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Original Research Article

The state of dyslipidemia after laparoscopic sleeve gastrectomy

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ABSTRACT

Background: Obesity and dyslipidemia have a strong relation to the development of cardiovascular diseases. Bariatric surgery is directed towards the loss of patient's weight and resolution of comorbidities as hyperlipidemia. Laparoscopic sleeve gastrectomy, a feasible restrictive procedure, is one the most popular and successful operations for achieving this purpose. The aim of present study was to evaluate the effect of laparoscopic sleeve gastrectomy on the lipid profile, comparing preoperative with postoperative results 12 months after surgery.
Methods: This study included fifty morbidly obese cases that underwent laparoscopic sleeve gastrectomy (LSG). Preoperative and postoperative BMI and lipid parameters were documented and analysed at 12 months postoperatively.
Results: The mean age of the studied group ±SD was 32.7±9.2 years, female predominance was found. BMI improved significantly after the LSG procedure with a mean±SD of 32.2±4 kg/m^2. A significant improvement of dyslipidemia was found with a p-value (<0.001) regarding the mean level±SD of total cholesterol (TC) (180.5±25mg/dl), triglycerides (TG) (127.2±14.7mg/dl), low density lipoprotein (LDL) (94.2±14.5mg/dl) and high density lipoprotein (HDL) (48.4±5.6 mg/dl).
Conclusions: Laparoscopic sleeve gastrectomy is a feasible and successful operation in reducing the body weight and subsequently improving the dyslipidemia of the morbid obese individuals.

Keywords: Cholesterol, Dyslipidemia, Hyperlipidemia, Morbid obesity, Sleeve gastrectomy

INTRODUCTION

Obesity is a major health problem that became an epidemic with its drawbacks on the socioeconomic status of both individuals and countries. It is still considered one of the potentially preventable causes of death. It has a genetic and environmental aetiological factors. Severe obesity is that when BMI raises above 35 kg/m^2 and if fatty tissues exceeded 20% or 25% of total weight of the body in males or females, respectively.[1,2] Morbid obesity contributes clearly in a lot of related co-morbidities as osteoarthritis, bony pain, hypertension, coronary heart disease, hyperlipidemia, diabetes type 2, sleep apnea, infertility, depression and some malignancies, that led to overall increase in mortality rates mainly due to coronary heart disease.[2,3]

Metabolic syndrome, which has a direct relation to obesity, is a common risk factor for developing diabetes mellitus and cardiovascular diseases. Dyslipidemia is a well-known independent risk factor for atherosclerosis and cardiovascular disorders. It can be diagnosed by laboratory markers as total cholesterol (TC), triglycerides (TG), high density lipoprotein (HDL) and low-density lipoprotein (LDL).[3-5]

Modification of the lifestyle, by changing dietary habits and behavior therapy, is the first line against obesity followed by pharmacological drugs as a second line of non-surgical weight loss therapies. It was proved that these methods are effective modalities but not in severe obesity in the long run.[2,3,6,7]

Surgical treatment is the mainstay of the most effective long-term treatment of obesity and obesity-related disorders. The decrease in the body mass is contributed to many factors, of them, metabolic and hormonal changes, great reduction of food intake, decreasing intestinal compliance for food and creating malabsorption state.[1,2]

Laparoscopic sleeve gastrectomy (LSG) was first introduced as a part of a duodenal switch procedure. Afterwards, it was stated as a separate restrictive procedure for weight reduction in morbid obese individuals. It gained popularity among surgeons and patients due to its technical feasibility, lower rate of complications and achievement of satisfactory results.[2,4,7]

The effect of bariatric surgery on the lipid profile was and still one of the main concerns of the studies done in evaluating bariatric procedures. Some of these studies reported a beneficial changes of lipid profile after surgical intervention regardless the performed procedure.[3]

METHODS

In the period between May 2016 and February 2017, fifty morbidly obese patients were included in this prospective study and underwent laparoscopic sleeve gastrectomy procedure in General and Laparoscopic Surgery Department, Kasr Al-Ainy hospital, Cairo University. Assessment of lipid profile, namely triglycerides (TG), total cholesterol (TC), high density lipoprotein (HDL) and low-density lipoprotein (LDL), was done during the preoperative preparation then in the postoperative follow up period 1 year later.

The choice of the patients for the surgery was done taking into consideration the reported guidelines i.e. BMI $\geq$ 40 kg/m^2 or BMI $\geq$ 35 kg/m^2 with comorbidities. Excluded from this study all cases with endocrinal causes of obesity, sweet eaters, ages below 18 years or above 60 years and psychologically non-compliant patients.

Traditional five ports laparoscopic sleeve gastrectomy was performed by the same surgeons under the same settings for all cases after preoperative preparation. Pneumoperitoneum was achieved by Veress needle to 12-15 mmHg followed by introduction of the five ports and tilting the table leg downwards.

Under visualization by scope 30 degree, devascularization of the greater curvature was done using Harmonic scalpel or Ligasure device starting from 4-6 cm proximal to the pylorus till reaching left crus of the diaphragm. 36-Fr bougie was inserted prior to cartridges firing.

After division of the stomach, leakage test with methylene blue dye was done, complete hemostasis, retrieval of the resected stomach then insertion of a Nelaton drain beside the residual gastric tube.

Removal of ports and closure of skin were done. Patients were hospitalized for 1-2 days postoperatively then discharged with regular follow up schedule.

Statistical analysis

Data was entered and statistically analyzed on the Statistical Package of Social Science Software program, version 23 (IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.). Data was presented using range, median, mean and standard deviation (SD) for quantitative variables and frequency and percentage for qualitative ones.

Change of variables over time was assessed through Paired t-test for quantitative variables and McNemar test for binary qualitative variables. Spearman correlation coefficients were calculated to signify the association between different quantitative variables.

Comparison between groups was performed using independent sample t-test (if normally distributed) or Mann Whitney test (if not normally distributed). P values less than or equal to 0.05 were considered statistically significant

RESULTS

The study included 50 cases, their ages ranged between 19 and 56 years, mean age ± SD (32.7±9.2) with female predominance (76%). Mean preoperative BMI (±SD) was 47±4.9 kg/m2. Demographic profile of patient's data are shown in Table 1. Preoperative and postoperative laboratory values are summarized in Table 2.

It worth notes that either age or sex were significantly related to pre or postoperative values of lipid parameters ($p>0.05$) except for LDL and HDL that were significantly correlated with patients' gender (p-values were 0.047 and 0.044, respectively)

Table 1: Demographic data of the patients.

Parameters	Values
Demographic data	(N=50)
Age (years) range (mean±SD*)	19-56 (32.7±9.2)
Median (IQR**)	33 (25-38)
Sex n (%)	
Male	12 (24%)
Female	38 (76%)

***SD**= standard deviation, ****IQR**= interquartile range (range between 25th -75th percentiles)

There is a highly significant improvement of BMI and lipid profile parameters post LSG in comparison to preoperative levels with p value <0.001.

This improvement has no significant correlation with age or sex of the patients (p values > 0.05) as shown in Table 3.

Table 2: Preoperative and postoperative variables of the studied cases and % changes in these variables.

Variables	Pre-operative	Post-operative	% changes
BMI (kg/m^2)			
Range (mean±SD*)	39.6-57.1 (47±4.9)	26.6-41.5 (32.2±4)	(-31.5±4.1)
median (IQR**)	46.2 (43.1 - 50.5)	3129.4-33.7)	-32.3 (-34.5- -28.2)
TC (mg/dl)			
range (mean±SD*)	139-360 (231.2±46.9)	119-245 (180.5±25)	(-20.4±11.9)
median (IQR**)	217.5 (201-267)	180 (165-199)	-23 (-28.6- -13.5)
TG (mg/dl)			
range (mean±SD*)	101-231 (156±25.9)	100-169 (127.2±14.7)	(-17.2±11.2)
median (IQR**)	153 (138-166)	126 (120-136)	-20.4 (-24.7- -9.9)
HDL (mg/dl)			
range (mean±SD*)	29-60 (42.2±6.6)	39-60 (48.4±5.6)	(16.3±14.7)
median (IQR**)	41 (39-46)	48 (45-52)	14.1(4.8-25.6)
LDL (mg/dl)			
range (mean±SD*)	86-156 (120.4±20.2)	65-122 (94.2±14.5)	(-21±10.2)
median (IQR**)	123 (101-141)	98 (82-105)	-22 (-27.7- -15.5)

*SD= standard deviation, **IQR= interquartile range (range between 25th -75th percentiles), BMI=body mass index, TC= Total cholesterol, TG= Triglycerides, HDL= High density lipoprotein, LDL= Low density lipoprotein, % change = (Post-pre/pre)*100

Table 3: Comparison of different measures regarding pre and postoperative levels.

	Preoperative	Postoperative	Mean difference	95% CI of the difference	P value
BMI kg/m^2	47±4.9	32.2±4	-14.8	-15.4 to -14.1	<0.001
TC mg/dl	231.2±46.9	180.5±25	-50.7	-60.3 to -41.2	<0.001
TG mg/dl	156±25.9	127.2±14.7	-28.8	-34.4 to -23.2	<0.001
HDL mg/dl	42.2±6.6	48.4±5.6	6.2	4.8 to 7.7	<0.001
LDL mg/dl	120.4±20.2	94.2±14.5	-26.2	-30.3 to-22.2	<0.001

CI=confidence interval, p value < 0.05 is significant, <0.001 is highly significant

Table 4: Correlation of BMI with lipid profile at different situations.

	Pre-operative BMI	
	r	P
Pre-operative cholesterol	0.698	<0.001
Pre-operative triglycerides	0.728	<0.001
Pre-operative HDL	-0.747	<0.001
Pre-operative LDL	0.695	<0.001
	Post-operative BMI	
Post-operative cholesterol	0.374	0.007
Post-operative triglycerides	0.311	0.028
Post-operative HDL	-0.243	0.089
Post-operative LDL	0.331	0.019
	BMI % change	
Cholesterol % change	0.118	0.416
Triglycerides % change	0.100	0.491
HDL % change	-0.168	0.244
LDL % change	-0.270	0.058

There was a significant relation between BMI and lipid profile in the pre and postoperative periods with significant p values indicating the strong relation between loss of weight and improvement of dyslipidemia, apart from postoperative HDL value (p=0.089) as summarized in Table 4.

DISCUSSION

Dyslipidemia is one of the major disorders associated with morbid obesity. It is considered as a preventable risk factor for cardiovascular diseases.

It was defined by American Diabetes Association (ADA) as the presence of one or more of the following parameters: Total cholesterol (TC) ≥ 200 mg/dl, triglycerides (TG) ≥ 150 mg/dl, low density lipoprotein-cholesterol (LDL-C) ≥ 100 mg/dl and high density lipoprotein-cholesterol (HDL-C) <40 mg/dl.[8]

Before statins, metabolic surgeries were directed mainly toward the control of hypercholesterolemia, reducing its absorption and thus minimizing the risk of cardiovascular death after the previous attack of myocardial infarction as was reported by Buchwald on 1964 and Buchwald et al. on 1990.[9-11] The recent era of laparoscopic metabolic surgery procedures raised the hope in controlling dyslipidemia beside the reduction of the excess body weight and resolution of other co-morbid diseases.

The procedures ranged from mainly malabsorptive to completely restrictive. Commonly performed procedures are bilio-pancreatic diversion, adjustable gastric banding, sleeve gastrectomy and Roux-en-y gastric bypass, which are recently considered the most effective way for reduction of excess weight.[9]

By being one stage easily performed weight loss metabolic surgery, sleeve gastrectomy is widely accepted as an effective and popular procedure for treating morbid obesity and its related comorbidities.[12]

Abnormal lipid profile and the metabolic syndrome are associated with morbid obesity. It was reported by Pe'qiugnot et al. that laparoscopic sleeve gastrectomy is successful in lowering the incidence of metabolic syndrome.[13]

Also, LSG was found to achieve similar results as Reux-en-Y Gastric bypass in increasing weight loss and treating the associated comorbidities.[14]

Short and long term follow up proved safety and efficacy of LSG as reported by many published studies, even for elderly individuals above 60 years old.[15-17]

In present study, lipid parameters were investigated and compared before and one year after laparoscopic sleeve gastrectomy, for a group of morbid obese patients. Thus, evaluating the sleeve procedure in controlling dyslipidemia and reducing its risks on cardiovascular system and in turn, the patient's life.

In present study, postoperative BMI values of the studied patients were improved significantly 12 months post LSG, with the mean difference 14.8 kg/m^2, regardless the age or gender of the patients which proves the efficacy of this procedure.

This result is so near to the documented reports of BMI improvement post LSG as mentioned by Kang and Le on a recent meta-analysis on 2017 comparing bariatric surgery effects on weight loss and BMI improvements. They found the greatest BMI reduction was reported with sleeve gastrectomy procedure that reached 14.4 kg/m^2.18 The same was found in smaller sample size studies during the last few years.[1,3,7]

In present study, lipid parameters were assessed separately before and after surgery and its relation to the BMI also was evaluated. Regarding the total cholesterol level, it was found that, there was a highly significant effect of LSG on its improvement 1 year postoperatively. All studied cases responded well to LSG with reduction of TC levels (mean difference 50.7) apart of two cases but their TC levels did not exceed the high normal values in pre- or postoperative periods, so were not of statistical importance.

Comparing this result with similar studies, the same was reported with significant lowering of serum TC level 12 months post LSG with various values of the mean difference, while results were not significant in some other studies. [1,4,5,7,9,20] To et al reported increase in the serum TC at 1 year interval post LSG but without being statistically significant.[19]

In present study, TG levels were significantly decreased after the LSG surgery with no relation to the age or the sex of the studied patients, reaching a mean difference of 28.8 and highly significant p-value (<0.001).

The similar published studies reported a significant reduction of TG levels after 6 and 12 months postoperatively but Szczuko et al reported a temporary rise in the TG levels only after one month of surgery and non-significant lowered values after 12 months.[1, 4,5,7,9,19,20]

The follow up values of LDL in this study was found to achieve a great reduction 1 year post LSG with highly significant p value and mean difference of <0.001 and 26.2 mg/dl, respectively, which is considered another important prove for the success of the operative procedure in correcting hyperlipidemia.

A significant reduction of LDL levels was documented by other studies as mentioned by Szczuko et al., with mean difference (22.05 mg/dl) and Hady et al., with mean difference in LDL level and p value of 26.57 and <0.05, respectively. Also, Heffron et al., reported a significand reduction with a mean difference of 22.0 mg/dl.1,4,9 Another significant reduction was achieved in the studies done by To et al and Erol et al while a non-statistically significant reduction of LDL levels were mentioned by Buzga et al.[7,19,20]

Regarding the HDL levels, in this study it was found that, there was a highly significant improvement with a mean difference of 6.2 mg/dl and p value (<0.001).

A similar significant rise in HDL levels was reported by other studies as Szczuko et al., Buzga et al., Heffron et al., To et al. and Erol et al.[1,7,9,19,20] while a non-significant improvement was reported by the study done by Hady et al.[4]

In present study, a significant strong relation was found between the loss of weight and the improvement of dyslipidemia after 12 months of LSG in the studied parameters as TC, TG, LDL but not with HDL.

Milone et al, found a similar significant relation between the BMI reduction and the improvement in the levels of TC, TG and LDL but not with HDL. After correlating their results with age and sex, the TC levels only showed a significant relation.[21]

To et al on the reverse, found no significant relation when correlated loss of weight with the improvement of lipid profile.[19]

CONCLUSION

Finally, it could be concluded that, laparoscopic sleeve gastrectomy is considered one of the main approaches that improves the body mass indices and lipid profile of morbidly obese patients during the first postoperative year. Nevertheless, a longer follow up period is required to confirm this improvement on the long run with real reduction of the incidence of cardiovascular insults.

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