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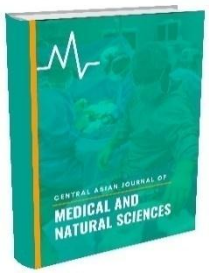

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Evaluation the Role of Vitamin B12 and Ferritin in Obese Patients Who Underwent Gastric Sleeve Surgery

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Abstract:

Background: Obesity is a public health problem and has led to advances in bariatric surgery. Laparoscopic sleeve gastrectomy (LSG) has become the most popular procedure worldwide; Due to continuous losing pounds and reducing obesity-related diseases. However, nutritional deficiencies are common due to altered digestive tract functions and anatomy, and poor absorption of micronutrients.

Objectives: To investigate after three months of bariatric surgery the levels of vitamin B12 and ferritin in patients who underwent bariatric surgery, we study the prevalence of micronutrient and vitamin deficiencies for the first (3) months before and after surgery, follow up the results of laparoscopic sleeve gastrectomy in terms of weight loss, obesity and comorbidities for obesity.

Materials and Methods: the analyzes were conducted for a group of 30 patients of both sexes who underwent sleeve gastrectomy and who were obese and had a body mass index of 40 kg / m2 or more. The study spanned from July 2022 to January 2023, after which they underwent sleeve gastrectomy in the hospital. Al-Zahrawi - Nineveh by specialized doctors and followed up for (3) months after the operation.

Results: the current study showed a significant decrease in vitamin B12, ferritin, hemoglobin, protein, albumin, creatinine, urea, sodium, potassium, and zinc levels in the serum of patients who underwent sleeve gastrectomy over the course of three months after the operation, compared with the serum of the same patients before. The results also showed a positive correlation between vitamin B12, ferritin, protein, and zinc. The results also showed a positive correlation between ferritin, vitamin B12, hemoglobin, and blood sugar.

Conclusion: The risk of developing vitamin b12 deficiency and iron deficiency after surgery due to insufficient intake and absorption of micronutrients, and patients who have undergone gastric sleeve surgery are at risk of developing micronutrient deficiencies, so nutritional supplements should be added, especially vitamin b12 and iron, and e. As gastrectomy included, BMI decreases in the long term.

Introduction

The World Health Organization (WHO) defines overweight and obesity as abnormal or excessive fat accumulation that poses a risk to human health[1]. Over the past three decades, bariatric surgery has evolved into a widely used and well-studied method of weight loss, with more than 2 million people undergoing it between 1993 and 2016.[2]. With sustained weight loss, 42% lower risk of obesity-related cardiovascular disease, and improved glycemic control, it enhances the long-term quality of life for obese patients. [2][3]. It is now the most effective treatment for patients whose body mass index is 40 or 35 kg/m2 due to lipid disorders, metabolism disorders, sleep apnea, and osteoporosis.[3]. There are three main ways that bariatric surgery affects weight loss, including calorie counting and nutrient malabsorption. [3], hrelin, the hormone that causes hunger, is less susceptible of being produced in the stomach, culminating in food restriction. Reducing the stomach's capacity prevents the patient from ingesting as much food as they could have before the procedure, and the meal's rapid passage through the digestive system decreases nutritional absorption and body mass. [4][5][6]. **Vitamin B12**: (Cobalamin) is a water-soluble vitamin that is essential for normal neurological function, red blood cell and DNA synthesis. It leads to a vitamin B12 deficiency which can turn into megaloblastic anemia. Affected patients may experience weakness, irritability, jaundice, and cognitive impairment [7] . Dietary vitamin B12 binds to dietary protein, and is absorbed after the stomach acid hydrolyzes. It then binds to gastric R protein which is secreted into Saliva and gastric fluids are digested by stomach acid, which then travels into the small intestine's duodenum., separated from the R-protein linker, free vitamin The intrinsic factor from the parietal cells of the stomach is linked by vitamin B12. F and B12 deficiencies may contribute to T-cell proliferation by allowing absorption in the terminal ileum. and affect the production of cytokines that lead to inflammation. B12 promotes the secretion of nerve growth factor and tumor necrosis factor and lowers IL-6 and epidermal growth factor levels, Myelin damage and reduced epidermal proliferation are caused by high levels of TNF and nerve growth factor. Vitamin B12 deficiency can negatively methylation reaction, increasing the inflammatory reaction response , and decreasing activity of natural killer cells [8][9]. **Ferritin:** Ferritin is a protein within cells that stores iron and releases it where and when needed. Iron deficiency anemia (IDA) is the most common nutritional disorder, responsible for 50% of anemia cases. IDA decreased red blood cell production due to low iron stores in the body and is predominantly characterized by microcytic erythrocytes, although it can also be present with normal erythrocytes. Serum ferritin is one of the main tests for iron deficiency and is the first evaluation required to clarify the causes of anemia [10] . The aim of the current study is to evaluate the role of vitamin B12 and ferritin for obese people after undergoing sleeve gastrectomy and their relation with some other biological parameters .

Materials and methods

Study design: 30 patients of both sexes participated in this study. All patients underwent gastric sleeve surgery and were followed up (before the operation, one month after the operation, and 3 months after the operation) suffering from obesity and their body mass index 40 kg / m ^{2} or more, and areas Their residence is Mosul. This study was conducted from the beginning of July 2022 until January 2023. The patients were continuous visitors to the National Center for Obesity Treatment, whose condition was confirmed by the specialized doctors. The patients underwent a set of tests, including calculating

the body mass index. Studying all the tests to qualify them to perform gastric sleeve surgery, Pregnant women, people infected with viruses such as Corona virus, and people with diseases of the upper gastrointestinal tract were excluded from this study. Patients were followed up after the operation, and each patient had a specific appointment for follow-up. Full information was taken for patients after obtaining the patient's consent, and the information included the name, Gender, age, height, weight, profession, residence location, phone number, marital status, cause of obesity, type of surgery, patient medical history, (5-6) ml of blood was drawn. Placed in sterile plastic tubes with air-tight caps devoid of any anticoagulant, left at room temperature for 20 min until the blood coagulated, and then centrifuged at 3000 rpm. Minute for 15 minutes for the purpose of obtaining blood serum and dividing the serum into several sterile and dry Eppendorf tubes and maintaining a temperature of (-20°)C degrees Celsius until the required chemical and hormonal tests are performed. The concentration of vitamin B12 and ferritin in the serum of gastric sleeve patients (before the operation, one month after the operation and three months after the operation) for both sexes was estimated using several ready-mades analyzes from the Italian company, Diasuren. Based on the chemical immunoassay (CLIA) method using the Liaison XL device [11][12] . the concentrations of (protein, albumin, urea, creatinine, blood sugar, potassium, sodium, zinc) were estimated using several standard kits from the German company Siemens. Hemoglobin concentration was estimated using a legendary device from a Polish company,

Statistical Analysis: Statistical analysis of the results was carried out to determine the differences between the groups of sleeve gastrectomy patients (before the operation, one month after the operation, 3 months after the operation) using the Duncan test for all variables and at the level of probability ($P \leq 0.05$), there were significant differences between the variables using the statistical program SPSS version 18 T- test [13].

Ethical considerations

The study was conducted under the ethical principles that have their origin in the Declaration of Helsinki. It was carried out with the patient's verbal and analytical approval before the sample was taken. The study protocol and the subject information and consent form were reviewed and approved by a local ethics committee according to document number 2022123 on the 27th of July 2022

Questionnaire form

Personal information: -

Patient name:

Sample number: the date of sample:

Gender: Age: Height: Weight:

Residence area:

Occupation (job description):

Phone number:

Marital status: Number of children:

Qualification:

Primary: Secondary: Bachelor: Master's Degree:

Is the patient taking?

Drinking alcohol: Smoking:

Operation Date:

Onset of obesity:

childhood: puberty:

Obesity related diseases:

Heart disease:

Diabetes:

Blood pressure:

Other:

None:

other notes:

Results

Table (1): The effect of gastric sleeve on the levels of vitamin B12, ferritin ,and other biochemical parameters.

Biochemical Parameters	Normal Range / Unit	Patients Group (Mean ± Standard Deviation)		
		Before the operation	One month after operation	Three months after operation
B12	(191 - 663) pg/ml	405.2 ± 73.87 a	282.96 ± 57.34 b	262.067 ± 45.66 c
Ferritin	Male (28 - 365) Female (5 - 148) ng/ml	105.06 ± 28.62 a	74.62 ± 16.97 b	42.35 ± 11.87 c
Hb	(11 - 17) g/dl	15.2 ± 1.30 a	13.66 ± 1.16 b	12.30 ± 1.07 c
S. protein	(64 - 82) mg/l	80.56 ± 6.71 a	74.26 ± 6.31 b	67.73 ± 5.93 c
S. Albumin	(34 - 50) mg/l	40.82 ± 5.61 a	38.5 ± 4.75 b	36.83 ± 3.93 c
S. Globuline	(18 - 36) mg/l	39.96 ± 3.72 a	35.76 ± 3.55 b	30.9 ± 3.45 c
Blood urea	(15-39) mg/dL	24.98 ± 6.51 a	25.93 ± 6.25 b	26.50 ± 6.44 c
S. Creatinine	(0.5 - 1.3) mg/dL	0.87 ± 0.28 a	0.78 ±0.28 b	0.72 ± 0.19 c
Fasting Blood Sugar	(65 - 118) mg/dL	111.96 ± 24.16 a	85.01 ± 15.58 b	63.0 ± 10.13 c
Serum Na	(135 - 148) mmol/l	152.53 ± 25.32 a	146.26 ± 24.87 b	140.63 ± 23.45 c
Serum K	(3.5 - 5.5) mmol/l	5.31 ± 065 a	4.66 ± 0.69 b	4.0 ± 0.59 c
S. Zinc	(70 - 150) mg/dL	165.96 ± 16.84 a	146.86 ± 15.87 b	125.73 ± 12.95 c

* Similar letters mean that there are no significant differences horizontally at the probability level ($P \leq 0.05$).

* Different letters mean that there are significant differences horizontally at the probability level ($P \leq 0.05$).

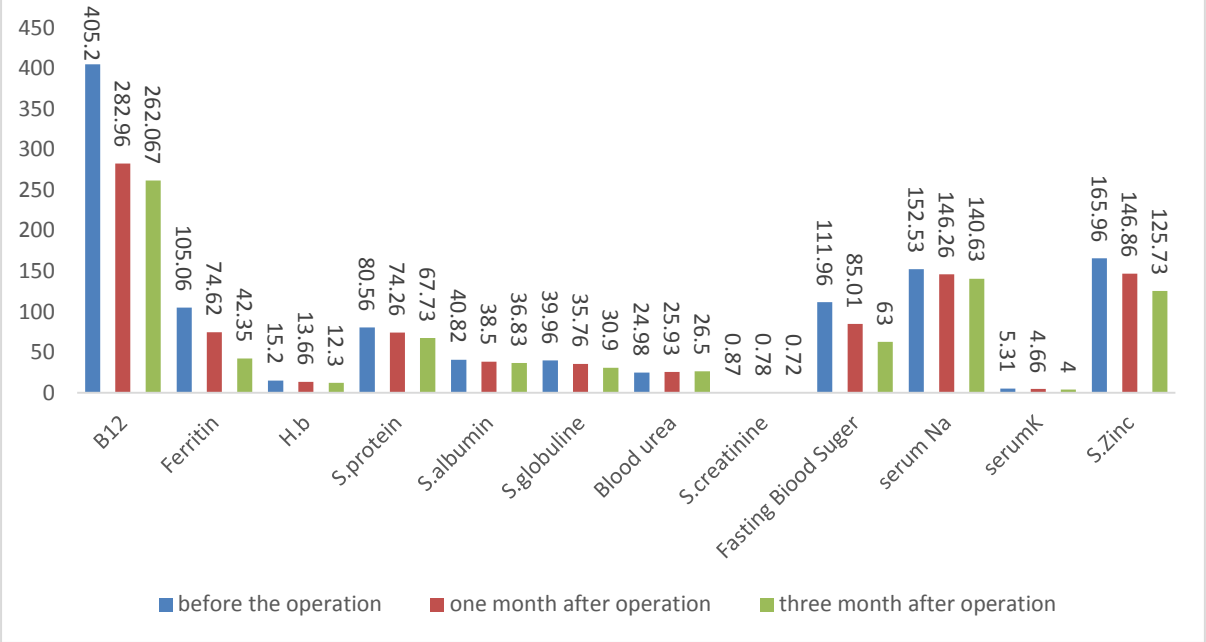

Figure 1: The effect of gastric sleeve on the levels of vitamin B12, ferritin ,and other biochemical parameters.

The results in Figure (1) and Table (1) showed a significant decrease in the levels of vitamin B12, ferritin hemoglobin, serum proteins, urea , creatinine ,blood sugar, sodium, potassium and zinc at the probability level ($P \leq 0.05$) in the serum of patients who underwent sleeve gastrectomy after one and three month of the operation compared with the same group of patients before the operation, the largest decrease was recorded after three months of operation compared to one month .

Table 2: Ccorrelation between B12 with other biochemical parameters

Biochemical parameters	Negative	Positive
Ferritin		0.5678
Hb	-0.468815	
S. Protein		0.5543
S. Albumin	-0.255543	
S. Globuline	-0.248496	
Blood urea	-0.133624	
S. Creatinine	-0.018265	
Fasting Blood Sugar	-0.380201	
Serum Na	-0.30145	
Serum K	-0.329042	
S. Zinc		0.586

The results in table (2) showed A positive correlation between vitamin B12, ferritin, protein, and zinc in serum of patients who underwent sleeve gastrectomy.

Table 3: correlation between ferritin with other biochemical parameters

Biochemical parameters	Negative	Positive
B12		0.5678
Hb		0.553
S. Protein	-0.225916	

S. Albumin	-0.283257	
S. Globuline	-0.134012	
Blood urea	-0.2437	
S. Creatinine	-0.17349	
Fasting Blood Sugar		0.5032
Serum Na	-0.39193	
Serum K	-0.40202	
S. Zinc	-0.4934	

The results in table (3) Shows a positive correlation between ferritin, vitamin B12, hemoglobin, and blood sugar in serum of patients who underwent sleeve gastrectomy.

Discussion

VitaminB12: Physiological and anatomical changes in the gastrointestinal tract lead to vitamin B12 malabsorption. Vitamin B12 deficiency is due to intolerance to dietary meat, which is the primary source of vitamin B12, and reduction of intrinsic factor in the final ileum, which is essential for vitamin B12 absorption [8][14]. After LSG, vitamin B12 absorption becomes insufficient due to decreased production of HCl, and due to decreased levels of vitamin B12 storage in the body [15][16] .

Ferritin: Ferritin deficiency is caused by decreased iron absorption, depletion of iron stores, and by reduced hydrochloric acid production after surgery. Intolerance to iron-rich sources such as red meat is another major cause of iron deficiency [17][18]. The faster passage of nutrients into the stomach after surgery makes it more difficult to absorb iron. Iron deficiency is one of the main causative factors for anemia[19].

Hemoglobin: Low hemoglobin is associated with several factors, high rates of nutritional deficiencies before surgery, anatomical changes in the digestive system after surgery, and low intake of nutrients such as red meat. Ferritin deficiency leads to iron deficiency, which is involved in hemoglobin synthesis[20][21].

Blood proteins: Protein intake is affected due to reduced stomach capacity. In addition, an aversion to high-protein foods due to odor and olfactory changes can contribute to reduced protein intake. After surgery, stomach acid secretion decreases. Pepsin is an enzyme necessary for the digestion and absorption of protein, as the conversion of pepsin into pepsin without adequate levels of pepsin keeps the dietary protein intact and thus hinders its absorption[22]. Albumin deficiency has been attributed to decreased oral intake, intolerance to protein-rich foods, non-compliance with protein supplementation, and decreased secretion of gastric HCl and pepsinogen enzymes[22], [23]. Globulin A decrease in protein and albumin leads to a decrease in globulin because the concentration of globulin is estimated by applying the relationship

Globulin = protein – albumin

Urea and Creatinine: Serum creatinine and urea are important clinical indicators for assessing renal function. A decrease in leptin after surgery damages the kidneys by inducing oxidative stress, stimulation of renal sympathetic nerves, and inflammation. of inflammatory factors (ie, vascular endothelial growth factor and IL-6); 30% of IL-6 originates from adipocytes and increased levels of IL-6 lead to increased inflammation. Free fatty acids can also stimulate macrophages to release TNF-α, while TNF-α factor can in turn stimulate adipocytes to release IL-6, which further amplifies TNF-α. Inflammatory response in the kidneys [24].

Blood sugar: The LSG patients showed improvements in glucose levels. One possibility is that the patients consumed little or no food in the immediate postoperative period, leaving the insulin-

producing cells in a resting state. Starvation alone is associated with improved glycemic control in T2D, meaning that their energy intake is significantly reduced, leading to a negative energy balance, a condition that increases glucose tolerance. Improving glucose homeostasis can reduce the need for diabetes medications due to reduced calorie intake from carbohydrates and glucose production in the liver [25].

Sodium: Changes in the concentrations of gastrointestinal hormones increase urine production, water intake, and sodium excretion, which may contribute to lower blood sodium concentrations. Cardiomyocytes in the atrial wall contain receptors that respond to increased atrial wall expansion by ANP synthesis and release. This peptide has the opposite effect of aldosterone causing a decrease in the volume of extracellular fluid by increasing the renal excretion of sodium, thus reducing the concentration of sodium in the blood. High blood pressure causes the atrial wall to contract and release ANP, which leads to a decrease in extracellular fluid volume through increased renal sodium excretion, thus reducing sodium concentrations in the blood [26].

Potassium: Potassium deficiency is caused by vomiting, diarrhea, and diabetic ketoacidosis. Hypokalemia is caused by dehydration, poor nutrient intake, and rapid weight loss [27], [28].

Zinc: As a decrease in zinc was observed in our study due to a decrease in the intake of red meat, which is a rich source of zinc, gastric capacity decreases after the LSG process, which leads to a decrease in zinc absorption, according to ZIP4. The primary regulator of zinc absorption in the intestine, and ZnT1 is important for the influx of zinc from the intestinal cell. Zinc transporter expression is regulated by cytokines, hormones, and zinc itself. Alterations in the expression of zinc transporters have important effects on zinc homeostasis. On the other hand, in cases of high intake of this mineral, the body reduces intestinal absorption and increases zinc excretion.[29].

A positive correlation is shown between vitamin B12, ferritin, protein, and zinc Table (2). LSG surgery removes a large portion of the stomach, which results in a significant decrease in stomach acid, which affects the absorption of vitamin B12, iron, zinc, and protein. Protein is a great source of B12, iron and zinc. Vitamin B12 binds to the Food contains protein, and it is subsequently absorbed. the hydrolysis of stomach acid and then binds to protein R. Deficiency of this nutrient leads to anemia. The inflammatory condition affects vitamin B12, iron, and zinc [8], [10], [14], [29]. Table (3) Shows a positive correlation between ferritin, vitamin B12, hemoglobin, and blood sugar. overweight (obesity), physical activity and poor diet; One of the most important causes of type 2 diabetes. In addition to genetic factors, this disease is associated with poor nutritional habits, such as eating large amounts of sugars or carbohydrates, and unregulated intake of iron and its supplements. As the iron deposited in the tissues leads to glucose changes in the skeletal muscles. It should be noted that iron is one of the most important nutrients needed by the human body. contributes to the formation of the vital fluid of the human body "blood" through the formation of the hemoglobin protein in red blood cells; Which carries oxygen and delivers it to the rest of the body's tissues [8], [20], [25].

Conclusion

In conclusion, our results highlight the significance of careful postoperative assessment regarding nutrition in addition to postoperative supervision. They should be inspired to go to regular follow-up appointments. Patient supplementation is a very important part of patient care after every bariatric procedure. Adding nutritional supplements to this regimen based on regular blood tests, especially for iron and vitamin B12. There is a need for awareness of healthy eating habits and lifestyle changes to reduce obesity

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