 17:878–884. [PubMed: 17894145]
22. Gould JC, Garren M, Boll V, et al. The impact of circular stapler diameter on the incidence of gastrojejunostomy stenosis and weight loss following laparoscopic Roux-en-Y gastric bypass. *Surg Endosc.* 2006; 20:1017–1020. [PubMed: 16763928]
23. Livingston EH, Ko CY. Assessing the relative contribution of individual risk factors on surgical outcome for gastric bypass surgery: a baseline probability analysis. *J Surg Res.* 2002; 105:48–52. [PubMed: 12069501]
24. DeMaria EJ, Sugerman HJ, Kellum JM, et al. Results of 281 consecutive total laparoscopic Roux-en-Y gastric bypasses to treat morbid obesity. *Ann Surg.* 2002; 235:640–645. [discussion 645–647]. [PubMed: 11981209]
25. Leslie DB, Dorman RB, Anderson J, et al. Routine upper gastro-intestinal imaging is superior to clinical signs for detecting gastrojejunal leak after laparoscopic Roux-en-Y gastric bypass. *J Am Coll Surg.* 2012; 214:208–213. [PubMed: 22265221]
26. Csendes A, Burgos AM, Braghetto I. Classification and management of leaks after gastric bypass for patients with morbid obesity: a prospective study of 60 patients. *Obes Surg.* 2012; 22:855–862. [PubMed: 22438218]
27. Serafini F, Anderson W, Ghassemi P, et al. The utility of contrast studies and drains in the management of patients after Roux-en-Y gastric bypass. *Obes Surg.* 2002; 12:34–38. [PubMed: 11868295]
28. Fobi MA, Lee H, Holness R, et al. Gastric bypass operation for obesity. *World J Surg.* 1998; 22:925–935. [PubMed: 9717418]
29. Oliak D, Ballantyne GH, Weber P, et al. Laparoscopic Roux-en-Y gastric bypass: defining the learning curve. *Surg Endosc.* 2003; 17:405–408. [PubMed: 12399853]

Table 1

Patient Characteristics.

<i>Demographics, n = 77</i>	<i>mean (range)</i>
Age	16.8 (13–23)
Sex (F/M)	52/25
Race (Black/White)*	7/68
BMI (kg/m ²)	59.4 (41.4–95.5)
BMI ≥ 60; no (%)	31 (40.3%)
Weight (kg)	172.5 (114–295)
<i>Comorbidities</i>	<i>n (%)</i>
OSA	46 (68.7%)
Dyslipidemia	38 (62.3%)
HTN	18 (29.0%)
GERD	15 (26.8%)
T2DM	8 (12.7%)
Asthma	11 (20.8%)
PCOS	11 (24.4%)

Note: Clinical data were collected as described in the methods. Data dictionary, with comorbidity definitions available from corresponding author upon request. BMI, body mass index; OSA, obstructive sleep apnea; HTN, arterial hypertension; GERD, gastroesophageal reflux disease; T2DM, type 2 diabetes mellitus; PCOS, polycystic ovary syndrome.

Table 2

Complications observed within 90 days of operation.

Incidence of Complications	Intraoperative			30 d		31–90 d		Total (90 d)	
Intra-operative									
	2	2.6%							
Liver laceration	1	1.3%							
Severe ischemia at Roux-limb	1	1.3%							
Conversion	0	0.0%							
Transfusion	0	0.0%							
Post-operative									
Mortality				0	0.0%	0	0.0%	0	0.0%
Pulmonary embolism				0	0.0%	0	0.0%	0	0.0%
Deep vein thrombosis				1	1.3%	0	0.0%	1	1.3%
Gastrojejunal stricture				6	7.8%	7	9.1%	13	16.9%
Leak				6	7.8%	0	0.0%	6	7.8%
Small bowel obstruction				4	5.2%	0	0.0%	4	5.2%
Dehydration				3	3.9%	2	2.6%	5	6.5%
Marginal ulcer				0	0.0%	1	1.3%	1	1.3%
Wound infection				1	1.3%	1	1.3%	2	2.6%
Reoperation				10	13.0%	0	0.0%	10	13.0%
Total subjects with any events				18	23.4%	10	13.0%	27	35.1%