



# Risk Factors and Outcomes of Postoperative Neck Hematomas: An Analysis of 5,900 Thyroidectomies Performed at a Cancer Center

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## Abstract

**Introduction** Postoperative neck hematoma (PNH) is an uncommon but potentially-lethal complication of thyroid surgery.

**Objective** To identify the risk factors for postthyroidectomy hematoma requiring reoperation, the timing, the source of the bleeding, the related respiratory distress requiring tracheotomy, and the late outcomes.

**Methods** We retrospectively analyzed the records of 5,900 consecutive patients submitted to surgery for thyroid diseases at a single institution.

**Results** In total, PNH occurred in 62 (1.1%) patients. Most cases of bleeding occurred within the first 6 hours after thyroidectomy, but 12.5% of the hematomas were observed after 24 hours. Obvious bleeding points were detected in 58.1% of the patients during the reoperation, with inferior thyroid artery branches and superior thyroid vessels being the most frequent bleeding sources. Only two patients required urgent tracheostomy. There were no hematoma-related deaths. Permanent hypoparathyroidism and recurrent laryngeal nerve injury are more frequent following reoperation for PNH. The factors significantly associated with PNH were: older age, concurrent lymph node dissection, and chronic lymphocytic thyroiditis. Gender, previous neck irradiation, presentation at diagnosis (symptomatic or incidental), substernal goiter, thyroidectomy for hyperthyroidism, prior thyroid surgery, malignant histology, the extent of the surgery (total versus non-total thyroidectomy), the use of energy-based vessel sealing devices, the use of the hemostatic agent Surgicel, and the placement of a surgical drain were not significantly associated with PNH.

**Conclusion** Hematoma after thyroid surgery is an uncommon complication, but it is related to significant postoperative morbidity. A better understanding of the risk factors and of the time until hematoma formation can help target high-risk patients for preventive measures and closer postoperative observation.

## Keywords

- ▶ thyroid
- ▶ hematoma
- ▶ complication
- ▶ surgery
- ▶ reoperation

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## Introduction

In recent years, the number of patients undergoing thyroid surgery has increased, largely due to an increase in the diagnosis of small thyroid cancers.<sup>1</sup> Although thyroidectomy is a relatively safe procedure, it may be associated with some clinically-concerning postoperative complications. Postoperative neck hematoma (PNH) is an uncommon but potentially life-threatening complication of thyroid surgery. In severe cases, PNH leads to airway compression, causing acute respiratory distress or even death, and emergency surgical treatment is usually required. It is particularly relevant to short-stay thyroidectomy on an outpatient basis.<sup>2</sup> According to Margolick et al.,<sup>3</sup> neck hematoma is the most common reason for reoperation, while postoperative hypocalcemia is the most frequent reason for hospital readmission.

A better understanding of the risk factors to develop post-thyroidectomy hemorrhage could help surgeons minimize the risk of PNH and select patients suitable for short-stay thyroid surgery. In the present study, we aimed to identify the risk factors associated with neck hematoma requiring surgical reintervention after thyroidectomy. We also reviewed our experience with PNH, analyzing the time course of events and late outcomes.

## Materials and Methods

### Patients and Data Collection

Data on patients undergoing thyroid surgery between January 1996 to December 2015 were retrospectively extracted from medical records. We excluded patients with concurrent head and neck cancers. We analyzed the patients and the operative data, as well the postoperative outcomes.

### Variables Analyzed

The following patient characteristics were assessed: age, gender, previous neck irradiation, presentation at diagnosis (symptomatic or incidental), substernal goiter, hyperthyroidism, previous thyroid surgery, pathological findings (malignant versus benign) and pathological lymphocytic thyroiditis. The operative characteristics analyzed were: extent of the surgery (total versus non-total thyroidectomy), concurrent lymph-node neck dissection, the use of energy-based vessel sealing devices – harmonic scalpel (Ethicon, Inc., Bridgewater, NJ, US) or LigaSure (Medtronic, Dublin, Ireland) – versus the conventional technique (electrocoagulation and “clamp-and-tie”), the use of the hemostatic agent Surgicel (Ethicon, Inc.), and the placement of a surgical drain. The time until the development of a PNH was determined by the interval in hours from the end of the thyroidectomy until the start of the reintervention operation. Given the difficulty in documenting when a wound hematoma is first identified, we think the time interval from the initial operation until the reoperation is a more reliable measure. The source of the bleeding, when identified, was noted, as well as the need for tracheostomy to ensure airway patency.

## Outcomes

Information about hematoma-related deaths and the need for urgent tracheostomy were recorded, as well as the postoperative complications. Hypoparathyroidism was defined by altered laboratory tests and/or the presence of symptoms of hypocalcemia postoperatively, and it was classified as transient or permanent if the duration was longer than 6 months. Likewise, the rates of recurrent laryngeal-nerve dysfunction (temporary or permanent) were compared between patients that had and those who did not have PNH. Wound infections were defined by the need for antibiotic therapy or the presence of purulent content during drainage.

## Statistical Analysis

All statistical analyses were performed using the Stata software (StataCorp., College Station, TX, US), version 10. For the continuous variables, the results are reported as median and range values, if not stated otherwise. Frequency distribution was used to describe the categorical variables (number of cases and relative percentage). For the statistical evaluation of the differences between the groups, the non-parametric Mann–Whitney U test was applied. The categorical variables were analyzed using the Chi-squared test for 2 × 2 tables, and the Fisher exact test was used when at least 1 expected frequency was lower than 5. To verify the normality of the data, the Shapiro–Wilk test was applied. Odds ratios (ORs) and their respective 95% confidence intervals (95% CIs) were estimated based on a logistic regression model and the stepwise forward technique, and a significance level of 10% was adopted to select the variables.

## Results

### Demographics

A total of 5,900 patients who underwent thyroid surgery were included. The median age was 45.3 years (range: 7–96 years), and 4,826 patients (82%) were women. Most patients – 4,554 (77.3%) – were operated because of nonpalpable nodules incidentally noted during a radiologic procedure. Clinically, 148 patients (2.5%) had substernal goiter. Only 180 patients (3.2%) had been submitted surgery due to hyperthyroidism. In total, 264 patients (4.9%) had previously undergone thyroid surgery. History of previous neck (thyroid) irradiation was observed in 103 cases (1.7%).

### Surgery

Most patients (91%) underwent total thyroidectomy. Concurrent lymph-node dissection was performed in 717 cases (12.2%): 547 patients (76.3%) had level-VI neck clearance, and 170 (23.7%) underwent central and lateral neck dissection. Energy-based surgical sealing devices were used in 1,505 patients (25.5%): the harmonic scalpel, in 1,072 (18.2%), and LigaSure, in 433 patients (7.3%). In the other 4,395 patients (74.5%), the conventional hemostasis technique (coagulation with electrocautery and ligation of blood vessels) was used. An adjunctive hemostatic agent (Surgicel) and a surgical drain were used in 1,631 (27.6%) and 2,327 patients (41.8%) respectively.

**Histology**

The final pathology reports showed malignancy in 3,928 patients (66.6%), and concomitant lymphocytic thyroiditis in 1,855 patients (31.4%).

**Postthyroidectomy Hematoma**

Out of 5,900 patients included in the study, 62 (1.1%) presented wound hematoma requiring reintervention. Out of these 62 patients, 56 (90.3%) had available information on the time of the onset of the postoperative bleeding. Out of these patients, 35 (62.5%) had wound hematoma within 6 hours postthyroidectomy, while 12 (21.4%) had wound hematoma between 6 and 12 hours postoperatively, 2 (3.6%), between 12 and 24 hours, and 7 (12.5%) more than 24 hours postthyroidectomy (►Fig. 1). During the study period, only two patients (3.2%) underwent tracheotomy related to airway compression. Obvious bleeding points were detected in 36 patients (58.1%) during the reoperation. Inferior thyroid artery branches, superior thyroid vessels, the Berry ligament, the anterior jugular vein, and the surface of the strap muscles were the most frequent bleeding sources (►Table 1).

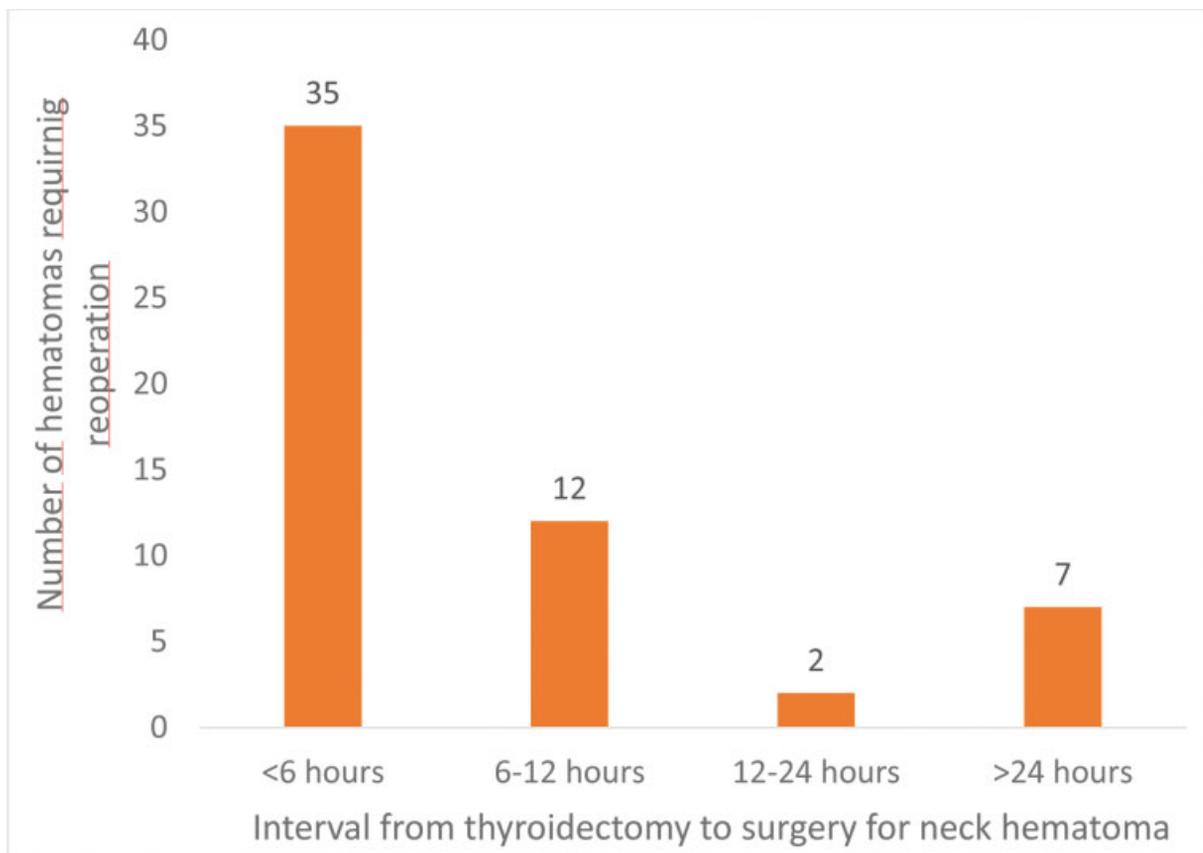
**Risk Factors for Postthyroidectomy Hematoma**

►Table 2 presents the bivariate analysis comparing the patients who did and did not present cervical hematoma.

**Table 1** Source of the postthyroidectomy bleeding

No obvious source	26 (41.9%)
Inferior thyroid artery branch	10 (16.1%)
Superior thyroid vessel	8 (12.9%)
Berry ligament	5 (8.1%)
Anterior jugular vein	4 (6.5%)
Strap muscle	4 (6.5%)
Thyroid remnant after lobectomy	2 (3.2%)
Middle thyroid vein	1 (1.6%)
External jugular vein	1 (1.6%)
Other sources of arterial bleeding	1 (1.6%)

Higher incidence proportions of PNH were significantly associated with older age, concurrent lymph-node neck dissection and chronic lymphocytic thyroiditis (►Table 3). Gender, previous neck irradiation, symptoms at presentation (non-incident diagnosis), substernal goiter, hyperthyroidism, previous thyroid surgery, malignant histology, the extent of the surgery, the use of energy-based vessel sealing devices, the use of a hemostatic agent, and the placement of a surgical drain were not associated with the occurrence of PNH.



**Fig. 1** Interval from thyroidectomy to surgery for neck hematoma.

**Table 2** Patient characteristics and postoperative neck hematoma

Characteristics		Patients, N (%)	No hematoma	Hematoma	p-value
Total		5,900 (100)	5,838 (89.9)	62 (1.1)	
Age (years)	Mean (range)	45.3 (7–96)	45.3 (7–96)	51.2 (14–82)	0.001***
	< 45 years	2,877 (48.8)	2,856 (99.3)	21 (0.7)	0.018*
	≥45 years	3,023 (51.2)	2,982 (98.6)	41 (1.4)	
Gender	Female	4,826 (81.8)	4,778 (99.0)	48 (1.0)	0.369*
	Male	1,074 (18.2)	1,060 (98.7)	14 (1.3)	
Previous neck irradiation		103 (1.7)	103 (100)	0	0.627**
Non-incident diagnosis		1,346 (22.7)	1,327 (98.6)	19 (1.4)	0.120*
Substernal goiter		148 (2.5)	146 (98.6)	2 (1.4)	0.666**
Hyperthyroidism		180 (3.2)	177 (98.3)	3 (1.7)	0.350*
Previous thyroid surgery		264 (4.9)	260 (98.5)	4 (1.5)	0.363**
Malignant histology		3,928 (66.6)	3,885 (98.9)	43 (1.1)	0.641*
Lymphocytic thyroiditis		1,855 (31.4)	1,827 (98.5)	28 (1.5)	0.019*
Surgery extent	Total thyroidectomy	5,367 (91)	5,310 (98.9)	57 (1.1)	0.789*
	Non-total thyroidectomy	533 (9)	528 (99.1)	5 (0.9)	
Concurrent neck dissection		717 (12.2)	704 (98.2)	13 (1.8)	0.033*
Hemostasis technique	Harmonic scalpel	1,072 (18.2)	1,062 (99.1)	10 (0.9)	Not accessible
	Ligasure	433 (7.3)	430 (99.3)	3 (0.7)	
	Conventional	4,395 (74.5)	4,346 (98.9)	49 (1.1)	
Use of hemostatic agent (Surgical)		1,631 (27.6)	1,621 (99.4)	10 (0.6)	0.042*
Placement of surgical drain		2,327 (41.8)	2,297 (98.7)	30 (1.3)	0.095*

Notes:

\*Chi-squared test.

\*\*Fisher exact test.

\*\*\*Mann-Whitney U-test.

**Operative Outcomes**

No patients died during hospitalization due to cervical hematoma. The operative outcomes were summarized in **Table 4**.

**Discussion**

Using an inpatient database of a single tertiary center, we investigated the incidence and risk factors for PNH requiring surgical reintervention in patients undergoing thyroidectomy. Among 5,900 eligible patients, only 62 (1.1%) had neck

hematoma. To our knowledge, this is the first study analyzing the factors influencing postthyroidectomy wound hematoma including a large sample from a cancer center in Brazil. The incidence of postoperative neck hematoma (1.1%) was similar to that reported in the literature (0.7% to 4.7%).<sup>4–9</sup>

In the present study, all patients were hospitalized for at least one day, and they were observed postoperatively for a minimum of seven days. We believe that this period of observation is long enough to capture a delayed occurrence of wound hematoma. We found that most 35 patients (62.5%) had PNH during the same hospitalization within 6 hours of

**Table 3** Multivariate analysis of risk factors for postoperative neck hematoma

Covariates	Crude analysis		Multivariate analysis	
	OR (95%CI)	p-value	OR (95%CI)	p-value
Age ≥ 45 years	1.87 (1.10–3.17)	0.02	2.03 (1.19–3.46)	0.009
Lymphocytic thyroiditis	1.81 (1.09–2.99)	0.021	1.78 (1.07–2.95)	0.026
Concurrent neck dissection	1.93 (1.04–3.58)	0.036	2.03 (1.09–3.8)	0.026
Use of hemostatic agent	2.00 (1.01–3.94)	0.046		
Placement of surgical drain	3.22 (1.26–8.21)	0.098		

Abbreviations: 95%CI, 95% confidence interval; OR, odds ratio.

**Table 4** Operative outcomes

	No hematoma	Hematoma	p-value
N	5,838	62	
Transient hypocalcemia	1,795 (30.8%)	27 (43.6%)	0.031*
Permanent hypoparathyroidism	304 (5.4%)	7 (12.1%)	0.037**
Transient recurrent laryngeal-nerve palsy	409 (7%)	7 (11.3%)	0.205**
Permanent recurrent laryngeal-nerve injury	139 (2.4%)	5 (8.1%)	0.017**
Postoperative infection	100 (1.7%)	3 (4.8%)	0.094**

Notes:

\*Chi-squared test.

\*\*Fisher exact test.

the thyroidectomy, which is often reported in the literature.<sup>5,8,10</sup> Godballe et al<sup>8</sup> reported that the median time for the onset of postoperative hemorrhage was 3 hours (range 0–105 hours).<sup>8</sup> In a multi-institutional international case-control study including 207 patients, Campbell et al<sup>11</sup> reported that 47% of hematoma patients returned to the operation room within 6 hours, and 79%, within 24 hours after thyroidectomy.<sup>11</sup> But some authors<sup>12</sup> reported longer periods of time until the onset of bleeding. Suzuki et al,<sup>13</sup> analyzing 51,968 patients from a Japanese database, found a PNH rate of 1.8%, with nearly 20% of wound hematomas occurring 3 or more days after the thyroidectomy.<sup>13</sup> In the present series, 7 patients (12.5%) had neck hematomas 24 hours postthyroidectomy. This relevant information when considering outpatient procedures.

The treatment for PNH depends on the symptomatology. Most hematomas need to be evacuated to prevent respiratory distress. When a severe hematoma with rapid mucosal edema and upper-airway swelling is detected, intubation or even tracheotomy are generally the first-step emergency treatments, rather than neck surgery. In the present study, we showed that only 2 (3.2%) out of 62 patients with wound hematoma underwent tracheotomy before reoperation, and both cases were diagnosed before 6 hours postthyroidectomy. Although uncommon, postthyroidectomy bleeding can be lethal in 0.01% to 1.34% of patients.<sup>6,14</sup> In the present study, no patients died due to cervical hematoma. This is largely due to early reoperation and fiber-optic-assisted tracheal intubation at the anesthetic induction.

The source of bleeding is identified during reoperation in 57% to 73.6% of patients.<sup>4,10</sup> In the present review, we were able to find a source of bleeding in 58.1% of the cases. Inferior thyroid artery branches and superior thyroid vessels were the most frequent bleeding sources.

The rate of postoperative complications is often higher after reoperation for neck hematoma.<sup>12</sup> We found higher rates of permanent hypoparathyroidism (12.1% versus 5.4%;  $p = 0.037$ ) and permanent recurrent laryngeal nerve dysfunction (8.1% versus 2.4%;  $p = 0.017$ ) in patients undergoing cervical reoperation due to hematoma compared with

patients without bleeding respectively. The rate of wound infection rate was also higher, but did not reach significance (4.8% versus 1.7%;  $p = 0.094$ ).

Several risk factors for postthyroidectomy hematoma have been described in the literature. Consistent with findings from previous studies, we found that older age,<sup>6–9,13–16</sup> inflammatory thyroid disease,<sup>6</sup> and concurrent lymph-node neck dissection<sup>13,15,16</sup> were independent risk factors for neck hematoma. We also found a higher risk of developing wound hematoma among male patients,<sup>6–10,13–17</sup> substernal or huge goiters,<sup>7,18</sup> and symptoms at presentation (non-incident diagnosis), but they did not reach statistical significance.

Previous studies revealed that thyroid histology, be it benign<sup>11,16</sup> or malignant,<sup>8</sup> can impact the postsurgical bleeding. Our findings are consistent with recent meta-analyses that failed to show any relationship between the pathological findings and the risk of hematoma formation.<sup>15,16,19</sup>

There is no consensus on the impact of the extent of the thyroid resection on postoperative bleeding. A higher risk of developing a postthyroidectomy hematoma has been described both after total<sup>13–16</sup> and partial<sup>6</sup> resections. We failed to show any association between the extent of the resection and the wound hematoma, possibly due to the small number of patients undergoing non-total thyroidectomies (9%) in our series. Similarly, we did not find an increased risk of developing hematoma among patients with previous thyroid surgery, which was suggested in previous publications.<sup>5,10,14–16,20</sup> Again, the present study included only a small number of patients with previous thyroid surgery (4.5%), and most of these cases were completion thyroidectomies, which can be performed without significant increased risk because the second surgery would avoid the first operative field.<sup>21</sup>

Unlike the results in previous publications,<sup>7,11,13,15,16</sup> the present study showed that patients with hyperthyroidism were not at a higher risk of developing wound hematoma. We speculate that a significant percentage of patients with toxic nodular goiter as a cause of hyperthyroidism in our series may influence the risk of postoperative hematoma. According to Quimby et al,<sup>19</sup> Graves disease but not toxic nodular goiter significantly increases the risk of developing PNH.

Energy-based surgical devices, such as bipolar scalpels and ultrasonic shears, are increasingly being used in thyroid surgery, aiming to improve surgical hemostasis.<sup>22,23</sup> In fact, data comparing different options for the intraoperative ligation of blood vessels show significantly reduction in operative time,<sup>24,25</sup> in blood loss,<sup>24,26</sup> and shorter hospital length of stay<sup>24,26</sup> in favor of the harmonic scalpel or LigaSure over standard ligation and coagulation, with no difference in the rate of postoperative complications.<sup>24–27</sup> The present study revealed no association between the use of energy-based vessel sealing devices and the occurrence of PNH. On the other hand, the use of a hemostatic agent (Surgicel) reduced the risk of PNH in the univariate analysis, but not in the multivariate analysis.

Surgicel, an oxidized cellulose mesh that adheres to tissue in areas of bleeding and helps form a hemostatic clot, is often used as an adjunctive hemostatic agent during thyroidectomy.<sup>11</sup> However, Amit et al,<sup>28</sup> in a prospective randomized controlled

trial, found no advantage in the application of Surgicel over conventional hemostasis in thyroid surgery.<sup>28</sup> Actually, Surgicel has shown increases in drain output, time until drain removal, and hospital length of stay.

The use of a postoperative drain plays no role in most thyroid surgeries because it can increase pain and the hospital stay, with no difference in hematoma formation.<sup>29,30</sup>

In Brazil, thyroidectomy is widely performed by head and neck surgeons and otolaryngologists, but general surgeons also perform thyroid surgeries, mostly in nonacademic hospitals. It is known that thyroidectomies performed at high-volume hospitals ( $\geq 75$  thyroidectomies per year) have a lower propensity of resulting in PNH, as compared with procedures performed in low-volume hospitals.<sup>15</sup>

We emphasize some important measures in the prevention of postthyroidectomy hematomas. Gentle tissue handling is strongly advised during thyroid surgery. Moreover, when using energy-based surgical devices, excessive traction should be avoided, as it may lead to premature rupture of blood vessels prior to proper sealing. Performing a Valsalva maneuver can help identify potential sources of bleeding before closing, and the performance of a loose reapproximation of the strap muscles could enable the earlier recognition of the hematoma and delay the lymphatic outflow blockage that leads to laryngeal edema.<sup>31</sup> Controlling postoperative vomiting and hypertension is equally important.

Some limitations are noteworthy in the present study. Firstly, the present was a single-center retrospective cohort study without randomization of treatment assignment. Secondly, the procedures were performed by different surgeons with variables levels of expertise, which can influence the outcomes.<sup>14,32</sup> Finally, the size of the tumor and of the thyroid gland,<sup>18</sup> the comorbidities (such as hypertension, chronic kidney disease and obesity),<sup>6</sup> and use of anticoagulation medications,<sup>13</sup> which were not available in the database, might act as confounding factors.

## Conclusion

Hematoma after thyroid surgery is an uncommon complication, but it is related to significant postoperative morbidity. Some patients present neck hematoma 24 hours postthyroidectomy. Older age, thyroiditis and concurrent lymph-node neck dissection are independent risk factors for postoperative bleeding. Careful hemostasis during surgery is mandatory to prevent postoperative hematoma. Closer postoperative monitoring of the neck is recommended for patients with one or more risk factors 24 hours postthyroidectomy.

### Conflict of Interests

The authors have no conflict of interests to declare.

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