Original
ISSN 2413-0516

Effects of Sleeve Gastrectomy on Thyrotropin Hormone (TSH) and Vitamin D Levels among Obese Patients in Nineveh Governorate

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(Submitted: 25 April 2023 – Revised version received: 14 May 2023 – Accepted: 29 May 2023 – Published Online: 26 August 2023)

Abstract

Objectives: This study aimed to assess the impact of bariatric surgery on thyrotropin (TSH), calcium, vitamin D, and lipid profile levels three months post-surgery among patients who underwent the procedure. We also investigated the prevalence of micronutrient deficiencies during the initial three months before and after surgery, along with monitoring the effects of gastric sleeve surgery on body mass index (BMI) reduction.

Methods: The study involved the analysis of data from a cohort comprising 30 patients of both genders who had undergone sleeve gastrectomy due to obesity, with a preoperative BMI of 40 kg/m^2 or higher. The research spanned from July 2022 to January 2023, with patients undergoing gastric sleeve surgery at Al-Zahrawi Hospital in Nineveh. These patients were subsequently followed up for a period of three months post-surgery.

Results: The study findings demonstrated a significant reduction in TSH, vitamin D, calcium, total cholesterol (TC), triglycerides (TG), low-density lipoproteins (LDLc), very low-density lipoproteins (VLDLc) cholesterol, and BMI in patients who underwent gastric sleeve surgery within the three-month follow-up period, in comparison to their pre-surgery levels. Additionally, there was a noteworthy increase in high-density lipoproteins of cholesterol (HDLc) in the serum of these patients post-operation. The results further indicated positive correlations between TSH, vitamin D, cholesterol, LDLc, and the Atherogenic Index. Likewise, positive correlations were observed between vitamin D, TSH, total cholesterol, triglycerides (TG), and LDLc.

Conclusion: Post-surgery deficiencies in vitamin D, calcium, and TSH levels are attributed to inadequate intake and absorption of micronutrients, highlighting the importance of nutritional supplementation. Sleeve gastrectomy offers a promising avenue for sustained BMI reduction in the long term.

Keywords: Thyrotropin, vitamin D, calcium, triglycerides, lipoproteins, LDL, lipoproteins, HDL

Introduction

Obesity has emerged as a global health epidemic, affecting more than 600 million adults worldwide. This condition, characterized by a persistent imbalance between energy intake and expenditure, has far-reaching implications for the health of affected individuals. As a systemic disease, obesity often leads to a cascade of comorbidities and compromises the functioning of multiple organ systems. Among the various health complications associated with obesity, endocrine system abnormalities, including hyperactivity of the hypothalamic-pituitary-adrenal axis and impaired growth hormone response to specific stimuli, have been noted. Furthermore, thyroid dysfunction frequently co-occurs in obese patients, further exacerbating the complexity of their health challenges.

Bariatric surgery has emerged as a primary treatment modality for addressing both weight loss and the amelioration of comorbidities, ultimately reducing the risk of mortality among obese individuals. However, while these surgical interventions offer substantial benefits, they also bring the potential for complications and expected outcomes, including the development of micronutrient deficiencies. In this context, the role of thyroid-stimulating hormone (TSH), a glycoprotein hormone comprising two non-covalently linked subunits hTSHα and hTSHβ, becomes particularly relevant. Understanding the dynamics of TSH and its relationship to bariatric surgery can shed light on the broader impact of these interventions on metabolic health. This paper delves into the intricate details of TSH and vitamin D levels following sleeve gastrectomy in obese patients, offering insights into the complex interplay between metabolic factors and surgical interventions. Vitamin D refers to the fat-soluble substances made by human skin upon exposure to ultraviolet B (cholecalciferol) or obtained from the diet (ergosterol) and activated in the skin upon exposure to light. Vitamin D receptors are found in many tissues. Vitamin D is necessary to maintain normal calcium metabolism, and low levels have been linked to an increased incidence of some types of cancer, heart disease, and osteoporosis.[7] Liver enzymes: overweight or obese individuals have a higher risk of developing fatty degeneration, which leads to impaired liver function,[8] while liver enzymes including alanine aminotransferase (ALT), and aspartate aminotransferase (AST), and y-glutamyl transferase (GGT) are primary biomarkers of liver injury. Abnormal liver enzymes indicate liver damage or an alteration in bile flow. Its blood levels are increased as a result of many conditions, including NAFLD, alcoholic steatohepatitis, and other liver diseases.[9,10] AST and ALT catalyze the transfer of the beta amino group from alanine and aspartic acid to beta-ketoglutaric acid, ALT is found mainly in the liver and is found in low concentrations in other tissues, perform bariatric surgery lead to a decrease in the degree of cirrhosis, improve the severity of nonalcoholic steatohepatitis (NASH) and nonalcoholic fatty liver disease (NAFLD), and lead to decreased plasma levels of the liver enzymes alanine aminotransferase (ALT) and aspartate aminotransferase (AST) in patients with Obesity, iron has been widely implicated in the pathogenesis of non-alcoholic fatty

liver disease. Iron causes oxidative stress to the liver and depletion of long-chain polyunsaturated fatty acids.[9,10]

Materials and Methods

This study was conducted from the beginning of July 2022 until January 2023, which is the period of collecting blood samples to demonstrate the effect of laparoscopic sleeve gastrectomy on a number of biochemical and hormonal variables in the blood serum of obese patients before the operation and after the operation in different time periods (first month, month third). For patients who underwent gastric sleeve surgery, whose condition was confirmed by specialized doctors, about (5–6) ml of blood was drawn for each group of gastric sleeve patients of both sexes, and placed in clean and sterile plastic tubes with tight covers and free of Any anticoagulant, it was left at room temperature for 20 minutes until the blood coagulated, then a centrifuge was performed at a speed of 3000 rpm for 15 minutes for the purpose of obtaining blood serum. The serum was divided into several sterile and dry Eppendorf tubes and kept at a temperature (–20) m until the required biochemical and hormonal tests are performed. The concentration of TSH and vitamin D in the blood serum of sleeve gastrectomy patients (before the operation and after the operation) of both sexes was estimated using several ready-made analyzes from the Italian company Diasorin with accreditation. According to the CLIA method (Chemiluminescent immunoassay) by the Liaison XL device,[6,11] calcium concentration, and liver enzymes (ALP, ALT, AST) were estimated using several ready-made analyzes using the Dimension device from the German company,[12,13,14] and cholesterol concentration was estimated, HDLc, and TG, using several ready-made analyzes from the French company Biolabo, based on the enzymatic method.[15,16] VLDLc concentration was estimated by applying the equation VLDLc = Triglyecerides/5, LDLc concentration was estimated by applying the equation LDLc = Total cholesterol in serum – (HDLc + VLDLc), The body mass index (BMI) was found by applying the relationship Weight (kg)/Square length (m).[4]

Statistical Analysis

Results were statistically analyzed using Excel, name The test we used, SPSS version 18, and the test type is *T*–test.[17]

Results and Discussion

Thyrotropin Hormone (TSH): The results in Figure 1 and Table 1 showed a significant decrease in TSH levels at a probability level ($P \leq 0.05$) in the serum of patients who underwent sleeve gastrectomy and in all specified time periods compared with the same group of patients. Before the operation, the largest decrease was recorded three months after the operation compared to one month. Low TSH is associated with decreased leptin levels after surgery. Leptin is produced by adipocytes and has been shown to influence the secretion of several hypothalamic hormones, including thyrotropin-releasing hormone.[18] The decrease in leptin levels after weight loss caused by bariatric surgery will lead to decreased TSH secretion. Thus, bariatric surgery, specifically procedures associated with fundoplication that result in lower ghrelin levels, may have an additive effect in improving thyroid function.[19,20]

Vitamin D: The results in Figure 1 and Table 1 showed a significant decrease in vitamin D levels at a probability level ($P \leq 0.05$) in the serum of patients who underwent sleeve gastrectomy and in all specified time periods compared with the same group of patients. Before the operation, the largest decrease was recorded three months after the operation compared to one month. Vitamin D deficiency is due to lack of exposure to sunlight, low consumption of Vitamin D, and

Table 1. **The effect of gastric sleeve on the levels of TSH hormone and vitamin D other biochemical parameters**

Biochemical parameters	Groups (Mean ± Standard Deviation)		
	Before the operation	One month after operation	Three month after operation
TSH mIU/L	3.433 ± 0.62^{a}	$2.49 \pm 0.61^{b,c}$	1.62 ± 0.69^{d}
Vitamin D ng/ml	90.13 ± 17.84^{a}	80.5 ± 16.6^{b}	$70.8 \pm 14.88^{c,d}$
Total S. Caicium mg/dl	9.68 ± 1.0^{a}	8.82 ± 0.88^{b}	7.8 ± 0.72^{c}
S. Cholesterol mg/dl	209.95 ± 26.77^{a}	190.61 ± 18.55^{b}	$160.23 \pm 17.22^{c,d}$
TG mg/dl	177.15 ± 20.21^{a}	$147.10 \pm 18.76^{b,c}$	124.18 ± 16.85^{d}
HDLc mg/dl	22.17 ± 2.35^{a}	28.82 ± 2.94^{b}	34.73 ± 3.21^{c}
LDLc mg/dl	152.7 ± 15.53^{a}	132.36 ± 14.84^{b}	$100.66 \pm 11.39^{c,d}$
VLDLc mg/dl	35.61 ± 7.42^{a}	29.42 ± 6.88^{b}	24.83 ± 5.91^{c}
S. Phospho lipid mg/dl	275.14 ± 27.09^{a}	319.12 ± 37.43^{b}	$221.62 \pm 25.11^{c,d}$
Atherogenic index	9.53 ± 0.97^{a}	$6.45 \pm 0.78^{b,c}$	4.87 ± 0.63^{d}
S. ALKphophatase U/L	98.67 ± 12.90^{a}	88.0 ± 12.34^{b}	$77.69 \pm 12.59^{c,d}$
S. ALT U/L	40.5 ± 9.67^{a}	33.17 ± 8.76^{b}	26.4 ± 7.12^{c}
S. AST U/L	46.9 ± 8.87^{a}	41.4 ± 8.31^{b}	34.9 ± 7.20^{c}
BMI kg/m^2	51.32 ± 5.45^{a}	45.32 ± 5.20^{b}	40.0 ± 5.0^{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 ($P \leq 0.05$).

sequestration of Vitamin D in adipose tissue. Role of cytokines and adipokines in obesity associated with low vitamin D. There is a growing awareness of the contribution of vitamin D to the modulation of immune reactions.[21] The synthesis and release of proinflammatory adipocyte-derived proteins is affected by body fat mass in parallel with vitamin D status found that vitamin D deficiency is positively associated with serum concentrations of some inflammatory adipokines, such as TNFá, C-reactive protein and IL-6 in obese subjects.[22,23]

Calcium: The results in Figure 1 and Table 1 showed a significant decrease in calcium levels at a probability level ($P \leq 0.05$) in the serum of patients who underwent sleeve gastrectomy and in all specified time periods compared with the same group of patients. Before the operation, the largest decrease was recorded three months after the operation compared to one month. Calcium deficiency results from decreased calcium absorption,[24,25] and calcium intake is often also low due to reduced intake of dairy products as a result of post-operative lactose intolerance. Results of studies indicate that vitamin D plays an important role in bone metabolism, calcium regulation in the body, decreased skeletal stress, lower estrogen concentrations in women, and lower plasma concentrations of both leptin and ghrelin.[26,27]

Lipid profile: The results in Figure 1 and Table 1 showed a significant decrease in the levels of cholesterol, triglycerides, low-density lipoproteins (LDLc), very low-density lipoproteins (VLDLc), and atherosclerotic factor, at the level of probability ($P \leq 0.05$) in the serum of patients who underwent sleeve gastrectomy and at all indicated time periods compared with the same group of patients. Before the operation, the greatest decrease was recorded after three months of the operation compared to one month, while the results showed a significant increase in HDLc levels at a probability level ($P \leq 0.05$) in the serum of patients who underwent gastric sleeve surgery and in all specified time periods compared with the same group of the patients. Before the operation, the greatest increase was recorded three months after the operation compared to one month. As the body begins to lose a lot of weight after LSG, and eating food in small quantities, especially in the first trimester, the body gets energy by burning fats and thus the body gets rid of excess fat, or because patients eat foods rich in proteins that reduce fats and increase HDL, and take mineral elements such as copper and magnesium that increase high-density lipoproteins and reduce low-density lipoproteins,[28] and this may be due to a decrease in ghrelin due to gastrectomy, and indicates Some studies indicate a relationship between ghrelin metabolism and HDLc.[29,30] In a three-month follow-up after the operation, a decrease in cholesterol concentration was observed, in addition to a decrease in body mass index, and this indicates a correlation between total cholesterol levels and body mass levels. The reason for improving the fat profile after bariatric surgery is due to a decrease in body mass. Decreased triglyceride levels are observed after LSG gastric sleeve surgery, which leads to a decrease in the volume of the stomach, and a decrease in the hormone cholecytokinin, which stimulates the secretion of pancreatic enzymes.[31,32,33]

Liver enzymes: The results in Figure 1 and Table 1 showed a significant decrease in the levels of alkaline phosphatase (ALP), aianine transaminase (S.ALT), and aspartate transaminase (S.AST) at a probability level ($P \leq 0.05$) in the serum of patients who underwent sleeve gastrectomy and at all indicated time periods compared with the same group of patients. Before the operation, the largest decrease was recorded three months after the operation compared to one

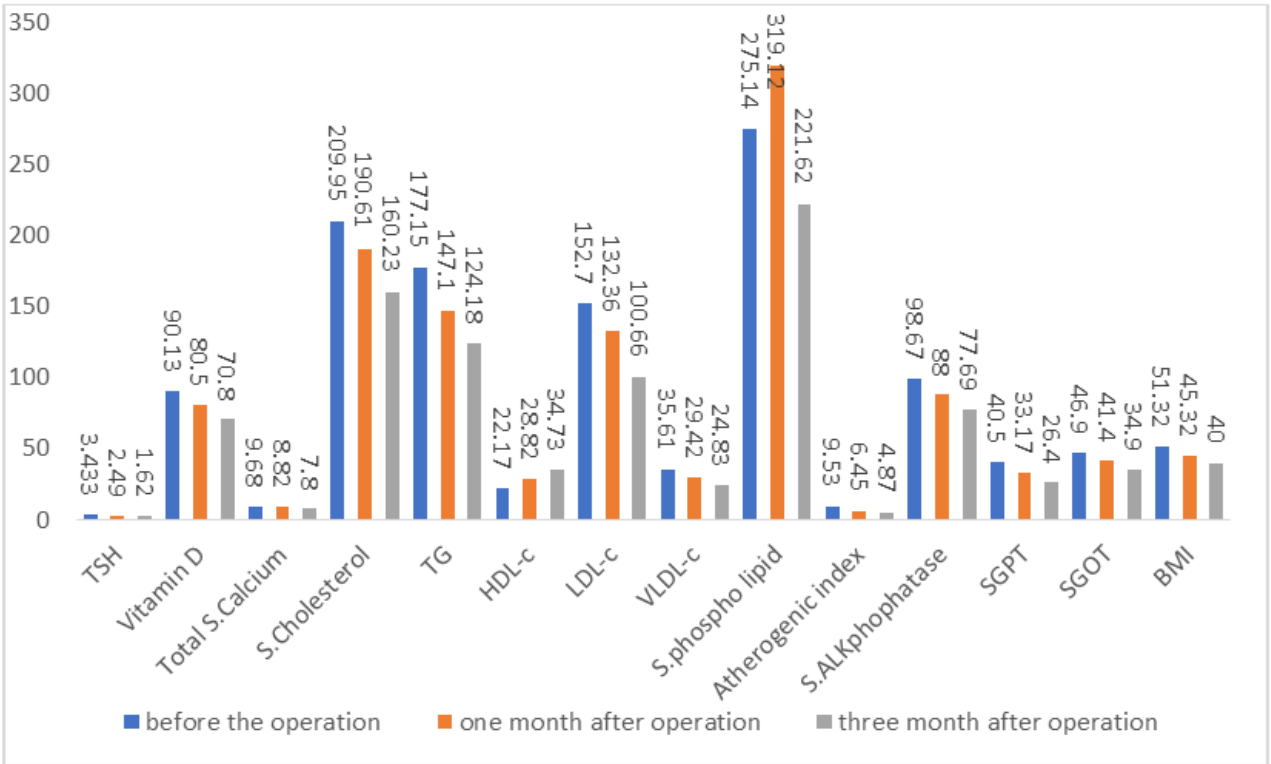

Fig. 1 **The effect of gastric sleeve on the levels of hormon TSH and vitamin D other biochemical parameters.**

month. Liver enzymes (AST, ALT, and ALP) Obesity is associated with non-alcoholic fatty liver disease, which is reflected in histological changes in the liver as well as changes in liver function.[3] Bariatric surgery is expected to stop liver damage mainly by inducing weight loss.[8,9] Another possible reason for the recovery in liver function after LSG may be that malabsorption may exacerbate the suboptimal compensatory capacity of antioxidants in the liver in an environment where free fatty acid mobilization, oxidation, and production of free radical species are increased due to rapid weight loss.[10] Experimental evidence suggests that LSG may act through changes in bile acid metabolism through farcinoid X receptors, affecting fatty acid metabolism in the liver.

Body mass index (BMI): The results shown in Figure 1 and Table 1 showed a significant decrease in BMI levels at a probability level ($P \leq 0.05$) in the serum of patients who underwent sleeve gastrectomy and in all specified time periods compared with the same group of patients. Before the operation, the largest decrease was recorded three months after the operation compared to one month. The results showed a significant decrease in BMI throughout the follow-up period. Weight is lost after LSG due to hormonal changes, calorie reduction and food intake. There is a direct relationship between weight and BMI, and vice versa.[34]

The results presented in Table 2 showed a positive association between TSH, vitamin D, cholesterol, LDLc, and Atherogenic Index. Increased TSH is associated with increased body weight. The sleeve gastrectomy reduces the size of the stomach, which leads to a decrease in the levels of the hormone ghrelin, which is produced from the basal cells of the stomach, which has a positive effect in improving the function of the stomach. Thyroid, always causes an improvement in metabolism and lipid levels, and also LSG leads to lower levels of the hormone leptin, leptin is produced by adipocytes and has been shown to affect the secretion of several thyroid hormones, including the hormone thyrotropin secretion, will lead to a decrease leptin after weight loss to lower TSH. People with hypothyroidism

Table 2. **Correlation between TSH with other biochemical parameters**

Biochemical parameters	Negative	Positive
Vitamin D		0.5784
Total S. Calcium	–0.2519	
S. Cholesterol		0.503
TG	–0.3986	
HDLc	–0.3564	
LDLc		0.5987
VLDLc	–0.27846	
S. Phospho lipid	–0.2976	
Atherogenic index		0.526
S. ALKphophatase	–0.21667	
S. ALT	–0.13591	
S. AST	–0.09823	
BMI	–0.36908	

Table 3. **Correlation between Vitamin D with other biochemical parameters**

Biochemical parameters	Negative	Positive
TSH		0.5784
Total S. Calcium	–0.381719	
S. Cholesterol		0.5837
TG		0.5205
HDLc	–0.39767	
LDLc		0.528
VLDLc	–0.3045	
S.phospho lipid	–0.329252	
Atherogenic index	–0.43626	
S. ALKphophatase	–0.237023	
S. ALT	–0.25508	
S. AST	–0.284629	
BMI	–0.33074	

may not get enough vitamin D for two possible reasons. First, low vitamin D levels may be the result of insufficient absorption of vitamin D from the gut. Second, the body may not adequately activate vitamin D.[18,35] Low vitamin D reduces the efficiency of calcium absorption in the intestine, and the body responds by enhancing the secretion of parathyroid hormone (PTH).[7]

The results in Table 3 showed a positive association between vitamin D, TSH, total cholesterol, triglycerides (TG), and LDLc. Several factors including decreased food intake, decreased excretion of HCl and intrinsic factor, vomiting, poor food choices, and food intolerance lead to nutrient deficiencies.[8,22] It is known that adipose tissue is not only a lipid storehouse, but also an active endocrine and immune system organ that can be implicated in the pathogenic mechanisms underlying dyslipidemia. The weakening of adipose tissue results from the stress of obesity: cells grow excessively because they store fat resulting in decreased oxygen delivery to the tissues; Individual cells die, and inflammation occurs in the adipose tissue. The cytogenetic increase indicates activation of the immune reaction in which pro-immune cytokines (tumor necrosis factor, C-reactive protein, interleukin-6) are released.[35]

Conclusion

Obesity surgery is one of the procedures that lead to long-term weight loss and improvement of obesity-related diseases. Patients who undergo obesity surgery are at risk of micronutrient deficiency, so the patient must be seen on regular visits in order to obtain the necessary nutritional supplements based on regular blood tests, especially Vitamin D and calcium.

Acknowledgment

I would like to extend my sincere thanks and appreciation to the Department of Chemistry at the College of Education for Girls, University of Mosul, Iraq.

Ethical Considerations

Each patient's written consent was obtained prior they take part in this study. On July 27, 2022, the Institutional Ethics Committee reviewed and authorized the study protocol, subject information, and consent form in line with Document 2022123.

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