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The Effect of Sleeve Gastrectomy on Thyroid Profile in Euthyroid Obese Patients (A Prospective Single Arm Observational Study)

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Abstract

Obesity is a major prevalent health problem affecting both developing and developed countries. It is associated with many co-morbidities and endocrinal abnormalities including thyroid dysfunction. Thyroid dysfunction has been associated with weight disturbances and changes in basal metabolic rate. Since laparoscopic sleeve gastrectomy (LSG) is currently the most surgically performed bariatric surgery, this study was conducted to correlate changes in thyroid profile with the percentage of excess body weight loss (%EBWL) associated with LSG. This study is a prospective single arm observational study conducted over 112 obese patients who underwent LSG in Kasr Alaini University Hospitals. Thyroid profile (free T3, free T4 and TSH), baseline weight, and excess body weight (EBW) were recorded preoperatively. Changes in thyroid profile after 3 and 6 months postoperative were recorded and correlated with the %EBWL. There was a statistically significant decrease in median and interquartile range (IQR) of T3 and TSH over the time of follow up (3 and 6 months postoperative (p value <0.001). However, there was no statistically significant change in T4 level over the time of follow up. There was a statistically significant weak positive association/correlation between EBW and free T3 (fT3) & free T4 (fT4) levels at baseline unlike thyroid stimulating hormone (TSH) which showed no correlation. As for correlation between changes in thyroid profile and % EBWL over the follow up period, there was no significant correlation between the percentage of change in hormonal levels with %EBWL at 3 months and at 6 months follow up. LSG induced weight loss is associated with a decrease in fT3 and TSH while fT4 is not significantly affected. Preoperative EBW is positively correlated with baseline fT3 and fT4 in contrast to % EWBL which showed insignificant correlation with the changes inthyroid profile 3- and 6-months post LSG.

Keywords: Obesity, Sleeve Gastrectomy,Euthyroid, Thyroid profile, % EBWL.

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1. Introduction

Obesity is a chronic medical condition that has emerged as a significant public health concern worldwide, given its prevalence and its association with poor health outcomes. The prevalence of obesity has been increasing steadily over the past few decades, and it is now considered a global epidemic [1]. The rising prevalence of obesity is influenced by genetic predisposition, environmental factors, and lifestyle changes. Overall, given the significant negative impacts of increased risk of comorbidities and decreased quality of life, it is crucial to prevent and manage obesity, promote healthy lifestyles, and reduce the economic burden imposed by the condition [2]. The effects of thyroid hormones are impacting nearly all body organs. Thyroid hormones activate genes that promote metabolic rate and thermogenesis, leading to increased energy and oxygen consumption. Moreover, thyroid hormones elevate the basal metabolic rate, body temperature, respiration rate, and oxygen consumption by upregulating the expression of Na+/K+ ATPase genes in various organs [3].

Thyroid status and obesity influence each other in a reciprocal manner. This is evidenced by research findings indicating that individuals with hypothyroidism often experience weight gain and an increase in body mass index (BMI). Additionally, obese individuals have a significant prevalence of thyroid function disorders [4]. The effectiveness of sleeve gastrectomy (SG) for weight loss and resolution of weight- related comorbidities with a relatively low risk of complications makes it an attractive bariatric procedure for both patient and surgeon. Thus, in recent years, LSG has become the most popular bariatric procedure performed worldwide [5]. Sleeve gastrectomy can lead to significant reductions in adipose tissue mass, improvements in metabolic function, and alterations in thyroid hormone levels and adipose tissue-derived hormone production. Further research is needed to fully elucidate the mechanisms underlying the metabolic improvements observed after sleeve gastrectomy [6].

2. Patients and Methods

This is a prospective single arm observational study conducted in Cairo University Hospitals during the period from December 2021 to February 2023 which included 112 euthyroid obese patients aged from 18 to 60 years candidates for LSG who gave no history of current or prior thyroid or other endocrinal abnormalities. Ethical approval for this study was granted upon evaluation by the Research Ethics Committee of Faculty of Medicine Cairo University in February 2021, (IRB: MD-401-2021). Patients were selected to undergo LSG after being informed about all other convenient bariatric surgical options and the possible outcomes, benefits, and potential risks of each by an independent surgeon who is not contributing to the study. Patients were informed and consented about the nature of the research, and the team ensured that the whole research process was fully understood and agreed to by each patient. All patients underwent a standard evaluation preoperatively, they were subjected to full preoperative assessment including thorough personal, medical, and surgical history. Routine full labs, complete endocrinal workup, echocardiography, electrocardiogram (ECG), chest X-Ray and pelviabdominal ultrasound (US) were done. Psychiatric evaluation and dietary counseling were done, and subjects stuck to a low caloric diet preoperatively for a period of 1-3 weeks prior to surgery according to the preoperative BMI. All co-morbidities that increase perioperative risk were controlled before surgery as much as possible. Patients data including age, sex, medical history, surgical history, weight, and height were recorded. Thyroid function tests namely TSH, free T3 and free T4 were done to all patients. Measurements of thyroid hormones in all patients whether preoperatively or in the follow up period were done on Cobas 6000 device (Roche Diagnostics, Penzberg, Germany) using electrochemiluminescence immunoassay technology (ECLIA). Reference ranges for thyroid profile were as follows: Free T3 >> 2.0 – 4.4 pg/Ml. Free T4 >> 0.9 – 1.7 ng/dL. TSH >> 0.270 – 4.200 µIU/mL. BMI was calculated and EBW was determined as the difference between the actual body weight and ideal body weight. Ideal body weight calculation varied according to gender. The equation used in men was 50 + (0.91 × [height in centimeters − 152.4]) and in women was 45.5 + (0.91 × [height in centimeters − 152.4]) [7]. Patients were scheduled for LSG using the standard surgical technique: Pneumoperitoneum using Verrus needle in Palmer's point, Insertion of four 12 mm trocars (epigastric, Rt and Lt upper quadrants and supra- umbilical just to the left of midline) and one 5 mm trocar (Lt anterior axillary line). Patient positioning in anti-Trendelenburg position with the operating surgeon between the patient's legs (French position). Devascularization of the greater curvature. Insertion of 36Fr bougie through the mouth and gastric transection using a linear stapler starting 3-6 cm proximal to the pylorus up to the angle of HIS. Methylene blue test is carried out. Hemostasis, drain insertion and specimen retrieval. In the 3-month and 6-month period post the procedure, patients presented to the bariatric follow up clinic, their weight at the time was recorded and the %EBWL was calculated. Measurements of fT3, fT4 and TSH were recorded.

3. Results and Discussion

The study included 112 euthyroid obese patients who underwent LSG, of which There were 10 males (8.9%) and 102 females (91.1%). The age of the study subjects ranged from 19 to 60 years with a mean age of 34.8±7.95 years. The BMI of the study subjects ranged from 40.5 to 71.1 with a mean value of 50.61 Kg/m^2 (Table 1). Of the total cases 25 (22.3%) were diabetic and 27 (24.1%) were hypertensive. 17 patients (15.2%) had other co-morbidities, mainly osteoarthritis and polycystic ovary syndrome. Regarding the ideal weight of the study subjects, it varied between 42.41 and 75.12 kg. while their EBW varied between 48.54 to 122.95 Kg (Table 1). Analysis of the thyroid profile measurements revealed that fT3 and TSH showed a decrease in mean and IQR comparing preoperative to 3 and 6 months follow up unlike fT4 which maintained almost steady levels. These changes were statistically significant where not only the 3 months follow up showed statistically significant difference from baseline readings but also the 6 months follow up is different from 3 months and baseline (p value <0.001). Nevertheless, there is no statistically significant change in T4 level over the time of follow up (Table 2). The percentage of change in TSH showed statistically significant difference with higher percentage of change in short term follow-up (3months) than long term (6months) 10.82 (5.81-15.2) compared to 7.99 (3.97:14.04) with a P-value 0.012. This means that the significant drop occurred after 3 months of follow up rather than after 6 months of follow up. However, the percentage of change in free T3 and free T4 showed no statistically significant difference at 3 months when compared to the percentage of change in 6 months or from baseline (Table 3). There is a statistically significant weak positive association/correlation between EBW and free T3 & free T4 levels at baseline (this means the increase in the EBW is associated with increase in the free T3 & freeT4), unlike TSH which showed no correlation (Table 4). As regards correlation between changes in thyroid profile and %EBWL over the follow up period, there was no significant correlation of the percentage of decrease in hormonal levels with %EBWL at 3 months and at 6 months follow up. Obesity is a major health problem with multifactorial etiology. The relationship between obesity and various endocrinal functions is a field of interest and would greatly help in understanding the pathophysiology of obesity [8]. Thyroid gland disturbances had widely been associated with obesity yet, few studies focused on the changes within euthyroid gland functions associated with weight loss. Moreover, no sufficient data corelates euthyroid gland functions with the amount of weight loss or with bariatric surgery namely sleeve gastrectomy [9]. Positive outcomes after bariatric surgery can be measured in several ways, including improvements in obesity-related comorbidities, quality of life, and weight loss [10]. This study was conducted over 112 euthyroid obese patients who underwent LSG as bariatric procedure. Excess body weight and percentage of excess body weight loss (% EBWL) were used as an indication for the degree of obesity and weight loss response respectively. Follow up of the patients included in this study revealed a significant decrease in both free T3 and TSH over 3 and 6 months follow up period (P-value <0.001) while free T4 levels showed no significant change (P-value 0.824).

Despite the crude decrease in values over time, the percentage of decrease for free T3 were insignificant, (P-value 0.533) unlike for TSH (P-value 0.012). Despite those changes in the thyroid profile, they were not correlated with % EBWL. The first study to evaluate the effect of LSG on thyroid hormones over 12 months follow up was conducted by Abu-Ghanem et al. 2015 on 38 euthyroid obese patients. It showed a significant decrease in TSH levels at 6-12-month post LSG compared to baseline levels (P-value <0.0001). In alignment with this study, free T4, results didn't show a significant change at baseline and at 6–12 months following LSG, However, the decrease in TSH following surgery did not correlate with EBWL [9]. Another study by Yang et al., (2017) conducted on 16 Chinese euthyroid obese patients following their thyroid profile changes 12 months post LSG has found a significant drop in TSH levels 12 months after LSG (P= 0.022). whereas free T3 and free T4 levels maintained almost steady levels P= 0.406 and 0.583 respectively [11]. The drop in serum TSH level was significantly correlated with decrease in BMI but not with EBWL or TWL [11]. A study by Juiz-Valiña et al., (2019) on 129 euthyroid obese patients compared to a control group of 31 patients with only 32% underwent LSG while the rest underwent LRYGB, showed that baseline TSH levels in obese group were higher than control group, in contrast to our study that showed a statistically significant weak positive association/correlation between EBW and freeT3 & free T4 levels at baseline (P=0.002) but not with TSH (P=0.318) [12]. While after 12 months follow up, TSH levels significantly decreased in bariatric surgery induced weight loss patient group (P<0.001), estimating a mean steady decrease around 0.034 units per month of follow-up, while in our study percentage change of decrease in TSH was higher in short term follow-up (3months) than long term (6months) [12]. In contrast to this study, the above-mentioned study showed that during follow-up, the more the excess weight loss, the lower the TSH values (p<0.001) [12]. Gokosmanoglu et al., (2020) came out with a consistent conclusion with our study regarding TSH levels (P=0.025) while following up 472 obese euthyroid patients for 1-3.6 years after bariatric surgery where only 174 of whom underwent LSG, and the rest underwent LRYGB. However, no statistically significant change was observed in fT4 and fT3 levels (P>0.05) [13]. Even though Almunif et al., (2020) studied 103 patients with overt or subclinical hypothyroidism who underwent LSG while our study included only euthyroid patients, it was found that hypothyroidism improved in 44% and totally resolved in 22% of the patients [14]. All patients achieved significant weight loss after surgery and a positively statistically significant association was found between BMI and serum TSH in a 12-month follow-up (P<0.005) [14]. Unlike most of the previously mentioned studies including ours, Chen et al., (2020) had found that the concentrations of FT4 significantly increased (P = 0.004) in their comparative study following 109 euthyroid patients, comparing obese post LSG to overweight to normal controls for 6 and 12 months [15]. Nevertheless, TSH levels significantly decreased from baseline to 12 months postoperatively (P<0.001), and FT3 levels were decreased significantly at 6 months and 12 months post LSG compared to baseline levels P = 0.001, P = 0.023, respectively) [15]. Aykota et al., (2021) conducted their study over 159 euthyroid patients, followed their fT3, fT4, and TSH values 6 months post LSG and compared them to the preoperative ones. They correlated the changes in TSH to not only % EBWL, but also BMI and % TWL [16]. Their study came out with inconsistent results to our study and most of the forementioned ones where fT4 levels significantly increased at 6 months after LSG; (p<0.001) while fT3 levels showed no change. Yet, TSH levels were significantly decreased (p<0.001) and showed positive correlation with BMI changes (r=0.200, p=0.015) but not with % EBWL and %TWL [16].

Table 1: Age, Gender, and Co-morbidities Distribution - Baseline characteristics of studied group.

			Median (IQR)	
		Mean± SD	**Minimum**	**Maximum**
Age		34.8±7.95	34.5(29-40)	19-60
BMI		50.61±7.04	50(44.7-55.43)	40.5-71.1
Ideal Weight		53.43±5.5	52.42(49.69-56.06)	42.41-75.12
EBW		76.89±16.55	76.49(62.53-89.73)	48.54-122.95
		N	**%**	
Gender	Male	10	8.90	
	Female	102	91.10	
	DM	25	22.30	
Co-morbidities	HTN	27	24.10	
	Others	17	15.20	

Table 2: Comparison of thyroid hormones over the time of follow up of patients.

	Base line	3 months follow up	6 months follow up	p value	Statisticaltest
T3 Median (IQR)	3.2 (2.7-3.53)	*2.92 (2.6-3.2)	*#2.77 (2.41-3.01)	<0.001	
T4 Median (IQR)	1.2 (1.1-1.28)	1.18 (1.1-1.25)	1.19 (1.1-1.3)	0.824	Related sample Friedman`stest
TSH Median (IQR)	2.51 (1.63-3.34)	*2.2 (1.31-3.01)	*#2 (1.2-2.77)	<0.001	

Table 3: Comparison of percent of change in thyroid hormone profile in three and six monthspostoperative (Wilcoxon test of significance).

	Three months from base line	Six months from 3 months	P value
Percent of change in T3	6.39 (3.05:10.19)	5.43 (2.94:9.14)	0.533
Percent of change in T4	-0.21 (-10.64:10.09)	0.32 (-9.41:8.19)	0.428
Percent of change in TSH	10.82 (5.81-15.2)	7.99 (3.97:14.04)	0.012

Table 4: Correlation between EBW and baseline thyroid profile (Spearman's rho test, P-value significant ≤ 0.05).

	EBW	
	r	**p value**
T3 base line	.292**	0.002
T4 base line	.288**	0.002
TSH base line	-0.095	0.318

Emphasizing their conclusions, Chen et al., (2022) conducted a follow up observational study on 85 euthyroid obese patients. 12 months post LSG, fT3 and TSH levels significantly decreased, (P<0.001 and P=0.002 respectively) while mean fT4 levels increased (P=0.013). However, those changes were not statistically correlated with BMI [16]. The most recent study adopting this topic by Kamal et al. 2023 included 106 euthyroid obese patients undergoing LSG, follow up thyroid profile was done 3, 6, and 12 months post operative and correlated with BMI, % TWL [17]. In variance with this study, results showed overall statistically significant increase in fT4 (p< 0.001), and no significant change in fT3. However, a statistically significant reduction in TSH (p < 0.001) was found that is negatively correlated with the 12-month BMI (r = 0.191, p= 0.049) and positively correlated 12-month TWL% (r = 0.327, p = 0.001) [18].

4. Strengths and Limitations

Fortunately, this study had points of strength including focusing only on the effect of LSG on thyroid profile, analyzing changes in thyroid hormones level within the euthyroid range for detection of minor changes and corelating these changes to % EBWL rather than BMI. Limitations to this study were sample size, being single arm observational study, relatively short period of follow up and dropouts. Overall, studies are consistent regarding the effects of LSG induced weight loss on TSH levels in previously euthyroid patients yet, a great diversity is found regarding it' effect on the thyroid gland hormones itself suggesting an unclear mutual implication. We recommend further studies comparing the effect of different surgical and non-surgical weight loss modalities on thyroid profile and assess the reversibility of this changes in cases of weight regain.

5. Conclusions

LSG induced weight loss is associated with a decrease in fT3 and TSH while fT4 is not significantly affected at 3 and 6 months postoperative. The percentage of change in TSH showed statistically significant difference with higher percentage of decrease in short term follow up (3 months) than long term (6 months). There is no significant correlationbetween the % EBWL and changes in the thyroid profile at 3- and 6-months post LSG. Preoperative EBW is positively correlated with baseline fT3 and fT4 unlike TSH which showed no correlation.

References

[1] P. P. Pitil, S. R. Ghazali. (2022). Overweight and obesity: a study among university students in Sarawak, Malaysia. International Journal of Health Promotion and Education. 1-13.

[2] G. A. Bray, K. K. Kim, J. P. Wilding, World Obesity Federation. (2017). Obesity: a chronic relapsing progressive disease process. A position statement of the World Obesity Federation. Obesity reviews. 18 (7): 715-723.

[3] A. C. Bianco, E. A. McAninch. (2013). The role of thyroid hormone and brown adipose tissue in energy homoeostasis. The lancet Diabetes & endocrinology. 1 (3): 250-258.

[4] S. Kommareddy, S. Y. Lee, L. E. Braverman, E. N. Pearce. (2015). Thyroid function and metabolic syndrome: a cross-sectional study in obese and overweight patients. Endocrine Practice. 21 (11): 1204-1210.

[5] S. Sullivan, N. Kumar, S. A. Edmundowicz, B. K. A. Dayyeh, S. S. Jonnalagadda, M. Larsen, C. C. Thompson. (2015). ASGE position statement on endoscopic bariatric therapies in clinical practice. Gastrointestinal endoscopy. 82 (5): 767-772.

[6] J. I. Mechanick, C. Apovian, S. Brethauer, W. T. Garvey, A. M. Joffe, J. Kim, R. F. Kushner, R. Lindquist, R. Pessah-Pollack, J. Seger, R. D. Urman, S. Adams, J. B. Cleek, R. Correa, M. K. Figaro, K. Flanders, J. Grams, D. L. Hurley, Shanu Kothari, M. V. Seger, C. D. Still. (2020). Clinical practice guidelines for the perioperative nutrition, metabolic, and nonsurgical support of patients undergoing bariatric procedures–2019 update: cosponsored by American Association of Clinical Endocrinologists/American College of Endocrinology, The Obesity Society, American Society for Metabolic & Bariatric Surgery, Obesity Medicine Association, and American Society of Anesthesiologists. Surgery for Obesity and Related Diseases. 16 (2): 175-247.

[7] R. G. Brower, M. A. Matthay, A. Morris, D. Schoenfeld, B. T. Thompson, A. Wheeler, W. J. Sibbald. (2000). Ventilation with lower tidal volumes as compared with traditional tidal volumes for acute lung injury and the acute respiratory distress syndrome. New England Journal of Medicine. 342 (18): 1301-1308.

[8] M. Castro, A. C. Moreira. (2003). Análise crítica do cortisol salivar na avaliação do eixo hipotálamo-hipófise-adrenal. Arquivos Brasileiros de Endocrinologia & Metabologia. 47: 358-367.

[9] Y. Abu-Ghanem, R. Inbar, V. Tyomkin, I. Kent, L. Berkovich, R. Ghinea, S. Avital. (2015). Effect of sleeve gastrectomy on thyroid hormone levels. Obesity surgery. 25: 452-456.

[10] A. de Hollanda, T. Ruiz, A. Jiménez, L. Flores, A. Lacy, J. Vidal. (2015). Patterns of weight loss response following gastric bypass and sleeve gastrectomy. Obesity surgery. 25: 1177-1183.

[11] J. Yang, Z. Gao, W. Yang, X. Zhou, S. Lee, C. Wang. (2017). Effect of sleeve gastrectomy on thyroid function in chinese euthyroid obese patients. Surgical Laparoscopy Endoscopy & Percutaneous Techniques. 27 (4): e66-e68.

[12] P. Juiz-Valiña, E. Outeiriño-Blanco, S. Pértega, B. M. Varela-Rodríguez, M. J. García-Brao, E. Mena, L. Pena-Bello, M. Cordido, S. Sangiao-Alvarellos, F. Cordido. (2019). Effect of weight loss after bariatric surgery on thyroid-stimulating hormone levels in euthyroid patients with morbid obesity. Nutrients. 11 (5): 1121.

[13] F. Gokosmanoglu, E. Aksoy, A. Onmez, H. Ergenç, S. Topkaya. (2020). Thyroid homeostasis after bariatric surgery in obese cases. Obesity Surgery. 30: 274-278.

[14] D. S. Almunif, F. Bamehriz, S. Althuwaini, T. H. Almigbal, M. A. Batais. (2020). The effect of laparoscopic sleeve gastrectomy on serum thyroid-stimulating hormone levels in obese patients with overt and subclinical hypothyroidism: a 7-year retrospective study. Obesity Surgery. 30: 1491-1497.

[15] X. Chen, C. Zhang, W. Liu, J. Zhang, Z. Zhou. (2020). Laparoscopic sleeve gastrectomy-induced decreases in FT3 and TSH are related to fasting C-peptide in euthyroid patients with obesity. Diabetes, Metabolic Syndrome and Obesity. 4077-4084.

[16] M. R. Aykota, M. Atabey. (2021). Effect of sleeve gastrectomy on thyroid-stimulating hormone levels in morbidly obese patients with normal thyroid function.

[17] Y. Chen, W. Zhang, Y. Pan, W. Chen, C. Wang, W. Yang, Chinese Obesity, Metabolic Surgery Collaborative. (2022). Thyroid Function Before and After Laparoscopic Sleeve Gastrectomy in Patients with Obesity. Obesity Surgery. 32 (6): 1954-1961.

[18] M. E. E. D. M. Kamal, H. A. Abou Aisha, M. H. Fahmy, A. K. Abosayed. (2023). The impact of laparoscopic sleeve gastrectomy on thyroid functions in Egyptian patients with obesity. Journal of Gastrointestinal Surgery. 27 (7): 1345-1352.