The THAI Journal of SURGERY 2025;46(3):109-115.
Official Publication of The Royal College of Surgeons of Thailand

Original Article

Factors Associated with Thyroid Surgery Complications at Maharat Nakhon Ratchasima Hospital

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Abstract

Background: Thyroidectomy is one of the most frequently performed operations for thyroid disease. Thyroidectomy was associated with increased morbidity and even mortality. Potential major complications of thyroid surgery include bleeding (0.3-1%), injury to the RLN (4- 6.6%) if the nerve is not identified), hypoparathyroidism (2-53%), hypothyroidism (5-41.9%), thyrotoxic storm (< 0.5%), injury to superior laryngeal nerve (0-25%), and infection (1-2%). This study assessed the current understanding of factors predicting such complications following thyroidectomy.

Objectives: To investigate factors associated with complications in thyroid surgery.

Materials and Methods: We performed a retrospective analysis of all patients aged > 15 years who underwent thyroid surgery for any thyroid disease at our institution between October 2022 and September 2023. Data was analyzed regarding demographics, clinical features, operative details, postoperative complications, and histopathology results of tissue specimens.

Results: A total of 278 patients were identified, comprising 187 females (67.26%) and 91 males (32.74%). 106 surgical complications were observed in 77 patients (27.7%). The most common complication in the study was hypocalcemia, occurring in 54 cases (19.4%). This was followed by hoarseness in 42 cases (15.1%). The final model revealed that subtotal/total thyroidectomy had a strong and significant association with complications (adjusted RR: 4.15; 95% CI: 2.63-6.55; $p < 0.001$). Similarly, a disease duration exceeding 10 years (adjusted RR: 1.46; 95% CI: 1.09–1.97; $p = 0.012$) and thyroid nodule weight exceeding 200 gm. was also statistically significant adjusted RR: 2.11; 95% CI: 1.05-4.24; $p = 0.035$).

Conclusion: The postoperative complications of thyroid surgery were associated with the subtotal/total thyroidectomy, a disease duration exceeding 10 years, and thyroid nodule weight exceeding 200 gm. Therefore, special caution must be exercised in patients with these characteristics.

Keywords: Thyroidectomy, Postoperative complications, Predictors

Introduction

Thyroidectomy is one of the most frequently performed operations for thyroid disease.[1,2] Although thyroid surgery is the most common and safe operation, complications can occur depending on the thyroid gland's anatomical structure and physiological function.[3] Some complications can be life-threatening.

Potential major complications of thyroid surgery include bleeding (0.3-1%), injury to the RLN (4- 6.6%) if the nerve is not identified), hypoparathyroidism (2-53%), hypothyroidism (5-41.9%), thyrotoxic storm (< 0.5%), injury to superior laryngeal nerve (0-25%), and infection (1-2%).[4]

From a study of complications from thyroid cancer surgery at the Otolaryngology Department, Maharat Nakhon Ratchasima Hospital in 2019, it was found that

Received for publication 17 December 2024; Revised 12 March 2025; Accepted 28 March 2025

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https://doi.org/10.64387/tjs.2025.272747

transient hypocalcemia was found in 50.7% and permanent hypocalcemia in 38.1%. Patients who underwent total thyroidectomy at one-stage surgery had a higher incidence of hypocalcemia than those who underwent two-stage surgery. It was found that 13% of patients with vocal cord paralysis after surgery were temporary, 1.5%, and 11.5% were permanent. Additionally, it was found that in patients who underwent selective neck dissection, a 9.3% incidence of chyle leakage occurred postoperatively.[5] In other studies, it was also found that patients who spent more time in surgery and had large intraoperative blood loss were associated with increased complications of thyroid surgery.[6]

In previous research, the patient's condition, the nature of thyroid disease, and the surgeon's level of expertise have been associated with postoperative complications. In the Thai population or the research institutes, there is still insufficient information on risk factors for complications from thyroid surgery.

This research may lead to improved practice guidelines. Further explorations into the predicting factors of these complications could help develop plans for prevention and proper management of any that may occur.

Materials and Methods

Objectives

The main goal is to investigate factors associated with complications in thyroid surgery. In addition, complications were compared between different surgical methods. There may be an association between risk factors, such as disease duration, the size or weight of the thyroid gland, and the type of surgery, etc.

Study design, setting, and patients

This retrospective cohort study was conducted between October 2022 and September 2023. 278 consecutive patients underwent thyroid surgery for various thyroid diseases at Maharat Nakhon Ratchasima Hospital (MNRH). Data were retrospectively retrieved from the hospital's medical electronic database. Per the protocol, preoperative evaluations include physical examinations, thyroid function tests, cervical ultrasonography, and thyroid scintigraphy. Fine-needle aspiration biopsy (FNAB) was performed for clinically palpable dominant thyroid nodules.

Inclusion criteria

All patients over 15 years of age who underwent thyroid surgery for any thyroid disease during the study were included.

Exclusion criteria

Patients with preoperative evidence of recurrent laryngeal nerve problems and patients presenting with symptoms of hypocalcemia or low serum calcium level during the preoperative evaluation.

Patients who underwent laparoscopic thyroidectomy.

Surgical technique

Staff surgeons performed all operations, specializing in General surgery and Head, Neck, and Breast surgery.[7]

Total thyroidectomy: This procedure involves the removal of both lobes and the isthmus. No thyroid tissue is left to produce the thyroid hormone.

Subtotal thyroidectomy: This procedure removes an entire lobe, the isthmus, and a part of the other lobe. A piece of one lobe of the thyroid will remain.

Left lobectomy: This procedure involves the removal of the entire left lobe of the thyroid.

Right lobectomy: This is the removal of the entire right lobe of the thyroid.

Intraoperatively, efforts were made to identify and preserve the recurrent laryngeal nerves, identifying at least one parathyroid gland during lobectomy and at least two parathyroid glands for subtotal or total thyroidectomy. Following the completion of thyroidectomy, a drainage tube will be inserted.

The anesthesiologist associated the vocal cords during intubation with an Ear, Nose, and Throat (ENT) specialist in case of postoperative symptoms developing.

Clinical diagnosis of thyroidectomy complications

This study highlighted frequent complications, including injury to the recurrent laryngeal nerve, which causes hoarseness, and hypoparathyroidism, which causes a low calcium level.

Serum calcium levels were usually assessed the day after surgery. Hypocalcemia was identified by a serum calcium level under 8.0 mg/dL, and an oral calcium supplement was administered. Assessment of symptoms associated with hypocalcemia, such as perioral numbness, extremity numbness, or spasm. The presence of

involuntary contraction of muscles in the hand and wrist occurs after an individual wears a blood pressure cuff inflated over their systolic blood pressure for 2-3 minutes (Trousseau's sign) or twitching of facial muscles in response to tapping over the facial nerve (Chvostek's sign). Permanent hypoparathyroidism is the requirement of calcium supplementation and/or vitamin D to maintain eucalcemia for six months postoperatively.[2,3]

An assessment of Recurrent Laryngeal Nerve Injury (RLNI) was conducted through postoperative patient interviews, where symptoms were recorded in medical progress notes. If the patient has hoarseness, loss of voice while speaking, choking or coughing while drinking water or eating, or a noisy voice during breathing.[8,9]

Other immediate complications after thyroid surgery that are commonly found include hematoma, infection, and airway obstruction.

Hematoma is caused by the accumulation of blood at the surgical site.

The signs and symptoms, such as swelling, bruising, and neck discomfort. In severe cases, it can compress the airway. The management is to immediate surgical evacuation of the hematoma.

Infection is caused by a bacterial infection at the incision site—signs and symptoms such as redness, warmth, swelling, pain, and fever.

Airway Obstruction is caused by swelling, bleeding, or hematoma formation compressing the airway. The signs and symptoms include difficulty breathing and stridors. The management is to emergency airway management and possible reoperation.

The occurrence of complications was the primary endpoint of the study. The patient's age and gender, the extent of resection, estimated blood loss, operative time, the identification of the RLN-parathyroid gland, postoperative serum calcium level, pathological results, and specimen weight (extracted from the pathology file) were also assessed as risk factors for the development of the above complications.

Sample size

The sample size was determined based on histopathological tissue results (carcinoma) from a pilot study with 14 samples. Patients with carcinoma exhibited a 2.1-fold higher risk of complications compared to those without carcinoma. The proportion of complications was 0.3. The base rate, the proportion of carcinoma in the group without complications, was estimated to be 0.46. The variance of this factor, explained by the regression relationship with other covariates, was 0.4. Using G*Power Version 3.1.9.7 with the Z-test family for Poisson regression, the required sample size was calculated to be at least 165 cases, with a significance level set at $\alpha = 0.05$ and $\beta = 0.2$.[10]

Statistical analysis

General demographic data from patient medical records were collected, including variables such as age, gender, underlying diseases, diagnosis, surgical procedures, blood loss during surgery, duration of surgery, postoperative serum calcium levels, complications, and histopathological results of tissue specimens.

Personal data and clinical data from both sample groups will be analyzed using descriptive statistics, including frequency, percentage, mean, and standard deviation. Differences between groups will be assessed using appropriate statistical methods, such as Fisher's exact test, *t*-test, or Mann-Whitney test, depending on the nature and distribution of the data.

Factors associated with postoperative complications will be analyzed using Poisson regression with robust variance in a full model strategy. Statistical significance will be determined at $P < 0.05$.

RESULTS

A total of 278 patients were selected from the electronic medical database during the study period. The baseline characteristics, clinical features, and complications of the study populations are summarized in Tables 1 and 2. The majority of patients in both groups were female: 90.9% in the complication group and 89.3% in the non-complication group ($p = 0.814$). The mean age was higher in the complication group (51.2 years, SD 16.1) compared to the non-complication group (48.6 years, SD 14.2). Underlying diseases were slightly more common in the complication group (39.0%) than in the non-complication group (32.8%), but the difference was not statistically significant ($p = 0.372$). Estimated blood loss > 100 ml was significantly higher in the complication group (27.3% vs. 9.9%, $p = 0.002$).

Table 1 Demographics and clinical characteristics

Factors	Complication n = 77 (%)	No complication n = 201 (%)	*P*-value
Female	70 (90.9)	117 (89.3)	0.814
Mean age, yrs. (SD)	51.2 (16.1)	48.6 (14.2)	
Age > 70 yrs.	12 (15.6)	7 (5.3)	0.023
Underlying disease	30 (39.0)	43 (32.8)	0.372
DM	14 (18.2)	9 (6.9)	0.020
HT	19 (24.7)	29 (22.1)	0.734
Subtotal/ Total thyroidectomy	57 (74.0)	24 (18.3)	< 0.001
Pathology (carcinoma)	40 (52.0)	37 (28.2)	0.001
Estimate blood loss > 100 ml.	21 (27.3)	13 (9.9)	0.002
Medians estimate blood loss, ml. (IQR)	50.0 (30.0, 150.0)	30.0 (20.0, 50.0)	NA
Duration of operation, min., mean (SD)	123.4 (65.3)	85.2 (30.6)	< 0.001
Weight of thyroid nodule > 200 gm.	5 (6.6)	7 (5.4)	0.064
Median weight of thyroid nodule (IQR)	37.8 (25.1, 82.0)	32.3 (18.1, 64.0)	NA
Duration of disease > 10 yrs.	4 (5.2)	1 (0.8)	0.064
Parathyroid identified	29 (37.7)	50 (38.2)	1.000
Identified LRN	57 (74.0)	89 (67.9)	0.433

SD = standard deviation, IQR = interquartile range, DM = Diabetic mellitus, HT = Hypertension, LRN = Recurrent Laryngeal Nerve

Table 2 Postoperative complications

Complications	n[#] (%)
Hematoma	1 (0.94)
Hoarseness	42 (39.63)
Vocal cord paralysis	1 (0.94)
Hypocalcemia	54 (50.94)
Others	8 (7.55)

[#] n = Number of complications occurring (Total 106 events)

These studies indicated that patients over 70 years of age experience more surgical complications than younger patients (15.6% vs. 5.3%). Patients with underlying conditions, particularly diabetes, have higher complication rates compared to non-diabetic patients (18.2% vs. 6.9%). Surgical techniques involving extensive thyroid glands were associated with a higher likelihood of complications. However, surgery for large thyroids (thyroid tissue weight > 200 gm) did not show a significant difference in complication rates. Hermann's study found that thyroid tissue weight > 200 gm is a factor that can cause more complications,[11] so we take it to see the relationship in the Multivariable regression model again. Longer surgical duration and carcinoma diagnosis were linked to a higher risk of complications. In the complications group, the average surgical time was 123.4 minutes, compared to 85.2 minutes in the non-complication group. Patients with carcinoma had more complications than those without carcinoma (52% vs. 28%).

In contrast, factors such as disease duration, intraoperative blood loss, and identifying the parathyroid gland or the Recurrent Laryngeal Nerve did not significantly affect complication rates.

A total of 106 surgical complications were observed in 77 patients (27.7%). The most common complication in the study was hypocalcemia, occurring in 54 cases (19.4%). This was followed by hoarseness, found in 42 cases (15.1%). All complications were temporary and resolved after treatment. Other complications included chyle leakage (1 case), sepsis (1 case), pneumonia (3 cases), tracheal injury (1 case), hypopharyngeal injury (1 case), and lung atelectasis (1 case). There were no deaths among the patients who underwent surgery.

As reported in Table 3, factors associated with postoperative complications included unadjusted and adjusted relative risks (RRs) with 95% confidence intervals (CIs) and *p*-values for seven factors. The final model revealed that subtotal/total thyroidectomy had a strong and significant association with complications (adjusted RR: 4.15; 95% CI: 2.63–6.55; $p < 0.001$). Similarly, a disease duration exceeding 10 years was significantly associated with complications (adjusted RR: 1.46; 95% CI: 1.09–1.97; $p = 0.012$). Although estimated blood loss greater than 100 ml showed a trend toward significance (adjusted RR: 1.34; 95% CI: 0.98–1.83; $p = 0.066$), it did not reach statistical significance. Conversely, thyroid nodule weight exceeding 200 g was significantly associated with complications, although this association was not statistically significant in the univariate analysis. (adjusted RR: 2.11; 95% CI: 1.05–4.24; $p = 0.035$).

Table 3 Multivariable regression model of factors associated with postoperative complications

Factors	Unadjusted RR (95% CI)	Adjusted RR[#] (95% CI)	*P*-value
Age > 70 yrs.	1.84 (1.23, 2.73)	1.10 (0.81, 1.50)	0.525
DM	1.79 (1.22, 2.63)	1.23 (0.83, 1.82)	0.311
Subtotal/total thyroidectomy	4.47 (2.91, 6.85)	4.15 (2.63, 6.55)	< 0.001*
Pathology (carcinoma)	1.84 (1.30, 2.61)	1.09 (0.78, 1.51)	0.617
Duration of disease > 10 yrs.	2.22 (1.38, 3.58)	1.46 (1.09, 1.97)	0.012*
Estimate blood loss > 100 ml.	1.92 (1.36, 2.70)	1.34 (0.98, 1.83)	0.066
Weight of thyroid nodule > 200 gm.	0.88 (0.36, 2.19)	2.11 (1.05, 4.24)	0.035*

[#] Each RR and 95% CI is adjusted for all other covariates listed in the model, *Statistically significant $p < 0.05$

Discussion

Postoperative complications following thyroid surgery can include hypoparathyroidism, represented by hypocalcemia, RLN injury or palsy, and hematoma. The incidence of transient hypoparathyroidism has been reported to range from 0.3-49%, and that of permanent from 0-13%. In addition, the incidence of RLN palsy has been found to range from 0-5% and hematoma from 0-3%.[4]

Hypoparathyroidism is the most common complication after thyroidectomy. Patients often develop transient hypocalcemia due to ischemia of the parathyroid glands. Permanent hypoparathyroidism is rare and requires lifelong treatment with calcium and vitamin D.

The incidence of identification and non-identification of parathyroid glands during surgery showed no differences between groups. This result revealed that more extended surgery caused more ischemic changes to parathyroid glands, leading to hypoparathyroidism.[12,13] Therefore, identification of the parathyroid gland may not prevent the development of hypocalcemia after surgery. However, calcium supplements should be considered for patients at high risk of developing this condition.

Similar to hypoparathyroidism, injury to the RLN may occur by severance, ligation, or traction.[14] Intraoperative RLN monitoring techniques are being increasingly used during thyroid surgery. Both continuous monitoring using endotracheal tube electrodes and intermittent monitoring by periodic stimulation and laryngeal palpation are used. The incidence of RLN injury was 7.6% in cases where the nerve was not identified.[15] This study found that identifying RLN did not significantly affect the incidence of complications.

In 1991, Hermann et al.[11,16] published monocentric data of 7,566 patients, demonstrating that an increasing resected thyroid weight correlated significantly with postoperative vocal cord paralysis in patients after thyroidectomy. Resection of > 200 gm thyroid tissue resulted in a vocal cord palsy rate of more than 12%. In our series, the rate of transient RLN palsy, which causes hoarseness, is the second most common complication. However, no statistically significant difference was found between the groups that identified and did not identify the RLN during surgery.

Acute respiratory distress or failure due to hematoma formation is lethal unless the hematoma is immediately removed. Meticulous hemostasis is, therefore, mandatory in thyroid surgery.[17] In our series, 1.3% of the patients experienced postoperative hematoma. The incidences of this complication were also unrelated to the extent of surgery. Postoperative surveillance should be conducted for 24 hours, and assessment guidelines should be followed to prevent complications.

Other complications include chyle leakage or fistula (1 case). The most common cause of chyle fistula is thoracic duct injury, mainly on the left side (responsible for 75-92% of cases).[18] Most (75%) are detected during or after surgery.[19,20] Chyle fistula is indicated by milky drainage, a sudden increase in drainage volume, a bulging supraclavicular fossa, and induration or erythema of the skin.[20,21] Most patients respond to administering a high-protein and low-fat diet supplemented with medium-chain triglycerides, total parenteral nutrition, compression dressing on the supraclavicular fossa, and using somatostatin analogs.[22-24] Patients who do not respond require surgical intervention for direct closure of the fistula.[25,26]

Our study found that chyle fistula occurred postoperatively in large goiter surgery with extensive blood (800 mL), and patients can be treated with non-operative management.

Other postoperative complications, such as sepsis 1 case, pneumonia 3 cases, and lung atelectasis 1 case, are found in elderly patients (> 65 years) with pre-existing diseases (such as diabetes mellitus, hypertension, dyslipidemia, chronic kidney disease, etc.) All patients recovered, and there were no deaths.

In other cases, such as a trachea injury (1 case) and a hypopharynx injury (1 case). This is found in the surgery of large thyroid glands that are tightly attached to adjacent organs due to inflammation or previous neck surgery. All of them underwent surgical repairs and made a complete recovery.

The study's final results found that factors associated with complications from thyroid surgery include the extent of the surgery, patients with large thyroid glands (> 200 gm), and a disease duration of more than 10 years. The cause may be a large thyroid gland that has been present for a long time and is attached to nearby organs. This makes surgery difficult and increases the chance of parathyroid gland ischemia. The more extensive the surgery performed, the greater the chance of nerve and parathyroid gland injury or ischemia.

Due to the limitations of this research, which is a retrospective study. There may be selection bias and information bias. In addition, long-term follow-up has not been performed because some complications may appear several months after surgery, and each surgeon's skills may differ, affecting the complications.

Conclusion

The result of our study suggests that the extent of thyroid surgery (subtotal or total thyroidectomy) increased the risk of surgical complications, particularly hypoparathyroidism, represented by hypocalcemia and transient RLN palsy that causes hoarseness. In addition, thyroid surgery was found to have more complications in patients with large thyroid glands (> 200 gm) and a disease duration of more than 10 years. Therefore, special caution must be exercised in patients with these characteristics.

Acknowledgments

The author would like to thank Dr. Kunyalak Na Rungsi for her contributions to the statistical analysis of this project, with her permission.

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