Assessment of hepatic steatosis before and after laparoscopic sleeve gastrectomy

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Background
Nonalcoholic fatty liver disease (NAFLD) is the cause of the new epidemic of chronic liver disease. Most patients are asymptomatic and accidentally diagnosed by imaging. Unfortunately, NAFLD can progress to inflammation, NASH, fibrosis, cirrhosis, HCC, decompensated cirrhosis, death, and/or liver transplantation might be required. Laparoscopic sleeve gastrectomy (LSG) has positive effects on the comorbidities associated with obesity. FibroScan and controlled attenuation parameter (CAP) can assess NAFLD non-invasively by measuring an area a hundred times larger than a biopsy sample.

Aim
To assess hepatic steatosis pre and post LSG by laboratory investigations and imaging (fibroscan and CAP).

Methods
Thirty patients were included in a prospective observational study according to the inclusion criteria. Full medical history, preoperative laboratory investigations and imaging were recorded. All patients underwent LSG and were followed up for 6 months postoperatively. Data were coded and analysed by using (SPSS) version 29.

Results
LSG was associated with a significant improvement in the controlled attenuation parameter CAP values, stiffness values and accordingly grades of steatosis and fibrosis as well as a highly significant decrease in BMI, and on follow-up fibroscan 6 months postoperatively. There was a significant improvement in total cholesterol, triglycerides, LDL and HDL.

Conclusion
LSG is associated with a significant improvement in BMI, lipid profile, CAP measurement and liver stiffness measurements which means improvement of steatosis. In morbidly obese candidates of bariatric surgery, Fibroscan with CAP (using the XL probe) was used as a simple non-invasive tool for detecting steatosis and fibrosis.

Keywords:
fibroscan, Laparoscopic sleeve gastrectomy, Nonalcoholic fatty liver disease, Nonalcoholic steatohepatitis, sleeve gastrectomy, steatosis, CAP

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Introduction

Nonalcoholic fatty liver disease (NAFLD) is considered the main cause of chronic liver diseases. Most patients are asymptomatic and accidentally discovered on imaging or through liver enzyme values. Most of the patients have nonprogressive courses [1]. Nonalcoholic steatohepatitis (NASH) is the inflammatory subtype of NAFLD, and despite being associated with a progressive course, it is under-recognized [2]. The incidence of (NASH) is expected to reach more than 50% during the upcoming decade. Globally, the growing obesity epidemic increases the prevalence of NAFLD-related HCC [3]. The cornerstone of the treatment is losing weight by modifying lifestyle through dietary changes, exercise, or bariatric surgeries [2].

Laparoscopic sleeve gastrectomy (LSG) is primarily a restrictive procedure leading to levels of hormones such as Ghrelin and Glucagon-like Peptide 1 being affected [4].

Although liver biopsy is still considered the golden standard for assessing fat in the liver accurately, less invasive diagnostic techniques are a must [5].

Among the non-invasive tests, Transient elastography (FibroScan(®), TE) with controlled attenuation

parameter (CAP) is a non-invasive test that has a good accuracy in quantifying the hepatic steatosis and fibrosis levels in NAFLD patients as well as the factors associated with the disease progression [6].

There are few studies that recently tried to evaluate the efficacy of fibroscan in the evaluation of NASH degree, also other few studies tried to evaluate the positive outcomes of bariatric surgery on improving the quality of life by increasing weight loss thus improving NASH and preventing the progression of cirrhosis.

Aim of the study

To assess the improvement of hepatic steatosis after laparoscopic sleeve gastrectomy operations in obese patients by using laboratory investigations along with non-invasive transient elastography and controlled attenuation parameter (CAP).

Patients and methods

Ethical consideration

The protocol was submitted to the Faculty of Medicine, Helwan University Research Ethics Committee for revision and was approved before conduction. The researchers explained to the participants the aim of the study and the procedure that will be done, and then a written consent was taken from them. All data of the participants were scored in codes to protect their privacy and confidentiality.

Type of study

A prospective observational study was conducted at the General Surgery department of Helwan University Hospital at Badr, Faculty of Medicine, Helwan University during the period from February 2022 to January 2023. This study included thirty morbidly obese patients who presented to our department to undergo laparoscopic sleeve gastrectomy and were diagnosed as NAFLD during the period from February 2022 to June 2022. The follow-up period was six months postoperatively.

Participants

The patients were selected according to the inclusion and exclusion criteria. Inclusion criteria were: 18–60 years old, both genders, body mass index more than 35 kg/m^2, laparoscopic sleeve gastrectomy was advised as the operation of choice to lose weight in patients with hepatic steatosis (bright liver in pelvi-abdominal ultrasonography, as well as degree of steatosis and fibrosis were detected by fibroscan and CAP). Exclusion criteria were the presence of other causes of liver diseases such as HCV, HBV, autoimmune diseases, daily alcohol intake, hepatotoxic drugs intake as well as redo cases and failed liver stiffness measurement and CAP assessment.

Methodology

All patients were assessed regarding demographics (age and sex), anthropometric measures (weight, height, BMI), full medical and surgical history, history of chronic liver disease, intake of alcohol or hepatotoxic drugs. Then they were clinically assessed. Laboratory investigations were done including complete blood picture (CBC), bleeding profile, liver function tests (Alanine aminotransferase transaminase/ALT & Aspartate aminotransferase/AST), kidney function tests, hepatitis C virus antibodies, hepatitis B virus antigens. This was followed by the diagnosis of fatty liver by bright liver in pelvi-abdominal ultrasonography, exclusion of excessive alcohol intake and other causes of chronic liver disease. The assessment of the degree of hepatic fibrosis and steatosis by fibroscan with controlled attenuation parameter was done within one month before laparoscopic sleeve gastrectomy.

All patients had laparoscopic sleeve gastrectomy. The patients were placed in the reverse Trendelenburg position. Trocars were inserted after pneumo-peritoneum. The nasogastric tube was used for stomach decompression. Omentum was divided from greater curvature and sealed by an energy device. Calibrating bougie was inserted before stapling. Stapling was done followed by staple line reinforcement. Good hemostasis was achieved before drain insertion and closure. Figures 1–7 show the operative steps.

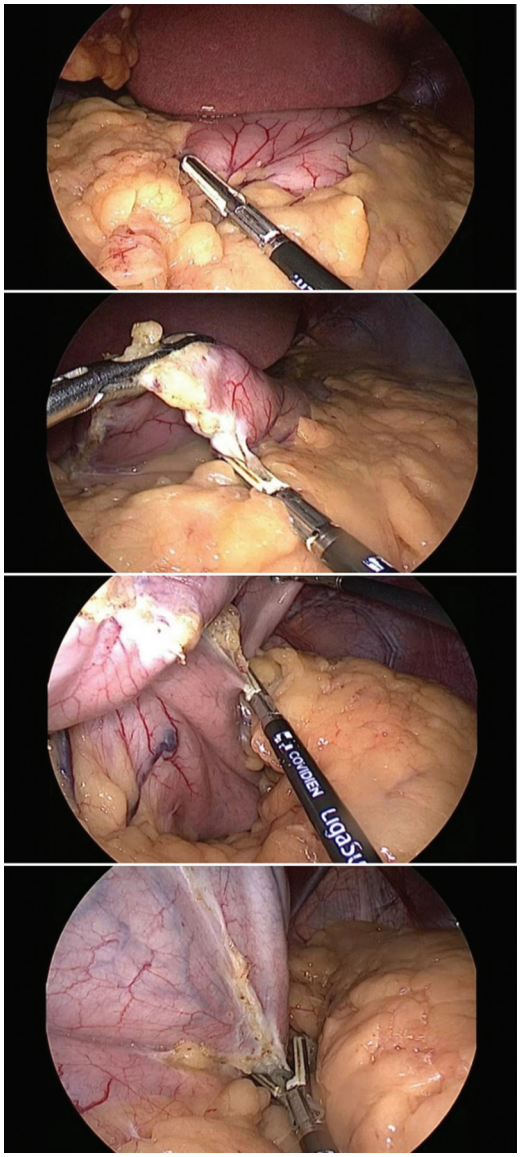
Postoperative follow-up included medications (antibiotics, analgesics and anti-inflammatory, PPIs, anticoagulant, anti-emetics, anti-spasmodic, laxatives

Figure 1

Fatty liver–intraoperative.

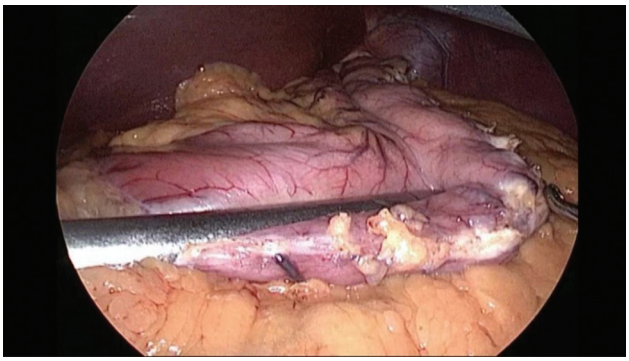
if needed, calcium, vit B, vit D, multivitamins and minerals and proteins in a later stage). Pain management was through Patient Controlled Analgesia (PCA): either IV or epidural. Compression bandages were wrapped around the lower limbs. The activity was essential both at the hospital and home. Breathing exercises were recommended to avoid respiratory problems. Staying hydrated was very important. They were advised to have a nutritional consultation by the clinical dietician.

Figure 2



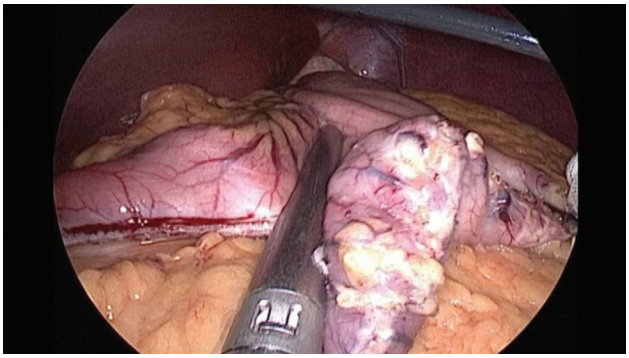
Division and sealing of omentum.

Figure 3



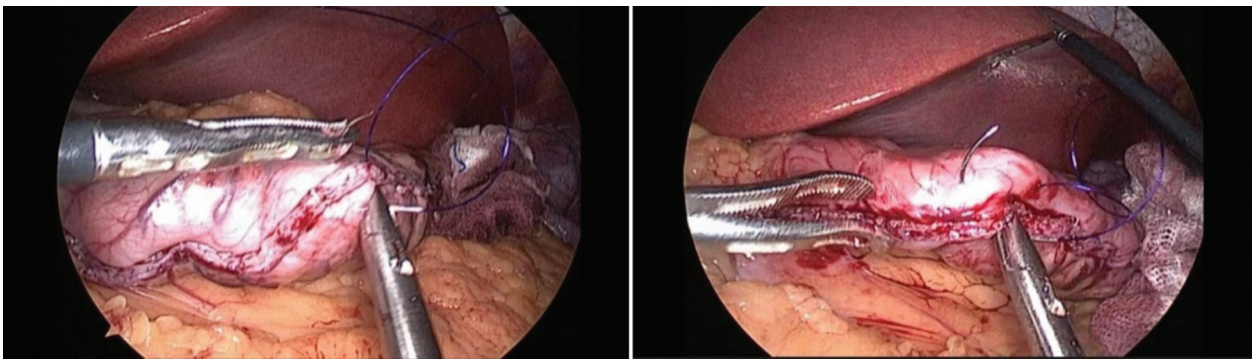
Insertion of first stapler.

Figure 4



Insertion of second stapler.

Figure 5



Staple line reinforcement.

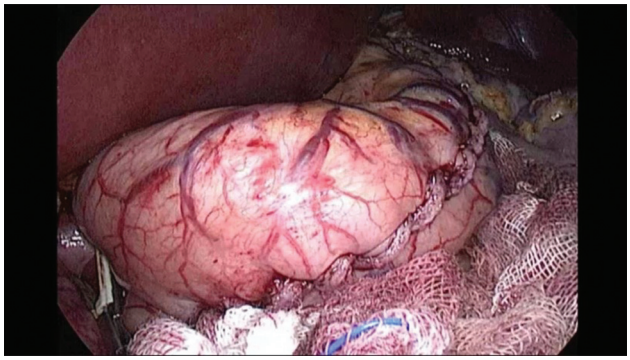
They were warned of any symptoms of concern that may require urgent consultation (high fever, chest pain, shortness of breath, pain in lower limbs, inability to urinate for more than eight hours or persistent pain).

Then follow-up evaluation was done by fibroscan and CAP six months post laparoscopic sleeve gastrectomy. All measurements of fibroscan and CAP were conducted by a well-trained hepatologist. The patients were fasting more than 4 h before the scan. The operator was blinded to patients' data.

Statistics

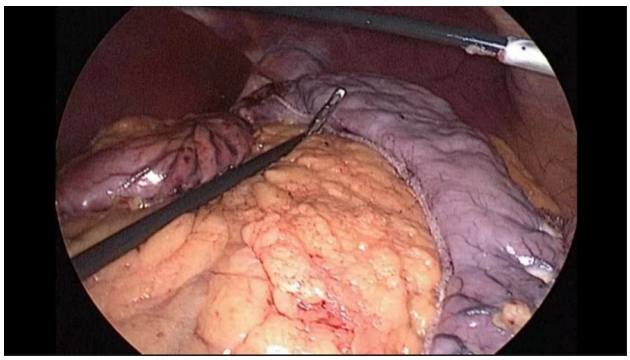
Data was coded and analyzed by using the statistical package for the Social Sciences (SPSS) version 29. Qualitative data were presented as numbers and percent. Quantitative data were tested for normality by the Shapiro-Wilk test and then described as mean and standard deviation for normally distributed data and median and range for non-normally distributed. Paired-sample t-tests were used to compare the data before and after surgery. The sign test was used to describe the changes in the degrees of steatosis and fibrosis. All statistical tests were two-sided. The accepted level of significance was when $P \leq 0.05$ and $P < 0.001$ was considered highly significant.

Figure 6



Methylene Blue test.

Figure 7



Sleeved stomach.

Results

Thirty patients were included in this study. Female patients were 23 out of 30 total patients with female dominance 76.7%. All demographic data are mentioned in Table 1.

As the results in Table 1 showed: there was a statistically significant decrease in BMI ($P < 0.001$) postoperatively. There was a statistically significant decrease in postoperative (six months) total cholesterol ($P < 0.001$), triglycerides ($P < 0.001$) and LDL ($P < 0.001$), along with a statistically significant

Table 1 Preoperative and postoperative data

	Preoperative	Postoperative	*P* value
Sex			
Male	7/30 (23.3%)		
Female	23/30 (76.7%)		
Age (years)			
Range	19–52		
Mean±SD	35.30±8.89		
Height (cm)			
Range	150–180		
Mean±SD	167±7.00		
Weight (kg)			
Range	105–168		
Mean±SD	131.27±17.13		
BMI (kg/m^2)			
Range	36.99–60.60	31.38–49.34	$P<0.001$
Mean±SD	47.41±6.38	38.92±5.00	
Total Cholesterol (mg/dL)			
Range	168–294	121–248	$P<0.001$
Mean±SD	234.80±34.88	185.07±6.80	
Triglycerides (mg/dL)			
Range	101–281	75–205	$P<0.001$
Mean±SD	190.70±58.86	135.63±38.41	
LDL (mg/dL)			
Range	85–210	71–148	$P<0.001$
Mean±SD	139.40±39.66	108.70±22.61	
HDL (mg/dL)			
Range	21–65	36–84	$P<0.001$
Mean±SD	41.90±12.95	60.43±13.98	
AST (U/l)			
Range	13–52	11–45	$P=0.048$
Mean±SD	27.13±10.03	25.30±7.60	
ALT (U/L)			
Range	17–56	18–51	$P=0.065$
Mean±SD	33.00±11.11	31.37±8.48	
CAP (dB/m)			
Range	251–387	178–331	$P<0.001$
Mean±SD	325.60±41.18	234.73±36.51	
LSM (kPa)			
Range	3.1–8.4	3.1–8.1	$P=0.023$
Mean±SD	6.06±1.84	5.63±1.81	

increase in HDL ($P<0.001$) when compared to the preoperative values.

There was a statistically significant decrease ($P=0.048$) in the value of postoperative AST when compared to it preoperatively. However, there was a non-significant decrease ($P=0.065$) in the value of the postoperative ALT, when compared to the preoperative value.

There was a statistically significant decrease in CAP measurements by fibroscan 6 months after LSG ($P<0.001$) when compared to it preoperatively. There was a statistically significant decrease in the stiffness measurements by fibroscan 6 months after LSG ($P=0.023$) when compared to it preoperatively. There was a statistically significant improvement in the grades of both steatosis ($P<0.001$) and fibrosis ($P=0.049$) when comparing their values preoperatively and postoperatively.

Discussion

Owing to the worldwide increase in obesity, NAFLD is the cause of the new epidemic of chronic liver disease. The global prevalence of NAFLD currently reaches 24%. It is characterized by evidence of hepatic steatosis (either by imaging or histologically) without secondary causes [7].

Most patients are asymptomatic and are incidentally diagnosed by imaging. Progression can happen leading to inflammation and fibrosis, leading to NASH. NASH can progress to hepatic fibrosis, leading to cirrhosis, which can be compensated or decompensated cirrhosis, or even hepatocellular carcinoma and eventually death. Also, liver transplantation might be required [8].

Laparoscopic sleeve gastrectomy is a common worldwide bariatric surgery procedure. Studies discuss its positive effects on the comorbidities associated with obesity, including hepatic steatosis [9].

FibroScan is an emerging tool for the non-invasive assessment of NAFLD. The advantages of Transient Elastography (TE) include assessment of an area a hundred times bigger than a biopsy sample, and a good correlation with hepatic steatosis and fibrosis [6].

In this study, bariatric surgery (Laparoscopic Sleeve Gastrectomy) was associated with a significant improvement in CAP values, liver stiffness values and grades of steatosis and fibrosis on follow-up fibroscan and CAP 6 months postoperatively.

There was significant improvement of the anthropometric and laboratory parameters after bariatric surgery. The patients in the present study had significant BMI and lipid profile reduction in the follow-up evaluations after 6 months.

Liver biopsy is still considered the gold standard for evaluating liver steatosis. However, it is not suitable for short follow-up periods (less than 1 year) in addition to its limitations as large number of patients refuses to redo it due to the risks of biopsy. Also, biopsies represent a very small portion of the liver unlike fibroscan which covers larger areas (about 100 times).

In this study, non-invasive imaging modalities (fibroscan and CAP in this study) helped in assessment of fibrosis and steatosis when used both preoperatively and during follow-up postoperatively. Harshit *et al.* mentioned that FibroScan could accurately assess fibrosis and hepatic steatosis in morbidly obese patients especially with BMI up to 45 kg/m^2.

Limitations

The study faced some limitations. Some patients' preoperative fibroscan examination failed. This may be due to causes of technical failure of transient elastography as differences in the subcutaneous distribution of fat, relatively higher BMI and higher circumference.

Conclusion

Since NAFLD will be a leading cause for the necessity of liver transplantation in the future, sleeve gastrectomy should be considered as an important option of treatment for NAFLD. The present study showed that laparoscopic sleeve gastrectomy is associated with significant improvement in BMI, lipid profile, CAP measurement and liver stiffness measurements. This means that NAFLD can improve after laparoscopic sleeve gastrectomy as measured by fibroscan and CAP along with the laboratory results. In morbidly obese candidates for bariatric surgery, fibroscan with CAP (using the XL probe) was used as a simple non-invasive tool for detecting steatosis and fibrosis.

Acknowledgements

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Nil.

Conflicts of interest

There is no conflict of interest.

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