

## Original Research Article

# Comparison of the effects of laparoscopic sleeve gastrectomy in adults and adolescents

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### ABSTRACT

**Background:** Obesity is an increasing problem worldwide regardless of age. Bariatric surgery is highly effective both in the treatment of obesity and in the improvement of obesity-related comorbidities. Laparoscopic sleeve gastrectomy is gaining popularity in both adolescents and the elderly.

**Methods:** A total of 64 patients who underwent laparoscopic sleeve gastrectomy, aged under 19 and older 65 between March 2013 and December 2019 were enrolled in this retrospective study. Demographic characteristics were recorded in all patients.

**Results:** Between March 2013 and December 2019, 64 patients who underwent laparoscopic sleeve gastrectomy were enrolled in this study. Forty-five patients were smaller than 19 years old and 19 patients were older than 65 years old. After 1-year follow-up, there was a significant improvement in glucose, insulin level, excess weight loss and body mass index in both groups ( $p < 0.001$ ). There was no significant difference in insulin levels ( $p = 0.2$ ) and body mass index ( $p = 0.94$ ) between two groups.

**Conclusions:** Careful patient selection after adequate risk versus benefit evaluation by an expert multidisciplinary team is essential. Laparoscopic sleeve gastrectomy is an effective treatment for obesity and its related comorbidities in both adolescents and adults.

**Keywords:** Adults, Adolescents, Bariatric surgery, Sleeve gastrectomy

### INTRODUCTION

The prevalence of obesity reaches epidemic rates worldwide, regardless of age groups. The number of obesities is increasing in the pediatric and adolescent groups. This poses a financial and health burden for the future of society.<sup>1</sup> Recent studies have shown that childhood obesity has tripled since the 1980s. One in 6 children or adolescents between 2 and 19 years of age is considered to be obese.<sup>2,3</sup> The incidence of obesity has increased in the USA in the last 5 years. It has been shown that 68% of the adult population is overweight

(body mass index (BMI)  $> 25 \text{ kg/m}^2$ ) and 35.7% is obese (BMI  $> 30 \text{ kg/m}^2$ ).<sup>4,5</sup> Bariatric surgery (BS) is highly effective both in the treatment of obesity and in the improvement of obesity-related comorbidities.

Diseases such as type 2 diabetes mellitus (T2DM), coronary artery disease (CAD), hypertension (HT) due to obesity are more common in both childhood and adults. The prevalence of T2DM worldwide is 8.3% and is expected to double in 2030 to 17.6%.<sup>6</sup> Obese patients in childhood are more likely to develop diseases such as CAD, T2DM, HT in the future. This rate is lower in non-

obese children.<sup>7</sup> In the elderly population, predisposition to comorbidities due to obesity and related deaths are more common than in the younger population.<sup>8</sup> A number of non-surgical methods can be used in the treatment of obesity and related diseases and the development of future diseases such as T2DM, CAD may be reduced.<sup>9</sup> Nevertheless; in the treatment of obesity, the results of drug treatments, lifestyle changes and behavioral treatments in terms of weight loss and long-term efficacy were poor.<sup>10,11</sup>

The aim of this study is to compare the effects of laparoscopic sleeve gastrectomy (LSG) between adults and adolescents.

## METHODS

The need for informed consent was waived because of the retrospective nature of the study. The study was conducted according to the principles of the Declaration of Helsinki. The medical records of the Bariatric Center of Excellence were retrospectively reviewed to identify all consecutive patients with morbid obesity smaller than 19 years old and older than 65 years old who underwent LSG between March 2013 and December 2019 at Ulus Liv Hospital. Patients who were smaller than 19 years old were referred to as group 1. Patients who were older than 65 years old were referred to as group 2.

All patients were considered fit for BS based on the guidelines of American Association for Clinical Endocrinologists, The Obesity Society, and the American Society for Metabolic and Bariatric Surgery.<sup>12</sup>

Patients fulfilling the following conditions were considered eligible for LSG; BMI  $\geq 40$  kg/m<sup>2</sup> or BMI  $>35$  kg/m<sup>2</sup> with comorbidities or BMI between 30-35 kg/m<sup>2</sup> with T2DM or metabolic syndrome. All patients were evaluated by a multidisciplinary team consists of a cardiologist, an endocrinologist and a pediatric endocrinologist, a dietetic, a psychologist, a pulmonologist and the anesthesiologist prior to surgery. Medical imaging was also performed (chest X-ray, abdominal ultrasonography and gastroscopy if it is necessary).

Adolescents were defined as individuals aged 10-19 years according to World Health Organization.<sup>13</sup> Inclusion criteria for the adolescent group were; morbidly obese adolescents aged 10-19 years who underwent LSG in the institution between March 2013 and December 2019. Blood analysis were performed preoperatively. Demographic data, BMI, comorbidities were recorded. Percentage of excess weight loss (EWL%) was also calculated. The ideal body weight was deemed equal to a BMI of 25. The patients were followed up by outpatient visits that were scheduled at 1st, 3rd, 6th, and 12th months postoperatively, and annually thereafter. The surgical technique has been reported in this article previously.<sup>14</sup>

## Statistical analysis

Analysis were conducted using Statistical Package for the Social Sciences 22.0 (SPSS Inc.; Chicago, IL, USA). The distribution of the variables was tested by Shapiro-Wilk test. Continuous variables with a normal distribution were expressed as mean and standard deviation values. Variables with non-normal distribution were expressed as median values with range. In the analysis of quantitative independent variables, Mann-Whitney U test was used. Friedman test was used to assess the differences between dependent quantitative variables. The results were evaluated in 95% confidence interval and  $p < 0.05$  was considered statistically significant.

## RESULTS

Between March 2013 and December 2019, 64 patients who underwent LSG were enrolled in this study. Forty-five patients were smaller than 19 years old (group 1) and 19 patients were older than 65 years old (group 2). The mean age for group 1 was  $17.36 \pm 1.88$ ; 35 (77.8%) patients were female. For group 2 the mean age was  $66.58 \pm 1.46$ ; 13 (68.4%) patients were female. The baseline characteristics are summarized in (Table 1). Hospital stay was the same in both groups 3 days.

**Table 1: Demographic characteristics and preoperative values.**

Parameters	Group 1 (n=45) (mean $\pm$ SD)	Group 2 (n=19) (mean $\pm$ SD)
<b>Gender (female/male)</b>	35/10	13/6
<b>Age (years)</b>	$17.36 \pm 1.88$	$66.58 \pm 1.46$
<b>Weight (kg)</b>	$123.24 \pm 23.55$	$124.92 \pm 30.48$
<b>BMI (kg/m<sup>2</sup>)</b>	$43.74 \pm 7.74$	$48.60 \pm 12.63$
<b>Insulin (<math>\mu</math>U/l)</b>	$31.55 \pm 16.54$	$18.10 \pm 10.28$
<b>Glucose (mg/dl)</b>	$95.11 \pm 10.66$	$140.11 \pm 68.90$

BMI body mass index, SD standard deviation

A significant increase was observed in EWL% during the 1-year follow-up period in both groups. The EWL% at the 1st, 3rd, 6th and 12th months in group 1 were  $28.91 \pm 9.74$ ,  $54.45 \pm 16.91$ ,  $75.23 \pm 23.70$ ,  $90.10 \pm 26.81$ ; respectively. It was statistically significant ( $p < 0.001$ ). Changes in EWL% were more modest; but significant ( $p < 0.001$ ) in group 2. At the 1st month EWL% was  $20.63 \pm 8.91$ . It increased  $37.39 \pm 16.88$ ,  $46.39 \pm 16.69$ ,  $63.28 \pm 23.69$  at the 3rd, 6th and 12th months respectively ( $p < 0.001$ ) (Table 2).

BMI changes in two groups were significant in themselves as EWL%. In group 1 at the preoperative, 1st, 3rd, 6th and 12th months, BMI values were;  $43.74 \pm 7.74$ ,  $38.43 \pm 6.85$ ,  $34.27 \pm 6.15$ ,  $30.68 \pm 5.57$ ,  $28.03 \pm 5.40$ ; respectively and statistically significant ( $p < 0.001$ ). In group 2, the mean BMI was  $48.60 \pm 12.63$  preoperatively.

At 1st, 3rd, 6th and 12th months, mean BMI were  $44.33 \pm 11.56$ ,  $39.39 \pm 9.88$ ,  $40.01 \pm 10.00$ ,  $34.71 \pm 9.87$ ; respectively ( $p < 0.001$ ). Whereas when authors compare

BMI changes (BMI preoperative – BMI 12th month) between two groups, there was not statistically significant difference ( $p = 0.94$ ) (Table 2).

**Table 2: Preoperative and postoperative values.**

Variable	Group 1	P value	Group 2	P value
<b>EWL%</b>				
1 <sup>st</sup> month	28.91±9.74	<0.001	20.63±8.91	<0.001
3 <sup>rd</sup> month	54.45±16.91		37.39±16.88	
6 <sup>th</sup> month	75.23±23.70		46.39±16.69	
12 <sup>th</sup> month	90.10±26.81		63.28±23.69	
<b>BMI (kg/m<sup>2</sup>)</b>				
preoperative	43.74±7.74	<0.001	48.60±12.63	<0.001
1 <sup>st</sup> month	38.43±6.85		44.33±11.56	
3 <sup>rd</sup> month	34.27±6.15		39.39±9.88	
6 <sup>th</sup> month	30.68±5.57		40.01±10.00	
12 <sup>th</sup> month	28.03±5.40		34.71±9.87	
<b>Insulin (μU/l)</b>				
preoperative	31.55±16.54	0.008	18.10±10.28	0.004
3 <sup>rd</sup> month	14.03±8.97		10.72±4.84	
6 <sup>th</sup> month	9.09±4.66		10.27±4.37	
12 <sup>th</sup> month	7.20±3.94		6.16±2.96	
<b>Glucose (mg/dl)</b>				
preoperative	95.11±10.66	0.015	140.11±68.98	0.012
3 <sup>rd</sup> month	85.57±7.07		114.20±27.64	
6 <sup>th</sup> month	86.05±6.53		108.83±25.34	
12 <sup>th</sup> month	83.39±8.42		93.50±9.13	

BMI body mass index, EWL excess weight loss

Decrease in fasting plasma glucose levels was observed compared with preoperative values in both groups. In group 1, preoperative mean fasting plasma glucose level was  $95.11 \pm 10.66$  mg/dl. At 3 months, mean fasting plasma glucose level was  $85.57 \pm 7.07$ , at 6 months  $86.05 \pm 6.53$  and at 12 months  $83.39 \pm 8.42$  ( $p < 0.001$ ).

Similarly, in group 2, changes in fasting plasma glucose levels were also significant. Fasting plasma glucose levels was higher in group 2 preoperatively, when compared to group 1 in the preoperative period ( $140.11 \pm 68.98$ ). At 3rd, 6th and 12th months fasting plasma glucose levels in group 2 were  $114.20 \pm 27.64$ ,  $108.83 \pm 25.34$  and  $93.50 \pm 9.13$  ( $p < 0.001$ ), respectively. When authors compared two groups according to fasting plasma glucose changes (glucose preoperative - glucose 12th month), there was statistically significant difference ( $p = 0.001$ ).

The fasting insulin level was significantly decreased compared to the preoperative level of  $31.55 \pm 16.54$  μU/l in group 1. It decreased by more than half of the initial value in the 3rd month ( $14.03 \pm 8.97$ ). Insulin levels continued to decline in the 6th ( $9.09 \pm 4.66$ ) and 12th ( $7.20 \pm 3.94$ ) months after surgery. It was statistically significant ( $p = 0.008$ ). In group 2, fasting insulin levels were decreased compared to preoperative levels  $18.10 \pm 10.28$ . At 3rd, 6th and 12th months fasting insulin

levels were  $10.72 \pm 4.84$ ,  $10.27 \pm 4.37$ ,  $6.16 \pm 2.96$  respectively. These findings were statistically significant ( $p = 0.004$ ). When two groups was compared according to insulin level changes (insulin preoperative - insulin 12th month), there was not statistically significant difference ( $p = 0.2$ ).

HT and T2DM were the most common comorbidities. In group 1, there were 4 diabetic and 6 hypertensive patients, whereas in group 2, there were 10 diabetic and 15 hypertensive patients. In group 1, did not have any morbidity; whereas in group 2, had 1 stenosis and 1 intraabdominal bleeding. The patient was managed with stenosis by endoscopic balloon dilatation and the patient with bleeding underwent surgery.

## DISCUSSION

Obesity and its related comorbidities are increasing worldwide and becoming an epidemic. It is thought that obesity currently affects at least 400 million adults and 30% of the US population will have a BMI greater than  $30 \text{ kg/m}^2$  in 2030.<sup>15,16</sup> Also, it is responsible for many comorbid diseases such as HT, T2DM, dyslipidemia, CAD.<sup>17</sup>

In the last 20 years, BS has become popular in the treatment of obesity and obesity related diseases.<sup>18-20</sup> BS

is very effective in maintaining and sustaining weight loss and reducing obesity-related comorbidities<sup>8</sup>. LSG is one of the most popular bariatric surgical treatment for obesity and related comorbidities worldwide due to its lower risk and easy technique.<sup>21</sup>

LSG is not only a restrictive procedure but also changes gastro-intestinal hormone levels, thus improves obesity-related comorbidities. LSG shows its effect by decreasing the volume of consumed food as a result of the reduction of ghrelin.<sup>22,23</sup>

Until recently, age was a relative contraindication because of uncertainty of benefits, and less tolerable complication rates.<sup>24,25</sup> There are very few publications on LSG in both the adolescent and the elderly groups in the literature. Recently, BS has been applied more to elderly and younger population. Recent publications suggest that BS in the elderly population is not only safe but also effective in weight loss and improvement of comorbidities.<sup>26-28</sup> Patient selection should be made by an experienced multidisciplinary team; in patients with a life expectancy of at least 10 years offers an ideal risk/benefit ratio.<sup>29</sup>

Similarly performing BS in adolescent population is controversial too. But recent studies have shown that BS has been proven to be a safe and effective treatment for obesity and improvement of obesity-related comorbidities.<sup>30,31</sup>

The effect of non-surgical methods on weight loss is poor.<sup>10</sup> LSG provides an effective and satisfactory weight loss in patients and leads to improved quality of life.<sup>32</sup> We have seen more modest weight loss and BMI decrease in the elderly population than in younger group, but still remain significant enough in the senior group. This can be explained by age-related decreased metabolic rate, decreased fat oxidation and reduced physical activity.<sup>33-35</sup> In this study, it was shown that EWL% increased significantly in the 1st year after LSG in both groups. According to the results, EWL% rates were better in the adolescent group. And the EWL% difference between two groups were statistically significant. This study results support the results of Luppi et al and Wang et al.<sup>36,37</sup>

One of the most important comorbidities related to obesity is T2DM and the other one is HT. LSG is also effective in the treatment of obesity-related comorbidities such as T2DM and HT.<sup>38</sup> One of the most important risk factors for impaired plasma glucose is family history of diabetes. Obese children have a 2.6-fold higher risk of prediabetes than non-obese children.<sup>39</sup> There was a significant decrease in glucose and insulin levels at the end of 1 year in both groups. Plasma glucose changes were significant between the two groups, whereas insulin changes were not. Early diagnosis and treatment of prediabetes also prevents the development of T2DM.<sup>40</sup> The effect of LSG on obesity-associated comorbidities,

such as T2DM and HT were not studied due to the small number of patients. This is one of the weakness of this study. And another limitation of the study is retrospective design with relatively small number of patients in both groups.

This study demonstrates that LSG is safe and effective for patients under the age of 19 and older than 65 years, leading to significant remission of weight loss and comorbidity. Metabolic improvement is also provided with weight loss. Especially in the selected patient group where non-surgical methods have failed, LSG is an effective procedure achieving and maintaining weight loss and improving its related comorbidities. Careful patient selection after adequate risk versus benefit evaluation by an expert multidisciplinary team is essential.

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