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The Effect of Sleeve Gastrectomy on Physiological Functions and Some Vital Indicators in Obese Patients in Najaf

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Abstract: *Obesity usually results from excessive nutrition, which causes a defect in the functions of the immune system as a result of the accumulation of fat, as excess fat in the body is associated with changes in the number of white blood cells, red blood cells, and platelets, and is associated with changes in the function of the thyroid gland, where obesity affects the permeability of vessels It is also related to many metabolic disorders, including iron balance disorders, so many surgical techniques have been developed to treat obesity, including the laparoscopic sleeve gastrectomy, which is one of the common procedures for treating obesity and has gained great popularity due to its great impact on weight. This study* ***aimed*** *to study the complications and some side effects (positive and negative) of sleeve gastrectomy. Five milliliters of blood samples were collected from 43 obese under laparoscopic sleeve gastrectomy at Al-Batool Al-Ahly Hospital and Al-Ghadeer Center in Al-Najaf Governorate from September 2022 to March 2023, included 18 male and 25 female as well as 19 obese did not went under sleeve gastrectomy included 18 males and 11 females were taken as a control group. The age of all obese participated in this study was (60-18) years and there body mass index greater than 35 kg / m^2, (19) obese people (8) males and (11) : The results showed a showed a insignificantly decrease in Ferritin protein levels and an increase in Thyroid stimulating hormone (TSH) levels in the patient group compared to the control group moreover , this study showed that there were no significant differences (P>0.05) in the following indicators hemoglobin (Hb), hematocrit (HCT), Mean corpuscular volume (MCV), and mean corpuscular hemoglobin (MCH), while there was increase in Platelets (PLTs), mean platelet volume (MPV), mean corpuscular hemoglobin concentration (MCHC), Red blood cell (RBC) s, and a decrease in white blood cell (WBC),* lymphocytes, *and Neutrophils in the patient group compared to the control group, depend on the gender of the patient group, the results showed a significant decrease in both ferritin and each of Hgb. RBCs, HCT, MCV, MCH and MPV, and a significant increase in the level of TSH in females compared to males as well as there were some changes in the studied parameters of sleeve gastrectomy patients divided according to the period after the operation.*

Keywords: gastric sleeve, thyroid-stimulating hormone, ferritin protein, CBC

1.Introduction

Obesity usually results from excessive nutrition, which causes an imbalance in the functions of the immune system as a result of the accumulation of fat, as excess fat in the body is associated with changes in the number of white blood cells, red blood cells, and platelets [1]. Obesity is associated with many metabolic disorders, including iron balance disorders, Because the resulting inflammation stimulates the hepcidin hormone, which can lead to a poor distribution of iron in the body [2] Obesity is associated with changes in the function of the thyroid gland, where obesity affects the permeability of blood vessels in the thyroid gland, and thus the occurrence of functional changes in the gland [3] as the degree of obesity is related Changes in the thyroid gland, which affects the levels of thyroid hormones [4] Obesity is also associated with hypothyroidism, as studies have shown a positive correlation between the thyroid hormone TSH and body mass index, as TSH levels increase in the blood of obese people compared to compared to thin people [5] Obesity treatment is difficult and complicated, but surgery has raised the levels of success in treatment. Many surgical techniques have been developed to treat severe obesity during the past fifty years, and this led to the emergence of laparoscopic surgery, which increased its effectiveness, popularity, and safety among the population [6]. Laparoscopic sleeve gastrectomy is the most common procedure for treating obesity all over the world and has gained great popularity due to its significant impact on weight in the medium and long term, treatment of diseases associated with obesity, and an improvement in quality of life [7] It was found that sleeve gastrectomy had a positive effect on the function of the thyroid gland, as a study conducted on 106 patients suffering from obesity and high levels of the TSH hormone showed an improvement in the function of the thyroid gland, as the levels of the TSH hormone decreased gradually and the levels of fT4 decreased after the operation, which indicates the restoration of normal thyroid functions to In addition to a decrease in body mass index, as this improvement was affected by weight loss after sleeve gastrectomy [8], in another study of the effect of laparoscopic sleeve gastrectomy on thyroid hormones, the study showed a significant decrease in TSH levels in obese thyroid patients after surgery [9] . Ferritin is a multi-unit protein whose units are arranged in a hollow spherical structure that works to maintain the balance of iron in the organism [10] The sleeve gastrectomy process has a negative effect on ferritin protein levels, as a study conducted on 20 obese people who underwent gastric sleeve surgery showed low levels of protein Ferritin during the first year following gastric sleeve surgery [11] In addition to iron deficiency, the incidence of iron deficiency after gastric sleeve surgery ranges between 1 and 54% [12] Iron levels decrease in the body after gastric sleeve surgery despite the decrease in inflammation, so it is usually recommended to follow A diet rich in iron and taking adequate nutritional supplements to avoid iron deficiency anemia after the operation [13].

This study aimed to evaluate the effect of laparoscopic sleeve gastrectomy on ferritin protein and TSH concentration as an indicator of iron stores in the body and thyroid gland function respectively and to find out if there is an effect of gastric sleeve surgery on hematological parameters.

2.Methodology

Condition of the study: The study included (62) obese, 43 of whom had undergone gastric sleeve surgery in Al-Batoul Al-Ahly Hospital and Al-Ghadeer Center in Al-Najaf Governorate, and 19 had not. this study was done during the period from September 1, 2022 until the end of March 2023

Participants: The group included patients who underwent laparoscopic sleeve gastrectomy due to obesity, with a body mass index of greater than 35 kg / m^2, divided into

18 males and 25 females, and their ages ranged between 18-60 years. The study also included a control group of obese people who did not undergo gastric sleeve surgery. Endoscope divided into (8) males and (11) females

Physiological and biochemical parameters:

For each group, the following were measured: Ferritin protein and TSH in serum and CBC in blood.

Blood sample: The samples were collected by drawing venous blood, as 5 ml of blood was drawn using medical plastic syringes, and then distributed into tubes according to the following 2ml placed in tubes containing anticoagulants used for the purpose of detecting blood variables represented by Complete Blood Count(CBC) 3ml were distributed into tubes that do not contain anticoagulants, and placed in a centrifuge for 10 minutes 3000 rpm for the purpose of obtaining serum and detecting the biochemical and hormonal variables represented by Ferritin TSH

Measurement of serum ferritin levels

Ferritin protein levels were measured using the Maglumi 2000 Plus device, and using the Ferritin kit equipped by the German company Snibe [14]

Measurement of serum thyroid stimulating hormone (TSH) levels

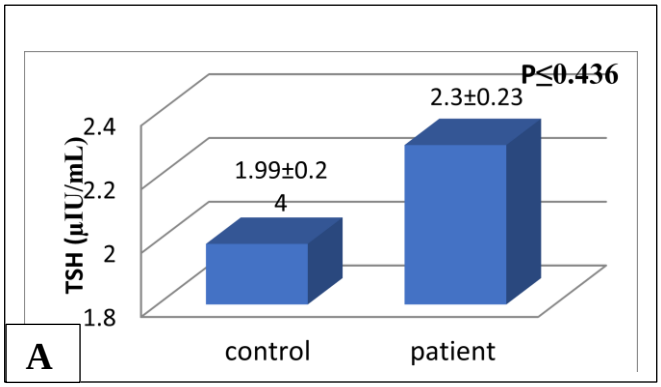
The level of TSH hormone in the serum was measured by a device (2000 Plus Maglumi) and by using a TSH kit equipped by the German company Snibe [15]

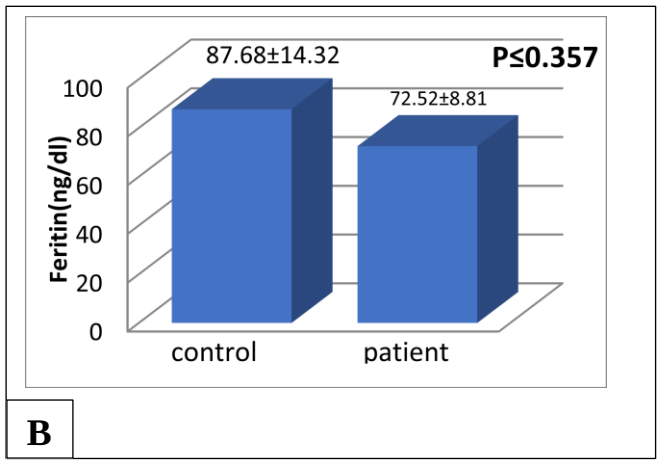
CBC complete blood count:the blood parameters represented by the complete blood count (CBC) were measured by the(Dymind DH 31) device

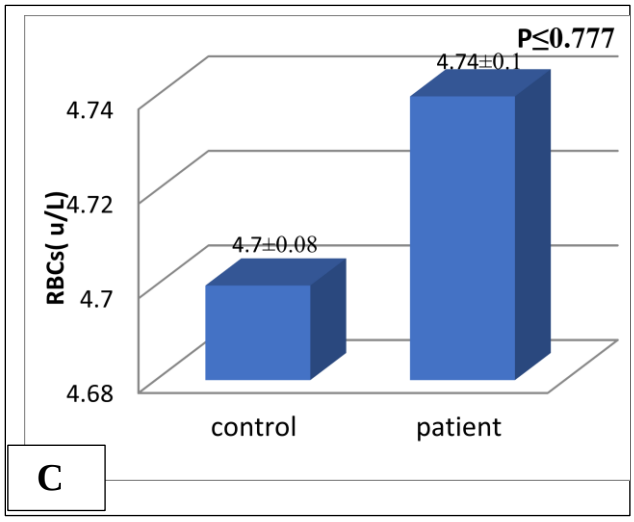
Statistical analysis: All the results of the current study were subjected to statistical analysis, and the statistical program SPSS version 32 was used for this purpose. The T-test and one-way analysis of variance were used for the purpose of comparing the averages of the coefficients included in the study. Significant differences were identified at the level of probability $P<0.05$

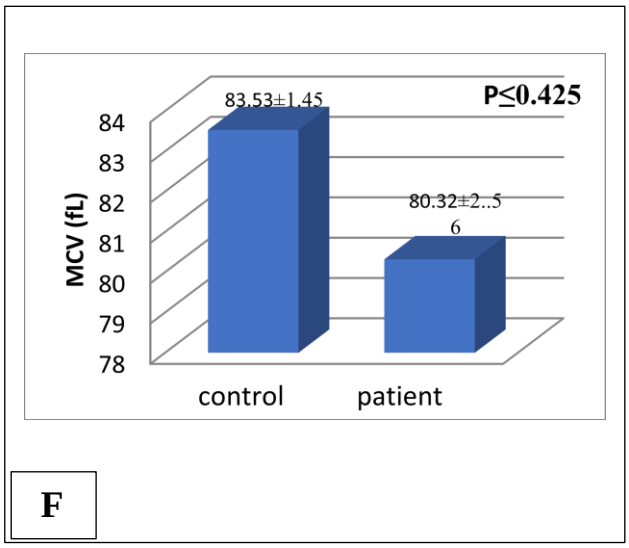
3.Results and Discussion: :

The results showed an increase in the level of thyroid-stimulating hormone (TSH) and a decrease in the level of ferritin protein, with no statistically significant difference, and an increase in the total number of red blood cells (RBCs) in the patients group compared to the control, and the results of the study indicated that there was no significant difference Statistically significant in hemoglobin levels and the volume of stacked cells in the patient group compared with the control group. A slight decrease was also found in the average red blood cell volume (MCV) in the patient group, with no statistically significant difference in the average amount of hemoglobin in red blood cells. The number of platelets (PLTs), the average volume of platelets, and the decrease of both the number of white blood cells (WBCs) (neutrophils) and (lymphocytes) in the patient group compared with the control group, as in Figure (1).









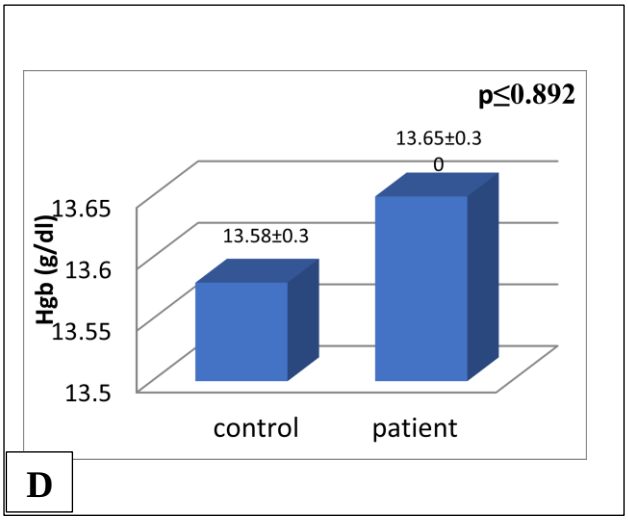
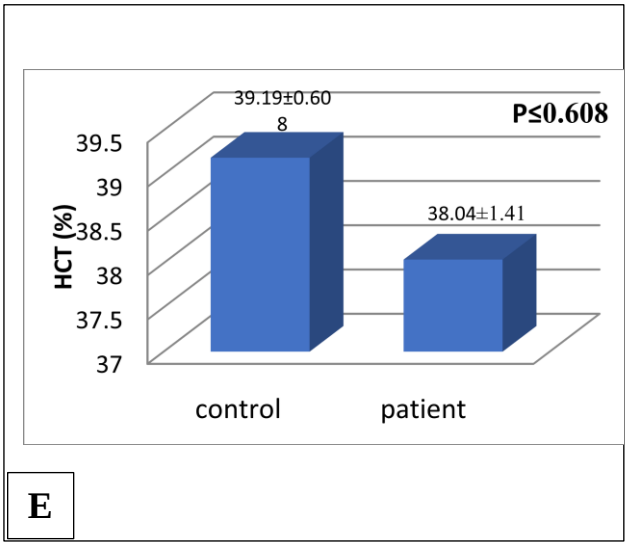
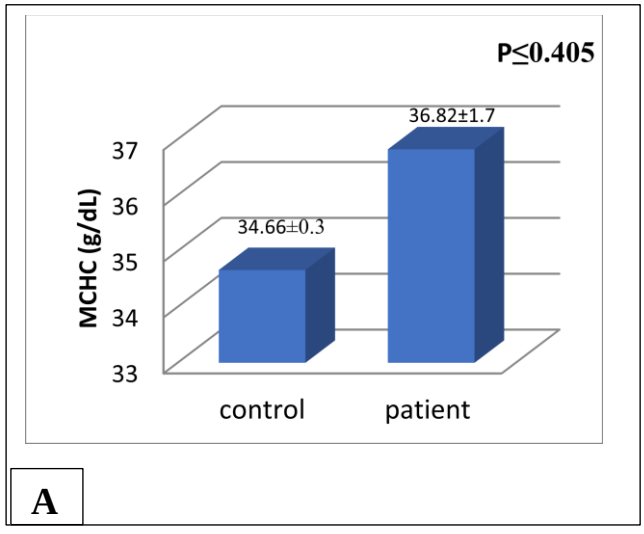


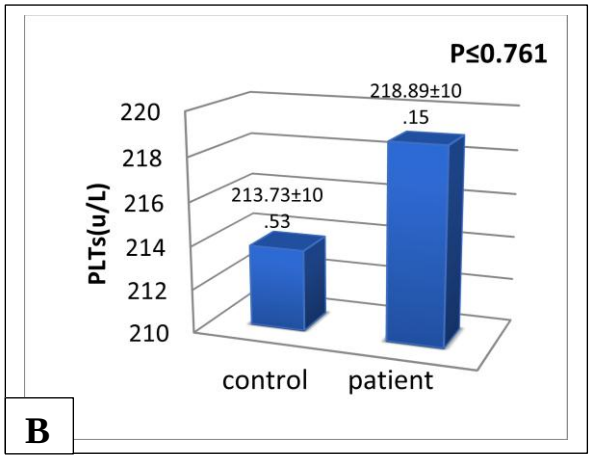
Figure (1) shows the levels of in the patient and control group

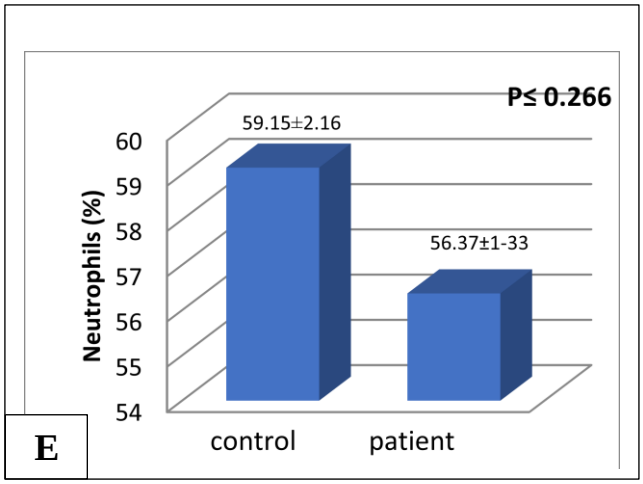
A. TSH, **B** Ferritin, **C**. RBCs, **D**. Hgb, **E**. HCT, F. MCV

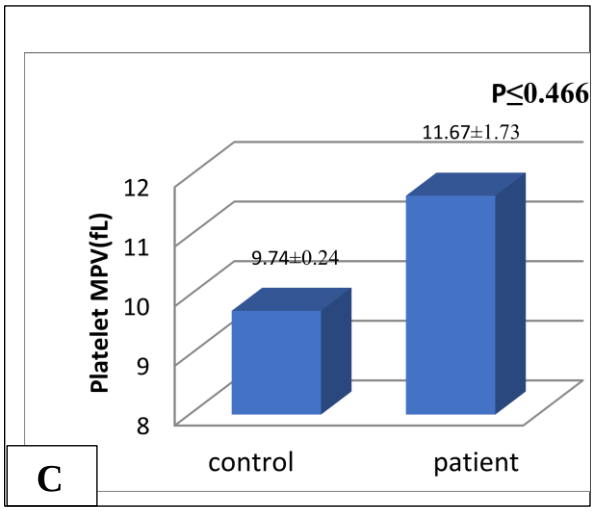
The results also showed that there was no statistically significant difference in the average amount of hemoglobin in red blood cells, the increase in the number of platelets (PLTs), the average volume of platelets, and the decrease in the number of both white blood cells (WBCs), neutrophils, and lymphocytes in the patient group compared to the control group, as shown in Figure (2)

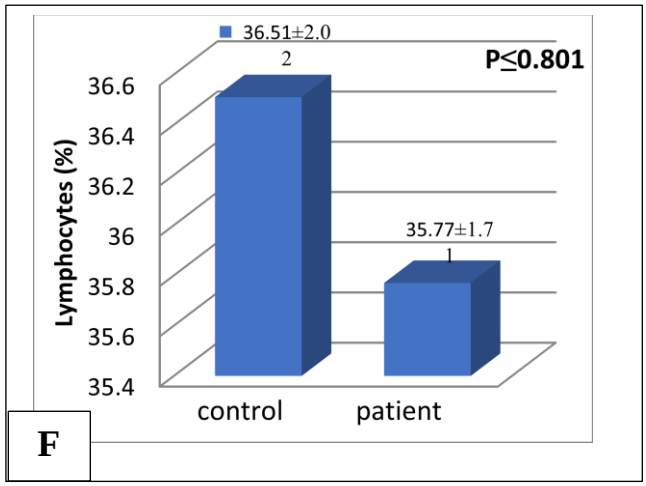












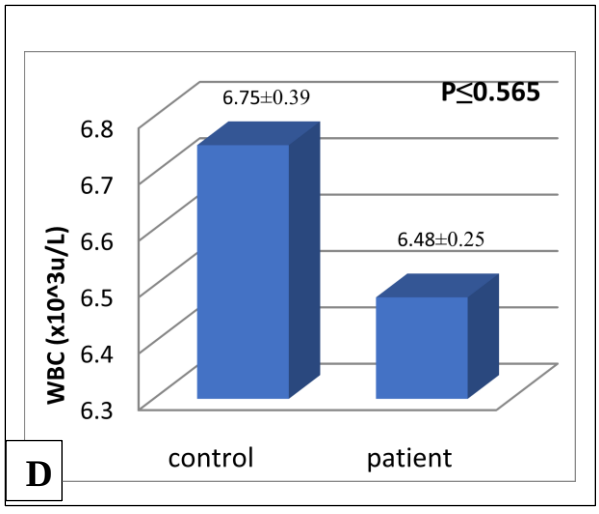


Figure (2) levels A. MCHC, B. Platelet , C . MPV, D. WBC, E. neutrophils,. F. lymphocytes in the patient group and the control group

The effect of sex on the biochemical and physiological indicators in the blood of patients after sleeve gastrectomy

The results of the current study indicated in Table (1) that there was a significant increase (P<0.05)) in the levels of ferritin protein in the blood serum of laparoscopic sleeve gastrectomy males, with a mean of (107.2 ± 13.21) compared to the mean of (47.55 ± 9.1) in females. A significant decrease (P<0.05) was observed in the concentration of thyroid-stimulating hormone (TSH) in the serum of gastric sleeve males with a mean of (1.89 ± 0.29), while females showed a higher mean of the concentration of the hormone (2.59 ± 0.33).

The current study also showed a significant increase (P<0.05) in the levels of hemoglobin in the blood of male sleeve gastrectomy patients, with an arithmetic mean of (15.47 ± 0.3) compared to female sleeve gastrectomy patients, which showed a mean of (12.34 ± 0.23) as shown in Table (1). A decrease in the number of red blood cells was also observed in Female sleeve gastrectomy patients with an arithmetic mean of (4.42 ± 0.12) compared to males (5.19 ± 0.12) with the appearance of a statistically significant difference (P<0.05) The results showed in Table (1) a significant decrease P<0.05 in the average hematocrit in male sleeve gastrectomy patients compared to In females, where the arithmetic mean of hematocrit in males was (43.16 ± 1.98), while in females it was (34.38 ± 1.6). The results showed a significant increase in mean corpuscular volume where he was in males (83.31 ± 3.32), while in females (78.16 ± 3.7), Table (1) showed an increase in the mean corpuscular hemoglobin of male sleeve gastrectomy patients with an average of (29.89 ± 0.38) compared to females, where the Mean Corpuscular Hemoglobin of females was (28.14 ± 0.66) with a significant difference at a significant level (P < 0.05). Table 1 shows that the Mean Corpuscular Hemoglobin Concentration of males was (38.28 ± 3.65), while in females it was (35.78 ± 1.34), a decrease in the Mean Corpuscular Hemoglobin Concentration in Females without significant differences, the results showed an increase in the number of platelets in the blood of female sleeve patients with an arithmetic mean of (241.8 ± 11.3) compared to males, where the average number of platelets in males was (187.07 ± 16.0) with a significant difference at a significant level of P<0.05. The current study showed a significant decrease (P<0.05) in the average volume of platelets in female sleeve gastrectomy patients, with an arithmetic mean (9.94 ± 0.41) compared with males, where the average platelet volume in males was (14.09 ± 4.11). The results showed there were no significant differences between the average number of white blood cells, Neutrophils and lymphocytes in females as compared with males.

Table (1) Biochemical and physiological indicators in males and females of the sleeve group

parameters	gender		p-value
	Male N= 18	Female N= 25	
Ferritin ng/mL)(	107.2±13.21 A	47.55±9.1 B	0.001
TSH (µ1U/ML)	1.89±0.29 A	2 .59±0.33 B	0.051
Hgb (g/ dI)	15.47±0.3 A	12.34±0. 23 B	0.001
RBCs (X10^6u/L	5.19±0.12 A	4.42±0.12 B	0.001
HCT (%)	43.16±1.98 A	34.38±1.6 B	0. 001
MCV(fL)	83.31±3.32 A	78.16±3.7 B	0.052
MCH(pg)	29.89±0.38 A	28.14±0.66 B	0.029
MCHC(g/dL)	38.28±3.65 A	35.78±1.34 A	0.476
PLTs (x10^3u/L)	187.07±16.0 A	241.8±11.3 B	0.006
MPV (f L)	14.09±4.11 A	9.94±0.41 B	0.053
WBCs (x10^3u/L)	6.66±0.38 A	6. 36±0. 29 A	0.752
Neutrophils (%)	56.55±2.03 A	56.25±1.81 A	0.913
Lymphocyte (%)	34.55±74 A	36.65±2.21 A	0.552

Different letters indicate a significant difference, mean ± standard error

-Changes in biochemical and physiological parameters in sleeve gastrectomy patients divided according to the postoperative period

The current study showed a variation in Ferritin protein levels in a group of gastric sleeve patients divided according to the time period after the operationhe time period (3-6) months after the operation showed the highest arithmetic mean of (75.11 ± 17.2) at a significant level (P < 0.05) compared to other time periods. It was noted in Table (2) a variation in the levels of TSH hormone in the serum of laparoscopic sleeve gastrectomy patients, divided according to the time periods after the operation, as the highest mean was

recorded in the group of patients who had undergone the operation ≥ 11 months, with a mean (2.43 ± 0.46), followed by the group of patients Those who spent (3-6) months after the operation with an arithmetic mean of (2.36 ± 0.41), while the group of patients who had undergone the operation (10-7) showed an arithmetic mean (2.08 ± 0.34) with no statistically significant difference. Table (2) showed the variation of hemoglobin levels in patients with laparoscopic sleeve gastrectomy according to the specified time periods, the group of patients within the time period (3-6) showed the highest arithmetic mean of (14.09 ± 0.54) compared to other time periods followed by the time period (≥11). With a mean of (13.57 ± 0.52), while the group of patients who had undergone the operation(7-10) months ago showed the lowest mean (13.15 ± 0.48) with no significant difference, according to Table (2) the highest mean of the number of red blood cells was In the group of patients with sleeve gastrectomy within the time period(3-6) months, the rate was (4.91 ± 0.17), followed by the group of patients within the time period(≥11) months, with a mean of(4.83 ± 0.2), while the time period(7-10) months showed the lowest mean (4.44 ± 0.13) without a statistically significant difference. The results showed variation in hematocrit levels in the blood of laparoscopic sleeve gastrectomy patients divided according to the time period after the operation. The time period (3-6) showed the highest arithmetic mean by (39.9 ± 2.95), while the period showed (10-7) months the lowest arithmetic mean of (35.02 ± 2.03) , The results showed a variation in the levels of Mean corpuscular hemoglobin and the highest average was in the category (7-10) months with an average of (29.58±0.69) while the category (≥11) months showed the lowest arithmetic mean of about (28.42±1.15) without the appearance of statistically significant differences, Table (2) shows the variation in the levels of Mean corpuscular volume in the patient group within the periods, the highest Mean corpuscular volume was in the patient group within the time period(≥11) where it reached (80.97 ± 3.44), followed by the group of patients within the time period (6-3) with a mean (80.35 ± 5.01), while the group of patients within the time period (10-7) showed the lowest mean (79.62 ± 4.5) with no significant difference. The results of table (2) that the highest Mean corpuscular hemoglobin concentration in the blood was for the group of sleeve patients within the time period (10-7) with an amount of (40.34 ± 4.99), followed by the group of patients within the time period (6-3) with a mean of (35.37 ± 1.99) while the period (≥11) showed an arithmetic mean (35.21 ± 0.48) without a significant difference. The results showed a variation in the numbers of platelets in the blood of sleeve gastrectomy patients divided according to the specified time periods, as a significant difference was recorded ($P<0.05$) and the highest arithmetic mean of the number of platelets for patients within the time period (≥11) was (231.15 ± 16.07), followed by the arithmetic mean of the number of platelets For patients within the time period 3-6) with an amount of (225.4 ± 14.2), and the lowest average was within the period (10-7), when it reached (198.05 ± 23.03). Category (10-7) followed by category (6-3) with an arithmetic mean of (10.39 ± 0.25), while the category (11 ≤) showed the lowest mean of (9.87 ± 0.34) without a statistically significant difference. The results shown in the table showed that there were changes in the average number of white blood cells in the blood of sleeve gastrectomy patients divided within the time periods, the period (3-6) showed the highest arithmetic mean for the number of white cells was (6.71 ± 0.38), followed by the time period (≥11) with a mean of (6. 11 ± 0. 56), while the time period (10-7) showed a mean of (6.56 ± 0.36), with no significant difference. he table showed changes in averages of neutrophil cells in the blood of laparoscopic sleeve gastrectomy patients within the time periods, the highest arithmetic mean of (59.3 ± 2.7) was in the group of patients within the time period (10-7), followed by the group

of patients within the time period (3-6) With a mean of (56.78 ± 1.91), while the time period (≥11) showed the lowest mean of the numbers of neutrophils in the blood by (52.91 ± 2.3), and there was no statistically significant difference. Variation was also observed in the averages of lymphocytes for sleeve gastrectomy patients within the time periods, as the highest arithmetic average of the number of lymphocytes was recorded for patients within the time period (≥11) with an arithmetic mean of (40.62 ±2.03), while the time period (6-3) showed the lowest arithmetic mean of (35.71 ± 2.23), while the time period (10-7) showed the lowest arithmetic mean (31.006 ± 4.15), with no statistically significant difference.

Table (2) Changes in biochemical and physiological indicators in sleeve gastrectomy patients divided according to the period after the operation

Parameters	Time period			p-value
	month 3-6N=17	7-10 mo. N= 14	≥11 mo.N= 12	
Ferritin ng/mL) (	75.11±17.2A	67.15±14.9B	74.5±12.3A	0.052
TSH (µ1U/Ml)	2.36±0.41A	2.08±0.34A	2.43±0.46A	0.839
Hgb (g/ dI)	14.09±0.54A	13.15±0.48A	13.57±0.52A	0.443
RBCs (X10^6u/L	4.91±0.17A	4.44±0.13A	4.83±0.2A	0.154
HCT (%)	39.9±2.95A	35.02±2.03A	38.66±1.6A	0.353
MCV(fL)	80.35±5.01A	79.62±4.5A	80.97±3.44A	0.980
MCH(pg)	28.67±0.43 A	29.58±0.69 A	28.42±1.15 A	0.558
MCHC(g/dL)	35.37±1.99A	40.34±4.99A	35.21±0.48A	0.406
PLTs (x10^3u/L)	225.4±14.2A	198.05±23.03 A	231.15±16.07A	0.401
MPV (f L)	10.39±0.25 A	15.15±5.76A	9.87±0.34 A	0. 427
WBCs (x10^3u/L)	6.71±0.38A	6.11±0.56A	6.56±0.36A	0.613
Neutrophils (%)	56.78±1.91A	59.3±2.7A	52.91±2.3A	0.175
Lymphocyte (%)	35.71±2.23A	31.006±4.15A	40.62±2.03A	0.089

Different letters indicate a significant difference, mean ± standard error

The current study showed a decrease in Ferritin protein levels in the serum of sleeve gastrectomy patients compared to the control group. Micronutrient deficiencies, specifically iron deficiency, are among the risk factors associated with bariatric surgery, as iron deficiency anemia is one of the recurring pathological conditions after gastric sleeve [16]. The results agreed with the study [17], which demonstrated a decrease in Ferritin levels after follow-up for a period of 1 year to 5 years of laparoscopic sleeve gastrectomy, which indicates the risk of infection Iron deficiency after surgery, and agreed with the study [18], which concluded that the highest prevalence rate of nutrient deficiency after sleeve gastrulation is Ferritin by 33.3%, and it came, respectively, after Vitamin D and Albumin deficiency t occurs due to nutrient deficiencies as a result of inadequate intake and absorption of micronutrients[19]., It also showed a slight increase in the number of blood platelets and the average volume of platelets in the patient group compared to the control group. This result was not consistent with the study [20], which showed a decrease in PLTs after 6 months of laparoscopic sleeve gastrectomy, and it also showed an increase in MPV levels significantly after the operation. The current study showed a decrease in the number of white blood cells, lymphocytes, and neutrophils in the patient group compared to the control group. The increase in white blood cells is closely related to the inflammatory state in obesity, as the number of WBCs, neutrophils, and lymphocytes increases with the increase in body mass index and decreases with its decrease, as the study showed. Decrease in numbers of WBC, neutrophils, and lymphocytes after weight loss, as they are affected by signs of obesity [21]. The results of this study agreed with the study [22], which demonstrated a decrease in WBC after bariatric surgery. Elevated WBC also agreed with the study [23], which indicated that weight loss

and control of glucose metabolism may mitigate chronic low-grade inflammation and reduce the number of As for gender, the current results showed a significant decrease in the level of Ferritin protein in the female group compared to the male group, and the decrease was statistically significant. These results agreed with the study [24], which showed that the percentage of people with anemia and the decrease in Ferritin level was more significant in females and indicated that The presence of other non-specific mechanisms that contributed to the development of anemia after bariatric surgery, the study explained Ferritin deficiency in females is due to a low-energy lifestyle that reduces the meal and thus a lack of nutritional requirements such as iron and the lack of daily intake of iron in the diet followed [25] Iron deficiency is common in people who suffer from obesity and may be exacerbated by bariatric surgery, especially for females in the premenopausal period who suffer from pre-existing iron deficiency [26], and the results showed a significant decrease in the concentration of Hgb, HCT, and RBCs in the female group compared to the group. Males, the result agreed with the study [27], which proved that levels of Hgb, HCT, and RBCs are significantly higher in males compared to females. This is due to the fact that men and women have different averages of Hgb, as females have lower levels of Hgb by about 12% of Males and similar sex-related differences were found in animals as well. This is due to the effect of sex hormones on the formation of red blood cells, as estrogen and androgens affect the renal microvasculature, which in turn affects the formation of red blood cells [28] The difference is attributed to the menstrual cycle in females, where Hgb concentrations vary according to the phases of the cycle [29] HCT levels are also associated with sex due to the influence of hormones, as a study conducted on 1273 males showed that males with low levels of testosterone had lower levels of HCT compared to males with normal testosterone levels [30], It also showed a higher level of platelets in females compared to males, with a decrease in the average volume of platelets in females. This is due to the fact that sex affects platelet biology. This result agreed with the study [31], which showed that females have a greater number of platelets compared to with males, mean platelet volume also correlates with sex and platelet count [32].

4.Conclusion: Although there was no significant difference between the ferritin protein levels in the control group and the patients group, the protein levels decreased after gastric sleeve gastrectomy, and its levels were affected by sex and body mass index however the sleeve gastrectomy was of high quality, clear effects with regard to some blood physiological parameters, especially a decrease in the number of white blood cells, neutrophils, and lymphocytes, which may indicate a decrease in low-grade inflammation resulting from obesity in the sleeved patients .

Ethical approval

The specimens of this study took the patient's approval for adult patients, precious and the consent of the irrigation for young people in age as the law and directives of the human rights organizations with adequate information in an ethical manner.

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