



Safety and Effectiveness of Roux-en-Y Gastric Bypass in Patients Between the Ages of 17 and 19

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Abstract

Background Bariatric surgery is becoming more appealing as an option in addressing adolescent obesity. Concerns that may be encountered status postbariatric surgery include complications and failure to lose weight. The aim of our study is to describe safety and effectiveness of laparoscopic Roux-en-Y gastric bypass (LRYGB) in patients between the ages of 17 and 19.

Methods A retrospective chart review was completed on LRYGB patients between January 2005 and May 2012. Fifteen patients less than 20 years of age were included. One patient was lost to follow-up, and therefore, 14 patients under the age of 20 were matched to 14 patients greater than 20 years of age for gender ($p>0.99$), preoperative body mass index (BMI) ($p>0.96$), and follow-up interval ($p>0.80$).

Results Mean postoperative BMI at last follow-up did not show statistical difference between the two ($p>0.74$). Mean percentage of excess weight loss (%EWL) in patients under the age of 20 was 43.1 ± 14.6 , 70.5 ± 17.0 , 69.8 ± 17.3 , and 54.8 ± 8.5 % at postoperative 6, 12, 24, and 36 months, respectively. In patients over the age of 20, mean %EWL was 39.9 ± 12.6 , 67.0 ± 18.6 , 60.2 ± 11.3 , and 56.2 ± 6.2 %. Both group of patients showed improvement/remission of their comorbid conditions. No statistical difference was present between the two groups in terms of weight loss and comorbidity resolution. Each group had a single patient that required a revision for weight regain.

Conclusion LRYGB in younger patients almost the age of 20 is both safe and effective when compared to matched adults in regard to weight loss, comorbid condition, and complications.

Keywords Roux-en-Y gastric bypass · Safety · Effectiveness · Adolescents · Complications

Introduction

Obesity is a prominent problem plaguing America including the adolescent population. Ogden et al. [1] reported that among children and adolescents aged 2 to 19 years, 12 % were at or above the 97th percentile of the body mass index (BMI) for age growth charts. Attacking the issue of adolescent obesity is vital since obese adolescents have a greater risk of becoming obese adults [2, 3]. It is still unclear how to address this crisis.

Although dietary modification and behavioral approaches are the initial and mainstay approaches to addressing the adolescent obesity problem, bariatric surgery is becoming more appealing as an option. Adolescents currently represent less than 1 % of patients undergoing bariatric surgery [4]. For adolescents, bariatric surgery is recommended in patients who have $\text{BMI} \geq 35 \text{ kg/m}^2$ with severe comorbidities such as type 2 diabetes, moderate to severe sleep apnea, pseudotumor cerebri, or $\text{BMI} \geq 40 \text{ kg/m}^2$ with mild comorbidities such as hypertension, dyslipidemia, insulin resistance, etc. [5–7]. Adolescents considering surgery are required to have attained 95 % of adult stature, demonstrate commitment to psychological evaluation, avoid pregnancy for 18 months after surgery, and adhere to postoperative nutritional guidelines [5–8]. The two most common bariatric procedures currently used are laparoscopic adjustable gastric banding and laparoscopic Roux-en-Y gastric bypass (LRYGB). In the recent years,

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laparoscopic sleeve gastrectomy has quickly gained popularity as well [6, 7].

The aim of this study was to evaluate the outcomes of RYGB in patients between the ages of 17 and 19 and compare to those of matched controls over the age of 20.

Material and Methods

Between January 1, 2005 and May 31, 2012, 2,048 patients underwent LRYGB at our institution. With approval of the Institutional Review Board, a retrospective chart review was completed in these patients. Patients were included into the study population if they were less than 20 years of age. These patients were then matched to a control population of patients who were 20 years of age or greater for similar gender, preoperative BMI, preoperative comorbidities, and follow-up interval.

LRYGB was performed by one surgeon according to the National Institutes of Health criteria for the management of morbid obesity. Surgical eligibility was established for a minimum BMI of ≥ 35 kg/m² with serious comorbidities (e.g., type 2 diabetes mellitus, obstructive sleep apnea) or BMI of ≥ 40 kg/m² with or without any comorbidity. It has been recommended that adolescent candidates for bariatric surgery should be severely obese (BMI ≥ 40 kg/m²), have attained a majority of skeletal maturity (generally ≥ 13 years of age for girls, and ≥ 15 years of age for boys), and have comorbidities related to obesity that might be remedied with durable weight loss [6–9]. In the present study, surgical eligibility for patients aged of 17 to 19 was the same as patients with the age greater than 20, as the patients would have acquired a majority of skeletal maturity by the age of 17. All patients underwent preoperative work-up, including ultrasound of the gallbladder and attempted weight loss by conventional means for greater than 6 months based on historical accounting from patients. Patients were followed up at our office clinic at 1, 3, 6, and 12 months postoperatively and yearly thereafter. Follow-up visits included weight measurement, clinical history and examination, and laboratory tests for blood glucose as well as nutrition deficiency. Comorbid conditions were recorded at each visit. Improvement of hypertension (HTN), diabetes mellitus (DM), and hypercholesterolemia (HCL) was defined as reduced number or dosage of medications. Remission of HTN was defined as blood pressure below 140/90 mmHg without medication. Remission of DM was defined as fasting glucose level below 126 mg/dl without medication. Remission of HCL was defined as LDL level below 160 mg/dl. Improvement of obstructive sleep apnea (OSA) was defined as less or no more usage of continuous positive airway pressure treatment.

Data points included age, gender, preoperative BMI, follow-up BMI, preoperative comorbidities, resolution of

comorbidities at follow-up, and complications. All data for age and BMI are demonstrated as mean \pm standard deviation unless otherwise noted. Statistical analysis was performed using descriptive analysis and two-tailed Student's *t* test, with $p < 0.05$ regarded as statistically significant.

Surgical Technique

Laparoscopic Roux-en-Y Gastric Bypass Technique

LRYGB was performed creating a 15–30-cc gastric pouch, with one transverse and four vertical firings of a linear stapler, on average. The jejunum was transected at 40 cm from the ligament of Treitz. The Roux limb was measured for 75 cm for patients with BMI less than 45 kg/m², 100 cm for BMI between 45 and 55 kg/m², and 150 cm for BMI over 55 kg/m². The Roux limb length was based on preoperative BMI only, and no difference was made between the adult and adolescent population. Jejunojejunostomy was created using a linear stapler as well, and the Roux limb was oriented in an antecolic, antegastric fashion. The gastrojejunal anastomosis was created using the linear stapler, and no buttress material was used. The staple line was reinforced with a running stitch of 2-0 Polysorb.

Results

Of the 2,048 patients, 15 patients were found to fit the inclusion criteria for the study population. One patient was lost to follow-up and excluded from the data analysis. Our patients included 13 females and 1 male with a mean age of 18.4 ± 0.8 years (range, 17–19; median, 18), mean BMI of 47.2 ± 11.1 kg/m² (range, 39.1–83.6; median, 43.6) at the time of LRYGB, and follow-up period of 15.7 ± 13.7 months (range, 1–48). These 14 patients less than 20 were then matched to 14 patients greater than 20 for gender ($p > 0.99$), preoperative BMI ($p > 0.96$), and follow-up interval ($p > 0.80$). Mean age was 42.4 ± 10.5 years (range, 22–59; median, 42) and mean BMI was 47.0 ± 10.4 kg/m² (range, 39.1–80.7; median, 43.6) in patients greater than 20. No patient older than 20 was lost to follow-up. Demographics of these patients are listed in Table 1. Mean postoperative BMI at last follow-up for the younger than 20 was found to be 33.8 ± 8.3 kg/m² (range, 23.2–53.4) and 29.5 ± 6.7 kg/m² (range, 22.8–44.9) for those older than 20. Mean postoperative BMI did not show statistical difference between the two groups ($p > 0.74$).

Data was recorded at postoperative checkups: 6, 12, 24, and 36 months from time of surgery. Mean percentage of excess weight loss (%EWL) in patients younger than 20 was 43.1 ± 14.6 % (range, 22.8–68.7), 70.5 ± 17.0 % (range, 49.1–99.5), 69.8 ± 17.3 % (range, 49.9–97.2), and 54.8 ± 8.5 %

Table 1 Demographics of patients over and under the age of 20

	Age <20	Age ≥20	<i>p</i> value
Number of patients	14	14	> 0.99
Male	1 (7.1 %)	1 (7.1 %)	
Female	13 (92.9 %)	13 (92.9 %)	
Age (years) ^a	18.4±0.8	42.4±10.5	< 0.01
BMI (kg/m ²) ^a	47.2±11.1	47.0±10.4	> 0.96
BMI at last follow-up (kg/m ²)	33.3±8.3	29.5±6.7	> 0.74
Follow-up (months)	15.7±13.7	17.4±20.0	> 0.80

BMI body mass index

^a At the time of laparoscopic Roux-en-Y gastric bypass

(range, 49.7–64.6). In patients older than 20, mean %EWL was 39.9±12.6 % (range, 13.0–58.1), 67.0±18.6 % (range, 54.6–99.8), 60.2±11.3 % (range, 43.9–74.5), and 56.2±6.2 % (range, 51.9–60.6). There was no difference in %EWL when comparing the groups: postoperative 6 months ($p>0.61$), 12 months ($p>0.71$), 24 months ($p>0.29$), and 36 months ($p>0.85$), respectively (Fig. 1).

With regard to DM, HTN, HCL, and OSA, nine (64.3 %) patients had no comorbid condition, and five (35.7 %) patients had one comorbidity among those younger than 20. Of those older than 20, eight (57.1 %) had no comorbid condition, five (35.7 %) had one to three, and one (7.1 %) had four comorbidities. Postoperatively, four patients in the younger than 20 group had improvement/resolution of comorbidities. Only one (7.1 %) patient in this group remained to have the same comorbid condition. In the older than 20 group, 11 (78.6 %) patients had no comorbid condition, and three (21.4 %) remained to have one to two comorbidities postoperatively. Due to a small number of patients, no statistical difference was found between preoperative and postoperative mean number of comorbidities in either

group ($p>0.07$ and $p>0.11$). Cumulative of comorbid conditions is shown in Fig. 2.

No complication was noted in these two groups of patients during the period of follow-up. However, one patient in each group required a revisional surgery for weight regain. One patient who was younger than 20 had a BMI of 83.6 kg/m² at the time of LRYGB and showed BMI of 53.4 kg/m² and %EWL of 49.9 % at 46 months after the procedure. As the upper gastrointestinal (UGI) study showed dilated pouch and anastomosis, this patient underwent revision of the pouch, creation of new gastrojejunostomy, and placement of proximal pericardial patch ring [10] 47 months following LRYGB. This revision was complicated with vomiting and gastric outlet obstruction 35 days postoperatively, and the patient required a readmission for 2 days. She underwent upper endoscopy during the readmission, which showed impacted food bolus just above the lower esophageal sphincter. This was endoscopically removed, and she did well after discharge.

Another patient who was older than 20 had a BMI of 39.7 kg/m² at the time of LRYGB and showed BMI of 29.0 kg/m² and %EWL of 60.6 % at 36 months after the procedure. However, she regained 8.8 kg within a period of 6 months and stated that she was feeling hungry every 2–3 h 24 months later. The UGI study showed dilated pouch and anastomosis, fast emptying of the contrast, as well as dilated blind limb. Thus, she underwent revision of the pouch, creation of new gastrojejunostomy, and placement of proximal pericardial patch ring [10], as well as resection of the dilated blind limb. She did well and showed BMI of 25.9 kg/m² and %EWL of 78.0 % 6 months following the revision.

Discussion

A multitude of studies have shown obesity to be pandemic in the adolescent population [1–3]. Although 20–30 % of obese

Fig 1 Comparison of percentage of excess weight loss following Roux-en-Y gastric bypass between patients less than the age of 20 and greater than the age of 20

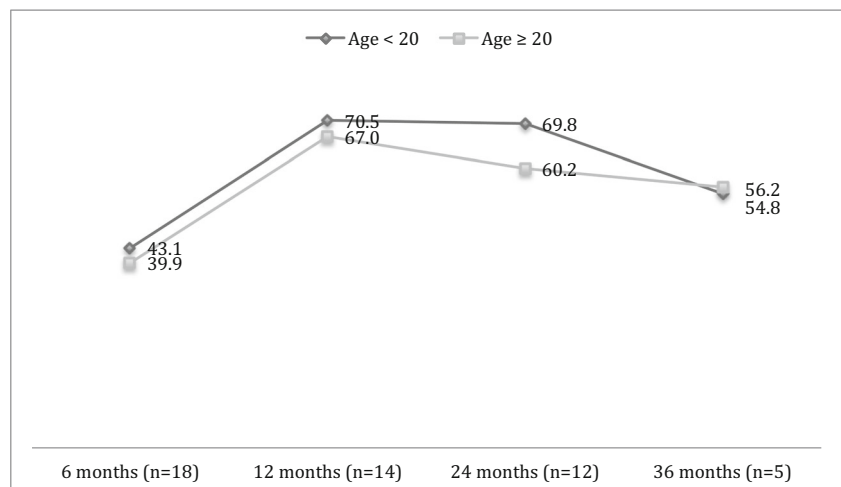
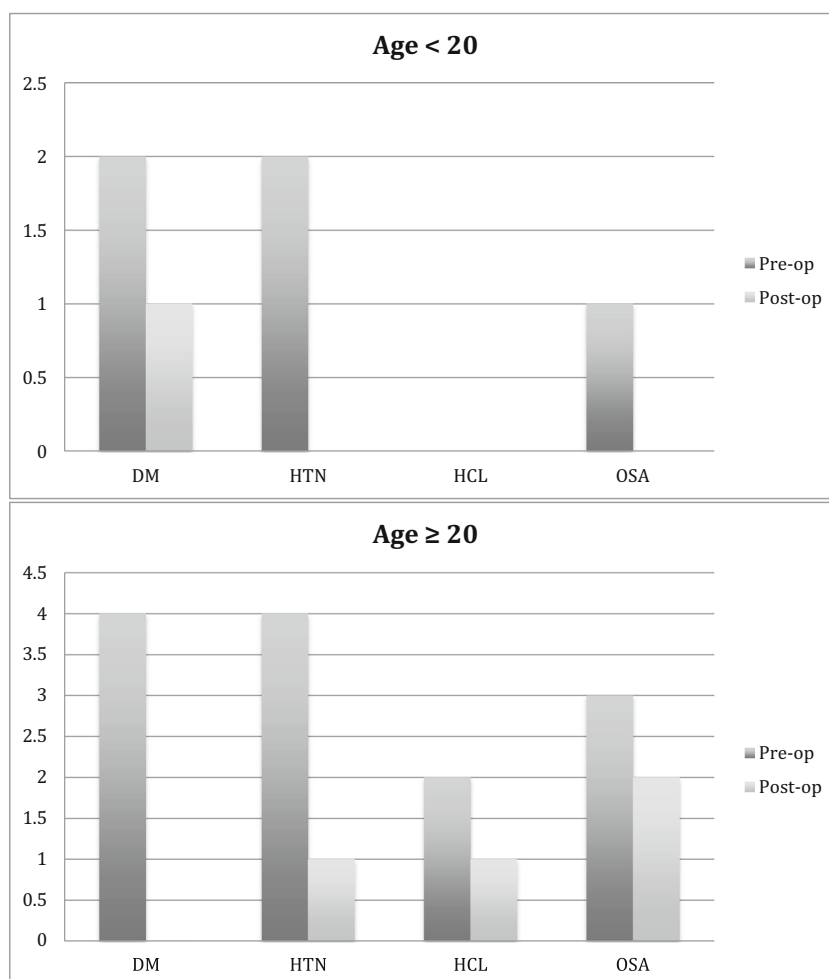


Fig. 2 Comparison of improvement/resolution of comorbidities following Roux-en-Y gastric bypass between patients under the age of 20 and greater than the age of 20. *DM* diabetes mellitus, *HTN* hypertension, *HCL* hypercholesterolemia, *OSA* obstructive sleep apnea



adolescents are reported not destined to be obese adults, majority will remain obese [11, 12]. Obesity in adults is associated with significant health risks specifically OSA, DM, HTN, and increased mortality [13]. Bariatric surgery for the adult population has been established as a means of treating not only obesity but also the comorbidities that accompany this disease [14]. Studies have established that bariatric surgery is beneficial for adolescents with regard to weight loss, resolution of comorbidities, and improvement in quality of life [5, 15–20]. Weight loss in adolescents after bariatric surgery mirrors weight loss in adults where there is an average of 50–60 % of excess weight loss in the first year and up to 75 % of excess weight loss by the end of the second year [5, 15]. The absolute BMI reduction in adolescents after surgery is approximately 35 % regardless of the BMI before surgery [5]. Much like adults, after surgery, there are resolutions of comorbidities in adolescents. HTN resolves in 50–100 % of adolescents, type 2 DM resolves in 91 %, and dyslipidemia in 88 % [16–18]. Other positive changes include reduction in triglyceride and total cholesterol levels and improvement in arthropathies, sleep apnea, and urinary incontinence [5, 15]. Bariatric surgery in this population must be

continuously studied, followed, and closely monitored for beneficial outcomes and detriments, as despite many positive improvements, nutritional issues are still of a concern in adolescents. The most common concerns are dehydration and protein deficiency [5, 21]. Other nutritional concerns include B vitamins, fat-soluble vitamins, and calcium deficiencies [5, 22–24].

Our study consists of adolescents in the upper range of age by definition (http://www.who.int/topics/adolescent_health/en/). Our younger than 20 patient population already reached majority of their skeletal maturity at the time of RYGB. However, we wanted to compare their results as adolescents to the adults for psychological and behavioral points of view. This study confirms previous reports that gastric bypass surgery for severely obese adolescents is effective with regard to weight loss and safe to perform with a low complication rate [5, 9, 20, 25, 26]. The study exemplifies how patients under the age of 20 have a similar rate of excess weight loss over time when compared to matched patients over the age of 20. With regard to weight regain, both group of populations had one patient that required revisional surgery. Thus, this study showed that patients

between the ages of 17 and 19 and those above 20 have similar response to LRYGB with regard to weight loss and maintenance of weight reduction.

The existing literature has popularized the idea that adolescents undergoing bariatric surgery should expect to have the same resolution of comorbidities as seen in the adult population [5, 15–18, 25–29]. Our study coincided with the literature with regard to improvement/resolution of comorbidities in the 17–19 years of age population. We should note that this study was missing younger adolescent patients and included only a small number of patients. In the current study, 80 % of comorbidities (HTN, DM, and OSA) showed either improvement or remission in patients younger than 20. We found that patients under the age of 20 had a smaller number of comorbidities when compared to the adult population to begin with preoperatively. This was understandable as the patients were significantly younger than the adult group and did not live long enough to develop more comorbidity. Clearly, further long-term studies need to be completed concerning the topic of comorbidity resolution as well as development of de novo comorbid condition postoperatively in this age group. Currently, Inge et al. [30] have examined 242 adolescents for perioperative complications and showed that bariatric surgery is safe in this population. Their study, the Teen-Longitudinal Assessment of Bariatric Surgery (Teen-LABS) Study, will also follow this population over time in an attempt to answer the question of comorbidity resolution.

This study has several limitations that should be considered when interpreting the results. First is the small study size that does not allow for adequate power or proper statistical analysis. This is an inherent problem regarding the topic of bariatric surgery in the adolescent population, as the operation is not performed in great volume. Next, the retrospective collection of our data, the case-control study design, the fact that all patients came from a single surgeon and center are additional limitations to the study.

This study was designed to compare the effectiveness and safety of LRYGB in patients under the age of 20, with those that are older than 20 years of age. By definition of the World Health Organization, adolescents are 10–19 year of age, and our patients only consisted of patients with older ages from ages 17 to 19. However, by comparing these patients with a comparable group of adults, we believe that a perspective on the adolescent population was provided.

Conclusion

LRYGB in younger patients almost the age of 20 is both safe and effective when compared to matched adults with regard to

weight loss and improvement of comorbid conditions and complications. Additional larger prospective studies will be needed to further evaluate this topic.

Conflict of Interest None of the authors have conflicts of interest or financial ties to disclose.

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