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A multidisciplinary approach to laparoscopic sleeve gastrectomy among multiethnic adolescents in the United States

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ABSTRACT

Background: Childhood obesity has become a serious public health problem in our country with a prevalence that is disproportionately higher among minority groups. Laparoscopic sleeve gastrectomy (LSG) is gaining attention as a safe bariatric alternative for severely obese adolescents.
Study design: A retrospective study on morbidly obese adolescents that underwent LSG at our institution from 2009 to 2017. Primary outcomes were weight loss as measured by change in BMI and percent excess weight loss (%EWL) at 1 year after surgery, resolution of comorbidities and occurrence of complications.
Results: Thirty-eight patients, of whom 71% were female and 74% were ethnic minorities, underwent LSG between 2009 and 2016. Mean age was 16.8 years, mean weight was 132.0 kg and mean BMI was 46.7. There were no surgical complications. Mean %EWL was 19.4%, 27.9%, 37.4%, 44.9%, and 47.7% at 1.5, 3, 6, 9, and 12 month follow up visits, respectively. Comorbidity resolution rates were 100% for hypertension and nonalcoholic fatty liver disease, 91% for diabetes, 44% for prediabetes, 82% for dyslipidemia and 89% for OSA.
Conclusions: LSG is an effective and safe method of treatment of morbid obesity in adolescents as it can significantly decrease excess body weight and resolve comorbid conditions. Further studies are needed to investigate the long-term effects of LSG in adolescents.
Clinical research study: Descriptive case series with prospective database.
Level of evidence: IV.

Obesity is an increasing worldwide epidemic affecting 35% of adults and 17% of children in the United States with a prevalence that is disproportionately higher among minority groups [1]. Childhood obesity sets the stage for a lifetime of comorbid conditions including diabetes, hypertension, dyslipidemia, depression and non-alcoholic fatty liver disease [2–4]. For patients with morbid/severe obesity (BMI >40 kg/m^2) and repeated failed attempts at medical management and weight loss programs, surgical interventions have proven to be a more effective alternative for achieving long-term weight loss [5,6]. The success of weight loss surgery (WLS) in the adult population has led to interest in surgical interventions in severely obese adolescents [7]. Pediatric patients, similar to adults, have WLS options including Roux-en Y gastric bypass (RYGB) and laparoscopic adjustable gastric banding (LAGB), yet controversy surrounds these procedures in the pediatric population given their complication profiles. Studies of laparoscopic sleeve gastrectomy (LSG) in adult populations have shown comparable results to RYGB and LAGB with less morbidity [8,9]. As such, LSG is gaining popularity as a safe bariatric alternative for morbidly obese adolescents [10–12].

A multidisciplinary approach is now the standard of care for pediatric patients undergoing bariatric surgery, and includes pediatricians, dietitians, psychologists, social workers, bariatric and pediatric surgeons [13,14]. The aim of this study is to provide a descriptive account of LSG in adolescent patients at our institution.

1. Methods

1.1. Design

This was a retrospective analysis of severely obese adolescents who underwent LSG at our institution from January 2009 through February

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2017. Study protocol was approved by the Institutional Review Board at Stanford University Medical Center (IRB-32664).

1.2. Participants

Morbidly obese adolescents with a BMI ≥40 kg/m^2 or ≥35 kg/m^2 with severe comorbidities who had participated in at least six consecutive months of evaluation at a medically supervised pediatric weight clinic were considered for the LSG procedure. Informed consent was obtained from parents with assent from the subject if he or she was less than 18 years of age, or informed consent was obtained directly from the participant for those older than 18 years of age.

Participants were evaluated by a multidisciplinary team consisting of pediatricians, pediatric surgeons, psychologists, dietitians, and social workers. Prior to the procedure all patients received metabolic lab work, a sleep study to evaluate for obstructive sleep apnea (OSA), pulmonary function tests, an electrocardiogram, a psychological assessment, a bone age x-ray to determine growth status, and an endoscopy to assess for GERD.

Comorbidities were defined using standard criteria. Participants were classified as having hypertension if they had systolic blood pressure (SBP) >140 mmHg and/or diastolic blood pressure (DBP) >90 mmHg at a minimum of two independent clinical evaluations, or if they reported the use of blood pressure lowering medication. Remission of hypertension was considered with two independent normal blood pressure values without medications. Diabetes was defined as a hemoglobin A1c ≥6.5%, a fasting plasma glucose ≥126 mg/dL, reported use of oral glucose lowering medication or insulin, or a previous diagnosis of diabetes [15]. Prediabetes was defined as hemoglobin A1c ≥5.7% but <6.5% or a fasting plasma glucose ≥100 mg/dL but <126 mg/dL. Remission of diabetes was considered with hemoglobin A1c <5.7, fasting glucose <100 mg/dL without hypoglycemic medications. Patients were classified with dyslipidemia with a low-density lipoprotein (LDL) cholesterol level of ≥130 mg/dL, high-density lipoprotein (HDL) cholesterol level of <40 mg/dL or a triglyceride level of ≥130 mg/dL [16,17]. Also, patients taking lipid lowering medication or previously diagnosed by a physician were classified as having dyslipidemia. Remission of dyslipidemia was considered with LDL <130, HDL >40 or triglyceride < 130 without medication. OSA was defined as an apnea-hypopnea index <2 [18]. Resolution of comorbidities was evaluated clinically at each follow-up visit, and biochemically at select intervals. Nonalcoholic fatty liver disease (NAFLD) was defined as elevated liver function tests in the setting of morbid obesity and no other obvious causes of liver disease [19]. These patients underwent liver biopsy during the weight loss procedure. Resolution or improvement was monitored via laboratory results. No liver biopsies were performed postoperatively.

The laparoscopic sleeve gastrectomies were performed by three pediatric surgeons who were trained in the procedure during fellowship. Their experience within adolescent bariatric surgery ranges between 3 and 8 years. In addition, an adult bariatric surgeon with more than 15 years of experience in bariatric surgery proctored approximately 50% of the procedures. During the gastrectomy, an 11.4 mm diameter adult endoscope was utilized both as a bougie as well as a visual monitor in order to avoid strictures. The gastrectomy was performed using standard endoGIA staplers, starting at about 6–7 cm from the pylorus. All patients had an abdominal drain in the vicinity of the staple line that was removed before discharge, and underwent an upper gastrointestinal contrast study on post-operative day 1.

1.3. Follow up

Postoperative visits with the surgeon were scheduled at 2 weeks and 1.5, 3, 6, 9 and 12 months and annually thereafter. All patients were also carefully followed by a dietitian, psychologist, and the pediatricians at similar intervals.

1.4. Statistical analysis

Data were analyzed using Statwing Inc. (www.statwing.com). Normally distributed continuous variables were described using mean ± standard deviation. Categorical variables were described using frequency distributions and are presented as percentages.

2. Results

A total of 38 adolescent patients underwent LSG between January 2009 and February 2017; 71% of patients were female and mean age was 16.8 years with a range of 13.7–19.4 years, and 74% were ethnic minorities (55% Hispanic, 11% African-American, 5% Native-American, 3% Hawaiian) and 47.4% received public insurance. Average weight was 132.0 kg and average BMI was 46.7. All patients had at least one preoperative comorbidity including type 2 diabetes, prediabetes, hypertension, dyslipidemia and OSA (Table 1).

On average the time of operation was 99.8 min and mean length of stay (LOS) was 3 days. Overall there were no serious surgical complications. One patient had concurrent resection of a duodenal mass that was causing moderate external compression of the duodenum and was found to be heterotopic pancreatic tissue. This patient had a previous history of chronic pancreatitis of unknown origin. In addition, he developed acute pancreatitis on postoperative day 5 and had a prolonged length of stay while receiving total parenteral nutrition. Since discharge the patient has had no further complications and has been asymptomatic. Two patients were readmitted during the 12-month surveillance period, one for dehydration and the other for an anaphylactic reaction to a food There no staple line leaks or strictures. There was no mortality.

The average weight loss was 13.1, 18.6, 25.1, 29.3 and 32.0 (kg) at 1.5, 3, 6, 9 and 12 months, respectively. Mean %EWL was 19.4%, 27.9%, 37.4%, 44.9%, and 47.7% at the 1.5, 3, 6, 9, and 12 month follow up visits, respectively (Table 2).

There was notable remission of comorbidities for the majority of participants when assessed one year after LSG. Twelve out of 12 subjects experienced resolution of hypertension. Five out of five patients had resolution of nonalcoholic fatty liver disease. Ten out of 11 participants had a resolution of diabetes. The one subject without resolution did show improvement in their diabetes control, with a decrease in their Hemoglobin A1c level postoperatively. Nearly half of participants (4 out of 9) with prediabetes went into remission. Of 22 patients,

Table 1
Preoperative demographics.

N	38
Mean age at surgery (y)	16.8 + 1.3
Min age (y)	13.75
Max age (y)	19.4
Gender, n (% Female)	27 (71.1%)
Race, n (%)	
Non-Hispanic White	10 (26.3%)
African American	4 (10.5%)
Hispanic	21 (55.3%)
Hawaiian	1 (2.6%)
Native American	2 (5.3%)
Insurance, n (% public)	18 (47.4%)
Mean BMI kg/m^2	46.7 + 5.7
Mean Weight (kg)	132.0 ± 24.6
Mean time of operation (min)	99.8 ± 26.1
Mean length of stay (days)	3.0 ± 1.0
Comorbidities, n (%)	
Type 2 diabetes	11 (28.9%)
Prediabetes	9 (23.7%)
Hypertension	13 (34.2%)
Dyslipidemia	22 (57.9%)
NAFLD	5 (13%)
Obstructive sleep apnea	
with CPAP	18 (47.4%)
without CPAP	16 (42.1%)