



Thyroid surgery and obesity: Cohort study of surgical outcomes and local specific complications



Mahmoud Farag^a, Kareem Ibraheem^a, Meghan E. Garstka^a, Hosam Shalaby^a, Christopher DuCoin^b, Mary Killackey^b, Emad Kandil^{a,*}

^a Division of Endocrine and Oncologic Surgery, Department of Surgery, Tulane University School of Medicine, New Orleans, LA, USA

^b Department of Surgery, Tulane University School of Medicine, New Orleans, LA, USA

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ABSTRACT

Introduction: Obesity is associated with numerous complications after elective general surgeries. The aim is to compare surgical outcomes and local specific complications in obese and non-obese patients after thyroid surgery.

Methods: Retrospective study over a 3-year period at a North American academic institution. Outcome measures were operative time, estimated blood loss, hospital length of stay, and local specific complications (hypocalcemia, recurrent laryngeal nerve injury, wound hematoma, wound seroma, and chyle leakage).

Results: A total of 469 patients were included (mean [SD] age, 50.11 [15.01] years; mean [SD] BMI, 30.5 [8.3] kg/m²; 207 [44.14%] obese). There was no difference in operative time (125.7 vs. 129.6, $p = 0.52$), estimated blood loss (16.88 vs. 14.56, $p = 0.28$), or hospital length of stay (0.95 vs. 0.95, $p = 0.96$). Overall, there was no difference in the rates of local specific complications between the two groups.

Conclusions: Obesity is not associated with adverse outcomes in patients undergoing thyroid surgery.

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Introduction

More than one-third (36.5%) of US adults are obese with Body Mass Index (BMI) ≥ 30 kg/m².¹ According to the Centers for Disease Control and Prevention, Louisiana, in which our center is located, is one of the top five states in obesity with prevalence of 35% or greater.² Obesity is known to be associated with many comorbidities, which raise the costs of health care and can be particularly burdensome considering the overall increase in life expectancy. Surgeons are reporting more obese patients than ever before, and more of the obese patients are undergoing thyroid operations.³

Obesity is considered by many surgeons as a challenge associated with perioperative complications that may lead to worse outcomes. A study performed on patients with pancreatic adenocarcinoma found that patients with BMI >35 kg/m² are more likely to have decreased survival rates after surgical resection.⁴ Another randomized trial conducted in Japan on patients with gastric cancer

undergoing lymphadenectomy concluded that overweight (BMI > 25 kg/m²) patients have an increased risk of postoperative complications.⁵ With regard to thyroid surgery, Harari and colleagues found that increasing BMI was significantly associated with longer length of hospital stay and longer anesthesia induction time.⁶ In the European population, Finel et al.'s study demonstrated that patients with BMI ≥ 25 kg/m² did not imply higher risk of postoperative complications or increase in length of hospital stay.⁷

Given the controversy in the literature surrounding the impact of obesity on surgical outcomes, the aim of our study is to evaluate the safety of thyroid surgery in obese patients by comparing the surgical outcomes and rates of local specific complications in obese versus non-obese patients at our North American institution.

Materials and methods

This is a retrospective cohort study performed under institutional review board approval using a prospectively collected clinical database. All surgeries were performed by a single surgeon at Tulane University Medical Center in New Orleans, Louisiana (E. K.). We included all patients aged ≥ 18 years who underwent thyroid surgery between January 2015 and December 2017. We excluded

* Corresponding author. Tulane University School of Medicine, Edward G. Schlieder Chair in Surgical Oncology, Chief of Endocrine and Oncologic Surgery Division, USA.

E-mail address: ekandil@tulane.edu (E. Kandil).

patients who primarily underwent parathyroid surgery. BMI was calculated using the following formula: BMI = weight (kg)/height (m^2). The World Health Organization (WHO) guidelines group patients into four categories: normal (BMI, 18.5–24.9 kg/m^2), overweight (25–29.9 kg/m^2), obese (30–34.9 kg/m^2), and morbidly obese (≥ 35 kg/m^2).⁸ In this study, we divided the patients into two groups: the non-obese group with BMI <30 kg/m^2 and the obese group with BMI ≥ 30 kg/m^2 .

The demographics and clinical characteristics of patients were collected, including age, gender, race, BMI, thyroid volume, thyroid disease (cancer, Hashimoto, Graves'), and type of procedure (total thyroidectomy, thyroid lobectomy, or completion thyroidectomy). Our primary outcomes were operative time, estimated blood loss, length of hospital stay, and thyroidectomy-specific postoperative complications. These complications were defined as: hypocalcemia, recurrent laryngeal nerve (RLN) injury, wound hematoma, wound seroma, and chyle leakage. Hypocalcemia was confirmed by measuring ionized serum calcium level. Operative time was defined as the time from skin incision to closure. Routine video laryngoscopy was performed preoperatively and at one week postoperatively in all patients to evaluate vocal fold function. Laryngoscopy was repeated until return of RLN function was documented in cases where there was evidence of postoperative vocal fold paresis.

Data are reported as mean (standard deviation) for continuous variables and as proportions for categorical variables. Student's *t*-test was used for continuous variables. The chi-square test was used for categorical variables. Statistical significance was set at $p < 0.05$. All statistical analyses were performed using IBM SPSS Statistics Software, version 23.0.

Results

A total of 469 patients were included. Two-hundred and seven patients (44.1%) were obese with BMI ≥ 30 kg/m^2 . The mean BMI for the obese group was 37.5 (7.4) kg/m^2 vs 24.9 (3.3) kg/m^2 in the non-obese group. The BMI range for the obese group was 30–81.5 kg/m^2 vs 15.7–29.9 kg/m^2 in the non-obese group. The mean age of our study population was 50.1 (15) years and the mean BMI was 30.5 (8.3) kg/m^2 . Most of the patients were female (378 cases, 80.6%). Two hundred and twenty-six patients (48.1%) were white, 197 (41.9%) were black, and 42 (8.9%) were of other ethnicities. The demographic and clinical characteristics of the two groups of our study population are shown in Table 1. No mortality was recorded during the study period.

Lobectomy was the most commonly performed thyroid surgery (210 cases, 44.8%). Of the obese group, 85 patients (41.1%) underwent lobectomy, 67 (32.4%) total thyroidectomy, and 54 (26.1%) completion thyroidectomy. In the non-obese group, 125 patients (47.5%) underwent lobectomy, 86 (32.7%) total thyroidectomy, and 51 (19.4%) completion thyroidectomy. Neck dissection was performed in 20 (9.7%) obese patients versus 32 (12.2%) cases in the non-obese group (Table 2). After comparing outcomes between obese and non-obese groups, there were no significant differences in operative time (125.7 (70) minutes vs. 129.6 (60) minutes, $p = 0.52$), total time in OR (180 (63) minutes vs. 189 (65) minutes, $p = 0.41$), estimated blood loss (16.9 (27.5) ml vs. 14.6 (16.5) ml, $p = 0.28$), or hospital length of stay (0.9 (1.4) day vs. 0.9 (1.8) day, $p = 0.96$) (Table 3). Fewer obese patients underwent thyroidectomy as an outpatient procedure (34.8% vs. 38%) but this finding was not significant, $p = 0.47$ (Table 4).

Table 1
Demographic and Clinical Characteristics of Patients, n = 469.

Variable	Non-obese BMI 30 (n = 262)	Obese BMI ≥ 30 (n = 207)	p-value
Age, years, mean (SD)	51.3 (16.1)	50.7 (13.6)	0.71
Gender (Female), n (%)	212 (80.9)	166 (80.2)	0.84
Race			
White, n (%)	141 (53.6)	85 (41.1)	0.01
Black, n (%)	83 (31.6)	114 (55.1)	<0.0001
Others, n (%)	35 (13.3)	7 (3.4)	0.00
BMI, mean (SD)	24.9 (3.3)	37.5 (7.4)	<.0001
Thyroid volume (cm^3), mean (SD)	46.5 (67.2)	58.2 (81.7)	0.14
Thyroid cancer, n (%)	106 (40.6)	72 (34.9)	0.21
Hashimoto thyroiditis, n (%)	63 (24.1)	58 (28)	0.33
Graves' disease, n (%)	22 (8.4)	11 (5.3)	0.21

Table 2
Types of thyroidectomy procedures.

Variable	Non-obese BMI 30 (n = 262)	Obese BMI ≥ 30 (n = 207)	p-value
Lobectomy, n (%)	125 (47.5)	85 (41.1)	0.16
Total thyroidectomy, n (%)	86 (32.7)	67 (32.4)	0.94
Completion thyroidectomy, n (%)	51 (19.4)	54 (26.1)	0.08
Neck dissection performed, n (%)	32 (12.2)	20 (9.7)	0.46

Table 3
Post-operative outcomes.

Variable	Non-obese BMI 30 (n = 262)	Obese BMI ≥ 30 (n = 207)	p-value
Operative time, min, mean (SD)	129.6 (60)	125.7 (70)	0.52
Total time in OR, min, mean (SD)	189 (65)	180 (63)	0.41
Estimated blood loss, ml, mean (SD)	14.6 (16.5)	16.9 (27.5)	0.28
Hospital length of stay, d, mean (SD)	0.9 (1.8)	0.9 (1.4)	0.96

Abbreviations: min, minute; ml, milliliter; d, day.

Table 4
Types of admission.

Variable	Non-obese BMI 30 (n = 262)	Obese BMI \geq 30 (n = 207)	p-value
Outpatient < 1 day, n (%)	100 (38)	72 (34.8)	0.47
Observation for 1 day, n (%)	136 (51.7)	110 (53.1)	0.76
Inpatient \geq 2 days, n (%)	26 (10)	25 (12.1)	0.46
Inpatient with neck dissection, n (%)	9 (34.6)	11 (44)	0.57

Table 5
Post-operative complications in patients.

Variable	Non-obese BMI 30 (n = 262)	Obese BMI \geq 30 (n = 207)	p-value
Transient Hypocalcemia, n (%)	4 (1.5)	2 (0.9)	0.59
Temporary RLN injury, n (%)	8 (3)	7 (3.4)	0.84
Permanent RLN injury, n (%)	1 (0.4)	4 (1.9)	0.10
Wound Seroma, n (%)	1 (0.4)	2 (0.9)	0.43
Wound Hematoma, n (%)	0 (0)	1 (0.5)	0.26
Chyle leakage, n (%)	3 (1.1)	1 (0.5)	0.44

Of the obese group, two patients (0.9%) experienced post-operative transient hypocalcemia versus four patients (1.5%) in the non-obese group ($p = 0.59$) and all cases resolved spontaneously within weeks. Seven patients (3.4%) in the obese group and eight patients (3%) in the non-obese group had temporary RLN dysfunction ($p = 0.84$). Five patients (four obese (1.9%) and one non-obese (0.4%)) developed permanent RLN dysfunction ($p = 0.1$). Two patients (0.9%) in the obese group developed wound seroma versus one patient (0.4%) in the non-obese group ($p = 0.43$). We observed only one case (0.5%) of wound hematoma in the obese group versus no cases in the non-obese group ($p = 0.26$). The incidence of chyle leakage was higher in the non-obese group with three cases (1.1%) in the non-obese group and one case (0.5%) in the obese group ($p = 0.44$) (Table 5).

Discussion

The prevalence of obesity and consequently the number of obese patients seen by surgeons is increasing at an alarming rate in the United States. There is increased importance in studying obesity and its effects on perioperative morbidity. A large prospective study, performed by Dindo et al., on 6336 patients undergoing elective general surgery procedures without including the endocrine surgeries,⁹ stated that higher BMI increases the risk of surgical site infection after open surgery. One explanation is that excessive subcutaneous fat caused decreased surgical site perfusion and oxygen tension, leading to predisposition of infection. They recommended laparoscopic surgery when feasible to reduce the risk of wound infection in obese population. To our knowledge, no North American studies have examined local specific complications after thyroidectomy based on BMI. Our study is the first study conducted in a North American medical center to evaluate all thyroidectomy-specific complications in obese versus non-obese patients.

Table 6
Effect of obesity on thyroid surgery.

Study	Country	Design	N	Significant Findings
Buerba et al., 2011 ¹⁰	USA	Retrospective	18,825	BMI \geq 30 kg/m ² , increased risk of wound complications after thyroid surgery BMI \geq 35 kg/m ² , more likely to sustain urinary tract infections
Duke et al., 2014 ¹¹	USA	Prospective	233	BMI \geq 25 kg/m ² , no increased risk for surgical complications after MIVAT
Finel et al., 2014 ⁷	France	Prospective	366	BMI \geq 25 kg/m ² , longer operative time in total thyroidectomy
Milone et al., 2016 ¹²	Italy	Retrospective	266	BMI \geq 25 kg/m ² , longer operative time in thyroidectomy
Tresallet et al., 2014 ¹³	France	Retrospective	1216	BMI \geq 30 kg/m ² , increased risk of permanent RLN injury
Harari et al., 2012 ⁵	USA	Retrospective	443	BMI 30–34.9 kg/m ² , longer hospital length of stay BMI \geq 35 kg/m ² , longer anesthesia induction time

Abbreviations: N, Sample size; MIVAT, Minimally Invasive Video-Assisted Thyroidectomy; RLN, Recurrent Laryngeal Nerve.

Interestingly, while reviewing the demographics of our cohort, we found that obesity is more prevalent in the black population, of them, 55.1% were obese versus only 41.1% of the white patients. This finding reflects trends noted by the Centers for Disease Control and Prevention.¹ We acknowledge that future work must be done on this topic to investigate causation in the trend and perhaps provide suggestions to address underlying disparities.

There was no significant difference in the incidence of local specific complications for obese versus non-obese patients after thyroidectomy in our study population. These findings are similar to those reported in the European population in a study conducted by Finel et al. in France on 366 patients.⁷ Interestingly, this group did report a longer operative time in patients with BMI \geq 25 kg/m² undergoing total thyroidectomy, which may be attributed to intraoperative difficulties due to body habitus. The same variable showed no significant difference in cases of partial thyroidectomy for the group of patients with BMI \geq 25 kg/m².

Similarly, Buerba et al. examined the outcomes of thyroidectomy and parathyroidectomy in 26,864 patients.¹⁰ Of note, their study did not evaluate local specific postoperative complications. Their results showed that obese (30–34.9 kg/m²) and morbidly obese (\geq 35 kg/m²) patients had an increased risk of having one or more complication(s) (odds ratio: 1.5, 1.6, respectively), especially wound complications (odds ratio: 2.3, 3.5, respectively) after thyroid surgeries. They also found that morbidly obese patients are more likely to sustain urinary tract infections (odds ratio: 2.2). There was no wound complications or urinary tract infections in our cohort.

With regard to previous work on minimally invasive thyroidectomy and obesity, Duke et al. conducted the largest minimally-invasive video-assisted thyroidectomy (MIVAT) study in North America, 233 MIVATs performed on 223 patients.¹¹ They concluded that being overweight or obese does not increase the risk of complications during or after MIVAT. Table 6 summarizes findings in the

literature about the outcomes of thyroid surgeries in patients with high BMI.

Hypocalcemia is one of the worrisome local specific complications in thyroid surgery, especially in patients undergoing total thyroidectomy and central neck dissections. In the literature, the rate of hypocalcemia after thyroidectomy ranges widely from 0.3% to 66.2%.¹⁴ Part of this wide variation may be attributed to the inclusion of a variety of different thyroid procedures, all with different risks of hypocalcemia.¹⁵ Our study showed only two cases (0.9%) of transient hypocalcemia in obese patients, and four cases (1.5%) in the non-obese group. There was no difference between the two groups and all cases resolved spontaneously within weeks. Of note, all six cases of hypocalcemia occurred after total thyroidectomy.

The incidence of RLN injury was not affected by BMI. Seven patients (3.4%) in the obese group and eight patients (3%) in the non-obese group had temporary RLN dysfunction. There was no difference between the two groups. More obese patients (four (1.9%) in the obese group versus one (0.4%) in the non-obese group) continued to have permanent dysfunction, reflecting a trend which did not reach statistical significance in the study population but which may merit further study in a larger population. We reported only one case of wound hematoma in the obese population and no cases of surgical site infection in either group. We had four cases of chyle leakage with only one of them occurred in the obese group. Three cases of them were complicated after a thyroid procedure with neck dissection.

This study showed that BMI ≥ 30 kg/m² does not significantly increase operative time at our institution or even total time in OR. This in contrast to the findings of Buerba et al., who showed that operative time was greater in overweight, obese, and morbidly obese patients (odds ratio: 2.4, 5.7, 13.4, respectively).¹⁰ Of note, the mean BMI for our population was 30.5 (8.3) kg/m², so it is possible that the lack of statistically significant increase in operative time for obese patients is reflected by the familiarity of the surgeon with performing these procedures in obese patients, whereas surgeons operating on a patient population with lower mean BMI may require more time for increased body habitus. We also found that obesity did not statistically increase hospital length of stay for our patient population, and perhaps this also reflects a familiarity with postoperative care for a population with generally higher BMI at our institution. This means that for thyroid surgeries at our institution, obesity did not affect the hospital length of stay. This is different from findings reported in colorectal, gastric, and thoracic surgeries^{16,17} which may be attributed to the less subcutaneous tissue in the neck, the smaller incisions for thyroid surgery as compared to laparotomy and thoracotomy, and/or excellent blood flow to the neck. Reduced hospital stay has many benefits, namely decreased overall cost of surgery, less hospital-acquired morbidity and higher patient satisfaction.

Our study has limitations that should be considered. This is a retrospective single institutional study of surgeries performed by one surgeon. Additionally, the low rates of complications did not allow for better stratification of the study population into the four categories of BMI based on the WHO guidelines. Future research should focus on multicenter studies with larger populations to increase statistical power and reveal any significant effects of obesity on thyroid surgeries.

Conclusions

In this study, obesity was not found to be associated with adverse outcomes in patients undergoing thyroid operations by a

single high-volume surgeon. Future multicenter studies and meta-analyses are needed to confirm the trends in safety and feasibility which we report at our North American institution.

Conflicts of interest

The authors certify that they have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

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