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Laparoscopic sleeve gastrectomy as first-line surgical treatment for morbid obesity among adolescents☆

Aslam Ejaz [a,*], Pankti Patel [a], Raquel Gonzalez-Heredia [a], Mark Holterman [b], Enrique F. Elli [a], Robert Kanard [b]

[a] Department of Surgery, University of Illinois Hospital and Health Sciences System, Chicago, IL
[b] University of Illinois College of Medicine at Peoria, Peoria, IL

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ABSTRACT

Background: The increasing prevalence of obesity has necessitated the increasing use of bariatric surgery in the adolescent population. Outcomes following laparoscopic sleeve gastrectomy (LSG) among adolescents, however, have not been well-studied. We report outcomes following LSG as a first-line surgical therapy in patients under 21 years of age.
Methods: All patients who underwent LSG as a primary surgical option for morbid obesity were identified at the University of Illinois at Chicago between 2006 and 2014. Standard clinicopathologic and outcomes data were recorded.
Results: We identified 18 patients (13 females, 5 males) who underwent LSG. Mean patient age was 17.8 ± 1.7 years. Mean BMI among all patients was 48.6 ± 7.2 kg/m^2 and did not differ by gender ($P = 0.68$). One patient (5.6%) experienced a 30-day perioperative complication (pulmonary embolism). Median LOS following LSG was 3 days (IQR: 2, 3). 2 patients (11.1%) were readmitted within 30-days because of feeding intolerance that resolved without invasive intervention. At a median follow-up of 10.6 (range: 0–38) months, percent excess weight loss (%EWL) among all patients was 35.6%. Among patients with at least 2 years follow-up (n = 3), %EWL was 50.2%.
Conclusions: Laparoscopic sleeve gastrectomy in morbidly obese adolescents is a safe and feasible option. Short- and long-term weight loss appears to be successful following LSG. As such, LSG should be strongly considered as a primary surgical treatment option for all morbidly obese adolescents.
Level of evidence: Level IV.

Obesity affects over 1 in every 5 adolescents in the United States [1]. Several contributing factors have been attributed to this obesity epidemic including increases in caloric intake, changes in the composition of the diet, decreasing levels of physical activity, and changes in energy intake versus energy expenditure [2,3]. Obesity in this adolescent population has far-reaching detrimental health effects including an increased risk for cardiovascular disease, cancer, diabetes, osteoarthritis, sleep apnea, and chronic kidney disease [1–3]. In addition, psychosocial morbidities secondary to obesity are also well reported and include social marginalization, decreased self-esteem, and decreased quality of life [3].

Given the rise in obesity among adolescents, several non-surgical treatments have been investigated. These include dietary modification, physical activity, behavioral modification, and pharmacotherapy. Most of these interventions, however, have led to unsatisfactory short- and long-term results [4]. As such, the utilization of weight loss surgery for severely obese pediatric patients has increased in recent years [5]. Laparoscopic adjustable gastric banding (LAGB) and laparoscopic Roux-en-Y gastric bypass (LGBP) are among the most common weight loss operations performed among adolescents [4,6,7]. However, recent studies have shown that these operations have a high potential for serious complications [4]. While long-term comparative data among the three operations is lacking, recent data has shown an increase in the use of laparoscopic sleeve gastrectomy (LSG) in the adolescent population [5].

Several studies have shown promising outcomes with LSG among adolescents, however these largely have previously come from international institutions [8–11]. Until data published from the multi-institutional observational study produced by the Teen-LABS consortium, outcomes following LSG among morbidly obese adolescents in the United States have not been well studied. As such, we report outcomes following LSG as a first-line surgical therapy in patients under 21 years of age at our institution.

1. Materials and methods

1.1. Study population and data collection

A retrospective analysis of all patients <21 years of age who underwent a laparoscopic sleeve gastrectomy (LSG) between 2006 and 2014 were identified from the prospectively collected University of Illinois Hospital Pediatric Obesity database. Standard patient demographic and clinicopathological characteristics including age, sex, race, and obesity-related comorbidities (hypertension, type 2 diabetes,

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* Corresponding author at: Department of Surgery, University of Illinois Hospital, 840 South Wood Street, Suite 376 CSN, Chicago, IL, 60612. Tel.: +1 312 996 6765.
E-mail address: aejaz1@gmail.com (A. Ejaz).

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Table 1
Description of cohort.

	All (N = 18)
Age at LSG, years (IQR)	17 (16, 19)
Sex	
Male	5 (27.8%)
Female	13 (72.2%)
Race	
White	4 (22.2%)
Black	11 (61.1%)
Hispanic	3 (16.7%)
Preoperative BMI (IQR)	47.7 (41.8, 55.3)

IQR – interquartile range.

obstructive sleep apnea, hyperlipidemia) were collected. In addition to patient-level variables, data on length-of-stay (LOS) and the presence of an in-hospital perioperative complication was collected [12]. The University of Illinois Institutional Review Board approved this study.

1.2. LSG patient qualifications and management

Morbidly obese adolescent patients <21 years of age (BMI ≥ 95th percentile for age and gender) were eligible for enrollment in the adolescent bariatric program. A comprehensive bariatric team comprised of pediatricians, dieticians, health educators, psychologists, and surgeons evaluated all patients. All patients underwent a medically supervised weight loss diet and exercise program prior to surgery. Patients who failed previous weight loss surgery (ie. LAGB) are not included in the current analysis.

1.3. Surgical approach

Two senior attending surgeons performed all the operations included in the current study. LSG was performed using a 36-French boogie approximately 4 cm from the pylorus. The sleeve gastrectomy was constructed using a linear stapler with tissue reinforcements.

1.4. Weight calculations and comorbidity assessment

Height and weight were recorded for each preoperative and postoperative patient visit. Follow-up visits were scheduled for at 2 weeks, 1 month, 3 months, and 6 months postoperatively followed by every 6 months thereafter. Comorbidites were assessed through a comprehensive history and physical examination as well as medication reconciliation. Comorbidities in this patient population (adolescents) were defined using previously published criteria from the Teen-LABS consortium [13]. Specifically, patients were considered to have diabetes mellitus if taking medications for the treatment of diabetes mellitus, had a high serum hemoglobin A_{1C} level, or had an abnormal fasting or impaired glucose tolerance test as previously defined [14]. Hypertension was recorded for patients with a systolic blood pressure in the 95th percentile or higher for their respective age/sex/height or if they were taking antihypertensive medications. Preoperative obstructive sleep apnea was diagnosed using polysomnography. Finally, hyperlipidemia was defined as patients taking medications for dyslipidemia.

Resolution of comorbidities is assessed using the American Society for Metabolic and Bariatric Surgery (ASMBS) standardized outcomes reporting in metabolic and bariatric surgery [15]. For diabetic assessment data that is incomplete (ie. no recent measures of glucose metabolism) in the absence of antidiabetic medications, these patients were recorded as partial remission.

Preoperative weight is defined as the weight immediately prior to LSG. As there is no standardized method to report weight-related calculations in adolescents, we utilized percent total weight loss (%TWL) and percent excess weight loss (%EWL) for all patients using the following calculations:

$$\%\text{TWL} = ((\text{preoperative weight} - \text{follow-up weight}) / \text{preoperative weight}) \times 100.$$

$$\%\text{EWL} = ((\text{preoperative weight} - \text{follow-up weight}) / (\text{preoperative weight} - \text{ideal body weight}) \times 100$$

$$\text{Ideal body weight} = \text{weight corresponding to the 85th percentile for the patient's age, gender and height.}$$

1.5. Statistical analysis

Categorical variables were reported as total frequencies and proportions; median and interquartile range (IQR) were used to describe continuous variables. Univariable analysis was conducted using Fisher's exact test, Kruskal–Wallis rank test, or ANOVA test as appropriate. All statistical analyses were performed using STATA version 13.0 (StataCorp, College Station, TX). All tests were two-sided and a *P*-value <0.05 was considered statistically significant.

2. Results

We identified 18 patients who underwent LSG as a primary weight loss procedure that met the inclusion criteria during the study period. Median age at the time of LSG was 17 years (IQR: 16, 19; range: 15–20) and the most patients were female (N = 13, 72%) (Table 1). Based on self-identification, nearly two-thirds of the patients were black (N = 11, 61.1%) with the remaining being white (N = 4, 22.2%) or other/multiracial (N = 3, 16.7%). Comorbidities were common with one-third of patients having type 2 diabetes at the time of presentation (N = 6, 33.3%); other comorbidities included hypertension (N = 4, 22.2%), hyperlipidemia (N = 1, 5.6%) and obstructive sleep apnea (N = 2, 11.1%).

At the time of LSG, median BMI was 47.7 (IQR: 41.8, 55.3) and mean BMI was 48.6 ± 7.2. Median hospital LOS following LSG was 3 days (IQR: 2, 3). Two patients (11.1%) experienced perioperative complications; one patient was diagnosed with a small sub-segmental pulmonary embolism (Clavien–Dindo grade 2) and one had a superficial surgical site infection (Clavien–Dindo grade 1). The 30-day readmission rate was 11.1% (N = 2) with both instances because of feeding intolerance that resolved without invasive intervention.

2.1. Weight loss outcomes

After a median follow-up of 10.6 months (IQR: 5.5, 19.5), overall %TWL and %EWL were 18.8% (IQR: 13.4, 30.4) and 35.6% (24.4, 55.6)

Table 2
Weight loss outcomes.

	6 months (N = 13)	1 year (N = 7)	2 years (N = 2)
Weight loss, kg (IQR)	25.7 (17.5, 33.4)	25.4 (15, 34.5)	37.7 (33.4, 42)
BMI, kg/m^2 (IQR)	41.7 (32.8, 45.1)	42.7 (29.7, 50.6)	37.4 (31.5, 43.3)
% Total weight loss (IQR)	17.4% (13.4, 24.6)	15.6% (9.8, 30.4)	32.4% (28.4, 36.5)
% Excess weight loss (IQR)	33.1% (24.4, 41.4)	24.9% (20.2, 69.6)	40.0% (18.6, 61.4)
BMI change, kg/m^2 (IQR)	-7.1 (−6.3, −12.1)	-8.6 (−4.6, −12.6)	-9.6 (−4.7, −14.5)

IQR – interquartile range.