Impact of bariatric surgery on morbidly obese hypothyroid patients

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Background
Obesity is considered a risk factor for many health issues, which includes cardiovascular, psychological, neurological, and musculoskeletal diseases. It is known that overt hypothyroidism induces obesity if not properly managed. The aim of current study is to evaluate effect of different bariatric surgeries on morbidly obese hypothyroid patients regarding thyroid-stimulating hormone, free T4, and dose of levothyroxine supplement needed.
Patients and methods
A retrospective cohort study was conducted on patients with morbid obesity and hypothyroidism from January 2021 to January 2023. We included patients more than 18 years old, obese (BMI $>40\,kg/m^2$ or $>35\,kg/m^2$ in association with uncontrolled comorbidities such as diabetes, hypertension, hyperlipidemia, and obstructive sleep apnea) with hypothyroidism undergoing bariatric surgery. Secondary objectives include assessment of weight reduction after bariatric surgery as excess weight loss and excess body mass index loss.
Results
The mean excess weight loss was 44.2%, while the mean excess body mass index loss was 88.22%. Sleeve gastrectomy surgery had the highest percentage of patients who reduced their thyroid hormone replacement (THR) dose (61.9%), followed by the Mini Gastric Bypass (MGB) group (47.5%). The Roux-en-Y Gastric Bypass (RGB) group had the highest percentage of patients who were off their THR dose (56.3%), followed by the sleeve group (31.8%). Only one (4.5%) patient in the sleeve group had an increased THR dose.
Conclusions
Bariatric surgery has a significant impact on the THR dose in patients with hypothyroidism. The type of surgery also affects the percentage of patients who reduced, stopped, or maintained their THR dose.

Keywords:
bariatric surgery, hypothyroidism, thyroid replacement hormone

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Introduction

Obesity is considered a risk factor for many health issues which includes cardiovascular, psychological, neurological, and musculoskeletal diseases. The rising prevalence of morbid obesity (BMI >30), affecting 30% of adult Americans, is acknowledged by the CDC. Bariatric surgeries effectively reduce weight and resolve associated comorbidities. Three types of bariatric surgeries are most commonly performed: laparoscopic sleeve gastrectomy, one-anastomosis gastric bypass and laparoscopic Roux-en-Y gastric bypass [1].

Most studies assess efficacy of bariatric surgeries through resolution or improvement of hypertension, diabetes mellitus, and dyslipidemia. However, other endocrinological disorders including hypothyroidism (overt or subclinical) are not well studied. Globally, it is thought that hypothyroidism affects 0.5–5% of general population and around 11% of patients with morbid obesity have hypothyroidism [2,3].

Overt hypothyroidism induces obesity if not properly managed. Furthermore, several studies suggest that obesity changes the levels of thyroid-stimulating hormone (TSH) and thyroid hormones. A metanalysis of 22 studies by Song *et al.* [4] showed that obesity increases the risk of hypothyroidism (risk ratio=1.86, 95% confidence interval=1.63–2.11, $P<0.001$) and significantly correlated with high levels of thyroid peroxidase antibody.

Also, total dose of levothyroxine is calculated according to body weight thus bariatric surgeries might reduce dose of levothyroxine supplement. On the other hand, bariatric procedures not only alter hormonal levels but also gastrointestinal physiology which might impact absorption of levothyroxine supplement. In a study of

93 patients, Khan and colleagues observed that bariatric surgery had decreased levothyroxine dose in 55.8% of patients [5,6].

In our study, the aim was to assess the impact of bariatric surgery on hypothyroidism in patients with morbid obesity.

Patients and methods

A retrospective cohort study was conducted on patients with morbid obesity and hypothyroidism. Study was conducted at Ain Shams University surgical hospitals starting from January 2021 to January 2023.

We included patients more than 18 years old, obese (BMI $>40\,kg/m^2$ or $>35\,kg/m^2$ in association with uncontrolled comorbidities such as diabetes, hypertension, hyperlipidemia, and obstructive sleep apnea) with hypothyroidism undergoing bariatric surgery. Patients with previous surgeries, not compatible for surgery, or had any type of thyroidectomy were excluded.

Study objective

Primary objective is to evaluate effect of different bariatric surgeries on morbidly obese hypothyroid patients regarding TSH, free T4, and dose of levothyroxine supplement needed. Secondary objectives include assessment of weight reduction after bariatric surgery as excess weight loss (EWL) and excess body mass index loss (EBMIL).

Data collection

Data were collected from patient records in a standardized form:

(1) Preoperative data: sociodemographic, age, sex comorbidities (diabetes mellitus, hypertension), clinical history and examination, preoperative investigations, baseline thyroid profile (TSH and free T4) levels, type of bariatric surgery done.

Postoperative data includes %EWL, % EBMIL, BMI, changes in TSH levels, and changes in doses or stoppage of thyroid replacement 1 and 6 months after surgery.

(1) %EWL is calculated as following=(preoperative weight–follow up weight)/(preoperative weight–ideal body weight)×100.
(2) %EBMIL is calculated as following=(preoperative BMI–follow up BMI)/(preoperative BMI–ideal BMI)×100.

Statistical analysis

Sample size: a minimal sample size of 350 participants, achieved 95% power to detect impact of bariatric surgeries on the dosage of levothyroxine supplement needed postoperative at a 0.05 significance level depending on results of Khan and colleagues.

The collected data were revised for accuracy and completeness, then coded and underwent analysis using SPSS statistics (Statistical Package for Social Sciences) software, version 28.0 (IBM, Chicago, Illinois, USA).

As regard descriptive statistics, mean and SD were used to describe parametric numerical data, while median and interquartile range were used for nonparametric numerical data. Nonnumerical data were described using frequency and percentage. Statistical tests that were appropriate for the data type were used for analytical statistics. Fisher's exact test was used to examine the relationship between two qualitative variables when the expected count is less than 5 in more than 20% of cells. The difference between the means of more than two study groups was tested for statistical significance using analysis of variance test. Post-hoc test was applied to compare all possible pairs of group means. *P* value less than 0.05 will be used as the level of significance.

Ethical considerations: informed consent were signed by patients who were invited and accepted to share in the research. All patients' data are confidential, and they were not mentioned by name at any published data. Patients had the right to refuse joining the research or withdraw at any time.

Results

Our study included 352 patients. The study population's characteristics are presented in Table 1. The mean age of the participants was 47±4.49 years, most of them were female (64.77%). Most of the participants had diabetes mellitus (79.26%) and hypertension (84.94%). About 22.16% had hypothyroidism. The most common performed surgery was sleeve gastrectomy (67.61%), followed by mini-gastric bypass (20.45%) and Roux-en-Y gastric bypass (11.93%). The mean height, weight, and BMI of the participants were 1.61±0.09 m, 106.05±13.92 kg, and $40.59±2.96\,kg/m^2$, respectively.

The mean TSH level preoperative was 3.27±0.63 mU/l, while mean TRH level was 151.51±5.52 ng/ml. The free T4 levels was 0.41±0.19 pmol/l. Meanwhile postoperative mean TSH levels was 3.45±0.37mU/l,

Table 1 Characteristics of study participants

	Mean±SD	Median (IQR)	Minimum–maximum
Age	47±4.49	48 (43–51)	40–55
Sex [*n* (%)]			
Male	124 (35.23)		
Female	228 (64.77)		
DM [*n* (%)]			
No	73 (20.74)		
Yes	279 (79.26)		
HTN [*n* (%)]			
No	53 (15.06)		
Yes	299 (84.94)		
Hypothyroid [*n* (%)]			
No	274 (77.84)		
Yes	78 (22.16)		
Surgery [*n* (%)]			
MGB	72 (20.45)		
Sleeve	238 (67.61)		
RGB	42 (11.93)		
Height	1.61±0.09	1.61 (1.55–1.65)	1.5–1.9
Weight	106.05±13.92	104.17 (96.19–114.16)	76.5–166.3
BMI	40.59±2.96	40.6 (38.6–41.9)	35.5–48.6

DM, diabetes mellitus; HTN, hypertension; IQR, interquartile range.

Table 2 Thyroid profile preoperative

	Mean±SD	Median (IQR)	Minimum–maximum
Pre-TSH	3.27±0.63	3.3 (2.9–3.6)	2–4.5
Pre-TRH	151.51 ±5.52	151 (148–154)	140–170
Pre-free T4	0.41±0.19	0.38 (0.29–0.58)	0.1–0.8

IQR, interquartile range; TSH, thyroid-stimulating hormone.

Table 3 Thyroid profile postoperative

	Mean±SD	Median (IQR)	Minimum–maximum
Post-TSH	3.45±0.37	3.4 (3.2–3.6)	2.7–4.5
Post-TRH	73.55±3.98	60 (83–74)	71–76
Post-free T4	1.03±0.34	0.86 (0.83–1.1)	0.4–1.8

IQR, interquartile range; TSH, thyroid-stimulating hormone.

mean TRH levels was 73.55±3.98 ng/ml, and mean free T4 levels was 1.03±0.34 pmol/l as shown in Tables 2 and 3.

Regarding weight loss, the mean EWL was 44.2%, while the mean EBMIL was 88.22% and there was no statistically significant difference between the three types of surgery regarding weight loss as shown in Tables 4 and 5 and Fig. 1.

Regarding the TRH dose postoperative at 1, 6 months, results in Table 6 and Fig. 2 showed that sleeve surgery had the highest percentage of patients who reduced their thyroid hormone replacement (THR) dose (61.9%), followed by the MGB group (47.5%) then RBG (18.8%), and this difference between the three types of surgeries was statistically significant (P=0.030). The RGB group had the highest percentage of patients who were off their THR dose (56.3%), followed by the sleeve group (31.8%). The MGB group had the lowest percentage of patients who were off their THR dose (27.5%). However, this difference did not show any statistical significance.

Both MGB and RGB groups had the highest percentage of patients who had the same THR dose (25%). The sleeve group had the lowest percentage of patients who had the same THR dose (4.76%), but none of the groups were significantly different from each other in this regard. Only one patient in the sleeve group had an increased THR dose (4.5%), while none of the patients in the MGB or RGB groups had an increased THR dose.

Discussion

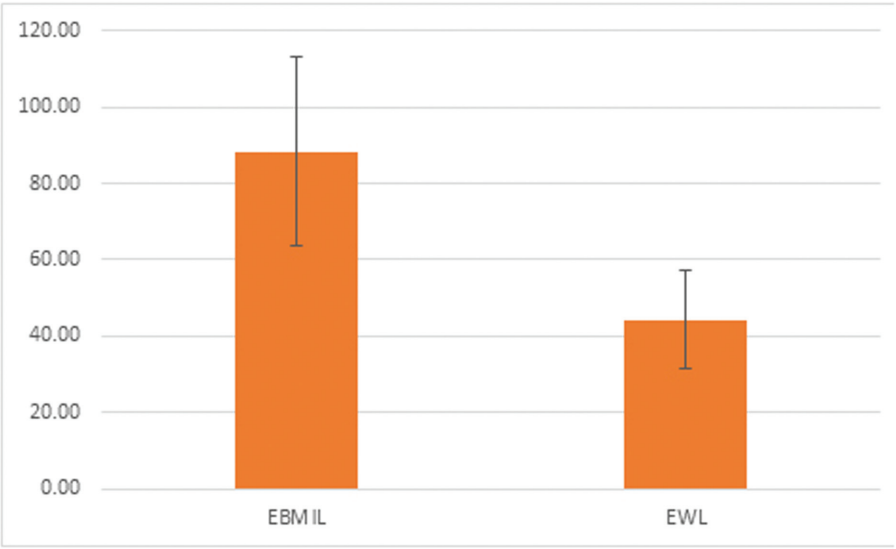
The present study aimed to assess impact of bariatric surgeries on hypothyroidism in patients with morbid obesity. The results of this study showed that bariatric surgeries had a significant effect on the thyroid

Table 4 Weight loss postoperative

	Mean±SD	Median (IQR)	Minimum–maximum
EWL	44.2±12.79	43.69 (35.99–51.88)	10.3–108.6
EBMIL	88.22 ±24.74	87.23 (74.36–100)	23.7–261.9

EBMIL, excess body mass index loss; EWL, excess weight loss; IQR, interquartile range.

Figure 1



Mean and SD of EWL and EBMIL of entire cohort after bariatric surgery. EBMIL, excess body mass index loss; EWL, excess weight loss.

Table 5 Bariatric outcome in relation to type of surgery

	MGB	Sleeve	RGB	ANOVA *F* test of significance		
	Mean±SD	Mean±SD	Mean±SD	Value	*P* value	Significance
EBMIL	43.7±44.2	14.94±12.79	2.3±0.68	0.107	0.899	NS
EWL	44.2±0	12.79±0	0.68±0	0.501	0.606	NS

ANOVA, analysis of variance; EBMIL, excess body mass index loss; EWL, excess weight loss.

function and levothyroxine therapy of hypothyroidism in patients with morbid obesity. The mean TSH level increased slightly after surgery, while the mean TRH level decreased by more than 50%. This is consistent with the findings of Pedro *et al.* [7], who reported slight difference in TSH levels between preoperative and postoperative periods. Also, Alfaifi *et al.* [8], reported a significant decrease in TRH levels after bariatric surgery.

In this study, the mean free T4 level increased by more than twofold. This is consistent with the findings of the paper by Cordido *et al.* [3] reported a significant increase in free T4 levels after bariatric surgery. These changes indicate an improvement in the thyroid hormone metabolism and feedback regulation after bariatric surgery. The results are consistent with previous studies that reported similar findings like Garcia-Moreno *et al.* [9] reported that bariatric surgery improved hypothyroidism in 44.5% of patients and resolved it in 22.2% of patients.

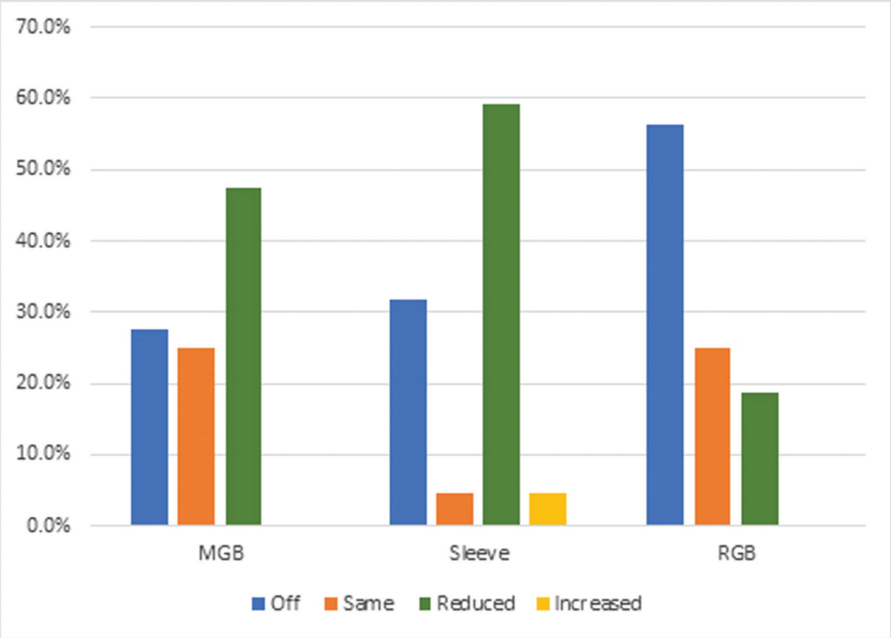
The percentage of patients who reduced or stopped their levothyroxine dose varied according to the surgery performed. Roux-en-Y gastric bypass and sleeve gastrectomy had the highest percentage of patients who stopped their dose followed by one-anastomosis gastric bypass. This is consistent with results of a meta-

Table 6 Effect of different types of surgery on thyroid hormone replacement dose

				Test of significance		
	MGB [*n* (%)]	Sleeve [*n* (%)]	RGB [*n* (%)]	Value	*P* value	Significance
THR dose postoperative						
Off	11 (27.5)	7 (31.8)	9 (56.3)			
Same	10 (25)	1 (4.5)	4 (25)	FE	0.030	S
Reduced	19 (47.5)	13 (59.1)	3 (18.8)			
Increased	0	1 (4.5)	0			

THR, thyroid hormone replacement.

Figure 2



Effect of different types of surgery on THR dose. THR, thyroid hormone replacement.

analysis that compares the changes in levothyroxine dose and thyroid function after different types of bariatric surgery in patients with hypothyroidism.

Sleeve gastrectomy had the highest percentage of patients who reduced their dose followed by mini-gastric bypass. Those results are comparable to the literature. Garcia-Moreno *et al.* [9] reported that bariatric surgery, specifically sleeve gastrectomy, improved hypothyroidism. This is also consistent to the results of Khan *et al.* [6] who reported sleeve group as the highest percent regarding reduction of levothyroxine dose postoperative. Also, Rudnicki *et al.* [2] reported that the numbers of patients who stopped THR completely was significantly higher in the laparoscopic sleeve gastrectomy group.

Azran *et al.* [10] found that levothyroxine dose decreases after bariatric surgery, especially after Roux-en-Y gastric bypass. However, several comparative trials none had not succeeded to establish the superiority of one procedure over the other like Garg *et al.* [11] and Fierabracci *et al.* [12]. Our results shows that the sleeve group had an increased THR dose (4.5%),which is consistent with Khan *et al.* [6] who reported increased THR dose in 4.3%.

Our results show that the mean EWL was 44.2%, while the mean EBMIL was 88.22%. This indicates that there was a significant weight loss after bariatric surgery. This is consistent with the findings of Juiz-Valiña *et al.* [13] who also reported mean EBMIL 72.2% after bariatric surgery. Also, Khan *et al.* [6] reported the EWL postoperative as 58.9%.

Conclusions

Bariatric surgery has a significant impact on the THR dose in patients with hypothyroidism. The type of surgery also affects the percentage of patients who reduced, stopped, or maintained their THR dose.

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Conflicts of interest

There are no conflicts of interest.

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