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The effect of laparoscopic sleeve gastrectomy on serum levels of vitamin A, D and B12 and iron profile in patients with morbid obesity: Short term outcomes

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ABSTRACT

Introduction: Laparoscopic sleeve gastrectomy (LSG) has emerged as a prominent surgical intervention for morbid obesity. In the present study, we aimed to evaluate the effect of LSG on serum levels of vitamins A, D, B12, and the iron profile in patients with morbid obesity.

Materials and Methods: This single-center, retrospective cohort study was conducted at Department of General Surgery between February 2021 and March 2023. Inclusion criteria were established in accordance with the American Society for Metabolic and Bariatric Surgery (ASMBS) guidelines. Exclusion criteria were as follows: pregnant or lactating women; those receiving medications known to affect vitamin or iron levels (e.g., anticonvulsants, long-term proton pump inhibitors); having prior gastrointestinal surgeries affecting nutrient absorption. A total of 116 patients who met the inclusion criteria were enrolled.

Results: The mean age of the participants was 38.7±7.5 years, and 80 of them (68.9%) were females and 36 of them (31.03%) were males. The mean preoperative BMI was 42.1±4.1 kg/m^2 A comparison of parameters before and after surgery showed that serum changes in vitamins A, B12, ferritin, and TIBC were not significantly different from before surgery, indicating that long-term LSG did not alter serum levels of these micronutrients. However, serum vitamin D showed a significant difference before and after surgery ($p<0.001$).

Conclusion: Nutritional deficiencies are a significant concern both before and after bariatric surgery. The results of the present study showed that laparoscopic sleeve gastrectomy is one of the most effective surgical methods that does not cause a lack of nutrients and vitamins in the long term.

Keywords: Bariatric Surgery, Laparsopic sleeve gastrectomy, Serum vitamins

Introduction

Laparoscopic sleeve gastrectomy (LSG) has emerged as a prominent surgical intervention for morbid obesity, offering significant advantages in terms of weight reduction and improvement in obesity-related comorbidities. This procedure involves the resection of nearly 75 to 80% of the stomach, creating a sleeve-shaped stomach that restricts food intake and alters hormonal signals related to appetite and metabolism.[1] It is associated with substantial weight loss and metabolic improvements, but it may lead

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to nutritional deficiencies due to reduced stomach volume and altered digestive processes.[2]

One of the primary concerns following LSG is the potential effect on micronutrient levels, particularly vitamins and iron, which are crucial for various physiological functions. Vitamins A, D, and B12, along with iron, play key roles in maintaining metabolic health, immune function, and red blood cell production.[3] Deficiencies in these nutrients may lead to several health issues, including anemia, bone disorders, and neurological complications.[4] According to Rashoo et al.,[5] LSG is one of the most effective surgical methods for obesity treatment and does not cause long-term nutrient and vitamin deficiencies or require supplementation. Mulita et al.[6] reported that one year after bariatric surgery, there was an increase in ferritin, magnesium, and vitamin B12 deficiencies. However, there was no significant difference between pre- and postoperative iron, folic acid, and phosphorus deficiencies. Decreased vitamin D levels are more common in individuals with obesity than in healthy individuals without obesity. Many patients undergoing bariatric surgery have decreased 25-hydroxyvitamin D [25(OH)D] levels. Vitamin D3 levels show an inverse relationship with body mass index (BMI) >30 kg/m^2.[7]

In light of these data, it is essential to monitor and manage the nutritional status of patients undergoing LSG to prevent and address potential deficiencies. In the present study, we aimed to evaluate the effect of LSG on serum levels of vitamins A, D, B12, and the iron profile in patients with morbid obesity. Understanding these effects would help tailor effective postoperative nutritional strategies and supplementation protocols to ensure optimal health outcomes and prevent complications associated with nutrient deficiencies.

Materials and Methods

Study Design and Study Population

This single-center, retrospective cohort study was conducted at the Department of General Surgery of Avrupa Şafak Hospital between February 2021 and March 2023. The study protocol was approved by the Institutional Review Board (IRB), and written informed consent was obtained from each participant. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Inclusion criteria were established in accordance with the American Society for Metabolic and Bariatric Surgery (ASMBS) guidelines as follows:[8] age between 18 and 65 years; BMI ≥40 kg/m^2 or BMI ≥35 kg/m^2 with obesity-related comorbidities; no history of gastrointestinal diseases affecting absorption; and no history of chronic diseases affecting vitamin or iron metabolism (e.g., liver disease, chronic renal failure). Exclusion criteria were as follows: pregnant or lactating women; individuals receiving medications known to affect vitamin or iron levels (e.g., anticonvulsants, long-term proton pump inhibitors); and those with prior gastrointestinal surgeries affecting nutrient absorption. A total of 116 patients who met the inclusion criteria were enrolled.

Preoperative Assessment

Prior to surgery, participants underwent a comprehensive preoperative evaluation, including a detailed medical history and physical examination, abdominal ultrasound, upper gastrointestinal endoscopy, functional respiratory tests, nutritional assessment, and dietary history taking. Baseline laboratory tests included serum levels of vitamin A, vitamin D, vitamin B12, iron, ferritin, and total iron-binding capacity (TIBC).

Surgical Procedure

All participants underwent LSG performed by two bariatric surgeons. The surgical technique involved:

- Creation of a small vertical sleeve along the stomach's greater curvature, resecting approximately 80% of the stomach.
- Use of standard laparoscopic equipment and techniques to minimize surgical complications.

Postoperative Follow-Up

All patients underwent standard LSG and received a multivitamin supplement for six months (Supradyn®, Bayer Pharmaceuticals, Germany, one capsule daily, and calcium citrate). The patients' postoperative diet was prescribed by a nutritionist in accordance with the protocol for sleeve gastrectomy patients. At six months, the patients were asked to discontinue multivitamin supplementation. One year after the operation, BMI values were recorded, and blood samples were analyzed to check serum levels of vitamins A, D, B12, ferritin, and TIBC. The results were recorded.

Statistical Analysis

Statistical analysis was performed using SPSS version 24.0 software (IBM Corp., Armonk, NY, USA). Continuous data were expressed as mean±standard deviation (SD) or median (min–max), while categorical data were expressed as number and frequency. Independent t-tests and chi-square tests were used to analyze the data. A p-value of <0.05 was considered statistically significant.

Results

A total of 116 patients with morbid obesity were included in this study. All patients completed the follow-up period. The demographic characteristics of the patients are shown in Table 1.

Table 1. Baseline and demographic characteristics of patients

Variables	Values
Male n (%)	36 (31.03)
Female n (%)	80 (68.9)
Age (year)	38.7±7.5
Height (cm)	165±8.9
Weight (kg)	
Preoperative	127.1±13.2
Postoperative	88.2±12.1
BMI (kg/m^2)	
Preoperative	42.1±4.1
Postoperative	31.2±4.2
Weight loss (kg)	37.7±7.8

BMI: body mass index.

At baseline, the mean age of the participants was 38.7±7.5 years, with 80 participants (68.9%) being female and 36 (31.03%) male. The mean preoperative BMI was 42.1±4.1 kg/m^2 (Table 1). The mean preoperative serum parameters were vitamin A: 18.6±8.2 g/dL, vitamin D: 26.3±7.1 ng/mL, vitamin B12: 409.7±239.1 pg/mL, ferritin: 66.2±59.8 ng/mL, and TIBC: 332.4±61 g/dL. One year after surgery, the mean BMI was 31.2±4.2 kg/m^2 (Table 1). The mean postoperative serum indices of vitamins A, D, B12, ferritin, and TIBC are given in Table 2. A comparison of pre- and postoperative parameters showed no significant changes in serum levels of vitamins A, B12, ferritin, and TIBC, indicating that long-term LSG did not alter serum levels of these micronutrients. However, serum vitamin D showed a significant difference before and after surgery (p<0.001) (Table 2).

Discussion

According to the World Health Organization (WHO), the prevalence of obesity worldwide has tripled since 1975, with more than 650 million adults being obese in 2016.[9] Bariatric surgical procedures promote weight loss through three main mechanisms: restrictive, malabsorptive, and a combination of both.[10] Restrictive bariatric surgeries primarily work by reducing the stomach's volume, limiting food intake, and consequently calorie consumption. These procedures usually do not significantly alter the digestive tract's absorption capabilities. Currently, as a restrictive procedure, LSG is preferred due to its simpler technique and fewer complications.[11] Malabsorptive bariatric surgeries involve modifications to the gastrointestinal tract that reduce nutrient absorption. These procedures typically combine elements of restriction with changes to the digestive process, resulting in more pronounced nutritional deficiencies.[10,12,13] Reduced stom-

Table 2. Pre- and postoperative serum indices of patients

Variable	Baseline	At Month 12	Normal range	p (t-test)
Vitamin A (µg/dl)	18.6±8.2	17.1±9.1	32-78 (µg/dl)	0.381
25 (OH) Vitamin D (ng/ml)	26.3±7.1	31.2±10.1	30-60 (ng/ml)	<0.001
Vitamin B12 (pg/ml)	409.7±239.1	411.1±226.1	200-800 (pg/ml)	0.141
TIBC (µg/dl)	332.4±61	335.6±61.1	250-310 (µg/dl)	0.653
Serum ferritin (ng/ml)	66.2±59.8	66.7±68.1	Male: 24-336 Female: 24-307 (ng/dl)	0.980
Serum iron (µg/dl)	82.1±21.2	85.7±60.1	50-150 (µg/dl)	0.212

TIBC: total iron-binding capacity.

ach capacity can lead to insufficient intake of essential vitamins and minerals. Deficiencies in vitamin B12, iron, calcium, and vitamin D are common.[14,15]

Before undergoing bariatric surgery, many patients with morbid obesity already experience nutritional deficiencies, often resulting from poor dietary habits, malabsorption issues, and the high prevalence of comorbid conditions such as type 2 diabetes and gastrointestinal disorders.

Vitamin D deficiency, although common in the general population, has a higher prevalence in patients with obesity, reaching up to 94%.[16] Following bariatric surgery, 10 to 73% of patients develop vitamin D deficiency.[17] Postoperative vitamin D deficiency can worsen due to reduced food intake, altered absorption, and increased metabolic demand. Bariatric patients often require higher doses of vitamin D supplementation to maintain adequate levels and support bone health.[18] The risk of osteoporosis and fractures can increase if vitamin D levels are not adequately managed.[19] The study by Kull et al.[20] showed that patients with obesity had lower levels of vitamin D before surgery, consistent with our study findings. Bariatric surgery may also lead to calcium deficiency due to altered absorption and impaired gastric acid secretion. Calcium deficiency contributes to bone loss and osteoporosis.[21] Supplementation and dietary modifications are necessary to prevent these complications.[22] Our study showed a statistically significant increase in serum levels of vitamin D in patients one year after LSG.

Following bariatric surgery, vitamin B12 deficiency is common due to decreased intrinsic factor production and changes in the digestive tract.[23] Long-term supplementation and monitoring are essential to prevent anemia and neurological complications.[24] In the study by Mulita et al.,[6] one year after SG, 15% of the study population had vitamin B12 deficiency. Vitamin B12 deficiency, particularly in malabsorptive BS, may manifest after three years of inadequate intake, causing megaloblastic anemia and neuropathy.[25,26] In contrast, there was no significant difference in vitamin B12 levels before and after LSG in our study.

Iron deficiency is a significant concern following bariatric surgery due to reduced gastric acid secretion and alterations in the absorption sites within the intestines.[27] Patients often require iron supplementation and dietary modifications to manage this deficiency.[15] Several studies have shown that the prevalence of this anemia can be up to 17% after surgery.[28] Iron deficiency occurs in 33 to 49% of patients within two years post-bariatric surgery.[29] Symptoms include microcytic anemia, fatigue, and lethargy. In our study, no decrease in serum ferritin was observed at one year, which can be attributed to differences in the follow-up period of patients, as well as the administered multivitamin supplement.

Previous studies have also shown an increased risk of vitamin A deficiency following bariatric surgery.[30] Vitamin A, a fat-soluble vitamin, requires adequate dietary fat for absorption, which may be compromised due to reduced dietary intake and malabsorption post-surgery.[31] In our study, no decrease in serum vitamin A was observed at one year.

Nonetheless, there are some limitations to this study. First, the single-center, retrospective design potentially leads to analytic bias. Second, we could only evaluate short-term results. Further large-scale, long-term, prospective studies are warranted to evaluate the long-term effects of LSG on micronutrient status and the efficacy of different supplementation regimens.

Conclusion

In conclusion, nutritional deficiencies are a significant concern both before and after bariatric surgery. The results of the present study showed that laparoscopic sleeve gastrectomy is one of the most effective surgical methods that does not cause long-term nutrient and vitamin deficiencies.

Effective management of nutritional deficiencies, which imposes exorbitant costs on patients, involves a multidisciplinary approach, including preoperative screening and postoperative monitoring. Nutritional counseling, regular blood tests, and appropriate supplementation are critical to addressing and preventing deficiencies. Customized dietary plans and patient education are essential for ensuring adequate nutrient intake and addressing potential absorption issues.

Disclosures

Ethics Committee Approval: This study was approved by the Istanbul Yeniyuzyil University Ethics Committee (15.10.2024 - 2024/10-1332).

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Conflict of Interest: None declared.

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