

Mid-Term Follow-Up after Laparoscopic Sleeve Gastrectomy in Obese Adolescents

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ABSTRACT: **Background:** Laparoscopic sleeve gastrectomy (LSG) is gaining credibility as a simple and efficient bariatric procedure with low surgical risk. Since surgical treatment for morbid obesity is relatively rare in adolescents, few results have been accumulated so far.

Objectives: To prove the safety and efficacy of LSG surgery in an adolescent population

Methods: Data were prospectively collected regarding adolescent patients undergoing LSG. All patients underwent pre- and postoperative medical and professional evaluation by a multidisciplinary team.

Results: Between the years 2006 and 2011, 32 adolescents underwent LSG in our center (20 females and 12 males). Mean age was 16.75 years (range 14–18 years), mean weight was 121.88 kg (83–178 kg), and mean body mass index 43.23 (35–54). Thirty-four comorbid conditions were identified. LSG was the primary bariatric procedure in all the patients. Mean operative time was 60 minutes (range 45–80 min). There were two complications (6.25%): an early staple line leak and a late acute cholecystitis. There were no deaths. Mean percent excess weight loss at 1, 3, 6, 9, 12, 24, 36, 48, and 60 months post-surgery was 27.9%, 41.1%, 62.6%, 79.2%, 81.7%, 71%, 75%, 102.9% and 101.6%, respectively. Comorbidities were completely resolved or ameliorated within 1 year following surgery in 82.4% and 17.6%, respectively.

Conclusions: LSG is feasible and safe in morbidly obese adolescents, achieving efficient weight loss and impressive resolution of comorbidities. Further studies are required to evaluate the long-term results of this procedure as well as its place among other bariatric options.

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KEY WORDS: laparoscopic sleeve gastrectomy (LSG), bariatric surgery, obesity, adolescents, bariatric surgery

and progressive increase in the proportion of obese adolescents [1,2]. During the early 1970s, 3%–6% of American children and adolescents were obese. By 2004, this number had increased to 16%–18% and in 2006 it was estimated to be 35%.

An Israeli survey of 3246 people aged 25–64 sampled in 1999–2000 showed that obesity rates increased with age and reached 22.4% in males and 40.4% in females at age 55–64 [3]. Another study [4] looked at the electronic records of children aged 5–7 in 39 pediatric primary care clinics in the years 2001–2004. Anthropomorphic measurements were performed in children who visited the clinic during the study period; 25.6% of them were found to be overweight and 11.9% were at risk of being overweight. A review of the situation in Israel found that 12% of Israeli adolescents aged 6–14 are overweight, with 2% of them obese [5]. Obesity is higher in boys and in children of Arab origin (compared to Jewish). Adolescents typically skip breakfast and give up physical activities as they grow older. They consume relatively low quantities of fruits while compensating their sugar needs with sweetened drinks [5].

The increased rate of adolescent obesity is especially troubling since obese children and adolescents have a 25% greater risk of progression to adult obesity [6] and may experience health problems before and during adulthood. Meyerovitch et al. [4] presented evidence that the number of laboratory tests and health care costs are increased in children with obesity or risk of obesity compared to normal-weight children. Obesity in adolescents is associated with hypertension, diabetes mellitus, hypercholesterolemia, fatty liver disease, obstructive sleep apnea, and premature cardiovascular disease [1,2,6–8]. Over 50% of overweight adolescents meet the criteria for the metabolic syndrome with insulin resistance and abdominal obesity. Dose-response correlation between body mass index during young adulthood and risk of death demonstrates a direct association between the existence of obesity-related health problems and increased mortality in adulthood [1,2,8]. Indeed, a twofold increase in the risk of mortality has been detected in obese adolescents as early as the fourth decade of life [1,2].

Obesity is a chronic and progressive disease, associated with related metabolic disorders, causing severe morbidity and mortality among children and adolescents. Population studies in the last few decades have demonstrated a dramatic

In addition, obese adolescents experience poor body image, psychological problems and a reduced quality of life. The traditional approach to obesity treatment in adolescence has been education towards lifestyle changes (i.e., improving eating habits and physical activity), diet programs and, rarely, pharmacological therapy. Unfortunately, these interventions suffer from poor effectiveness and negligible long-term success [1,2,6,7]. With the proven success of bariatric surgery and the explosive increase in procedures performed in the last two decades, the issue of bariatric surgery for the adolescent population is gaining interest but is still controversial [1,7,9-16]. A recent publication provides best-practice guidelines for pediatric obesity treatment [17]. Prominent points of concern are the effect of bariatric surgery on normal growth and sexual development, as well as the psychological implications [2,18].

Several groups have published their results on bariatric surgery in the adolescent population with laparoscopic adjustable gastric banding and laparoscopic Roux en-Y gastric bypass and found these procedures safe and effective [7,10-12]. Laparoscopic sleeve gastrectomy is a relatively new addition to the bariatric armamentarium, recently reported to be effective in adolescents as well [19,20]. When compared to laparoscopic adjustable gastric banding, the advantages of LSG are the absence of multiple adjustments, a greater weight loss, and an added favorable hormonal change contributing to satiety. In contrast to laparoscopic Roux en-Y gastric bypass, there is no malabsorptive component and vitamin deficiencies are infrequent.

We report here our initial experience with LSG in adolescents, expanding on perioperative and mid-term follow-up data.

PATIENTS AND METHODS

DATA COLLECTION

A prospective database of all bariatric procedures is meticulously kept at our institution. This database was queried for patients aged 14–18 years old who underwent the LSG procedure between January 2006 and December 2011. All adolescent patients met the criteria defined by the Israel Ministry of Health guidelines for bariatric surgery in this age group [21]. Database management and study protocol were approved by the institutional review board.

Patients were evaluated by a multidisciplinary team that included pediatricians, bariatric surgeons, dietitians, psychologists, and an endocrinologist.

SURGICAL TECHNIQUE

LSG was performed using a 4–5 port technique. The greater curvature was freed from omental and short gastric attachments using Harmonic Ace® ultrasonic shears (Ethicon,

Endo-Surgery, Cincinnati, OH, USA) commencing 5 cm proximal to the pylorus all the way up to the angle of His, with great care taken to fully mobilize the posterior fundus and expose the left crura. The stomach was then longitudinally resected alongside a 36F bougie (Pilling® Maloney Bougie Tungsten, Teleflex Medical, High Wycomb, UK) with multiple loads of endoscopic staplers (Endo GIA – Tyco, Covidien, or Echelon 60 – Ethicon). Postoperative swallow studies with water-soluble contrast (Telebrix Gastro®, Guerbet, France) were performed on the first postoperative day to verify unhindered passage through the sleeve and detect early leaks. When this study was satisfactory, patients were placed on clear liquids and were discharged on postoperative day 2 with detailed dietary instructions for a liquid diet for 1 week and progression to a pureed diet until the first office visit.

FOLLOW-UP

Follow-up visits with the surgeon were scheduled at 1, 3, 6, 9, and 12 months after surgery, and annually thereafter. All patients were also carefully followed by a designated dietician and a psychotherapist. A cognitive behavioral therapy program was mandatory as well. The Bariatric Analysis and Reporting Outcome System questionnaire (BAROS) [22] was performed 1 or 2 years after surgery. This was administered by the patient's specific therapist either at a scheduled office visit or telephonically.

STATISTICAL ANALYSIS

Analysis of data was performed using SPSS 11.0 statistical analysis software (SPSS Inc., Chicago, IL, USA). Normally distributed continuous variables were described using mean \pm standard deviation, whereas continuous variables with distributions significantly deviating from normal were described using median (minimum-maximum). Categorical variables were described using frequency distributions and are presented as frequency (%).

RESULTS

Between January 2006 and December 2011, 1192 patients underwent LSG in a multidisciplinary bariatric center in Israel. We identified 32 patients (2.68%) between the ages of 14 and 18 years (mean age 16.7). Twenty were female (62.5%). Mean (range) weight and BMI were 122 kg (83–178 kg) and 43.2 kg/m² (35–54 kg/m²), respectively. None of the patients had undergone a previous bariatric procedure. The mean operative time was 60 minutes (range 45–80 minutes).

There was one early leak diagnosed by a clinical picture of acute left shoulder pain and tachycardia on postoperative day 5, treated by resection of the leak site in the proximal stapler line and drainage. Another patient presented with acute

LSG = laparoscopic sleeve gastrectomy

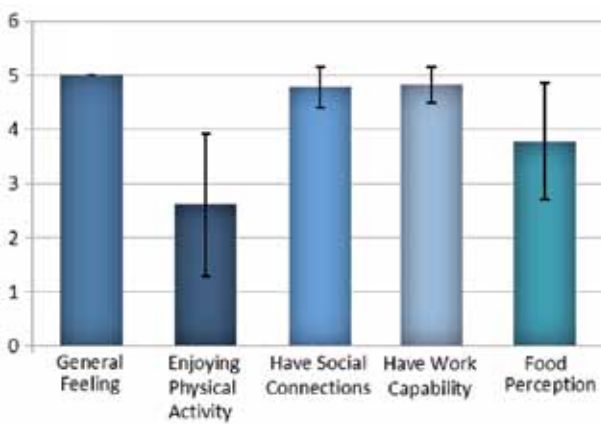
BMI = body mass index

Table 1. EWL% in adolescents after laparoscopic sleeve gastrectomy

Time (mo)	Mean EWL (%)	Min EWL (%)	Max EWL (%)	No. of patients
1	27.9	14.8	52.3	29
3	41.4	17.5	72.2	27
6	62.6	27.6	86.8	19
9	79.2	54.9	100	13
12	81.7	41.4	106.7	15
24	71	18.2	99	8
36	75.9	54.3	88.1	4
48	102.9	82.9	129.3	3
60	101.6	97.5	105.7	2

EWL (%) was calculated as (weight loss/baseline excess weight) x100.

Figure 1. Quality of life in adolescent patients after laparoscopic sleeve gastrectomy.



Quality of life was measured by the BAROS questionnaire 1–2 years after surgery

cholecystitis 10 months after surgery, at the age of 17; his weight loss was 82%EWL at the time. He underwent elective uneventful laparoscopic cholecystectomy.

The mean %EWL at 1, 3, 6, 9,12, 24, 36, 48 and 60 months was 27.9%, 41.1%, 62.6%, 79.2%, 81.7% , 71%, 75%, 102.9% and 101.6%, respectively [Table 1]. Twenty patients (62.5%) had one to four comorbidities including diabetes mellitus type 2, hypertension, obstructive sleep apnea, hyperlipidemia, asthma, and low back pain [Table 2]. Most preoperative comorbidities (82.4%) were completely resolved within 1 year after surgery, while the rest (17.6%) were ameliorated [Table 3].

BAROS questionnaires at 1 or 2 years following surgery were obtained in 22/31 (71%) and are elaborated in Figure 1. The sexual performance section of the questionnaire was omitted due to the participants’ age. All patients rated their self-satisfaction and social activities as excellent. It is interest-

%EWL = percent excess weight loss

BAROS = Bariatric Analysis and Reporting Outcome System

Table 2. Prevalence of major comorbidities among adolescent patients before laparoscopic sleeve gastrectomy

Patient no.	Gender	BMI	Age (yr)	Weight (kg)	DM	HTN	OSA	Hyperlipidemia	Asthma	LBP
1	F	48	15	116	+					
2	F	40	16	88.2					+	
3	M	46	18	134						
4	M	54	15	155						
5	F	49	16	123.2		+		+		
6	M	50	18	178		+				
7	M	40	18	98				+		+
8	M	38	16	83						+
9	M	44	18	130.2		+				
10	M	44	18	130						
11	F	49	17	129.5						
12	F	38	17	110				+		
13	F	37	18	98						+
14	F	41	18	116.6					+	+
15	M	47	17	173				+		
16	F	42	18	111						
17	F	48	18	128						
18	F	42	17	106						
19	F	37	17	112				+	+	+
20	F	36	15	98						+
21	F	36	15	100.7	+	+		+		+
22	F	40	14	102		+				+
23	F	40	15	112			+		+	+
24	F	40	17	112.1						
25	M	39	16	130		+	+	+		
26	F	53	17	156						
27	M	51	17	145						
28	M	43	17	138						
29	M	45	18	136				+	+	
30	F	44	15	121.6						+
31	F	45	18	132						
32	F	35	17	97.2		+				

BMI = body mass index, DM = diabetes mellitus, HTN = hypertension, OSA = obstructive sleep apnea, LBP = low back pain

ing to note that only a mild increase in physical activity scores was reported despite weight loss and rigorous encouragement for such activity by the entire team.

DISCUSSION

The medical and psychological consequences of adolescent morbid obesity are well documented and include premature morbidity and mortality [1,2,6,15,18,23]. Pediatric textbooks

Table 3. Resolution and amelioration of major comorbidities among adolescent patients within 1 year after laparoscopic sleeve gastrectomy

Comorbidity	No. of patients	Resolution	Improvement
Diabetes mellitus	2	2	
Hypertension	7	5	2
Obstructive sleep apnea	2	2	
Hyperlipidemia	8	6	2
Asthma	5	3	2
Low back pain	10	10	
Total	34	28	6
%	100	82.4	17.6

are being rewritten with chapters devoted to disease processes previously prevalent solely in the adult population. In light of this, prevention of morbid obesity in adolescents should be a top priority. Behavioral interventions in schools or specialty health care settings result in small-to-moderate short-term improvements which vary by treatment intensity and setting [1,2,15,18,24]. Regretfully, the same poor response was seen when these were supplemented by pharmacological agents such as sibutramine or orlistat, with side effects of varying severity [2]. Obese children have a 70% chance of becoming obese adults [23].

LSG is an effective treatment enabling significant weight loss and long-term weight control in adults [16]. It has been shown to improve both quality of life and longevity. LSG has been documented to effectively reduce cardiovascular risk factors in adolescent patients [20], with impressive remission rates of arterial hypertension (100%), insulin resistance (96.2%), dyslipidemia (58%), and type 2 diabetes mellitus (50%) [19].

Bariatric surgery for adolescents is practiced, albeit in small numbers. In the United States these surgeries account for 0.7% of adult cases performed each year [17]. Consequently, there is insufficient data regarding its merits and drawbacks. In the current study, the outcome of LSG in adolescents, as measured by excess weight loss, was equal to that reported for LRYGB [10-12]. Our results are also similar to those reported in the literature for LSG [19,20] and superior to those for LAGB [7,13]. In all adolescent patients in the cohort presented, either complete resolution or amelioration of comorbidities of obesity was observed [Table 3]. This compares well with the results obtained for LSG [19,20], LAGB [23] and LRYGB [10-12].

Several authors have elaborated on the merits and advantages of LSG as a stand-alone or putative first-stage bariatric option. When considering the specific population discussed here, namely adolescents, some of these advantages are more prominent. The lack of malabsorption is especially important in young individuals whose growth and maturation are not

yet complete. In this patient population, safety is of even greater significance as the life expectancy is longer than that of their adult counterparts, and LSG is probably safer than LRYGB. When compared to LAGB, the safety and malabsorption issues are still debated, but LSG is advantageous since continuous band manipulation is not required and there is less vomiting and better quality of life.

Of special interest to us was to evaluate the patients' self-esteem after surgery since adolescents are very sensitive regarding their body image, and a positive change might indicate an additional motivation for maintaining a healthy lifestyle. Indeed, the BAROS questionnaire conducted at 12–24 months post-surgery revealed that the vast majority of the adolescents felt good about themselves, their social condition, and their attitude to food. Boza et al. [19] showed similar results using BAROS, demonstrating very good or good quality of life after surgery (40% and 60%, respectively). Kim and co-workers [18] reported frequent abnormal eating behaviors in pre-surgery adolescents that included binge eating (48%), rapid eating (44%), eating-associated guilt (36%), eating until uncomfortably full (36%), loss of control (24%), eating when not hungry (24%), and eating alone (20%). It is interesting to note that adolescents' attitude to food was dramatically improved after surgery, whereas little effect was observed in their attitude to physical activity. These observations were not statistically significant, probably due to the small sample size, but more investigational efforts are warranted.

An updated position of the committee of the American Society for Metabolic and Bariatric Surgery (ASMBS) was recently put forward, recommending LSG as an approved bariatric procedure [16]. We posit that this may also be extended to adolescents.

The obvious limitation of this work is the small number of patients and the relatively short follow-up. Nonetheless, LSG has been shown to be safe and effective in this rather controversial population.

CONCLUSIONS

Research evaluating the treatment of morbidly obese adolescents has improved in terms of quality and quantity in the past several years; however, it is still questionable. LSG seems to be an excellent, safe and efficient bariatric procedure for the treatment of morbid obesity in adolescents. Additional long-term studies are necessary to confirm LSG surgery as a durable procedure. When considering this important public health issue, policy makers should not ignore the importance of obesity prevention efforts as well as treatment.

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LRYGB = laparoscopic Roux en-Y gastric bypass

LAGB = laparoscopic adjustable gastric banding

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“Don’t be yourself. Be someone a little nicer”

Mignon McLaughlin (1913-1983), American journalist and author

“A strong nation, like a strong person, can afford to be gentle, firm, thoughtful, and restrained. It can afford to extend a helping hand to others. It is a weak nation, like a weak person, that must behave with bluster and boasting and rashness and other signs of insecurity”

Jimmy Carter (born 1924), 39th U.S. President and Nobel laureate. He and his wife Rosalynn established the Carter Center in 1982, a non-profit organization that works to advance human rights. He travels extensively to conduct peace negotiations, observe elections, and advance disease prevention and eradication in developing nations