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Postoperative Bleeding Risk in Thyroid Surgery: Differences between Conventional and Endoscopic Video-Assisted Neck Surgery Methods

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Background: Postoperative bleeding is a potentially life-threatening complication following thyroidectomy, but the risk factors and timing remain insufficiently understood. The bleeding rate for endoscopic surgery, specifically video-assisted neck surgery (VANS), also remains unclear in Japan.
Methods: We conducted a retrospective case-control study of postoperative bleeding requiring readmission to the operating room.
Results: The overall postoperative bleeding rate was 1.85%. Multivariate analysis revealed that postoperative bleeding was independently associated with antithrombotic therapy (odds ratio 2.95; 95% confidence interval 1.15-7.59) and dialysis (odds ratio 6.53; 95% confidence interval 1.75-24.2). Among patients with postoperative bleeding, the complication developed within 6 h in 56.1% and within 24 h in 93.0%. The postoperative bleeding rate in endoscopic surgery was 1.6%. The most common site of bleeding was around the thyroid in conventional surgery and around the flap in endoscopic surgery.
Conclusions: Post-thyroidectomy bleeding is associated with antithrombotic therapy or dialysis. While the bleeding rate in endoscopic surgery is similar to that in conventional surgery, the bleeding site differs. (J Nippon Med Sch 2024; 91: 432–438)

Key words: postoperative hemorrhage, thyroidectomy, video-assisted surgery, papillary thyroid carcinoma

Introduction

Postoperative bleeding in thyroid surgery is a rare but serious complication that can progress to laryngeal edema, leading to asphyxia and even cardiac arrest[1–3]. This significant complication is a matter of considerable concern regardless of the facility, and incidence rates and risk factors have been reported from various countries[1–3]. In recent years, endoscopic surgery has become widely adopted in facilities across Japan. Endoscopic surgery in the thyroid area was first reported by Hüscher in 1997[4]. Subsequently, in Japan, Shimizu et al.[5] developed video-assisted neck surgery (VANS) using a suspension method. Various approaches, including those from the anterior chest, axilla[6], and transoral route[7], have since been reported. In Japan, the VANS method, which employs an approach through a small incision under the clavicle, is the most widely used. This method is easier to master than other methods because the incision is closer to the neck, making it similar to conventional thyroid surgery. Additionally, the surgical site can be palpated and assisted directly by extending a finger from the incision. However, the frequency of postoperative bleeding with the VANS method has not yet been reported.

In this study, we aimed to elucidate the risk factors for postoperative bleeding in all thyroid surgeries and to clarify differences in the frequency and situations of postoperative bleeding between conventional and endoscopic surgeries. We utilized data from our institution, in which

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both types of surgery are routinely performed, to achieve this objective.

Materials and Methods

Patients

This retrospective case-control study involved patients who underwent thyroid surgery at Nippon Medical School Hospital between January 2011 and December 2023. Information was collected from the electronic medical record system. Those who experienced postoperative bleeding were included in the study. Patients with postoperative bleeding were defined as those requiring open wound exploration and hemostasis in the operating room, excluding those managed conservatively. Patients with thyroid disease who underwent only neck dissection or biopsy were also excluded.

The endoscopic surgery performed at our hospital uses the VANS method. A 4-cm skin incision is made under the clavicle, and the pectoralis major and pectoralis minor muscles are dissected to create a skin flap. A 5-mm camera port is then inserted on the lateral side of the neck. The anterior musculature and sternocleidomastoid muscle are dissected to access the thyroid gland. Indications for this procedure include thyroid cancers less than 2 cm in diameter without lymph node metastasis, benign nodules less than 6 cm in diameter, and Graves' disease with a thyroid gland weighing less than 60 g.

Patients were admitted to the hospital 1 or 2 days prior to surgery for both conventional and endoscopic procedures and were typically discharged approximately 4 days after surgery. Following surgery, patients were monitored by a nurse every hour for the first 4 hours.

This retrospective study was performed in accordance with the ethical guidelines of the Helsinki Declaration, and we obtained informed consent from all patients and approval for this study from the Ethics Committee of Nippon Medical School (approval no. B-2023-845). All data were analyzed anonymously.

Parameters Analyzed

The parameters analyzed in the study encompassed various risk factors for postoperative bleeding, including age, sex, and comorbidities such as diabetes, hypertension, antithrombotic therapy, and dialysis. In addition, the study examined the preoperative diagnosis (benign nodule, thyroid cancer, or Graves' disease), need for reoperation, different surgical techniques (lobectomy, total thyroidectomy, lobectomy by VANS method, or total thyroidectomy by VANS method), and extent of lymph node dissection (none, central compartment, unilateral lateral neck dissection, or bilateral lateral neck dissection).

In addition, the site and duration of bleeding were also assessed. Sites of bleeding were categorized into four groups: perithyroidal, involving the superior thyroid artery, inferior thyroid artery, and the region near the Berry ligament during thyroidectomy; skin flap, including the anterior neck muscle, pectoralis major muscle, and anterior jugular vein manipulated while raising the skin flap; lateral neck dissection, encompassing the internal jugular vein and sternocleidomastoid muscle manipulated during neck dissection; and unknown, where the bleeding points were unclear. Bleeding duration was defined as the time from completion of surgery to the diagnosis of postoperative bleeding.

Statistical Analyses

Statistical analyses were conducted using the Mann-Whitney U test, χ^2 test, or Fisher's exact test for the aforementioned risk factors to compare the bleeding and nonbleeding groups, respectively. Logistic regression analysis was employed for multivariate analysis of risk factors for bleeding. Site and duration of bleeding were compared between conventional and endoscopic methods in the bleeding group using the Mann-Whitney U test, χ^2 test, or Fisher's exact test, respectively. In all cases, values of $p < 0.05$ were considered significant. All statistical analyses were performed using EZR15, a modified version of R Commander specifically designed to include statistical functions commonly used in biostatistics[8].

Results

Risk Factors for Postoperative Bleeding

Among the 3,130 patients (616 men, 2,514 women) who underwent thyroid surgery, 57 (1.85%) experienced postoperative bleeding. Bleeding risk factors are detailed in **Table 1**. The 57 patients with bleeding comprised 17 men (2.8%) and 40 women (1.6%). While a tendency was seen toward a greater frequency of bleeding in men, the difference was not significant. A preoperative diagnosis of Graves' disease tended to show a higher incidence of postoperative bleeding (3.0%), but this difference was not significant (p=0.235). No significant differences were observed in age, extent of neck dissection, reoperation, preoperative diagnosis, or presence of diabetes. However, the risk of bleeding was significantly associated with the use of anticoagulants (p=0.005) and dialysis (p=0.0008).

Multivariate analysis included age, sex, preoperative diagnosis, dialysis, and anticoagulants. Antithrombotic therapy (odds ratio [OR] 2.95, p=0.025) and dialysis (OR 6.53, p=0.005) were identified as significant risk factors

Table 1 Association between clinical characteristics and postoperative bleeding

Characteristics	Study cases	Controls	p-value
Age, years	37.7±11.5	51.8±16.4	0.763
Sex			0.052
Female	40 (1.6)	2,474 (98.4)	
Male	17 (2.8)	599 (97.2)	
Comorbidities			
Hypertension	9 (1.7)	509 (98.3)	1.000
Diabetes	1 (1.1)	93 (98.9)	1.000
Antithrombotic therapy	6 (6.1)	93 (93.9)	0.008
Dialysis	3 (15.8)	16 (84.2)	0.005
Indication for surgery			0.235
Benign tumor	21 (1.8)	1,155 (98.2)	
Thyroid cancer	26 (1.6)	1,591 (98.4)	
Graves' disease	10 (3.0)	327 (97.0)	
Surgical procedure			0.784
Lobectomy	23 (1.7)	1,325 (98.3)	
Total thyroidectomy	20 (2.2)	893 (97.8)	
Lobectomy by VANS	13 (1.6)	793 (98.4)	
Total thyroidectomy by VANS	1 (1.6)	62 (98.4)	
Reoperation	1 (1.4)	73 (98.6)	1.000
Lymph node dissection			0.884
No	34 (2.0)	1,690 (98.0)	
Central neck dissection	17 (1.8)	945 (98.2)	
Unilateral lateral neck dissection	5 (1.3)	375 (98.7)	
Bilateral neck dissection	1 (1.6)	63 (98.4)	

VANS: video-assisted neck surgery

Table 2 Multivariable logistic regression analysis of risk factors for postoperative bleeding after thyroidectomy

Risk factors	OR	95%CI	p-value
Age, years	0.998	0.98-1.01	0.780
Sex			
Female	1.00	(reference)	
Male	1.58	0.866-2.89	0.135
Antithrombotic therapy	2.95	1.15-7.59	0.025
Dialysis	6.53	1.75-24.2	0.005
Indication for surgery			
Benign nodule	1.00	(reference)	
Thyroid cancer	0.873	0.485-1.57	0.652
Graves' disease	1.65	0.755-3.61	0.209

OR: odds ratio, CI: confidence interval

(**Table 2**).

Timing of Postoperative Bleeding and Patient Symptoms

The median time to bleeding in the overall case population was 245 min (range 10-5,073 min). Fourteen patients (24.6%) experienced bleeding before leaving the operating room, with bleeding occurring within 6 h in 32 patients (56.1%) and after 24 h in only 4 patients (7%). All cases of postoperative bleeding occurred during hospitalization (**Fig. 1**). All patients exhibited cervical swelling as a symptom of postoperative bleeding, with 13 patients experiencing respiratory distress and one suffering cardiac arrest. No fatalities were encountered. Among the 57 patients who underwent reoperation for postoperative bleeding, 3 experienced rebleeding. Bleeding sites were distributed as follows: perithyroidal in 24 patients (42.1%), skin flap in 25 patients (43.9%), neck dissection in 2 patients (3.5%), and unknown in 6 patients (10.5%).

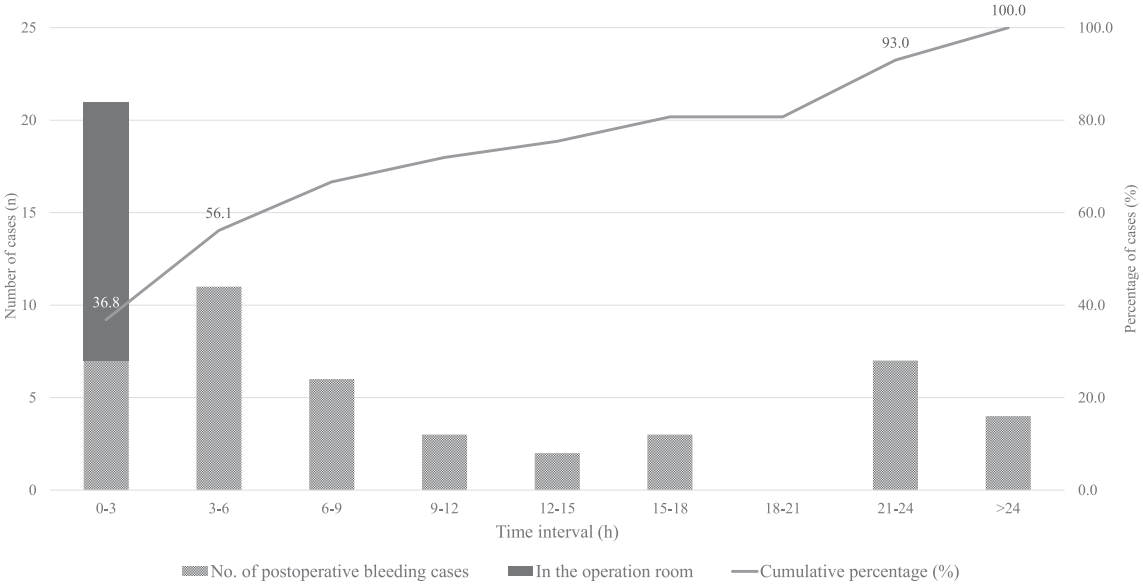

Fig. 1 Time course for the 57 patients requiring reoperation for postoperative bleeding

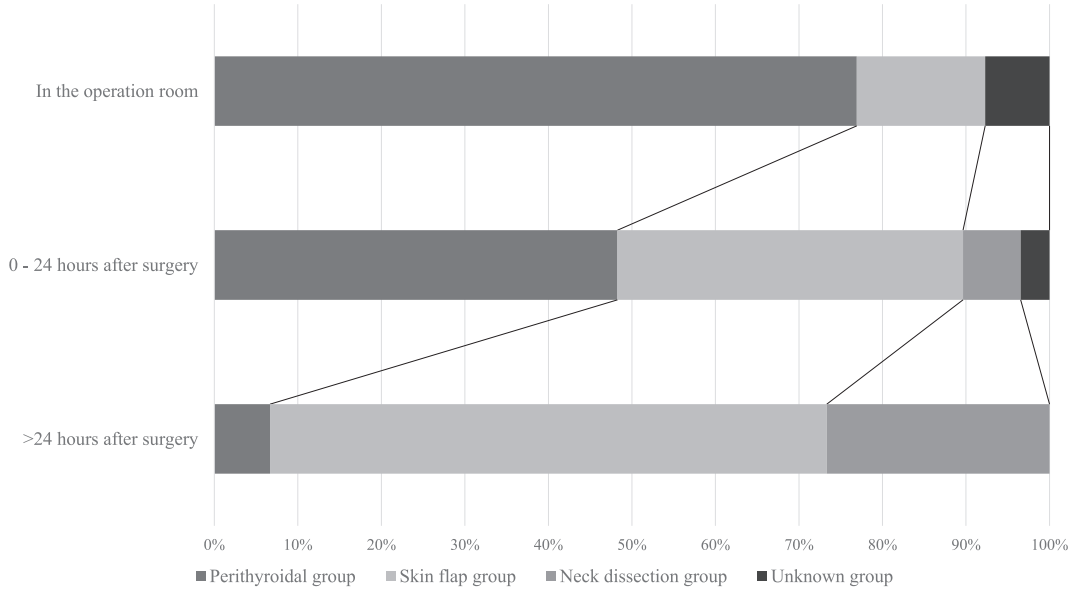

Fig. 2 Immediately after surgery, perithyroidal bleeding predominates, but by 24 h postoperatively, skin flap bleeding becomes more common.

Figure 2 shows a comparison of bleeding sites by bleeding time. Immediately after extubation, perithyroidal bleeding was the most prevalent (76.9%), whereas skin flap became more common after 24 h (62.5%).

Conventional Surgery and VANS Method

The background characteristics of patients undergoing conventional and endoscopic procedures are presented in **Table 3**. The mean age of patients undergoing conventional surgery was 51.8 years, compared to 37.7 years for endoscopic surgery, indicating a younger patient population undergoing endoscopic surgery. When comparing sexes, 1,664 women (73.6%) underwent conventional surgery and 850 (98.8%) underwent endoscopic surgery. The proportion of women undergoing endoscopic surgery was higher than that of women undergoing conventional surgery. In terms of diagnosis, 646 patients in the conventional group (28.6%) had benign nodules, 1,323 (58.5%) had thyroid cancers, and 292 (12.9%) had Graves' disease, whereas 530 patients in the endoscopic group (61.0%) had benign nodules, 294 (33.8%) had thyroid cancers, and 45 (5.2%) had Graves' disease. With endoscopic surgery, benign nodules accounted for the highest proportion ($p<0.001$).

Regarding cases of postoperative bleeding according to

Table 3 Characteristics of patients undergoing conventional and endoscopic surgeries

	Conventional surgery	Endoscopic surgery	p-value
Age	51.8	37.7	<0.001
Sex			
Female	1,664 (73.6)	850 (97.8)	<0.001
Male	597 (26.4)	19 (2.2)	
Diagnosis			
Benign nodule	646 (28.6)	530 (61.0)	<0.001
Thyroid tumor	1,323 (58.5)	294 (33.8)	
Graves' disease	292 (12.9)	45 (5.2)	

Table 4 Comparisons of bleeding time and bleeding site between conventional and endoscopic surgeries

	Conventional surgery (n=43)	Endoscopic surgery (n=13)	Total (n=57)	p-value
Time bleeding was identified (min)	641.2 (range 10-5,073)	461.2 (range 22-1,404)		0.350
Bleeding point				<0.001
Perithyroid, n (%)	24 (55.8)	1 (7.1)	25 (43.9)	
Skin flap, n (%)	11 (25.6)	13 (92.9)	24 (42.1)	
Neck dissection, n (%)	2 (4.7)	0 (0.0)	2 (3.5)	
Unknown, n (%)	6 (14.0)	0 (0.0)	6 (10.5)	

surgical technique, there were 23 patients (1.7%) who had undergone lobectomy, 20 (2.2%) who had undergone total resection, 13 (1.6%) who had undergone lobectomy by the VANS method, and 1 (1.6%) who had undergone total thyroidectomy by the VANS method. Thus, surgical techniques caused no significant differences in bleeding rates (p=0.784) (**Table 1**).

Table 4 provides a comparison between conventional and endoscopic procedures. Median bleeding time was 233 min for conventional surgery and 322 min for endoscopic surgery, showing no significant difference (p=0.35). Further, regarding the site of bleeding, perithyroidal bleeding was the most common after the conventional method, occurring in 24 cases (55.8%), followed by skin flap bleeding, which occurred in 11 cases (25.6%). With endoscopic surgery, perithyroidal bleeding occurred in 13 patients (92.9%), making it by far the most common site and indicating a significant difference between sites of bleeding according to surgical techniques (p<0.001).

Discussion

Risk Factors for Postoperative Bleeding

Postoperative bleeding is a very rare complication, with a reported frequency of 0.3-6.5%[9–14]. The frequency of postoperative bleeding in our hospital was 1.85%. However, preventing postoperative bleeding is challenging. Many studies have attempted to predict risk factors for postoperative bleeding, and reported risk factors include male sex[15–18], advanced age[15–17], surgical procedure[16–18], diagnosis[19], reoperation[20], and use of anticoagulant medications[19]. In a meta-analysis by Liu et al.[20], age, sex, presence of Graves' disease, use of antithrombotic agents, bilateral surgery, neck dissection, and prior thyroid surgery were identified as significant risk factors for postoperative bleeding. In our study, antithrombotic therapy and dialysis were identified as clear risk factors, leading to notably higher bleeding rates than normal, with ORs of 2.95 (1.15-7.59; p=0.025) and 6.53 (1.75-24.2; p=0.005), respectively. Patients receiving antithrombotic therapy or undergoing dialysis require particularly careful monitoring due to tissue fragility and a tendency for difficulties in blood pressure control. We encountered one case of cardiac arrest in a patient undergoing both antithrombotic therapy and dialysis. The heightened risk of postoperative bleeding, combined with the distance between the patient's bed and the nurses' station, as well as a lack of team experience with the management of thyroid surgery patients, may have contributed to the delayed response. Based on this experience, we aim to manage patients at high risk of bleeding in the Surgical Intensive Care Unit or relocate them to a room closer to the nurses' station the day following surgery, with frequent monitoring rounds.

Men and patients with Graves' disease also exhibited

Table 5 The three patients with two postoperative bleeding events

Case	Age, years	Sex	Diagnosis	Surgical procedure	First bleeding point	Second bleeding point
1	24	F	Thyroid cancer	Lobectomy by VANS	Unknown	Skin flap
2	64	M	Benign nodule	Lobectomy	Unknown	Skin flap
3	43	M	Thyroid cancer	Lobectomy	Perithyroidal	Unknown

VANS: video-assisted neck surgery

higher bleeding rates of 2.8% (p=0.052) and 3.0% (p= 0.235), respectively, although these differences were not significant in our study.

Comparison of Conventional and VANS Methods

Patients undergoing surgery using the VANS method tended to be younger than those undergoing the conventional procedure. This demographic difference may stem from a preference for using the VANS method in younger patients due to the superior cosmetic outcomes. In addition, while malignant cases predominated in the conventional method, benign cases were more prevalent in the VANS method. This could be attributed to the fact that the VANS method does not require extra-glandular invasion or lateral lymph node metastasis in malignant cases, which limits the indications.

No significant difference in bleeding frequency was evident between conventional and endoscopic techniques (p=0.784). However, a distinct variation in the distribution of bleeding sites was noted between conventional and endoscopic surgeries. With the conventional method, bleeding was most commonly perithyroidal, with skin flaps being the second most common site. Conversely, with the endoscopic method, skin flaps were the predominant site of bleeding, accounting for 13 cases (92.9%). This disparity may be attributable to the larger area available for skin flap creation in endoscopic procedures. The pectoralis major perforating branch is rich in blood flow and particularly susceptible to bleeding. Efforts are therefore made to preserve the fascia of the pectoralis major muscle while raising the skin flap, as deep fascial penetration can lead to blood vessel involvement in the muscle layer.

The reason why endoscopic surgery leads to fewer cases of bleeding in the perithyroidal region than conventional surgery is unclear. However, it could be due to the fact that endoscopic surgery is indicated only for patients with limited tumor size and a lack of complications. Due to the frequent bleeding from the skin flap, we perform clavicular gauze compression postoperatively when observing large vessels while raising a skin flap or encountering bleeding from the pectoralis major muscle intraoperatively.

Postoperative Bleeding

Diagnoses of bleeding have been reported to be made within 6 hours in 43-80% of cases and within 24 hours in 80-97% of cases[21,22]. In our study, the timing of bleeding diagnosis was within 6 hours after surgery in 56.1% of cases and within 24 hours in 93.0%. No patients showed postoperative bleeding after discharge from the hospital, and the longest interval before bleeding was 4 days after surgery. However, this could be attributed to the longer duration of hospitalization seen in Japan compared to other countries. The most common site of bleeding was in the perithyroid area immediately after surgery, with bleeding increasingly arising around the skin flap as time progressed. Insufficient hemostasis and bleeding immediately after surgery may be caused by increased airway pressure during extubation or a sudden rise in blood pressure. Over time, the percentage of cases of bleeding from skin flaps increased, which may have been due to increased postoperative body movements and fluctuations in blood pressure.

Three patients experienced rebleeding after postoperative bleeding (**Table 5**). In two of these cases, wounds reopened in the operating room, but no obvious bleeding points were found. In one, we encountered an extremely rare event: following surgery for postoperative bleeding, the patient presented again with cervical swelling. Although the patient responded well to conservative treatment, the prolonged course of bleeding and absence of the blood clots typically seen at the time of drain removal led to suspicion of congenital coagulopathy. Subsequent examination led to a diagnosis of hemophilia A[23]. This case underscores the importance of closely monitoring the course of postoperative bleeding. Based on this case, routine Factor VIII measurement cannot be recommended from a risk-benefit (cost-balance) perspective. However, a more detailed investigation of bleeding episodes is called for. In this case, a postoperative interview revealed that the patient had been informed that it had been difficult to stop bleeding during surgery for a fracture 20 years previously, and that he frequently experi-

enced nosebleeds.

Limitations

This study was retrospective in nature, potentially introducing biases in data collection. In addition, due to the limitations in case selection for endoscopic surgery, comparing conventional and endoscopic procedures under identical conditions was not possible.

Conclusion

We investigated the risk of postoperative bleeding in thyroid surgery and compared conventional and endoscopic procedures using data from our institution. Given the higher risk of postoperative bleeding associated with antithrombotic therapy and dialysis, careful postoperative observation is necessary. In addition, while bleeding sites tended to differ according to whether conventional or endoscopic surgery was used, bleeding rates were comparable.

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Conflict of Interest: The authors declare no conflicts of interest.

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