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The Effect of Laparoscopic Sleeve Gastrectomy on Vitamin D, Calcium and Fat Metabolism

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INTRODUCTION

As obesity continues to be one of the greatest health struggles of our time, bariatric surgery is a valuable therapeutic tool for both the treatment of morbid obesity and associated co-morbid conditions. Regardless of the procedure performed, there are nutritional deficiencies that can occur both pre and postoperatively, and pose a challenge to patient and clinician alike. This study will review the nutritional risks of bariatric surgery and will also touch on the evaluation and prevention of nutritional deficiencies that can occur both pre and postoperatively. Regardless of the procedure performed, there are nutritional deficiencies that can occur both pre and postoperatively, and pose a challenge to patient and clinician alike. This study will review the nutritional risks of bariatric surgery and will also touch on the evaluation and prevention of nutritional deficiencies that can occur both pre and postoperatively.

Researchers looking at individual nutrients have found deficiencies of vitamin D, thiamine, vitamin C and others. Thus, overall we can clear paint a picture of the morbidly obese patient and Folate 6%. For some nutrients such as vitamin D and Selenium, the nutrient levels were significantly changed before surgery than they were one year after surgery. Researchers looking at individual nutrients have found deficiencies of vitamin D, thiamine, vitamin C and others. Thus, overall we can clear paint a picture of the morbidly obese patient and Folate 6%. For some nutrients such as vitamin D and Selenium, the nutrient levels were significantly changed before surgery than they were one year after surgery.

Deficiencies left untreated can cause acute or chronic problems that can be serious if not addressed. While it may not be cost effective or practical to broadly assess nutritional status prior to surgery, it is becoming increasingly common to check not only for anemia, but also for common treatable problems such as vitamin D or thiamine deficiency.

Deficiencies left untreated can cause acute or chronic problems that can be serious if not addressed. While it may not be cost effective or practical to broadly assess nutritional status prior to surgery, it is becoming increasingly common to check not only for anemia, but also for common treatable problems such as vitamin D or thiamine deficiency.

Other disorders, including small intestinal bacterial overgrowth, can promote micronutrient deficiencies, especially in patients with diabetes mellitus. Recognition of the clinical presentations of micronutrient deficiencies is important, both to enable early intervention and to minimize long-term adverse effects.
There is very limited data available on the impact of the vertical sleeve gastrectomy (SG) on micronutrient status. Most literature refers to SG as a purely restrictive procedure (since it is limited to surgical alteration of the stomach), which may give the impression that there should be minimal impact on vitamins and minerals – similar to gastric banding. However, the position statement from the ASMBS notes that, “The mechanisms of weight loss and improvement in comorbidities seen after SG might be related to gastric resection, neuro-hormonal changes related to gastric restriction or gastric emptying, or some other unidentified factor or factors.” Because vitamin and mineral status can be adversely impacted in the absence of malabsorption, it is not surprising that even the limited available data begins to indicate some challenges.

Dyslipidemia is common feature in obese patient and major risk factor for development of atherosclerosis and then heart related diseases. Bariatric surgery has proven to be an effective treatment against obesity related comorbidities achieving high rate of remission in disease such as type 2 DM or arterial hypertension among others.

In these cases of dyslipidemia, studies have shown acceptable short term outcome after bariatric surgery reaching more than 85% of resolution in one year. Due to its greater efficiency and low complication rate LSG has become more widely accepted as a definitive treatment for morbidly obese patients.

Hyperlipidemia is widely recognized as major co-morbidity in severe obese patients. So now a day’s bariatric surgeries are increasingly focused on lipid profile in the drive to potentially reduce cardiovascular related disease.

**PATIENTS AND METHODS**

This prospective case series study was carried out on 40 morbidly obese patients at the surgical departments in Kasr Al-ainy and Sayed Galal Hospitals from May 2018 to March 2019. All patients were subjected to full clinical preoperative evaluation as well as investigations. Patients’ demographics including: age, gender, BMI were recorded. Clinical evaluation aimed at assessment of degree of obesity and detection of different complications of morbid obesity like hypertension, Diabetes mellitus, obstructive sleep apnea & skeletal problems.

**Methods of the study:**

These patients underwent sleeve gastrectomy operation by the standard technique. Preoperative (immediately before surgery) & postoperative (3 & 6 months) assessment of the serum levels of vitamin D, Calcium, Cholesterol and Triglyceride was done. Informed consent was obtained from all patients included in the study.

**Preoperative investigations:**

**Laboratory investigations:** CBC, FBS, Renal function tests: Urea & creatinine, Liver function tests: ALT, AST, Albumin, Bilirubin (total & direct) and coagulation profile. Serum levels of vitamin D, Calcium, Cholesterol and Triglyceride was done and repeated at 3 and 6 months postoperatively.

**Imaging:** CXR, Abdominal ultrasound.

**Cardiac assessment:** ECG & Echocardiography.

**Respiratory function tests.**

**Upper GI endoscopy** if the patient complains of manifestations of GERD.

**Preoperative Diet:**

All patients are required to start a Liquid Diet 2 weeks before their surgery date. Followings this diet will not only jump start weight loss but will also help reduce the size of the liver making the procedure easier to perform and thus more successful. During this time it is important to include a protein shake multiple times daily to help ensure good nutritional status prior to surgery. Aim for a goal of 60-80 grams of protein per day obtained from the protein shake. It would also be beneficial to add a general multivitamin and calcium supplement as a safety net in meeting basic nutrient needs. While swallow form of supplements will be acceptable long-term, initially chewable forms are recommended for optimal digestion and absorption.

**Intervention in details: Operative technique**

The procedure was done under general anesthesia with oro-tracheal intubation the patient was placed in the supine position. Elastic compression stockings were placed on the legs. Prophylactic antibiotics, Ampicillin and ceftriaxone intravenously were administrated. Laparoscopic technique began with CO2 insufflation by using Veress needle until the working pressure reached 14 mm Hg. The insufflation site was Palms point, 1 inch below the left costal margin in the midclavicular line.

The operation was carried out using 5 ports. The first trocar for the optic was placed slightly above and to the left of the umbilicus using a 10 mm port. We used 30 degree optic. After entering abdominal cavity, the position of Veress needle was inspected for the possible organ injury. Two 12 mm port were placed in both right and left hypochondria in the midclavicular line as the surgeon’s working ports and another 5 mm or 10 mm according to the liver size in the epigastrium for the liver.
retraction. A fifth 5 mm port was placed in left anterior axillary line for the assistance
In steep reverse Trendelenburg position, dissection began with opening of the greater omentum using a scaling device (Harmonic: an ultrasonic dissector Ethicon Endosurgery, Cincinnati, OH, USA or Ligasure (Auto suture Bariatric Covidien) along the greater curvature of the stomach. The dissection continued proximally to the gastroesophageal junction and the left crus. The short gastric vessels were sealed carefully and care was taken to avoid injury to the spleen. The left crus was completely freed of any attachments to avoid leaving a posterior pouch when constructing the sleeve in this region and completed distally to approximately 3-6 cm proximal to the pylorus. The dissection was completed by freeing any posterior attachments of the stomach to the pancreas.

Once the dissection completed, a 36 Fr bougie was introduced orally by the anesthesiologist through the esophagus and inside the stomach. The surgeon then guided it along the lesser curvature and into the pyloric channel and duodenal bulb. The greater curvature of stomach was transected by a linear stapler (Echelon 60 Endopath Stapler and Cutter. 60 mm: 1 green, 2 gold and 2 blue, Ethicon, Cincinnati, OH) or (Covidien Endopath Stapler: 1 green and 4 blue) from antrum starting about 3-6 cm proximal to pylorus till angle of His.

All patients were given antibiotic (third generation cephalosporin), proton pump inhibitor, analgesic and chemical and physical thrombo-prophylaxis. Multivitamins and micronutrient supplementation were administered in the usual doses. Patients were examined preoperatively and throughout a 6 month follow-up period (preoperative, 3 and 6 months postoperatively) in the department and obesity and metabolic surgery clinic. Furthermore, short- and long-term results with regard to BMI, weight, %EWL and important laboratory parameters (Hemoglobin level, iron level, Vitamin B12, Calcium, Vitamin D, Zinc level, Copper level & Albumin level, Lipid profile).

Follow up and Outcome parameters:
All patients were followed up for early post-operative complications (30 days) like Bleeding, Leaks, Infections and VTE. Patients were reviewed at 1, 3, 6 and 12 months postoperative for % EWL, control of preoperative comorbidities and manifestations of vitamin and micronutrients deficiencies (hair loss, teeth problems, edema, Anemia etc.) Postoperative Medications & Supplementation:
Ceftriaxone 1 g Vial: Once daily for 48 hours (Intravenous or Intramuscular). Proton Pump Inhibitor tab: 40 mg twice daily for 6 months. Multivitamin and mineral supplement should include; Iron, Selenium, Copper: 2 mg (minimum), Zinc (ratio of 8-15 mg zinc for each 1 mg. Multivitamin and mineral supplement (chewable tab): Once daily for 6 months then according to the results of the routine follow up laboratory investigations. Iron: 45 to 60 mg daily (100 mg daily for menstruating women) 200 mg ferrous sulphate, 210 mg ferrous fumarate or 300 mg ferrous gluconate daily. Vitamin B12: Intramuscular injections of 1mg vitamin B12 once weekly in the first month then monthly for 5 months. Calcium: calcium citrate is the preferable form: 500-600 mg of calcium three times per day. Vitamin D: 20 mcg (800 IU) vitamin D per day. Protein Powder without fat or carbohydrates: once daily. Prophylactic anticoagulation to prevent thromboembolic disease: 40 Units vial subcutaneous for 2 weeks after the operation.

Statistical analysis:
Data were collected, revised, coded and entered to the Statistical Package for Social Science (IBM SPSS) version 23. The quantitative data were presented as mean, standard deviations and ranges when parametric. Also qualitative variables were presented as number and percentages. The comparison between groups regarding qualitative data was done by using Chi-square test. The comparison between more than two related groups regarding quantitative data and parametric distribution was done by using Repeated Measures ANOVA test followed by post hoc analysis using Bonferroni test. The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the p-value was considered significant as the following: P-value > 0.05: Non significant (NS), P-value < 0.05: Significant (S), P-value < 0.01: Highly significant (HS).

RESULTS
This study was conducted on 40 morbidly obese patients presenting to the bariatric and metabolic surgery clinic in the Cairo university hospital (Kasr Alaini School of medicine and Sayed Galal Hospital). Out of these 40 morbidly obese patients, 29 were females (72.5%) and 11 were males (27.5%). The mean age was 34.38 ± 7.7. The mean body mass index (BMI) was 47.74 ± 5.65 kg/m². Table (1)

Table 1: Demographic data of the studied cases.

<table>
<thead>
<tr>
<th>Sex</th>
<th>Female</th>
<th>29 (72.5%)</th>
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<td></td>
<td>Male</td>
<td>11 (27.5%)</td>
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<table>
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<tr>
<th>Age</th>
<th>Mean ± SD</th>
<th>Range</th>
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<tr>
<td></td>
<td>34.38 ± 7.7</td>
<td>20 – 54</td>
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<tr>
<th>BMI</th>
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<td></td>
<td>47.74 ± 5.65</td>
<td>38 – 60</td>
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Energy-dense diets often consumed by obese individuals do not indicate nutrient adequacy. Sanchez et al\textsuperscript{11} performed an analysis on the diets of candidates preparing for bariatric surgery, finding mean energy intake to be 2801 ± 970 kcal/d, composed of 93.5 ± 28.6 g/d of protein (13.9% ± 3.3% calories), 101.8 ± 49.7 g/d of fat (32.5% ± 8.2% calories), and 386.4 ± 144.7 g/d of carbohydrates (55.0% ± 91.0% calories)\textsuperscript{11}.

Extreme variability in results occurred due to an outlier reporting an intake of >7000 kcal/d and another reporting an intake of 1000 kcal/d. Per this diet analysis, dietary intakes of iron, calcium, and vitamin D were below the recommended dietary allowance, while other vitamins and minerals met recommendations (zinc, copper, folic acid, vitamin B12, and phosphorus)\textsuperscript{12}.

Of the 40 patients evaluated in our study, 7 patients had 1 preoperative micronutrient deficiency (17.5 %), 9 patients had 2 preoperative micronutrient deficiency (22.5 %), 8 patients had 3 preoperative micronutrient deficiency (20 %), 2 patients had 4 preoperative micronutrient deficiency (5 %) and 2 patients had 5 preoperative micronutrient deficiency (5 %). Overall 27 patients included in our study (67.5%) had at least one micronutrient deficiency prior to surgery.

Our results were comparable to recent literature that showed that candidates of bariatric surgery had multiple micronutrient deficiencies before surgery. A cross-sectional study from a group in Baltimore, Maryland, found that nearly 40% of 58 candidates for bariatric surgery had multiple micronutrient deficiencies\textsuperscript{13}.

In another study by Degan and colleagues showed that out of 103 patients evaluated, 67% had at least 1 micronutrient deficiency despite more than adequate macronutrient intake. They also conducted an analysis of the diets among their candidates for bariatric surgery. Despite high energy and macronutrient intake, most micronutrients evaluated did not meet recommendations. Dietary intake of iron, calcium, folic acid, vitamin B12, and vitamin B1 were below the dietary reference intakes for 46%, 48%, 58%, 14%, and 34% of the study population, respectively, indicating poor diet quality\textsuperscript{12}.

Regardless of inadequate intake, biochemical markers did not show a high prevalence for deficiency except for vitamin D, as seen in the majority of candidates (83%). However, 59% of the population was taking supplements, which may have improved its baseline micro-nutrition. Better nutrition status in folic acid and vitamin B12 was seen among participants who reported the use of supplementation, suggesting a role for preoperative supplementation with this population. Unfortunately, data were lacking regarding the exact type and duration of supplements used\textsuperscript{14}.

The most common preoperative deficiencies in these candidates for bariatric surgery are in folate, vitamin B12, iron, and vitamin D. However, 59% of the population was taking supplements, which may have improved its baseline micro-nutrition.
Aims and methods: The aim of this study was to investigate further the effect of LSG on hyperlipidemia. This study showed that LSG resolved or improved lipid profile in a majority of patients. The main obesity related metabolic risk factors of CVS involve low HDL level. During the 6th postoperative months, significant
change in lipid profile had been reported specially an increase of HDL cholesterol, decrease in TG level and LDL cholesterol. Similar results were obtained by team of Zhang et al. as in our study. Low level of HDL cholesterol and high TG are the main risk factor for cardiovascular disease in obese patient. Regarding the cardiovascular risk the observed increased HDL and decrease TG level are fairly positive prognostic factor.

Similar results were obtained by Vidal et al. with a significant improvement of lipid profile following LSG. In this study 6 month after LSG we observed not only decreased total cholesterol, decrease TG and LDL cholesterol but also increase in HDL cholesterol.

CONCLUSION

There was a highly statistically significant decrease in the levels of vitamin D, serum calcium at 3 and 6 months post-operatively than the preoperative levels. Also, there was a highly statistically significant improvement of serum lipid profile at 3 months and 6 months post-operatively than the preoperative levels in the form of decrease in total cholesterol, triglyceride and LDL cholesterol and increase in HDL cholesterol. Although, the results of this study were comparable to other recently published studies, the short term follow up period after the operation and the relatively low number of patients included represented potential limitation of this study.

REFERENCES


