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MINERALS DEFICIENCY IN IRAQI PATIENTS UNDERWENT TO SLEEVE GASTRECTOMY SURGERY

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Abstract:

Background: Sleeve gastrectomy (SG) is simple, relatively safe, and more effective procedure which gained more popularity to reduce the weight in morbidly obese patients and reduce the obesity complications. However, some consequences still unknown. Therefore, the Aim of the study designed to evaluate the outcomes of nutrients elements deficiency in Iraqi patients underwent to sleeve gastrectomy. Methods: this is a comparative study of 160 patients submitted to SG, 80 males and 80 females evaluated for hemoglobin, Ferritin, Calcium, zinc, vitamin D, B12, Mg, and Phosphorous serum levels. We performed these dosages in the preoperative period and at 12 months after surgery. Results: Hemoglobin level in females decrease from 11.7±0.08 before SG to 10.7±0.22 after SG and in males also decreased from 12.7±0.09 to 11.8 ± 0.13 after SG. Ferritin level in females was drop from 56.1±5.5 before SG to 22.2±6.1 after SG, same matter in males, from 61.9±9.7 to 27.3±8.2. Calcium level in females was 9.20 ± 0.62 in Pre-operation period to 8.7 ± 0.61 in post-operation. In males the level reduced from 9.43 ± 0.62 to 8.8 ± 0.61. Zinc level in females was 91.50 ± 21.6 before SG decreased to 75.2±6.1 after SG same matter in males. Serum Vitamin D level in females before SG was 41.2 ± 28.4 and in male 40.1 ± 28.9 decreased after SG to 22.7 ± 25.61 and 22.4 ± 25.61 respectively. Vitamin B12 level in females was 410.7±247.3 and in males was 413.7±247.3 in pre-operation period then in post-operation period was decreased through 1 year follow up to 403.1±236.4 and 405.1±236.4 respectively. While the Magnesium, and phosphorous level in females and female arise in post-operation period by compare with pre-operation. Conclusion: The patients undergoing sleeve gastrectomy suffering from minerals, trace elements and vitamins deficiencies, therefore treatment protocol with supplements required to healthy life management.

Keywords: Minerals Deficiency; Sleeve gastrectomy surgery, SG, Vitamin, supplements.

Introduction

Over the last decade, sleeve gastrectomy (SG) has been the most often done metabolic procedure in the world, and represent more than 50% of registered procedures.[1] SG is typically thought of as a treatment with limitations, the reduction in G cells that lead to decrease gastric acid production and intrinsic factor secretion that led to interference with vitamin B absorption. The laparoscopic sleeve gastrectomy (SG) has overtaken other metabolic treatments as the most popular one globally during the past ten years.[2] Sleeve gastrectomy is a constrictive procedure that can decrease the hormone ghrelin, which promotes hunger.[3] With vital favorable outcomes, SG may be associate with many risks, such as nutritional deficiencies which occur in postoperative, and in some cases a nutritional deficiencies present even before bariatric surgery and this lead to exaggerate the outcome and given bad prognosis.[4] Micronutrient deficiencies are caused by a number of factors in SG patients, including decreased food intake due to smaller stomachs, decreased levels of the appetite-suppressing hormones ghrelin and other GI hormones, decreased food tolerance, and slower metabolism of some micronutrients due in part to the loss of intrinsic factor.[5] SG is now regarded as a safe technique that leads to significant and sustained weight loss, comorbidity reduction, and quality of life improvements.[6] Early research claimed that SG did not increase the risk of nutritional deficiencies.[7] Recent investigations have found measurable postoperative vitamin B12, vitamin D, iron, and folate deficits .[8] frequently the nutritional deficiencies are seen in people have obesity. Pre-existing vitamin deficiencies may worsen, and even new vitamin deficiencies may develop sometime in patients following bariatric surgery.[9] folic acid, Vitamin B12, iron, calcium, and thiamine are the most common factors associated with nutritional deficiencies among patients who undergo SG to weight loss purpose. However, the studies associated with nutritional deficiencies among SG patients are limited.[10] Therefore the current study designed to seal the gaps in information about nutrients deficiencies in Iraqi patients undergoing to Sleeve gastrectomy.

Materials and methods

Patients

The current study included 160 patients undergoing to SG. According to sex, 80 patients were males and 80 females. Mean of Males ages was 38 years, and the females 35 years. the patients with any problems (systematic diseases) that interfere with absorption, metabolism, transport, and excretion of minerals, trace element, and vitamins were excluded from the study to avoid affect the real values of parameters in the study. Written consent from each patient were collect before the patients enrolled the study. The patients were selected and follow up continued to 12 months. 5 ml of venous blood collected to laboratory tests achievement. 2 ml put in EDTA tube and the other 3 ml in gel tube to serum separation.

Pre-operative workup

All the patients were tested to hematologic and metabolic parameters and vitamin deficient before Gastroscopy and abdominal ultrasound performed them. the patients were clinically

examined by a dietitian, psychiatrist, cardiologist, pulmonologist, endocrinologist and anesthetist for any Interferences that may occur with the operation.

Post-operative workup

At first, the ethics committee approved this study at Diyala University- Faculty of Science, and written consent was obtained from all patients (doc. No.2334/2018-6). A total of 160 patients who underwent Sleeve gastrectomy in the surgery department of Baqubah General Hospital, Diyala - Iraq during December 2018 to August 2022 and who complete more than one year of follow-up. Patients were re-evaluated at post-SG at 12^{th} months in terms of laboratory tests. According to sex, the participants divided into Males and Females, and laboratory measurements of Hb, Calcium, vit D, zinc, B12, Mg, Ferritin, and Phosphorous were tested in the preoperative periods 12 months for analysis of micronutrient deficiencies.

Postoperative Vitamin and Mineral Recommendations

At time of operation 2018–2022, the patients recommended to vitamins supplement and minerals including an over-the-counter multivitamin-mineral supplement. All the patients were regulating the set of supplement and dose of each one as regime treatment as following. These supplements were given to patients through 1 year (follow up time), shown in table 1.

Table 1: shown minerals, trace elements, and vitamins and their doses given to each patient in post-operative period:

Vitamins/minerals/trace elements	*Dose*
Vit D, µg	*10*
Vit B1 (thiamine), mg	*1.4*
Vit B2, (riboflavin) mg	*1.6*
Vit B3 (niacin), mg NE	*19*
Vit B5 (pantothenic acid), mg	*5*
Vit B6 (pyridoxine), mg	*1.6*
Vit B12, µg	*2*
Mag^{+2}, mg	*100*
Zn, mg	*12*
Ca^{+2}, mg	*10*

Measurements

Hemoglobin, blood urea, Calcium, zinc, Ferritin, vit D and B12 were measured with fasting venous blood samples. The samples frozen at − 20 degrees Celsius during the collection time then sent to the laboratory to analysis.

Statistical analysis

Student t test was done to compare results between study groups. In normal distribution data Standard deviation and mean were used, while median values used to non-normal data

distribution, p value ≤ 0.05 was considered as significant value. The statistical analysis achieved by SPSS software version 21 (IBM Corp., Armonk, NY, USA).[12]

Results

The current study included 160 patients 80 females and 80 males. The results of current study shown there was changes occurred in the level of hemoglobin and ferritin between pre-and post-operative patients' group. The results indicated that the mean of hemoglobin % in females in preoperative period 11.7±0.08 this level decrease to 10.7±0.12 during postoperative duration, in males Hb level in preoperative period was 12.7±0.09 and in postoperative reduce to 11.8±0.13. The level of serum ferritin in females in preoperative period was 56.1±5.5 and the level significantly decrease to 22.2±6.1 and while in males the level was 61.9±9.7 in preoperative period to 24.3±8.2 in postoperative period during the follow up as shown in table 2.

Table (2): shown the results of Hb% and ferritin level in patients before and after SG in both males and females.

Sex	Hemoglobin (%)			Ferritin (ug/L)		
	Rreoperations (mean±SD)	Post-operations (mean±SD)	Pvalue	Rreoperations (mean±SD)	Post-operations (mean±SD)	P value
Male	12.7±0.09	11.8±0.13	0. 6	61.9±9.7	24.3±8.2	0.3
Female	11.7±0.08	10.7±0.12	0.6	56.1±5.5	22.2±6.1	0.01

Results expressed as mean (standard deviation).

The results shown significant differences in both level of calcium and zinc between the pre and postoperative period. The level of calcium ions in female was 9.20 ± 0.62 in preoperative period then decrease to 8.7 ± 0.61, in postoperative period, in males also the level decrease in pre- to postoperative period 9.43 ± 0.62 to 8.7 ± 0.61 respectively. In preoperative period the zinc plasma concentration in female was 91.50 ± 21.6 then decreased to 75.2±6.1 in postoperative period, in males also decreased from 89.96 ± 21.4 to 72.3±8.2. this mean, in post-operative duration, level of Calcium and Zinc were significantly decreased in patients in both male and female after SG, as shown in table 3.

Table (3): shown Calcium and zinc level during pre and postoperative period.

Gender	Calcium (mg/dl)			Zinc (µg/dL)		
	Pre-operations mean±SD	Post-operations mean± SD	P value	Reoperations mean± SD	Post-operations mean± SD	P value
Male	9.43 ± 0.62	8.8 ± 0.61	0.004	89.96 ± 21.4	72.3±8.2	0.001
Female	9.20 ± 0.62	8.7 ± 0.61	0.004	91.50 ± 21.6	75.2±6.1	0.001

Results expressed as mean (standard deviation)

The results of current study shown there was a significant difference in level of vitamin D and non -significant in B12 between pre- and post-operative period. In female, Vitamin D level in female decreased from 41.2 ± 28.4 to 22.7 ± 25.61, and in males 40.1 ± 28.9 to 22.4 ± 25.61 after SG. Vitamin B12 concentration in female was 410.7±247.3 before SG then decreased to 403.1±236.4 after SG, same matter for males decreased from 413.7±247.3 to 405.1±236.4, as shown in Table 4.

Table (4): Vitamins D and B12 level according to sex during the pre- and postoperative period.

Gender	Vitamin D (ng/mL)			Vitamin B12 (pg/mL)		
	Preoperations mean±SD	Post-operations mean± SD	P value	Reoperations mean± SD	Post-operations mean± SD	P value
Male	40.1 ± 28.9	22.4 ± 25.61	0.001	413.7±247.3	405.1±236.4	0.251
Female	41.2 ± 28.4	22.7 ± 25.61	0.001	410.7±247.3	403.1±236.4	0.251

Results expressed as mean (standard deviation).

The current results shown at the 1-year follow-up there was a significant difference in Magnesium and phosphorous concentration between pre- and post-operative duration in both males and females. Serum magnesium in males before SG was 1.9 ± 0.9, and in females was 1.8± 0.4 then arise after laparoscopic sleeve gastrectomy surgery to 2.2± 0.04, 2.0 ± 0.05 respectively. Phosphorous level in both males and females increased after SG by compared their level before SG, as shown in table 5.

Table (5): Magnesium and Phosphorous level before and after SG in males and females.

Gender	Magnesium (mg/dL)			Phosphorous (mg/dL)		
	Preoperations mean±SD	Post-operations mean± SD	P value	preoperations mean± SD	Post-operations mean± SD	P value
Male	1.9 ± 0.9	2.2 ± 0.04	0.5	3.7 ±0.6	4.0 ±0.46	0.001
Female	1.8± 0.4	2.0 ± 0.05	0.5	3.8 ±0.5	4.1 ±0.45	0.001

Results expressed as mean (standard deviation)

Discussion

Even with the recommendations about use of nutritional supplementation, a large proportion of patients undergoing gastrectomy have vitamins and minerals deficiencies, mainly of micronutrients, in the postoperative period. [13]

Around the world, Iron deficiency anemia(IDA) is one of the most prevalent forms of anemia.[14] Multi-factors associated with iron deficiency development, including reduced iron intake, inadequate iron absorption, and increased iron requirements during periods such as infancy, adolescence, pregnancy, breastfeeding, and heavy menstrual bleeding in women which occur during the menstrual cycle.[15] Inadequate iron intake is most common among the causes

of IDA which occur due to poor dietary choices before surgery, which frequently involve unconscious and vegetarian diets. In post-bariatric surgery patients, several factors contribute to iron deficiency anemia, including intraoperative bleeding, the use of proton pump inhibitors, reduced post-operative food intake, and intolerance to iron-rich foods such as red meat.[16] Calcium is crucial for various physiological processes, including muscle contraction, blood clotting, protein secretion, and neuronal excitability. Our findings consistent with previous research showing that reduced serum calcium levels are frequently observed following bariatric surgeries.[17] However, some studies have reported no significant alterations in calcium metabolism post-bariatric surgery[18],[19]. Additionally, evidence suggests that obesity may offer some protection against osteoporosis, and even moderate weight loss can lead to a reduction in bone mineral density.[20]

The prevalence of zinc deficiency is believed to rise after bariatric surgery. In our study, female patients exhibited significantly lower serum zinc concentrations and a higher incidence of zinc deficiency in post-surgery.[21] This higher rate of zinc deficiency in females by compared to males, may be due to differing dietary patterns. Our findings align with those of Mohammadi et al., who also reported a similar trend of zinc deficiency among female patients, although they found no significant correlation between zinc deficiency and sex.[22]

We observed a significant improvement in vitamin D levels post-operatively. However, some patients remained deficient in vitamin D despite supplementation,[23] and these finding consistent with our study. Rates of deficiency increase to 30-40% during the winter months, as most vitamin D is obtained through sunlight exposure on the skin. This is influenced by various factors including season, sunscreen use, cloud cover, time spent outdoors during optimal sun exposure, and the amount of skin exposed.[24] The stomach contains parietal cells and chief cells that secrete gastric acid and intrinsic factors essential for the absorption of vitamin B12 and calcium. This principle suggests that laparoscopic sleeve gastrectomy may cause long-term deficiencies in vitamin B12 and calcium.[25] Despite removing most of the antrum in LSG, we found no change in vitamin B12 deficiency after LSG. This could be due to the compensating mechanisms of the GI tract.

The data regarding potential changes in magnesium levels following bariatric surgery is inconsistent. One possible explanation for these contradictory findings is that different types of bariatric procedures may have distinct effects on serum magnesium levels. For instance, hypomagnesemia has been reported more frequently in patients who underwent jejunoileal bypass. Various confounding factors, such as changes in magnesium absorption or side effects like diarrhea, could contribute to the discrepancies observed among different bariatric surgical methods.

Future studies could focus on long-term follow-up to determine the persistence of these deficiencies and the effectiveness of different supplementation strategies. Additionally, investigating the impact of dietary modifications and lifestyle changes post-surgery could provide further insights into managing nutrient deficiencies in these patients.

Conclusion

This retrospective study found that laparoscopic sleeve gastrectomy significantly impacted specific nutritional deficiencies in patients one-year post-surgery. Understanding these deficiencies helps in preventing and managing nutritional complications through tailored oral nutritional supplementation.

Authors contributions

All authors have equal contribution.

Conflicts of Interest

The authors in this study have no conflicts of interest.

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Ethical approval

We obtained a written informed consent from all participants prior enrolled in the current study.

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