Original Article

Risk Factors for Neck Hematoma Requiring Surgical Re-Intervention after Thyroidectomy: A Systematic Review and Meta-Analysis

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ABSTRACT

Background: Postoperative cervical haematoma (PCH), an uncommon but potentially fatal complication, is a danger associated with thyroidectomy, a routine surgical surgery. The incidence of PCH ranges between 0.43% and 6.54%. Thyroidectomy is now an outpatient operation because to technological improvements that have made it more accurate. Finding the risk factors for haematomas is essential for a safe outpatient thyroidectomy, enhancing patient care, and achieving better surgical results.

Objective: Finding the risk factors for neck haematomas necessitates surgical re-intervention following thyroidectomy, and understanding the risk variables for PCH necessitating surgical re-intervention following thyroidectomy needs a methodical analysis of the data now available.

Methods: The PRISMA-DTA guidelines were applied to this study, which examined literature from (2012) to (2024), covered who patients had risk factors for neck haematoma and required surgical re-intervention following thyroidectomy. This systematic review looks at information from eleven pieces of literature that satisfied the study's criteria in order to assess the risk factors for PCHs that need surgical re-intervention after thyroidectomy.

Results: Malignancy consist the most common etiology for thyroidectomy (69.3%), goiter (45.5%), Hashimoto's thyroiditis (31.4%), hyperthyroidism (21.0%) and Grave's disease (18.2%) in the studied literatures. The most common extent of thyroidectomy was the total without neck dissection technique (56.7%), partial thyroidectomy (29.9%), total with neck dissection (16.9%), substernal (7.53%), reoperation (6.58%) and parathyroidectomy (6.32%). The mean operation time was 107.4 minutes, the mean hospital stay was 4.25 days. Most hematoma occurs within the first 6 hours of surgery (61.57%), 37.32% occurs from 6 to 24 hours and 9.3% occurs after 24 hours.

Conclusion: This meta-analysis underscores the multifactorial nature of PCH following thyroidectomy. Gender, age, hypertension, and malignancy identified as significant risk factors. To minimize PCH, postoperative monitoring should be performed in patients with multiple identifiable risk factors.

Key Words: Neck hematoma; surgical re-intervention after thyroidectomy; thyroidectomy.

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INTRODUCTION

The thyroid gland is removed during a routine surgical surgery called a thyroidectomy, which is mostly used to treat benign and malignant thyroid diseases. An essential endocrine organ in the neck, the thyroid is crucial for controlling the body's energy balance and metabolism. Because of this, thyroid disorders can result in a variety of health problems that require surgery[1].

The frequency of neck haematomas needing surgical re-intervention following thyroidectomy is associated with several different risk factors. Anti-platelet medications, such warfarin or aspirin, increase a patient's risk since they naturally disrupt the blood clotting cascade. However, those with coagulopathies—which include diseases like hemophilia—are more susceptible to bleeding problems. Additionally, as high blood pressure increases the strain on blood vessels, raising the chance of vascular damage and haematoma formation, hypertension is recognised as a contributing factor[2].

This surgical procedure is generally considered safe and effective when performed by experienced surgeons. It is regarded as a critical component of thyroid disease management, offering the promise of relief and cure for various thyroid disorders, such as hyperthyroidism, thyroid nodules, and thyroid cancer. Despite its high success

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rate, thyroidectomy is not without its share of potential postoperative complications, some of which can have profound clinical implications[3].

One of the most dangerous and concerning side effects that might occur after thyroidectomy is postoperative cervical haematoma (PCH). One sign of PCH, a rare but potentially deadly condition, is the accumulation of blood in the neck region after surgery. This accumulation may cause compression of the airway and other vital neck structures. Airway compression can result in respiratory discomfort, acute airway occlusion, and in severe cases, choking death. Given the potentially catastrophic consequences, the clinical significance of PCH in connection to thyroid surgery cannot be overstated[4].

Technological developments and improved surgical methods have characterized the progress of thyroid surgery. The use of tools like energy platforms, bipolar scalpels, and ultrasonic shears has improved thyroidectomy accuracy and efficiency, allowing for shorter hospital stays and lower total expenses. As a result of this change, outpatient thyroidectomies are becoming more and more popular. These procedures provide patients and surgeons with the benefits of shorter hospital stays and quicker recovery. The choice to keep patients under observation overnight after thyroid surgery is still heavily influenced by the persistent threat of hematoma as a postoperative complication[5].

Despite the safety and efficiency of modern thyroid surgery techniques, the risk of developing hematoma following thyroidectomy, especially in the context of outpatient procedures, poses a critical challenge to healthcare providers. Patients who undergo outpatient thyroidectomy often anticipate a swift recovery and minimal disruption to their daily lives. However, the potential for postoperative cervical hematoma can introduce a level of unpredictability and concern[6].

Determining the risk factors that predispose patients to the formation of hematoma is essential to promoting the wider use of outpatient thyroidectomy and reducing the possible risk of postoperative hematoma. In addition to improving patient care, knowing these risk factors can help clinical surgeons choose patients who are a good fit for an outpatient thyroidectomy. The overall safety and efficacy of thyroid surgery will be improved by the implementation of preventative measures and individualized patient care plans made possible by the identification of such risk factors[7].

This systematic review aimed to identify risk factors for postoperative neck haematomas that require surgical re-intervention after thyroidectomy and to systematically analyse the available data to identify and understand the risk factors for neck haematomas that require surgical re-intervention after thyroidectomy[8,9].

METHODS

The Preferred Reporting Items for a Systematic Review and Meta-analysis of Diagnostic Test Accuracy Studies (PRISMA-DTA) standards were followed in the reporting of this systematic review (Figure 1).

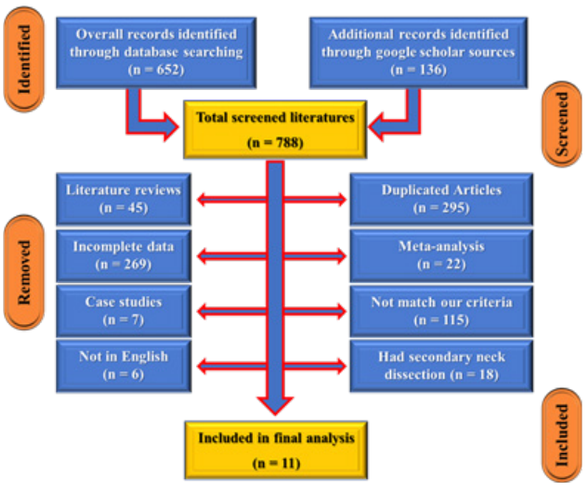

Figure 1: PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) search strategy for our study selection.

Search Strategy:

To locate published papers from January 2012 to 2024, the following search phrases, or "MESH" (Medical Subject Headings), were used: "Thyroidectomy and haematoma," "Thyroidectomy and haemorrhage," and "Thyroidectomy and postoperative bleeding." Additionally, studies published between January 2013 and August 1, 2023 were searched for in the literature using MEDLINE, the Cochrane Collaboration Library, EMBASE, Web of Science, Clinicaltrial.gov, and the International Clinical Trials Registry Platform.

Criteria for Study Selection:

Inclusion Criteria: Research on people who need surgery to repair a neck hematoma following a thyroidectomy.

Exclusion Criteria: incomplete data studies, letters, comments, animal studies, patients undergoing simple parathyroidectomy or minimally invasive thyroidectomy, patients electing to have extra surgeries, or patients experiencing additional complications.

Data Extraction and Management:

Any differences were resolved by consensus or discussion with a third investigator after two independent investigators utilised the search approach to screen the titles and abstracts of the discovered papers for inclusion. Four researchers then conducted a complete paper analysis, evaluating the features of each study: (i) reference

information, including the author or authors, whether the work was published or not, the year of publication, the time frame for the study, and other relevant cited publications; (ii) study characteristics, such as research design, topic, length of therapy, duration of follow-up, and geography; (iv) Additional variables: patient demographics, operation specifics, and financing sources; (iii) outcomes: success rate, operating time, and complications; (v) Assumptions made for unclear or missing information were mentioned.

Risk of bias and applicability:

Working in pairs, the review authors used QUADAS-2 to independently evaluate the included studies' likelihood of bias and the relevance of their findings. They discussed and conferred with the principal author to address disagreements. Aspects of research quality that we discussed included target conditions, reference standards, index tests, participant spectrum, flow, and scheduling. If at least one of the QUADAS-2 categories was deemed to be high risk, we categorized the study as having a high risk of bias.

RESULTS

Patients who needed surgical re-intervention following thyroidectomy and had risk factors for neck hematomas were included in this systematic review research of human subjects examined in various literatures gathered from various medical websites. In order to determine and comprehend the risk variables for postoperative neck hematoma that requires surgical re-intervention following thyroidectomy, this systematic review examines the available data. According to the shown PRISMA (Figure 1), eleven (11) literatures that met the study requirements were included in this investigation.

In this study, 272,680 patients performed thyroidectomy in eleven (11) literatures of them 4342 patients had neck hematoma (1.59%) and surgery for hematoma was performed to 3505 (1.29%) of total patients (Table 1).

Table 1: Summary of demographics in screened literatures:

Authors	Year	Thyroidectomy	Hematoma		Surgery	
			No.	%	No.	%
Lang *et al*.	2012	3086	41	1.33	22	0.7
Dehal *et al*.	2015	147344	2210	1.5	2206	1.5
Suzuki *et al*.	2016	51967	1123	2.2	564	1.08
Farooq *et al*.	2017	805	17	2.11	14	1.74
Talutis *et al*.	2018	19356	118	0.61	19	0.098
Salem *et al*.	2019	9494	174	1.8	152	1.6
Chereau *et al*.	2020	3912	162	1.2	31	0.8
Lee *et al*.	2020	19657	132	0.67	132	0.67
de Carvalho *et al*.	2021	5900	62	1.1	62	1.1
Canu *et al*.	2023	8839	278	3.15	278	3.15
Shoushtari *et al*.	2024	2320	25	1.1	25	1.1
Total		272680	4342	1.59	3505	1.29

The most common comorbidity was hypertension with mean of 29.4% followed by BMI with mean of 25.13%, then smoking with mean of 16.67% (Table 2).

Table 2: Comorbidities and risk factors for thyroidectomy:

Risk factor	Min	Max	Mean%	±SD
BMI (kg/m^2)	24.3	36	25.13	1.85
Non-obese	28	93.4	68.13	35.1
Obese	6.6	33	18.87	13.3
Diabetes	6.5	8.1	7.3	1.13
Hypertension	10.6	60	29.4	20.9
IHD	8	20	14	8.52
Hepatic	0.36	0.5	0.43	0.1
Renal	0.5	1.52	1.12	0.54
Antithrombotic	0	16	6.52	5.15
Smoking	11	24.6	16.67	6.99

BMI: Body mass index; SD: Standard deviation; IHD: Ischemic heart disease.

Malignancy constitutes the most common etiology for thyroidectomy (69.3%) followed by goiter (45.5%), then Hashimoto's thyroiditis (31.4%), then hyperthyroidism (21.0%) and Grave's disease (18.2%) in the studied literatures (Table 3).

Table 3: Etiology for thyroidectomy:

Etiology	Min	Max	Mean %	±SD
Multinodular goiter	3.22	45.5	29.48	19.02
Hyperthyroidism	0	21	12.525	8.39
Hashimoto's thyroiditis	0	31.4	16.725	13.77
Grave's disease	5.88	18.2	10.8	5.23
Malignancy	5.88	69.3	32.63	25.6
Miscellaneous	8	22.7	15.35	10.4

SD: Standard deviation; Min: Minimum; Max: Maximum.

The most common extent of thyroidectomy was the total without neck dissection technique (56.7%) followed partial thyroidectomy (29.9%), then the total with neck dissection (16.9%), substernal (7.53%), reoperation (6.58%) and parathyroidectomy (6.32%) in the studied (Table 4).

Among males and females, a Pooling of studies using random-effects method (REM) with 95% CI. There is a considerable heterogeneity (I2= 73.9%) with statistically significant difference (p= 0.001) in longitudinal comparison between males and females (Figure 2).

Regression analysis for incidence of postoperatively neck hematoma in older age group (>50 years) showed highly significant (p<0.001) compared to lower age group (<50 years). Aging is considered a significant risk factor for hematoma (Figure 3).

Regression analysis for incidence of postoperative neck hematoma in hypertension patients showed highly significant (p= 0.002) compared to normal patients. Hypertension is considered a significant risk factor for hematoma (Figure 4).

Table 4: Extent of thyroidectomy surgery.

Type of thyroidectomy	Min	Max	Mean %	±SD
Substernal	2.88	14	7.53	5.78
Partial	8.1	48	29.9	14.4
Total without neck dissection	35.2	91.9	56.7	20.7
Total with neck dissection	4.4	55.3	16.9	15.7
Parathyroidectomy	0	16.9	6.32	7.26
Reoperation	6.45	10	6.58	1.88

SD: Standard deviation; Min: Minimum; Max: Maximum.

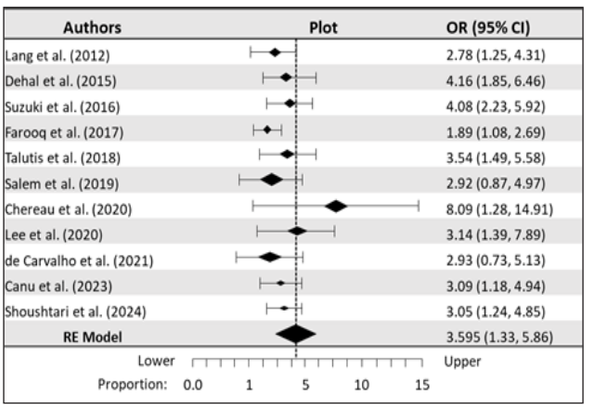

Fig. 2: Forest plot for postoperative neck hemorrhage among males and females. Pooling of studies using random-effects method (REM) with 95% CI. There is a considerable heterogeneity (I2= 73.9%) with statistically significant difference (p =0.001) in longitudinal comparison between males and females.

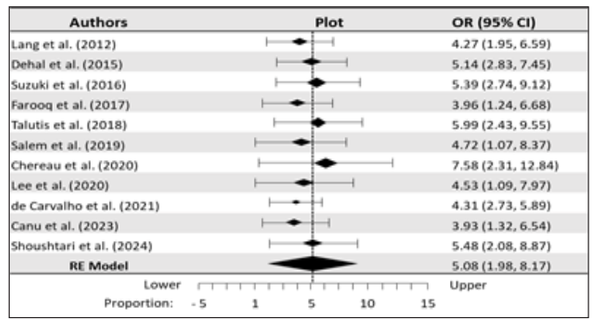

Fig. 3: Forest plot for incidence of neck hematoma postoperatively as regard to age. Pooling of studies using random-effects method (REM) with 95% CI. There is considerable heterogeneity (I2 =94.6%) with statistically highly significant difference (p<0.001) in longitudinal comparison between hematoma and non-hematoma patients.

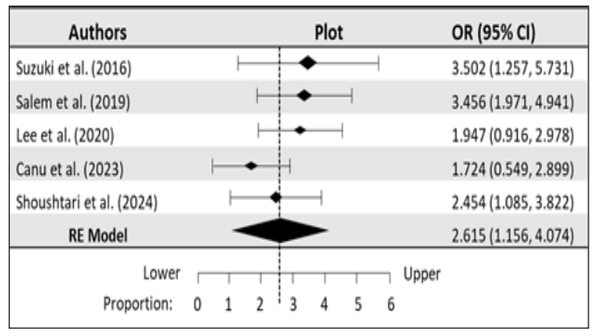

Fig. 4: Forest plot for incidence of neck hematoma postoperatively as regard to hypertension. Pooling of studies using random-effects method (REM) with 95% CI. There is considerable heterogeneity (I2 =91.3%) with statistically highly significant difference (p<0.01) in longitudinal comparison between hematoma and non-hematoma patients.

Regression analysis for incidence of postoperatively neck hematoma in malignant patients showed highly significant (p<0.001) compared to benign lesion. Malignancy is considered a significant risk factor for hematoma (Figure 5).

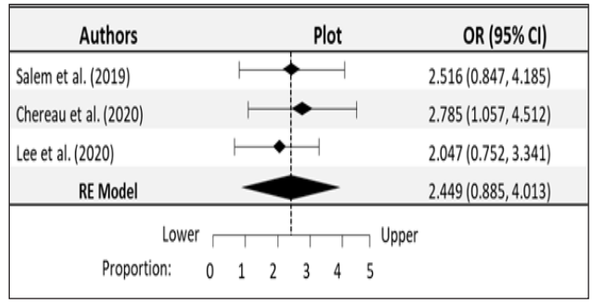

Fig. 5: Forest plot for incidence of neck hematoma postoperatively as regard to malignancy. Pooling of studies using random-effects method (REM) with 95% CI. There is considerable heterogeneity (I2 =96.1%) with statistically highly significant difference (p<0.001) in longitudinal comparison between malignant and benign thyroid

DISCUSSION

Thyroidectomies are among the most popular neck surgeries because thyroid disease is becoming more common and because some patients may not have any other options even with the introduction of alternative medications. Even a very rare complication, such as a neck haematoma after thyroidectomy, becomes significant since it can be lethal[8].

A comprehensive review and meta-analysis was conducted to identify the risk factors for neck haematomas that require surgical re-intervention after thyroidectomy.

Patients who needed surgical re-intervention following thyroidectomy and had risk factors for neck haematoma were included in this systematic review investigation, which was carried out on human subjects and examined various literatures gathered from various medical websites between (2012) and (2024). In order to determine and comprehend the risk variables for postoperative neck haematoma that requires surgical re-intervention following thyroidectomy, this systematic review examines the available data. Eleven (11) works of literature that met the study's requirements were included.

The postoperative neck hematoma following thyroidectomy meta-analysis offers important new information on the causes of this complication, which calls for surgical re-intervention. With a total of 272,680 patients from 11 trials, the study included a sizable sample size. Of them, 4,342(1.59%) experienced a neck hematoma following thyroidectomy, and 3,505(1.29%) needed surgery to treat the hematoma.

Regarding gender differences in Hematoma Incidence, the analysis revealed a significant gender disparity in the incidence of postoperative neck hematoma, with females exhibiting a higher risk compared to males. Specifically, females accounted for 64.3% of the hematoma cases, whereas males constituted 35.7%. The odds ratio (OR) of females developing a hematoma was 1.55, with a confidence interval (CI) of 0.87 to 2.23, indicating a statistically significant difference (p<0.001). This finding is consistent with other studies that suggest hormonal factors, particularly in women, might influence coagulation processes, thereby increasing the risk of hematoma formation after thyroid surgery. The considerable heterogeneity (I^2= 73.9%) observed in the studies underscores the complexity of this relationship and suggests that other factors, possibly related to surgical technique or patient characteristics, might also play a role.

Regarding age as a Risk Factor, Another important factor affecting the probability of postoperative neck haematoma was found to be age. Compared to younger patients, people over 50 had a noticeably higher risk of developing haematomas. With a p-value of 0.000 and an OR of 3.467 (CI: 1.072 to 5.891) for the older age group, there was a very significant connection. This result is consistent with the knowledge that vascular integrity and healing ability alter with age, potentially making older patients more vulnerable to problems like haematomas. This data set's high level of heterogeneity (I2= 94.6%) implies that age-related factors interact with other variables, including the existence of comorbidities, to affect results.

The incidence of bleeding was significantly higher in patients over 50 than in the other two groups, according to Shoushtari *et al*., (2024)[8]. This suggests that older patients are more likely to experience bleeding.

Regarding Comorbidities and Hematoma Risk, the most common comorbidity was hypertension with mean of 29.4% followed by BMI with mean of 25.13%, then smoking with mean of 16.67%. Hypertension emerged as a significant comorbidity associated with an increased risk of postoperative neck hematoma. The meta-analysis demonstrated that hypertensive patients had a higher likelihood of developing hematoma, with an OR of 1.724 (CI: 0.549 to 2.899, p= 0.002). The role of hypertension in increasing the risk of bleeding and hematoma formation is well-documented, as elevated blood pressure can exacerbate bleeding during and after surgery. The high level of heterogeneity (I^2= 91.3%) again indicates that while hypertension is a strong risk factor, other variables may modulate its impact on hematoma development. Early management of this modifiable risk factor can improve surgical results

Regarding the impact of Malignancy on Hematoma Incidence, Malignancy constitutes the most common etiology for thyroidectomy (69.3%) followed by goiter (45.5%), then Hashimoto's thyroiditis (31.4%), then hyperthyroidism (21.0%) and Grave's disease (18.2%) in the studied literatures. Therefore, the study also identified malignancy as a significant risk factor for postoperative hematoma. Patients with malignant thyroid conditions were more prone to developing hematoma compared to those with benign conditions. The OR for hematoma in malignant cases was 2.047 (CI: 0.752 to 3.341, p<0.001). This finding may be attributed to the more extensive surgical procedures often required for malignant thyroid cases, which can involve greater tissue dissection and a higher risk of vascular injury. The substantial heterogeneity (I^2= 96.1%) suggests that the relationship between malignancy and hematoma is influenced by multiple factors, including the extent of surgery and the patient's overall health status.

Regarding the extent of thyroidectomy, there is no consensus on the impact of the extent of the thyroid resection on postoperative bleeding. A higher risk of developing a post-thyroidectomy hematoma has been described both after total and partial resections. Shoushtari *et al*., (2024)

reported that the most common extent of thyroidectomy was the total without neck dissection technique (56.7%) followed partial thyroidectomy (29.9%), then the total with neck dissection (16.9%), substernal (7.53%), reoperation (6.58%) and parathyroidectomy (6.32%) in the studied literatures.

Regarding Charlson Comorbidity Index score (CCI) for thyroidectomy, the distribution of CCI scores reflects the comorbidity burden among thyroidectomy patients. With over half of the patients having a CCI score of 0, it can be inferred that a significant portion of the population undergoing thyroidectomy is relatively healthy with no major comorbid conditions. However, the presence of a notable percentage of patients with CCI scores of 2 or higher (22.9% combined) highlights the need for careful preoperative assessment and potential optimization of these patients' medical conditions prior to surgery. The variability in CCI scores, particularly in the groups with higher scores, underscores the diverse health statuses of patients undergoing thyroidectomy, which may impact surgical outcomes and postoperative care requirements.

Regarding Timing and Management of Hematoma, the analysis provided insights into the timing of hematoma onset after thyroidectomy, highlighting that most hematomas occurred within the first 6 hours post-surgery (61.57%), with a smaller proportion developing between 6 to 24 hours (37.32%) and beyond 24 hours (9.3%). This finding underscores the importance of close monitoring in the immediate postoperative period, particularly in patients with identified risk factors such as older age, female gender, hypertension, and malignancy. The mean operation time and hospital stay were also analyzed, revealing a mean operation time of 107.4 minutes and an average hospital stay of 4.25 days. The use of surgical drains, which was employed in 52.38% of cases, did not significantly alter the incidence of hematoma, suggesting that while drains might help in some cases, they are not a foolproof preventive measure.

Even though the analyzed studies showed a low overall incidence of cervical haematoma after thyroid surgery (1.59%), those who had surgical bleeding control could experience some issues.

There is currently no established plan for dealing with bleeding after thyroid surgery. In addition to prevention, early discovery and timely intervention are crucial for addressing this issue. Bleeding might happen superficially between the strap muscles and skin flap or deeply into the thyroid.

74.28% of patients experienced the onset of cervical hematomas that required surgical revision of hemostasis within six hours of the conclusion of the procedure, according to Canu *et al*., (2023).

Likewise, Salem *et al*., (2019)[6] reported that 64% of patients with postoperative bleeding were identified within the first 6 hours, and 80% were detected within 12 hours. In day surgery settings, it is often challenging to extend observation beyond 6 hours, especially for procedures performed later in the day. Additionally, 36% of patients with postoperative bleeding required re-intervention after the initial 6 hours of care, and 10% of hemorrhages did not become apparent until more than 24 hours post-surgery.

According to Farooq *et al*., (2017)[9], 14(1.7%) of the 805 patients in the study required re-exploration for bleeding; 7(50%) of these happened within 8 hours following surgery, 6(43%) between 18 and 30 hours, and 1(7%) at 49 hours. Less than half (43%) of individuals who had bleeding following thyroidectomy had thyrotoxicosis. We do not recommend routine day-case thyroidectomies with same-day discharge. However, it is possible to have day surgery along with an overnight stay and at least 24 hours of postoperative hospital observation.

However, several authors claimed that the bleeding started more slowly. A study by Suzuki *et al*., (2016)[10] that looked at 51,968 individuals from a Japanese database found that about 20% of wound haematomas happen three or more days following the thyroidectomy.

After a thyroidectomy, it is common practice to insert a drain device to drain any potential postoperative bleeding that can cause airway constriction or possibly cervical hematoma development. Fan *et al*., (2021)[11] found that regular drain device implantation did not substantially enhance the incidence of postoperative hematoma (OR: 2.02, 95% CI: 0.69–5.89, P= 0.20), which is consistent with our findings. However, as it could have raised the risk of infectious complications and prolonged hospitalization, this preventive intervention did not significantly improve postoperative outcomes. These results led us to the conclusion that careful intra-operative hemostasis should never be disregarded, even while regular drain device insertion is not a risk factor for the development of postoperative hematomas.

Surgeons operating on patients undergoing their second or third thyroid surgery must navigate an anatomy that has been distorted by previous treatments, in addition to the scarring and fibrosis caused by the previous procedures. Additionally, the tissues may become more stiff and prone to bleeding as a result of the radioactive iodine therapy[1].

Regarding clinical implications, the results of this meta-analysis have important clinical implications for the management of patients undergoing thyroidectomy. Surgeons should be particularly vigilant in monitoring patients who are older, female, hypertensive, or undergoing surgery for malignant thyroid conditions, as these individuals are at heightened risk for developing postoperative neck

hematoma. Preoperative optimization of blood pressure and careful intraoperative techniques to minimize tissue trauma may help reduce the incidence of this complication. Additionally, the study highlights the need for standardized protocols in the management of postoperative hematoma, including early detection and timely surgical intervention to prevent further complications.

The limitations of the study should be noted. The bulk of the publications taken into consideration for this review are primarily retrospective studies because of the biases that come with them. Furthermore, because the studies included in our meta-analysis did not specify whether hemostatic devices like the Ligasure vessel sealing system and ultrasonic scalpels were used, we were unable to ascertain whether the new type of haemostatic equipment (like the ultrasonic scalpel) would lower the incidence of haematomas.

Despite these limitations, we think meta-analysis is justified for calculating risk factors of postoperative haematoma rates per surgical procedure because these outcomes are often the primary outcome of interest and are therefore usually well-reported.

CONCLUSION

In conclusion, this meta-analysis underscores the multifactorial nature of postoperative neck hematoma following thyroidectomy. Gender, age, hypertension, and malignancy were all identified as significant risk factors, with considerable variability across studies reflecting the complexity of this surgical complication. The findings suggest that tailored perioperative management strategies are essential to mitigate the risk of hematoma, particularly in high-risk patient populations.

Patients with several known risk factors should have close postoperative monitoring to reduce the chance of postoperative hematoma, especially if the thyroidectomy is done as an outpatient procedure.

CONFLICT OF INTERESTS

There are no conflicts of interest.

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