

Laparoscopic Roux-En-Y Gastric Bypass in Morbidly Obese Adolescents

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Background/Purpose: Obesity has contributed significantly to morbidity and premature deaths in the adolescent population. Because many patients do not respond to dietary modification, exercise regimens, or pharmacologic treatment, weight reduction surgery has become a viable alternative, although the morbidity of conventional gastric bypass has tempered enthusiasm for this approach. Experience with the laparoscopic approach has not been reported previously. The authors examined the outcome of adolescents undergoing laparoscopic Roux-En-Y gastric bypass (lap RYGB).

Methods: Medical records of patients less than 20 years of age ($n = 4$; 3 girls, 1 boy) who had undergone lap RYGB for morbid obesity were reviewed. All patients met National Institute of Health criteria for bariatric surgery. Outcome variables examined included weight; body mass index (BMI); hospital length of stay (LOS); comorbid conditions; and tol-

erance of a regular diet. Mean time to follow-up was 17 months.

Results: All procedures were completed laparoscopically. There were no complications. The average LOS was 2 days. Patients with greater than 20-month follow-up lost an average of 87% of their excess body weight and had nearly complete resolution of comorbidities (including hypertriglyceridemia, hypercholesterolemia, asthma, and gastroesophageal reflux disease).

Conclusion: Laparoscopic gastric bypass is a safe alternative in morbidly obese adolescents who have not responded to medical therapy.

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INDEX WORDS: Laparoscopic Roux-en-Y gastric bypass, adolescents, outcome analysis.

THE PREVALENCE of obesity in children and adolescents has been increasing over the last 20 years, and 25% of all children in the United States are obese.^{1,2} Some postulate that this observation may be secondary to the informatics generation in which children are engaged in more sedentary activities, as a result of increased access to computers. Concern has arisen because of the development of numerous comorbid conditions directly related to obesity. Indeed, type 2 diabetes, hyperlipidemia, hypertension, and cardiac disease are being diagnosed in adolescents at an alarming rate.¹ These conditions also are associated with an increased mortality.

Gastric bypass surgery has been proposed as a viable option when dietary modification and exercise programs have failed. Laparoscopic procedures for morbid obesity emerged in the mid 1990s in the wake of laparoscopic cholecystectomy.³ Since that time, the overall experience and the associated complications have been reported widely, mainly in the adult population. In children, the use of surgical intervention, open or laparoscopic, for the treatment of morbid obesity has rarely been performed. We report the outcome of a group of adolescents who underwent laparoscopic Roux-en-Y gastric bypass (RYGB) for morbid obesity.

MATERIALS AND METHODS

Participants

We reviewed the medical records of all patients under the age of 20 years ($n = 4$; 3 girls, 1 boy; range, 17 to 19 years of age) who underwent a laparoscopic RYGB for morbid obesity at the University of Pittsburgh Medical Center. All patients met established criteria set by the National Institutes of Health (NIH) for candidacy for bariatric surgery.³ Additionally, patients should (1) have a body mass index (BMI) of 35 with co-morbid conditions or BMI ≥ 40 with or without co-morbid conditions, (2) have a comorbidity that should be improved by the surgery, (3) be able to comprehend the risks and benefits and the surgical procedure, (4) have no glandular etiology for their obesity, (5)

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Presented at the 33rd Annual Meeting of the American Pediatric Surgical Association, Phoenix, Arizona, May 19-23, 2002.

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0022-3468/03/3803-0029\$35.00/0

doi:10.1053/jpsu.2003.50074



Fig 1. The Schauer-Ikramuddin technique of laparoscopic RYGB. (See text.)

have attempted to lose weight by conventional means, and (6) be willing to be observed over a long period of time. This retrospective review was approved by the Institutional Review Board at the University of Pittsburgh. Telephone interviews also were conducted with the patients to obtain follow-up information. Interviews were completed successfully in all cases. No patient who was contacted refused to participate in the study.

Each patient underwent a laparoscopic RYGB via the Schauer-Ikramuddin technique (Fig 1). Briefly, this procedure involves an intrabdominal end-to-side gastrojejunostomy constructed with a linear cutting stapler. A small enterotomy is made in the posterior wall of the gastric pouch and also near the proximal end of the Roux limb. A flexible endoscope (30F) acting as a bougie is passed through the anastomosis into the jejunal limb. The anterior layer is secured with a running 2-0 absorbable suture.⁵ A recent modification that was used in our patients included an antecolic instead of a retrocolic anastomosis. An antecolic Roux-limb reduces the risk of bowel herniation through the transverse mesocolon defect required by the retrocolic technique.

On postoperative day one, patients had an upper gastrointestinal study to look for an anastomotic leak and or delayed emptying. Patients with a normal study finding are started on a clear liquid diet, and their diet is advanced as tolerated. They usually are discharged on postoperative day 2, with a follow-up outpatient appointment scheduled for 1 to 2 weeks. This is an abbreviated pathway of our post-operative care;

preoperative and postoperative care, however, are largely institution dependent.

The following variables were examined: weight, height, body mass index (BMI), average length of hospital stay, comorbid conditions, and ability to tolerate a regular diet. Mean time to follow-up was 17 months (range, 4 to 22 months). Numeric values are presented as the mean \pm SE.

RESULTS

Demographics

There were 4 participants (3 girls and 1 boy). All patients were under the age of 20 (range, 17 to 19 years of age). All patients met criteria set by the National Institute of Health for candidacy for bariatric surgery. In our patient population, the mean BMI was 55.14 with a range of 45 to 66. The mean weight of patients was 350 lbs, range, 268 to 431 lbs; the range of patient height was 5 feet 4 inches to 5 feet 9 inches.

Operative Procedure and Course

Each patient underwent a laparoscopic RYGB. The procedure was performed using 4 to 6 laparoscopic port sites. The average operating time was 2 to 3 hours. The estimated blood loss was 25 to 50 mL and no patient required conversion to an open procedure. There were no intraoperative or postoperative complications. The average length of stay was 2 days, and all patients tolerated a liquid diet on discharge.

Comorbid Conditions

Co-morbid conditions identified in our cohort included hypertriglyceridemia, hypercholesterolemia, degenerative joint disease (DJD), sleep apnea, asthma, and gastroesophageal reflux disease (GERD). The presence of elevated levels of triglyceride and cholesterol in the serum was confirmed preoperatively and monitored postoperatively. DJD, sleep apnea, and asthma were diagnosed by history. GERD was confirmed by relief of symptoms with antacids, histamine antagonists, or proton pump inhibitors. On questioning patients during telephone interviews, those whose follow-up was 20 months or greater (3 girls) had complete resolution of all comorbid conditions. The boy had a follow-up of only 4 months and had persistent sleep apnea.

Weight Loss and Diet Tolerance

Each patient was in excess of his or her ideal body weight with an average BMI of 55. The patients lost an average of 87% of their excess body weight combined, resulting in a mean BMI of 35 (Table 1). Excluding patient 4 (with the shortest follow-up), the mean BMI postoperatively was 28. The patients with a follow-up of nearly 2 years have maintained their weight loss. Most

Table 1. Preoperative and Postoperative Weight and BMI in Adolescents Undergoing Laparoscopic Roux-en-Y Gastric Bypass

Patient No.	Preoperative Wt/BMI	Postoperative Wt/BMI	Follow-Up
1	268 lb/45	140 lb/22	21 mo
2	287 lb/45	150 lb/24	20 mo
3	413 lb/66	240 lb/38	22 mo
4	430 lb/63	379 lb/55	4 mo

have incorporated physical activity and group sports into their lifestyle. All patients are able to tolerate a regular diet without any restrictions. No patient required supplemental enteral feeding.

DISCUSSION

Here we report on a small cohort of adolescents with favorable results after a laparoscopic RYGB. Patients have maintained their weight loss with significant resolution of their comorbid conditions nearly 2 years later. Age range for our patients is comparable with what has been reported elsewhere in the literature by other investigators who perform different types of bariatric surgery such as open RYGB or vertical gastric banding in adolescents (mean age, >17 years).⁶

All children qualified for bariatric surgery according to National Institutes of Health (NIH) guidelines. These recommendations include patients with a BMI greater than or equal to 35 with comorbid conditions, or BMI \geq 40 without comorbid conditions. Most surgeons and insurance companies follow these guidelines.⁴ In addition to these criteria, other factors should be considered for children and adolescents, most notably compliance with follow-up appointments, comprehension of the procedure to be performed, and realistic expectations. The Unit on Growth and Obesity and Child Health and Human Development of the National Institutes of Health (NIH) suggests that surgery for the morbidly obese adolescent be performed with extreme caution, as there may be several adverse consequences.⁷ There is reluctance among pediatricians and surgeons to recommend bariatric surgery owing to the lack of evidence-based reports and long-term follow-up. Therefore, current recommendations from this branch of the NIH include intensive weight-management surgery only in children who have not responded to conventional weight-management programs and who have significant complications related to their obesity.⁷ Additionally, surgery should be performed only in specialized centers that have a comprehensive weight-management program. Meeting the above recommendations, we elected to perform laparoscopic RYGB in these patients.

Early approaches to surgical management of morbid obesity in children were first reported in the 1980s.⁸ This report from the University of Iowa described 41 children

who underwent either a gastric bypass ($n = 33$) or gastroplasty ($n = 8$); (Eleven of these children had Prader-Willi syndrome.) The 30 genetically normal children had an average weight of 148 kg at operation, 108 kg at 3 years, and 122 kg at 5 years. There were 2 deaths, at 3 months and 39 months (respectively). There were also eight nonlethal complications, which included wound infections, abscess, dehiscences, etc. Of the 41 patients, 10 required a revision to achieve satisfactory weight loss. Although the authors concluded that gastric bypass and gastroplasty were safe procedures to perform in children, the overall weight loss was modest and was not sustained at 5 years.

Rand and Macgregor report on 34 children aged 11 to 19 who received either a RYGB ($n = 30$) or vertical banded gastroplasty ($n = 4$) over a 10-year period. Preoperative average weight was 131 kg/BMI 47. At the 6-year follow-up, BMI = 32 and patient's average excess body weight loss was 66%. There were no major complications in this study; however, 5 patients required a surgical revision (gastric pouch reduction) after they were deemed to have unsatisfactory weight loss or had regained more than 18 kg.

In a more recent study, Strauss et al⁶ retrospectively reviewed 10 adolescents, aged 17 years or younger, who underwent gastric bypass surgery, with a follow-up of >1 year in 9 of the 10 patients. There was a mean weight loss of 62% of excess weight, with significant improvements in comorbidities and quality of life. Postoperative recovery was uneventful. Three patients required subsequent operations: cholecystectomy (2) and an exploratory laparotomy for a small bowel obstruction. The remainder of the complications were protein-calorie malnutrition and micronutrient deficiency.

No major complications occurred and no concurrent open surgery was required. Complications that have been reported in other series include anastomotic leak or stricture and mechanical failure, such as stapler malfunction.¹⁰ In one series the reported rate of complications was as high as 40%; however, this percentage is variable and is often dependent on the experience of the hospital centers.

Comorbid conditions in bariatrics are those that are caused by or affected by excessive weight.⁴ These include heart failure, type 2 diabetes, sleep apnea, cancer

(eg, uterine, ovarian, breast, and colon), osteoarthritis, respiratory problems, gastroesophageal reflux disease, gall bladder disease, stress urinary incontinence, depression, and inability to conceive. Surgeons who perform laparoscopic or open RYGB report a decrease in cholesterol levels, triglycerides, improved respiratory function and GERD. There also is some evidence to support that, in conjunction with resolution of type 2 diabetes mellitus, HbA1c is decreased.¹¹ Although often difficult to measure objectively, there is some evidence that weight reduction surgery improves self-esteem and depression in these patients.¹²

In our small series, after performing laparoscopic RYGB in adolescents, the average weight loss was 87%. This weight loss is greater than that reported in other studies. This observation may be secondary to our small sample size and follow-up of 22 months, but we do emphasize to our patients the importance of an exercise program to help maintain weight reduction.

Postoperatively, patients are started on a clear liquid diet and slowly advanced to a full liquid diet. In patients in whom delayed emptying, edema, or stenosis is noted

at the anastomosis on postoperative water-soluble contrast swallow, a gastric or jejunal feeding tube may be inserted. None of our patients required feeding tube insertion or enteral supplementation. In fact, all patients continue to tolerate a regular diet without restrictions.

Laparoscopic RYGB is a safe procedure to be performed in morbidly obese adolescents. Patients should be selected carefully, educated, and followed up closely postoperatively. Although few laparoscopic RYGBs have been performed in children under age 16, as experience with this approach increases or as more young children fit similar profiles as the adolescent, this procedure may be considered for younger patients as well. A strong support network is also important to help to ensure success. Therefore, a multidisciplinary approach is necessary that involves (1) the parents or family, (2) pediatricians, (3) surgeons, (4) dieticians and exercise therapists, and (5) psychiatrists. Finally, laparoscopic RYGB should be performed only in selected centers with extensive laparoscopic experience, not only to perform the operations, but also to successfully manage potential complications.

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