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Liver assessment post laparoscopic mini gastric bypass versus sleeve gastrectomy operation in obese and morbidly obese patients

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***Abstract*---**Background: Morbid obesity is a severe disorder associated with major co-morbidities reduced quality of life (QoL) and reduced life expectancy. Aim and objectives: The purpose of the study was to compare the effect of laparoscopic mini gastric bypass versus sleeve operation on liver function in a prospective randomized study. Subjects and methods: This study was a prospective study conducted on 80 patients who visit the general surgery clinic at Damietta university hospital (Al Azhar University) and National hepatology and tropical medicine research institute (NHTMRI); patients were being divided into 2 groups: Group A (40 patients): Undergoing laparoscopic sleeve gastrectomy surgery. Group B (40 patients): undergoing laparoscopic mini gastric bypass surgery. Results: There a gradual significant decrease from preoperative to 12 months postoperative regarding ALT and AST in Group A, while there a gradual significant decrease from preoperative to 12 months postoperative regarding AST in Group B, Conclusion: This study demonstrated a low prevalence of abnormal LFT in our morbidly obese patients who underwent bariatric surgery. This may serve as an indirect indication of a lower prevalence of significant liver damage in these subjects. According to the results of our study we recommend LSG rather than LMGB in patients suffering from NAFLD as it has comparable weight loss results with

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reversal of NAFLD as well as lower rates of postoperative cholelithiasis and development of liver cirrhosis.
***Keywords*---**Liver, laparoscopic Mini Gastric Bypass, Sleeve Gastrectomy Morbid Obesity.

Introduction

Morbid obesity is a severe disorder associated with major co-morbidities reduced quality of life (QoL) and reduced life expectancy. The health benefit of bariatric surgery is well established, including effective long-term weight control, resulting in improvement obesity-related co-morbidities such as diabetes, hypertension, sleep apnea and hyperlipidemia [1]

Although there are several therapies for morbid obesity including medication, behavior, and alternative therapies such as acupuncture, these treatments cannot resolve obesity-related comorbidities or do not demonstrate long-term and sustained success. In some patients, they may even result in adverse reactions [2] Bariatric surgery is the most effective treatment of morbid obesity; not only is it a weight-reducing surgery but also a metabolic surgery, it results in excellent long-term sustained weight loss and hence in reduction of comorbidities [3]

Today, Roux-en-Y gastric bypass (RYGB) and sleeve gastrectomy (SG) are the most commonly performed procedures. The one-anastomosis gastric bypass (OAGB) or omega loop/mini gastric bypass is an up-and-coming procedure and is regarded as a technically simpler bypass accompanied by an increased %excess weight loss (%EWL), but very little complications [4].

Bariatric surgery induced the disappearance of NASH from nearly 85% of patients and reduced the pathologic features of the disease after 1 year of follow-up. It could be a therapeutic option for appropriate morbidly obese patients with NASH who do not respond to lifestyle modifications [5]

On the other hand severe liver dysfunction may also occur after bariatric procedures such as OAGB and RYGB that may lead to steatosis/fibrosis, cirrhosis, ascites, encephalopathy, hepato-renal syndrome and gastro-intestinal bleeding [6] The purpose of the study was to compare the effect of laparoscopic mini gastric bypass versus sleeve operation on liver function in a prospective randomized study.

Patients and Methods

This study was a prospective study conducted on 80 patients who visit the general surgery clinic at Damietta university hospital (Al Azhar University) and National hepatology and tropical medicine research institute (NHTMRI)
Patient groups: 80patients were being divided into 2 groups: **Group A (40 patients):** Undergoing laparoscopic sleeve gastrectomy surgery. **Group B (40 patients):** undergoing laparoscopic mini gastric bypass surgery.

Inclusion criteria: Adult patients above 16 years old from both sexes. Morbid obese patients with BMI >40and BMI >35 with associated comorbidity such as Hypertension, DM, Arthritis and sleep apnea who failed other obesity control modalities like lifestyle modification, diet and medications, negative virology for HCV, HBV and HIV and normal hormonal profile

Exclusion criteria: Exclusion of any other cause of liver disease rather than NASH and NAFLD such as hemochromatosis, alpha 1-antitrypsin deficiency, Wilson disease, autoimmune disease, alcoholic liver disease, patient's age below 16 years, hypothyroid patients and patients who are not fit for surgery

Candidates must be subjected to the following:
Prior to surgery: Full history taken and clinical examination and liver imaging that confirm ether normal liver parenchyma, NASH or NAFLD, liver function tests (AST, ALT, ALP, serum bilirubin, serum albumin, Prothrombin time and I.N.R.), serum creatinine, complete blood count (CBC), HBsAg, HCV Ab, HBA1C .for diabetic patients, thyroid function tests, lipid profile, ECG and echocardiography

Post-surgery follow up: CBC, liver profile and creatinine and lipid profile at month 3, 6 .12**,** Radiological evaluation by ultrasound at month 3, 6, 12 and liver biopsy or Fibroscan if we need (parenchymatous changes)

Statistical Analysis: All data were collected, tabulated and statistically analyzed using SPSS 22.0 for windows (SPSS Inc., Chicago, IL, USA) & MedCalc 13 for windows (MedCalc Software bvba, Ostend, Belgium). Data were tested for normal distribution using the Shapiro Walk test. Qualitative data were represented as frequencies and relative percentages. Chi square test (x2) and Fisher exact was used to calculate difference between qualitative variables as indicated. Quantitative data were expressed as mean ± SD (Standard deviation) for parametric and median and range for non-parametric data. All statistical comparisons were two tailed with significance Level of P-value ≤ 0.05 indicates significant while P> 0.05 indicates non-significant difference.

Results

Table (1)
Demographic data of the two studied groups

Variable		**Group A** (n=40)	**Group B** (n=40)	**t / x^2**	**P**
Age (years) Mean ± SD		37.15 ± 6.29	38.4 ± 6.76	.856	.394
Sex	Male	8 (20%)	26 (65%)	**16.57**	**0.000**
	Female	32 (80%)	14 (35%)		
Weight (kg) Mean ± SD		127.63 ± 23.37	136.6 ± 29.51	1.51	.136
Height (cm) Mean ± SD		165.93 ± 8.77	165.23 ± 8.89	.354	.724
BMI (kg/m^2) Mean ± SD		46.83 ± 8.79	49.6 ± 9.11	1.39	.169

There is a significant difference between the two studied groups regarding sex. Table (1)

Table (2)
Preoperative laboratory parameters between the two studied groups

	Group A (n=40)	**Group B** (n=40)	**T**	**p**
Hemoglobin (g/dl) Mean ± SD	12.86 ± 1.11	13.1 ± 1.45	.831	.408
PLT ($x10^3/L$) Mean ± SD	227.38 ± 34.39	219.33 ± 32.15	1.08	.283
TLC ($x10^3/L$) Mean ± SD	6.45 ± 0.888	6.7 ± 0.436	1.59	.114
ALT (U/L) Mean ± SD	26.67 ± 24.95	30.94 ± 26.55	.132	.699
AST (U/L) Mean ± SD	27.22 ± 16.32	28.64 ± 16.11	1.02	.935
INR Mean ± SD	0.944 ± 0.053	0.967 ± 0.058	1.85	.068
TSH (g/dl) Mean ± SD	2.36 ± 1.02	2.32 ± 1.21	.159	.873
Creatinine (mg/dl) Mean ± SD	0.821 ± 0.151	0.755 ± 0.131	**2.09**	**.041**
Calcium (mg/dl) Mean ± SD	9.23 ± 0.555	9.61 ± 0.615	**2.91**	**.005**
TC (mg/dl) Mean ± SD	211.47 ± 34.32	211.97 ± 40.29	.059	.953
TG (mg/dl) Mean ± SD	144.56 ± 71.56	159.71 ± 69.21	.962	.339
LDL (mg/dl) Mean ± SD	145.17 ± 27.42	137.47 ± 32.78	1.14	.258
HDL (mg/dl) Mean ± SD	42.35 ± 10.5	42.01 ± 5.11	.184	.854

This table shows that there is a significant difference between the two studied groups regarding creatinine and calcium. Table (2)

Table (3)
Preoperative ultrasound findings between the two studied groups

	Group A (n=40)	**Group B** (n=40)	**x^2**	**P**
Free	8 (20%)	7 (17.5%)	2.13	.545
Cholecystectomy	0	1 (2.5%)		
Fatty liver	29 (47.5%)	31 (77.5%)		

Gall stones	3 (7.5%)	1 (2.5%)		

There is no significant difference between the two studied groups regarding US findings. Table (3)

Table (4)
3-months postoperative laboratory parameters between the two studied groups

	Group A (n=40)	**Group B** (n=40)	**T**	**p**
Hemoglobin (g/dl) Mean ± SD	11.69 ± 0.957	12.26 ± 1.35	**2.18**	**.032**
PLT ($x10^3/L$) Mean ± SD	216.13 ± 29.59	205.67 ± 33.23	1.49	.141
TLC ($x10^3/L$) Mean ± SD	5.77 ± 0.685	6.23 ± 1.54	1.72	.088
ALT (U/L) Mean ± SD	24.38 ± 22.42	36.68 ± 19.65	1.03	0.413
AST (U/L) Mean ± SD	23.53 ± 14.18	33.3 ± 16.21	1.30	.407
TSH (g/dl) Mean ± SD	1.78 ± 0.414	1.88 ± 0.823	.687	.494
Calcium (mg/dl) Mean ± SD	8.66 ± 1.65	9.11 ± 0.709	1.58	.117
TC (mg/dl) Mean ± SD	188.65 ± 30.94	185.97 ± 32.83	.376	.708
TG (mg/dl) Mean ± SD	125.31 ± 55.17	139.32 ± 35.53	1.35	.181
LDL (mg/dl) Mean ± SD	126.25 ± 24.31	114.39 ± 35.56	1.74	.086
HDL (mg/dl) Mean ± SD	44.07 ± 9.75	43.77 ± 3.65	.182	.856
BMI (kg/m^2) Mean ± SD	43.05 ± 13.78	42.18 ± 7.36	.352	.726

There is a significant difference between the two studied groups regarding hemoglobin. Table (4)

Table (5)
6-months postoperative laboratory parameters between the two studied groups

	Group A (n=40)	**Group B** (n=40)	**T**	**p**
Hemoglobin (g/dl) Mean ± SD	12.17 ± 1.14	12.27 ± 1.47	.339	.735
PLT ($x10^3/L$) Mean ± SD	210.67 ± 35.28	211.67 ± 24.66	.147	.884

TLC (x10³/L) Mean ± SD	6.05 ± 0.715	6.03 ± 1.01	.102	.919
ALT (U/L) Mean ± SD	22.45 ± 13.18	37.44 ± 23.39	**3.14**	**.000**
AST (U/L) Mean ± SD	20.27 ± 13.45	35.44 ± 18.31	**1.85**	**0.05**
TSH (g/dl) Mean ± SD	1.78 ± 0.692	1.84 ± 0.701	.385	.701
Calcium (mg/dl) Mean ± SD	9.02 ± 0.587	9.24 ± 0.659	1.58	.119
TC (mg/dl) Mean ± SD	173.24 ± 29.19	164.94 ± 24.66	1.37	.174
TG (mg/dl) Mean ± SD	110.06 ± 44.09	113.09 ± 30.63	.357	.722
LDL (mg/dl) Mean ± SD	112.94 ± 22.83	102.94 ± 23.99	1.91	.059
HDL (mg/dl) Mean ± SD	45.25 ± 8.04	46.9 ± 3.23	1.21	.232
BMI (kg/m²) Mean ± SD	35.05 ± 8.87	36.55 ± 6.07	.883	.381

There is a significant difference between the two studied groups regarding ALT and AST. Table (5)

Table (6)
12-months postoperative laboratory parameters between the two studied groups

	Group A (n=40)	**Group B** (n=40)	**T**	**p**
Hemoglobin (g/dl) Mean ± SD	12.31 ± 1.32	12.55 ± 1.65	.718	.475
PLT (x10³/L) Mean ± SD	214.33 ± 34.01	213.25 ± 30.38	.149	.881
TLC (x10³/L) Mean ± SD	5.97 ± 0.658	6.51 ± 0.873	**3.12**	**.003**
ALT (U/L) Mean ± SD	20.53 ± 11.67	24.97 ± 20.91	3.21	**0.000**
AST (U/L) Mean ± SD	18.64 ± 9.52	17.55 ± 10.34	1.17	0.608
TSH (g/dl) Mean ± SD	1.56 ± 0.597	1.78 ± 0.721	1.49	.141
Calcium (mg/dl) Mean ± SD	9.21 ± 0.662	9.42 ± 0.599	1.49	.141
TC (mg/dl) Mean ± SD	150.27 ± 24.52	145.73 ± 22.34	.866	.389
TG (mg/dl) Mean ± SD	89.79 ± 33.89	93.97 ± 28.37	.598	.552
LDL (mg/dl)	92.86 ± 21.98	89.61 ± 20.61	.682	.497

Mean ± SD				
HDL (mg/dl) Mean ± SD	45.77 ± 5.07	49.74 ± 3.71	**3.99**	**.001**
BMI (kg/m²) Mean ± SD	30.01 ± 7.96	31.22 ± 4.89	.819	.415

There is a significant difference between the two studied groups as regard TLC and HDL and ALT. Table (6)

Table (7)
Preoperative and postoperative BMI between the two groups

BMI (kg/m²) Mean ± SD	Preoperative	3m postop.	6m postop.	12m postop.	**P**
Group A	46.83 ± 8.79	43.05 ± 13.78	35.05 ± 8.87	30.01 ± 7.96	**.000**
Group B	49.6 ± 9.11	42.18 ± 7.36	36.55 ± 6.07	31.22 ± 4.89	**.000**

repeated measures ANOVA.

There a significant decrease from preoperative to postoperative follows up time intervals regarding BMI in both groups. Table (1)

Table (8)
Preoperative and postoperative ALT and AST between the two groups

ALT (U/L) Mean ± SD	Preoperative	3m postop.	6m postop.	12m postop.	**P#**
Group A	26.67 ± 24.95	24.38 ± 22.42	22.45 ± 13.18	20.53 ± 11.67	**.001**
Group B	30.94 ± 26.5	36.68 ± 19.65	37.44 ± 23.39	24.97 ± 20.91	**0.24**
AST (U/L) Mean ± SD					
Group A	27.22 ± 16.32	23.53 ± 14.18	20.27 ± 13.45	18.64 ± 9.52	**.012**
Group B	28.64 ± 16.11	33.3.34 ± 16.21	35.44 ± 18.31	17.55 ± 10.34	**.005**

Friedman test

There a gradual significant decrease from preoperative to 12 months postoperative regarding ALT and AST in Group A, while there a gradual significant decrease from preoperative to 12 months postoperative regarding AST in Group B

Table (9)
Preoperative and postoperative significant ultrasound findings between the two studied groups

Group A	Preoperative	3M postop.	6M postop.	12M postop.
No significant findings	39 (97.5%)	39 (97.5%)	40 (100%)	39 (97.5%)
Gall stones	1 (2.5%)	1 (2.5%)	1(2.5%)	1 (2.5%)

Group B	Preoperative	3M postop.	6M postop.	12M postop.
No significant findings	39 (97.5%)	39 (97.5%)	37 (92.5%)	36 (90%)
Gall stones	1 (2.5%)	1 (2.5%)	3 (7.5%)	3 (7.5%)
Cirrhotic changes	0	0	0	1 (2.5%)

Group B was higher regarding gall stones incidence compared to group A after 6 and 12 months postoperative follow up. Otherwise, there was only one patient who developed cirrhotic changes in group B. Table (9).

Discussion

This was a Retrospective and Prospective study was conducted on 80 patients who visit the general surgery clinic. They were divided into 2 groups: Group A (40 patients): undergoing laparoscopic sleeve gastrectomy surgery. Group B (40 patients): undergoing laparoscopic mini gastric bypass surgery. The duration of the study ranged from 6-12 months.

Higher BMI more than 40 and co morbidities support the decision for MGB rather than sleeve; however there are other factors that influence the surgical decision, the cooperativeness of the patient, life style and patient preference The role of radiologists in surgical treatment of obesity is mainly to evaluate conditions immediately after surgery and detection of early complications. In 12 months patients showed weight loss by 35.9% in LSG, 37% in LMGB, these results came in agreement with Gaby Kansau and colleagues study named Laparoscopic sleeve gastrectomy versus laparoscopic mini gastric bypass: One year outcomes Also Udai Wijetunga, and colleagues in a study titled Reversal of Nonalcoholic Fatty Liver Disease with Bariatric Surgery in South Asians: Does the Type of Surgery Matter?, revealed that LSG has a more favorable effect on complete reversal and improvement of NAFLD when compared with LMBG. This effect seems to be independent of weight loss. Thus LSG should be considered ahead of LMBG when bariatric surgery is planned for obese patients with NAFLD. [7]

In our study 47.5% of patients undergoing LSG had fatty liver by preoperative u/s assessment while 77.5% of patients undergoing LMGB had the same issue In Group A, There a gradual significant decrease from preoperative to 12 months postoperative regarding ALT and AST, while there a gradual significant decrease from preoperative to 12 months postoperative regarding AST in Group B otherwise one patient in that group developed cirrhotic changes. That said the lipid profile improved in both groups postoperatively This came in agreement with Mohamed Deabes et al., 2020 as there was a high significant difference between before and after surgery as regard triglycerides, cholesterol, HDL and LDL.

In the study of Mahdy et al. (2016), they reported that there was a significant improvement between before and after surgery as regards, triglyceride, cholesterol, HDL and LDL. Patients with LSG and LMGB did not show a significant difference in baseline AST and ALT. At 6 months post procedure, AST and ALT levels were lower in patients with LSG than patients with LMBG. Thus LSG showed a greater degree of AST and ALT reduction compared to LMBG. At 6 months post-procedure, patients who underwent LSG had less patients with

elevated AST and ALT as compared to LMBG. Overall LSG showed a higher rate of complete reversal of NAFLD (75.0% vs 44.4%) and improvement of the grade of NAFLD (91.7% vs 66.7%) on USS imaging when compared with LMBG.
Although some studies suggested that ALT alone or both ALT and AST might be used as follow-up markers of NAFLD in patients undergoing bariatric surgery, Dixon et al. indicated that decreases in GGT levels, and less frequently in AST levels, might predict histologic recovery more accurately in these patients [8]. In our study the development of cholelithiasis in patients undergoing LMGB was higher than patients undergoing LSG, with a percentage rising from 2.5% preoperatively to 7.5% postoperatively in the former and 2.5 % preoperatively and postoperatively in the latter.

Ahmed talha and colleagues in a study named Cholelithiasis after bariatric surgery, incidence, and prophylaxis: randomized controlled trial The mean percentage of excess weight loss (%EWL) was significantly higher in those who develop gallstones than others. [9] While Tapas Mishra and colleagued in a study named Prevalence of Cholelithiasis and Choledocholithiasis in Morbidly Obese South Indian Patients and the Further Development of Biliary Calculus Disease After Sleeve Gastrectomy, Gastric Bypass and Mini Gastric Bypass concluded that he incidence of post-bariatric surgery development of cholelithiasis was 10.53 %; individually, it was 8.42 % in LSG group, 13.4 % in LRYGB group and 12.7 % in MGB patients, However in this study LMGB has shown elevation in both ALT and AST postoperatively compared to LSG, it has shown highe incidence of postoperative cholelethiasis as well as highe incidence of cirrhotic changes.

We recommend LSG rather than LMGB in patients suffering from NAFLD as it has comparable weight loss results with reversal of NAFLD as well as lower rates of postoperative cholelithiasis and developemnnt of liver cirrhosis More prospective multi-center studied is needed to confirm the results of our study. Furthermore Khalil et al., [10] found that the laparoscopic sleeve gastrectomy with loop bipartition) group had significantly lower fasting blood glucose and glycated hemoglobin (HbA1c) levels in 1 month, 3 months, 6 months, and 12 months postoperatively.

In the study in our hands, among group A, there was a significant change from preoperative to postoperative follow up time intervals regarding BMI, TSH, TC, TG, and LDL. Our results were supported by study of Ruiz-Tovar et al., [11] as they reported that preoperatively, 84% of the patients presented liver steatosis. A significant reduction of steatosis could be observed 12 months after surgery ($p < .001$). Preoperative degree of steatosis showed a direct correlation with AST ($p = .008$) and ALT ($p = .007$) and an inverse correlation with HDL-cholesterol ($p = .019$). The reduction of liver steatosis showed an inverse correlation with the increase of HDL-cholesterol between pre- and postoperative determinations ($p = .008$).

Furthermore, Aksoy et al., [12] found a significant difference between pre- and post-surgical liver enzymes (ALT, AST, GGT, ALP), similar to previous findings demonstrating positive effects of bariatric surgery on liver enzymes and histologic findings of the liver [13] Although some studies suggested that ALT alone or both ALT and AST might be used as follow-up markers of NAFLD in patients undergoing bariatric surgery, Dixon et al. indicated that decreases in GGT levels, and less frequently in AST levels, might predict histologic recovery more accurately in these patients Xourafas et al., [8]. In their study, they did not perform liver biopsy, but they found that ALT, AST levels were significantly higher in patients with grade III steatosis.

In the last decade, some articles have reported an appealing outcome for the MGB. It has been described as a reasonable laparoscopic operation meeting many of the criteria of an ideal weight loss surgery. The results presented regarding the perioperative period have been encouraging in terms of safety. A short operative time corresponding with very low rates of mortality, morbidity, and LOS (length of hospital stay) have been reported, with a favorable outcome for MGB even compared with RYGBP. [14]

The present study showed that among group B, there was a significant change from preoperative to postoperative follow up time intervals regarding BMI, ALT, AST, TSH, TC, TG, LDL and HDL. Our results were supported by study of Mohamed Deabes et al., [15] as they reported that in gastric mini bypass group, there were significant differences between before and after surgery as regard FBG, HbAIC, triglyceride, cholesterol, HDL and LDL.

In the study of, Lee et al., [16] they reported that there was a significant difference between before and after surgery as regard Hb. In their study, MGB proved to be effective in the long term, significantly outperforming even RYGB in several parameters including BMI reduction, resolution of metabolic syndrome, and the need for revision surgery due to both bowel obstruction and internal hernia. According to Musella et al., [17] there was a significant difference between before and after surgery regarding control of DM.

Conclusion

This study demonstrated a low prevalence of abnormal LFT in our morbidly obese patients who underwent bariatric surgery. This may serve as an indirect indication of a lower prevalence of significant liver damage in these subjects. According to the results of our study we recommend LSG rather than LMGB in patients suffering from NAFLD as it has comparable weight loss results with reversal of NAFLD as well as lower rates of postoperative cholelithiasis and development of liver cirrhosis

Conflict of interest: no conflicts of interest.

References

1. Ignat M, Vix M, Imad I, D'Urso A, Perretta S, Marescaux J. Mutter; British Journal of Surgery. 2017; 104(3):248–256.
2. Flegal KM, Kit BK, Orpana H. Association of all-cause mortality with overweight and obesity using standard body mass index categories: a systematic review and meta-analysis. JAMA. 2013; 309(1):71–82
3. Sundbom M. Laparoscopic revolution in bariatric surgery. World J Gastroenterol. 2014; 20(41): 15135–43.

4. Torgersen Z, Osmolak A, Forse RA. Sleeve gastrectomy and Roux En Y gastric bypass: current state of metabolic surgery. CurrOpinEndocrinol Diabetes Obes. 2014; 21(5): 352–357. doi: 10.1097/MED.0000000000000099
5. Guillaume L, Robert C, David B, Marie P, Hélène V, Julien L, et al. Gastroenterology, 2015.
6. Magdalena E, Felix B, Kathae in a Staufer Obes surg. 2018; 28(3): 812-819
7. Wijetunga U, Bulugahapitiya U, Wijeratne T. SAT-111 Reversal of Nonalcoholic Fatty Liver Disease with Bariatric Surgery in South Asians: Does the Type of Surgery Matter?. *J Endocr Soc*. 2019; 3(Suppl 1): SAT-111. Published 2019 Apr 30. doi:10.1210/js.2019-SAT-111
8. Xourafas D, Ardestani A, Ashley SW, Tavakkoli A. Impact of weight-loss surgery and diabetes status on serum ALT levels. Obes Surg 2012; 22:1540–7.
9. Talha A, Abdelbaki T, Farouk A. Cholelithiasis after bariatric surgery, incidence, and prophylaxis: randomized controlled trial. *Surg Endosc,* 2020; 34: 5331–5337. https://doi.org/10.1007/s00464-019-07323-7
10. Khalil O, Mansy H and Abdalla WS. Laparoscopic sleeve gastrectomy with loop bipartition versus laparoscopic sleeve gastrectomy in treating obese people with type II diabetes mellitus: a prospective randomized comparative study. The Egyptian Journal of Surgery, 2019; 38(3); 610-9.
11. Ruiz-Tovar, J, Alsina, M. E, Alpera, M. R, & OBELCHE Group. Improvement of nonalcoholic fatty liver disease in morbidly obese patients after sleeve gastrectomy: association of ultrasonographic findings with lipid profile and liver enzymes. Acta Chirurgica Belgica, 2017; 117(6), 363-369.
12. Aksoy, E. K, Göktaş, Z, Albuz, Ö, Akpınar, M. Y, Öztürk, D, Buluş, H, & Uzman, M. Effects of sleeve gastrectomy on liver enzymes, non-alcoholic fatty liver disease-related fibrosis and steatosis scores in morbidly obese patients: first year follow-up. Journal of Laboratory Medicine, 2019; 43(2), 115-122.
13. Nickel F, Tapking C, Benner L, Sollors J, Billeter AT, Kenngott HG, et al. Bariatric surgery as an efficient treatment for on-alcoholic fatty liver disease in a prospective study with 1-year follow-up: BariScan Study. Obes Surg 2018; 28:1342–50.
14. Noun R, Skaff J and Riachi E. One thousand consecutive mini-gastric bypass: short-and long-term outcome. Obesity Surgery, 2012; 22(5): 697-703.
15. Mohamed D, Abd-Elal Nafh M, Mohamed A. Comparative study of outcomes between laparoscopic single anastomosis sleeve ileum bypass (sasi bypass) versus laparoscopic mini-gastric bypass in morbid obese patients. Al-azhar medical journal, 2020; 49(3): 957-970.
16. Lee WJ, Almulaifi A, Tsou JJ. Laparoscopic sleeve gastrectomy for type 2 diabetes mellitus: predicting the success by ABCD score. Surg Obes Relat Dis, 2015; 11:991-6.
17. Musella M, Susa A, Greco F. The laparoscopic mini-gastric bypass: the Italian experience: outcomes from 974 consecutive cases in a multicenter review. Surgical Endoscopy, 2014; 28(1): 156-163.