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MINI REVIEW

The patterns and treatment of postoperative hemorrhage and hematoma in total endoscopic thyroidectomy via breast approach: experience of 1932 cases

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Abstract

Purpose Postoperative hemorrhage and hematoma formation is a potentially lethal complication in thyroid surgery, although the patterns and treatment of hemorrhage after total endoscopic thyroidectomy (TET) via breast approach has not been reported previously. We aim to share our experience about postoperative bleeding.

Methods A retrospective analysis of 1932 patients who underwent TET from April 2008 to May 2018 in our institution was carried out. The patterns of postoperative hemorrhage and hematoma formation that need surgical treatment were summarized and focused on the relation to the source of bleeding and the time interval between first surgery and hemorrhage. Related risk factors were analyzed by univariate or multivariate analysis processes.

Results The overall rate of hemorrhage and hematoma occurrence was only 0.724% (14 in 1932 patients). Of them, 12 occurred in the first 24 h after surgery, and the other two occurred after withdrawal of the drainage tube. The principle independent risk factors for postoperative hemorrhage and hematoma were age (older than 35 years old) and lateral compartment dissection (LCD) revealed by multivariate regression. During re-exploration, obvious bleeding points were detected in 13 patients. Among them, 12 bled from the vessels in the main trocar cavity and another 1 bled from a broken vein located between the two heads of the sternocleidomastoid (SCM) muscle with LCD.

Conclusions Hemorrhage after TET usually occurs within 24 h, and the main video trocar cavity was the area most likely to bleed. Age and LCD may increase the bleeding risk. Appropriate dissection level is the main solution to prevent postoperative hemorrhage.

Keywords Postoperative hemorrhage · TET · Risk factor · Management

Introduction

Most Chinese young women tend to generate hypertrophic scarring, which is extremely conspicuous in the neck after open thyroid surgery (OTS). Hence, endoscopic surgery is warmly welcomed in thyroid disease because of its obvious cosmetic result especially for total endoscopic thyroidectomy (TET) and its perfectly concealed scars [1–3]. In our center we have performed more than 2000 cases of TET since 2006. The recent indication of TET has been expanded from benign thyroid diseases to malignant nodule and hyperthyroidism with or without special lymph node metastasis [4, 5, 6-8]. The development of new energy equipment such as bipolar scalpels, ultrasonic shears, and energy platforms 6–8 makes thyroid surgery, especially for TET, much safer. However, airway obstruction arising from postoperative hemorrhage and hematoma formation still remains a potential life-threatening complication [9]. Even for well-trained endocrine thyroid surgeons, airway obstruction ranks as the first cause of overnight patient complication incident during the postoperative period. Because of the unique expanded working space and different operation procedure, the hemostasis is more difficult in TET compared with OTS. Meanwhile, postoperative hemorrhage presented in TET shows different

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characteristics the extensive surgical flap is separate in the prethoracic area. Until now, the patterns and treatment of hemorrhage and hematoma formation after TET have not been reported. Improvement of hemorrhage prognosis, prevention, and dispose may be achieved by sharing the surgery experience while staying focused on the treatment procedure.

In this study we reviewed our experience on the diagnosis, prevention, and treatment of postoperative hemorrhage and hematoma formation based on 1932 cases (thyroidectomy with or without neck dissection) after TET performed in our institution. The clinical correlation factors including time interval, the sources of bleeding, and potential risk factors were analyzed. Finally, some useful skills in preventing hemorrhage were discussed.

Materials and Methods

Patients and study design

We performed a consecutive case series review of patients who underwent TET via breast approach at the Second Affiliated Hospital of Zhejiang University from April 2008 to May 2018. All surgeries were carried out by three thyroid surgery specialists in the Department of Thyroid Surgery. A total of 1932 consecutive patients were included in this study. The data presented was collected retrospectively. The review was approved by the Ethics Committee of the Second Affiliated Hospital of Zhejiang University.

The inclusion criteria and patient selection for TET were as follows: (1) Female, younger than 50 years old who has the cosmetic requirement or male patient who cared about the scar in the neck. (2) The nodule was smaller than 2 cm in diameter if malignancy was suspected or smaller than 6 cm if the lesion was believed to be benign. (3) The whole weight of the thyroid estimated by presurgical ultrasound was less than 60 g. (4) No fixed, fused, or cystic lymph node suspected as metastasis was found in the neck by ultrasound or CT scan. (5) No distant metastasis was discovered before surgery. The resection scope of surgery was determined by the lesion location and distribution. Briefly, the benign nodule called for thyroid lobectomy, near total lobectomy, or partial lobectomy on the lesion side. For malignant tumors if the lesions were concentrated in one lobe, thyroid lobectomy with ipsilateral central compartment dissection (CCD) was performed. If the lesions were distributed to two lobes, total thyroidectomy and CCD for both sides was performed. For Grave's disease, total or near total thyroidectomy was carried out. For some cases, lateral compartment dissection (LCD) was performed endoscopically if needed.

Surgery procedure

All TET procedures were similar throughout the study period. Most procedures were carried out through breast approach, whereas others were carried out through the breast areola approach. In summary, a 12-mm incision was made for observing via video camera parasternally at the nipple level (breast approach) or at the inner side of the right mammary areola (whole areola approach) and two more 5-mm to 6-mm incisions were made at the upper margin of bilateral mammary areolas for working instruments. The working space was built widely to the hyoid bone, laterally to the medial edge of the sternocleidomastoid (SCM) muscles in the normal side, and to the lateral edge of the SCM muscles on the lesion side. The method of thyroidectomy, CCD, and LCD was described previously [10–12]. In the whole procedure, usually a unipolar electrocoagulation and a harmonic scalpel (Johnson and Johnson) were used.

Perioperative treatment and data collection

Preoperation evaluation and treatment taken out as OTS. Comorbidities, such as hypertension and diabetes, were required to be well controlled. All other vital organ functions were evaluated as regular. Only postoperative hemorrhage or hematoma required re-exploration and were defined as positive events in this study (bleeding group). All the relevant data were searched and collected from our hospital patient information system. The basic clinical characteristics of the bleeding group and the control group were analyzed. Possible risk factors such as the distribution of postoperative bleeding sources and times, as well as the interval between the first surgery and the re-exploration, were discussed.

Statistical analysis

Means ± standard deviation (SD) were used to express the variables. Statistical analysis performed by IBM-SPSS 19.0 statistical analysis software (SPSS Inc., Chicago, IL). The significance of categorical variables evaluated with the chi-square analysis. Univariate and multivariate analyses were carried out. Variables that were suspected as risk factors of postoperative bleeding and were significant in the univariate analysis were entered into a multivariate analysis. Statistical significance was indicated as positive by p values < 0.05.

Results

Our department has performed TET since June 2006, and we have finished more than 400 cases before April 2008. In

Table 1 comparison of patient characteristics between the bleeding group and the control group

Patient characteristics	Bleeding group ($N = 14$)	Control group ($N = 1918$)	*P*-value
Sex			
Female	13	1822	--
Male	1	96	
Age (years)	39.29 ± 7.83	33.89 ± 8.74	
<35	2	1043	<0.01
≥35	12	875	
Primary tumor			
Benign	8	630	0.10
Malignant	6	1288	
With hyperthyroidism			
No	14	1851	-
Yes	0	67	
With HT			
No	12	1663	0.75
Yes	2	255	
With LND			
No	12	1893	<0.01
Yes	2	25	
Hypertension			
No	13	1778	0.63
Yes	1	140	

HT Hashimoto Thyroiditis, *LND* lateral neck dissection

the whole study period from April 2008 to May 2018, we recorded a total of 1932 cases of TET (average age 33.92 ± 8.72 years) and recorded every TET surgery by video for further study and research. Among these patients, 1835 were women and 97 were men. Of these, 14 patients (0.724%) developed postoperative bleeding or hematoma and needed further reoperation. In the bleeding group, 13 patients were women and 12 were over 35 years old; the average age was 39.29 ± 7.83 years.

The basic clinical characteristics of the bleeding group and the control group (including sex, age, primary tumor pathology with or without hyperthyroidism, LCD, and hypertension) were summarized and analyzed in Table 1. We found age (>35 years) and surgery with lateral neck dissection (LND) were considered to be risk factors for postoperative bleeding and hematoma whereas sex, primary tumor diameter, and Hashimoto's thyroiditis show no significant influence on postoperative bleeding (Table 2).

We analyzed the time interval between the initial surgery and the reoperation. As shown in Table 3, most re-exploration (12 in 14, 85.71%) happened within 24 h. All 12 patients had symptoms within 24 h. Among them, 7 patients presented with swelling around the neck or the anterior chest wall, and one presented with chest wall pain.

Table 2 multivariate analysis of all factors associated with postoperative bleeding and hematoma after TET

Covariates	OR	95% confidence interval	*P* value
Sex	0.184	0.019–1.769	0.143
Age	1.097	1.007–1.195	0.035
Primary tumor			
Diameter	2.26	0.436–11.723	0.332
With HT	0.738	0.083–6.603	0.786
With LND	0.024	0.002–0.278	0.003

Another 2 patients formed hematoma immediately after extraction of the drainage tube over 24 h (see Table 3). All patients recovered well after reoperation, and the average hospitalization days were 8.12 ± 1.78 days. The average length of stay in the hospital was 6.62 ± 1.89 days for the control group.

During re-exploration, 13 of the 14 (92.85%) bleeding patients exhibited many clots along the main trocar cavity. Two patients were found bleeding from a ruptured vein located between the sterno-head and the cleido-head of the SCM muscle in the operation area with LCD.

As presented previously, the most possible bleeding sources were the main trocar cavity and the operation space in the anterior chest wall. To prevent and early diagnose hemorrhage in the cavity room, we designed a visual separation bar and trocar that is now commercially available (Fig. 1). Distinct from the traditional metal separation bar, the newly designed bar has a special see-through head accompanied with a trocar (see Fig. 1a, b) and could be used for real-time observation during blunt separation In our experience an exposed fascia that is white means the correct level (Fig. 2a), a yellow surface (see Fig. 2b) usually means oversuperficial, and red or obvious muscle usually means deep layer (see Fig. 2c, d). Under the help of a visual bar, the separation level can be adjusted at any time during dissection. The visual trocar was used for observation and for detecting bleeding sites when extracting the trocar at the end of the surgery. Figure 2e presents a picture of a scraping from a bleeding patient during TET (see Fig. 2e). It shows a separated artery in the main trocar area, which was missed in ligation the first time and was proved to be the bleeding source during the re-exploration (see Fig. 2f).

Discussion

Thyroid disease, even most of malignant thyroid lesions, usually had a good prognosis after successful surgical management with high security. As expected, thyroid surgeries usually have low morbidity, but postoperative hemorrhage and hematoma formation still remain the most

Table 3 Characteristics of bleeding, the sources, first sign and times of bleeding and the interval between the finish of first surgery and reoperation

Patient	Age	gender	First surgery	Pathology	Diagnosis of bleeding			Time of reoperation (hour)[a]	Sources of bleeding
					Clinical symptom	Time (hour)[a]	Possible causes		
1	36	Female	RT + ipsilateral CCD and LND	PTC	Mass in the chest	5	Not found	6	Vein between two heads of the right sternocleidomastoid muscle
2	24	Male	LT + ipsilateral CCD	PTC	Swelling in the neck and anterior chest wall	46	Extration of Drainage tube	47	An artery in the anterior chest wall on the tube way
3	48	Female	RT	Benign	Hematoma on the anterior chest wall	8	Not found	9	Surface on the -Pectoralis Major muscle in the main trocar cavity
4	40	Female	RT + ipsilateral CCD	PTC	Swelling in the neck and bleeding from the outlet of the tube	96	Extration of Drainage tube	96.5	An artery in the anterior chest wall on the tube way
5	43	Female	RT	Benign	Swelling in the neck and anterior chest wall	5	Vomitting	8	An artery in the anterior chest wall on the in the main trocar cavity
6	39	Female	Near total thyroidectomy	Benign	More than 130 ml blood in the drainage tube	5	Vomitting	14	Hematoma in the main trocar cavity, not bleeding source was detected
7	45	Female	Near total thyroidectomy	Benign	Pain on the anterior chest wall, and hematoma formed 6 h later	10	Not found	19	Hematoma on the anterior chest wall, bleeding spot not been detected
8	37	Female	Near total RT	Benign	Swelling in the neck and anterior chest wall	3	Vomitting	6	An artery in the anterior chest wall on the in the main trocar cavity
9	26	Female	LT	Benign	Hematoma on the anterior chest wall	6	Not found	8	An artery in the anterior chest wall on the in the main trocar cavity
10	47	Female	RT + ipsilateral CCD and LND	PTC	Swelling in the neck and anterior chest wall	7	Vomitting	10	An artery in the anterior chest wall on the in the main trocar cavity
11	37	Female	RT + ipsilateral CCD	PTC	Hematoma on the anterior chest wall	12	Incomplete bleeding stop	13	Hematoma in the main trocar cavity
12	37	Female	RT	Benign	Swelling in the neck and anterior chest wall	9	Vomitting	12	An artery in the anterior chest wall on the in the main trocar cavity
13	46	Female	LT + ipsilateral CCD	PTC	Swelling in the neck and anterior chest wall	15	Vomitting	16	Interval between two heads of the left sternocleidomastoid muscle
14	45	Female	Near total thyroidectomy	Benign	hematoma formed	2	Not found	2	An artery in the anterior chest wall

RT right lobectomy, *LT* left lobectomy, *LND* lateral neck dissection, *CCD* central compartment dissection, *PTC* papillary thyroid cancer

[a]The time here means the interval between the finish of first surgery and this event

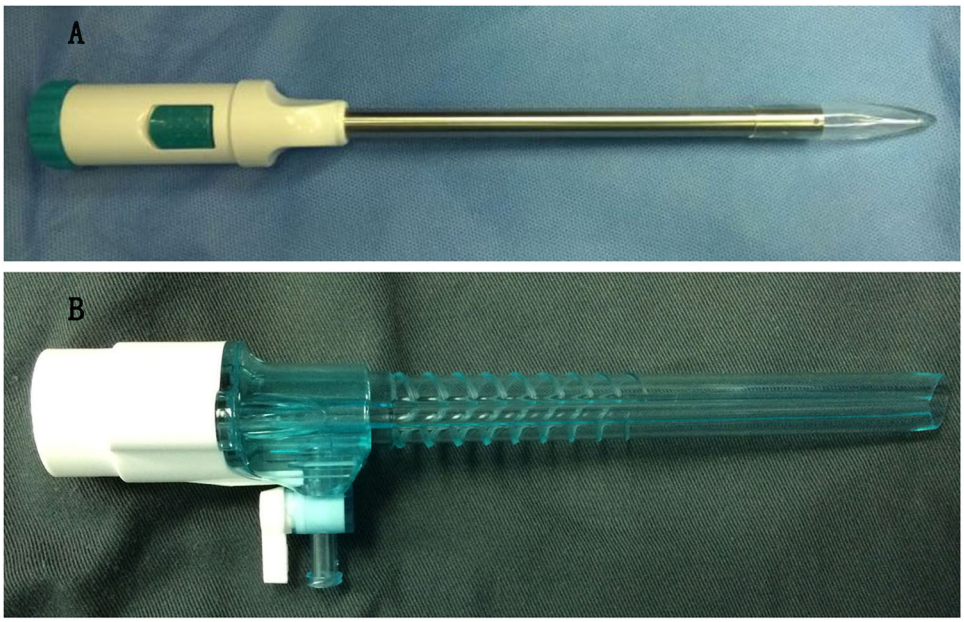

Fig. 1 Our designed seperation bar and trocar. **a**: the bar has a special see-through head which is designed as flat cone for seperation. **b**: the see-through trocar is made by plastic and has a small hole at the boundary for a small tube which was used to suture smoke during surgery

serious complication of thyroid surgery and sometimes threatens patients' lives both in OTS and TET [13–15]. However, several previous studies have only discussed the risk factors of bleeding in OTS [9, 16, 17]. The unique patterns and experience on the prevention and treatment of postoperative bleeding of TET have never been reported. The use of TET has been warmly welcomed in Asian countries [11, 12]. In recent years in our department, more than one fourth of patients with a thyroid nodule asked for TET. It is very important to summarize the postoperative bleeding treatment for TET systemically.

For OTS, reported postoperative hemorrhage and hematoma formation ratio ranged from 0.3 to 4.2% in the literature [9, 15, 18, 19]. The ratio varied greatly because of the complicated risk factors and different ethnicities. For Chinese people, a recent article reported a bleeding ratio as 0.853% based on 5156 cases study [9]. In our department we showed that the bleeding rate was 0.724% (14 in 1932 cases) of TET, which is similar to OTS. For TET surgery, extra procedure includes the thoracic flap separation. Relative experience was included in our previous articles to prevent anterior thoracic bleeding. Also, in TET surgeries, most of the procedures were finished by a single surgeon. Usually the operator used one hand to tract the thyroid and another hand to perform the operation. So the need for extrusion and operation on the surrounding tissue and muscle was significantly reduced. Besides, in TET, the traction strength was much less and the surgery procedure was more time-consuming and elaborated. We thought the factors listed previously may explain the trend of low postoperative bleeding rate of TET, especially in the thyroid and surrounding area. In this study, the bleeding was located in this area in only one case.

On the other hand, TET surgeries require a larger dissected area on the anterior chest wall, where the dissection was usually done by blunt force or scalpels and, as a result, raise the risk of bleeding. It is also confirmed by this report that 12 cases in 14 were bleeding from the vessels on the anterior chest wall. The most effective way to reduce the postoperative bleeding is to dissect in the correct anatomical level, namely in the anatomy level of the superficial fascia. Our designed visual separation bar could be used effectively to judge and adjust the separation level. In previous reports [18, 20–22], male sex, older age, benign and larger nodule, wider surgery area, previous thyroid surgery, and other comorbidities such as Graves disease and use of anticoagulant or antiplatelet medications were considered to be major risk factors of postoperative hemorrhage and hematoma of OTS. We are the first to discuss this issue regarding TET. From our study, once can conclude that age and surgery with LCD were considered as individual risk factors for postoperative bleeding; the rest of the factors had no statistical difference, perhaps because (1) TET has strict indication criterion, thus most patients had similar clinical characteristics. For example, most patients subjected to TET were young women and with rare comorbidities. (2) The ratio of bleeding was very low, so extremely vast samples were needed to make the differences statistically significant.

The only two risk factors found in our study with LCD were age and surgery. Some reports found there was no difference on risk of patients' age in OTS. We considered that young patients usually had looser and clearer tissue space, which was important during building working space in TET. Also, because the average age of patients in our study was 33.92 years old, we selected age 35 as our boundary. A wider surgery area, like that required with

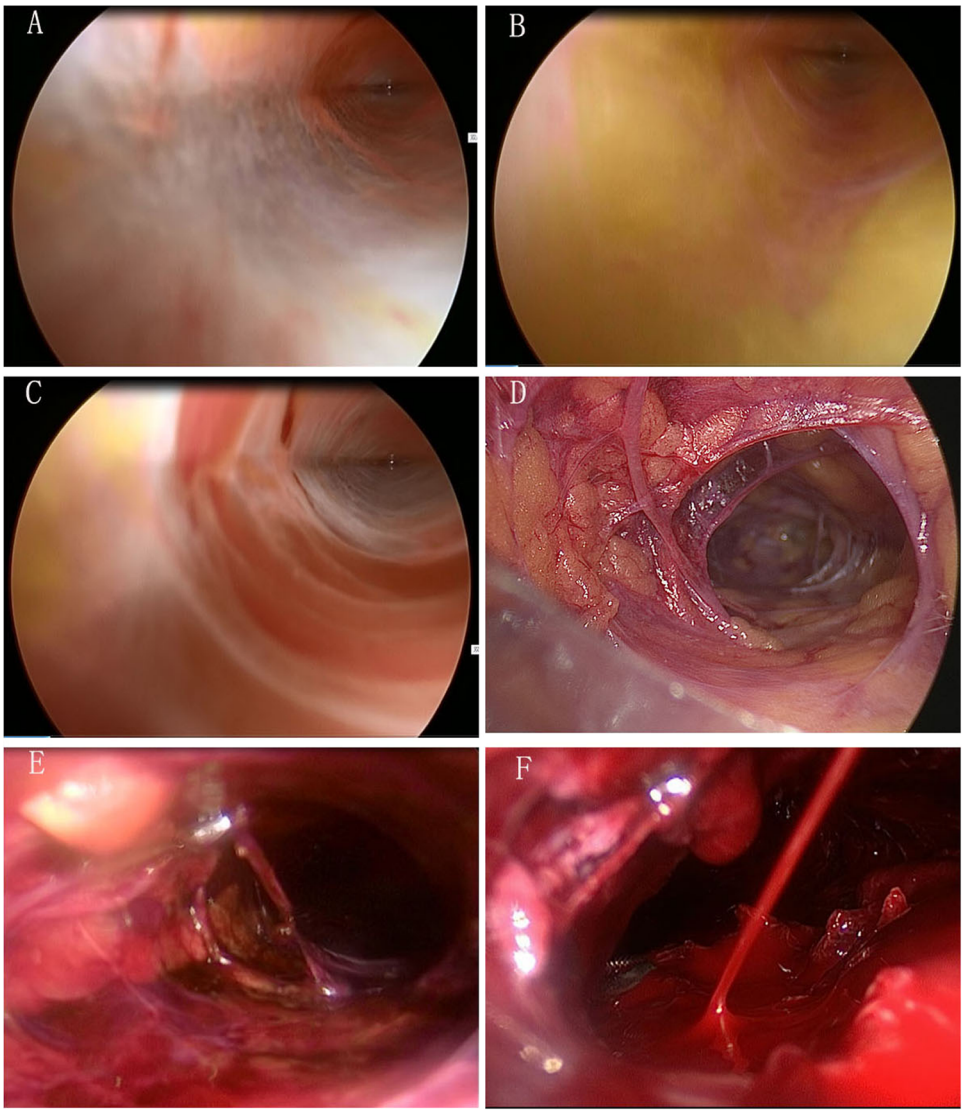

Fig. 2 Real-time observation during blunt separation and operation with our see-through bar and trocar. **a**: correct level, **b**: too superficial, **c**: too deep, **d**: too deep. **e**: A seperated artery in the main trocar area from bleeding patient 5 during TET. **f**: The same artery showed bleeding during the re-exploration

Fig. 3 The "suture compressed bandage" method using full-thickness pure interrupted suture about 1 cm around the bleeding site with a folding gauze compressed the bleeding area

LCD, results in a larger dissected area and wound surface, so it is easy to understand that it acts as risk factor of postoperative bleeding in previous OTS reports and in our study. Although some cases require LCD, we usually choose a breast/chest wall procedure, which is more convenient for visual monitoring of operation using a scope. Also, in our study, extraction of the drainage tube caused two patients to bleed. We recommend removing the drainage tube gently to avoid vessel incision.

Something more important than risk factors for reducing postoperative bleeding was strict hemostasis in TET, especially for the area in the anterior chest wall. Repeatedly inserting the trocar and operation arms may cause tissue damage of the chest area and make it easier to bleed. In our experience, the bleeding of this area usually could be stopped by ultrasonic shears. However, sometimes when the bleeding is from the subcutaneous tissue at the anterior wall of chest in the working space, it is seriously possibly to burn

the skin with continuous hemostatic operation of ultrasonic shears. We developed a "suture-compressed bandage" method using full-thickness pure interrupted suture about 1 cm around the bleeding site with a folded gauze pad compressed to the bleeding area (Fig. 3). The stitches can be removed after 48 to 72 h if no more bleeding confirmed.

An expanded dissection area on the chest wall helps reduce the risk of suffocation when bleeding because that blood could be dispersed in the chest space rather than aggregate in the neck to oppress the trachea. Taken in this sense, postoperative bleeding with TET is less dangerous than with OTS. The most common manifestation of bleeding after TET was swelling on the chest wall and in the neck. Thus careful observation was needed for early diagnosis and treatment, especially in the first 24 h after surgery.

In conclusion, postoperative hemorrhage and hematoma formation with TET most often happened within 24 h after surgery or extraction of the drainage tube. Older age and an expanded surgical area may increase the risk of postoperative bleeding. Strict hemostasis and advanced equipment for monitoring the operation area may be useful in reducing the ratio of hemorrhage. However, predicting which kind of patients are at risk for the development of bleeding after TET is generally difficult, and intense monitoring is still necessary during the first 24 h after operation.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

Informed consent Informed consent was obtained from all individual participants included in the study.

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References

1. Qu, R., Li, J., Yang, J., Sun, P., Gong, J., Wang, C., Treatment of differentiated thyroid cancer: can endoscopic thyroidectomy via a chest-breast approach achieve similar therapeutic effects as open surgery? Surg. Endosc. (2018). https://doi.org/10.1007/s00464-018-6221-1
2. W. Zhang, D.Z. Jiang, S. Liu, L.J. Li, X.M. Zheng, H.L. Shen, C. X. Shan, M. Qiu, Current status of endoscopic thyroid surgery in China. Surg. Laparosc. Endosc. Percutan. Tech. **21**(2), 67–71 (2011). https://doi.org/10.1097/SLE.0b013e318213961d
3. X.D. Chen, B. Peng, R.X. Gong, L. Wang, B. Liao, C.L. Li, Endoscopic thyroidectomy: an evidence-based research on feasibility, safety and clinical effectiveness. Chin. Med. J. **121**(20), 2088–2094 (2008)
4. J.J. Jeong, S.W. Kang, J.S. Yun, T.Y. Sung, S.C. Lee, Y.S. Lee, K.H. Nam, H.S. Chang, W.Y. Chung, C.S. Park, Comparative study of endoscopic thyroidectomy versus conventional open thyroidectomy in papillary thyroid microcarcinoma (PTMC) patients. J. Surg. Oncol. **100**(6), 477–480 (2009). https://doi.org/10.1002/jso.21367
5. Y.S. Chung, J.H. Choe, K.H. Kang, S.W. Kim, K.W. Chung, K.S. Park, W. Han, D.Y. Noh, S.K. Oh, Y.K. Youn, Endoscopic thyroidectomy for thyroid malignancies: comparison with conventional open thyroidectomy. World J. Surg. **31**(12), 2302–2306 (2007). https://doi.org/10.1007/s00268-007-9117-0.
6. Y. Pons, J. Gauthier, E. Ukkola-Pons, P. Clement, E. Roguet, J.L. Poncet, C. Conessa, Comparison of LigaSure vessel sealing system, harmonic scalpel, and conventional hemostasis in total thyroidectomy. Otolaryngol. Head Neck Surg. **141**(4), 496–501 (2009). https://doi.org/10.1016/j.otohns.2009.06.745
7. P.F. Alesina, T. Rolfs, M.K. Walz, Bipolar thermofusion vessel sealing system (TVS) versus conventional vessel ligation (CVL) in thyroid surgery--results of a prospective study. Langenbeck's Arch. Surg. **395**(2), 115–119 (2010). https://doi.org/10.1007/s00423-009-0571-z
8. J.L. Pardal-Refoyo, [Hemostatic systems in thyroid surgery and complications]. Acta Otorrinolaringol. Esp. **62**(5), 339–346 (2011). https://doi.org/10.1016/j.otorri.2011.03.004
9. J. Liu, Z. Li, S. Liu, X. Wang, Z. Xu, P. Tang, Risk factors for and occurrence of postoperative cervical hematoma after thyroid surgery: a single-institution study based on 5156 cases from the past 2 years. Head Neck **38**(2), 216–219 (2016). https://doi.org/10.1002/hed.23868
10. G. Dionigi, L. Boni, F. Rovera, A. Bacuzzi, R. Dionigi, Neuromonitoring and video-assisted thyroidectomy: a prospective, randomized case-control evaluation. Surg. Endosc. **23**(5), 996–1003 (2009). https://doi.org/10.1007/s00464-008-0098-3
11. Z.Y. Li, P. Wang, Y. Wang, S.M. Xu, L.P. Cao, R.S. Que, Endoscopic thyroidectomy via breast approach for patients with Graves' disease. World J. Surg. **34**(9), 2228–2232 (2010). https://doi.org/10.1007/s00268-010-0662-6
12. Z. Li, P. Wang, Y. Wang, S. Xu, L. Cao, R. Que, F. Zhou, Endoscopic lateral neck dissection via breast approach for papillary thyroid carcinoma: a preliminary report. Surg. Endosc. **25**(3), 890–896 (2011). https://doi.org/10.1007/s00464-010-1292-7
13. S. Schopf, T. von Ahnen, M. von Ahnen, H.M. Schardey, U. Wirth, New insights into the pathophysiology of postoperative hemorrhage in thyroid surgery: an experimental study in a porcine model. Surgery **164**(3), 518–524 (2018). https://doi.org/10.1016/j.surg.2018.05.022
14. H.S. Lee, B.J. Lee, S.W. Kim, Y.W. Cha, Y.S. Choi, Y.H. Park, K.D. Lee, Patterns of post-thyroidectomy hemorrhage. Clin. Exp. Otorhinolaryngol. **2**(2), 72–77 (2009). https://doi.org/10.3342/ceo.2009.2.2.72
15. A. Bergenfelz, S. Jansson, A. Kristoffersson, H. Martensson, E. Reihner, G. Wallin, I. Lausen, Complications to thyroid surgery: results as reported in a database from a multicenter audit comprising 3,660 patients. Langenbeck's Arch. Surg. **393**(5), 667–673 (2008). https://doi.org/10.1007/s00423-008-0366-7
16. G. Materazzi, C.E. Ambrosini, L. Fregoli, L. De Napoli, G. Frustaci, V. Matteucci, P. Papini, S. Bakkar, P. Miccoli, Prevention and management of bleeding in thyroid surgery. Gland Surg. **6**(5), 510–515 (2017). https://doi.org/10.21037/gs.2017.06.14

17. S.T. Alshahrani, R. Dolz-Marco, R. Gallego-Pinazo, M. Diaz-Llopis, J.F. Arevalo, K.I.C.R.S. Group, Intravitreal dexamethasone implant for the treatment of refractory macular edema in retinal vascular diseases: results of the KKESH International Collaborative Retina Study Group. Retina **36**(1), 131–136 (2016). https://doi.org/10.1097/IAE.0000000000000616
18. C. Godballe, A.R. Madsen, H.B. Pedersen, C.H. Sorensen, U. Pedersen, T. Frisch, J. Helweg-Larsen, L. Barfoed, P. Illum, J.E. Monsted, B. Becker, T. Nielsen, Post-thyroidectomy hemorrhage: a national study of patients treated at the Danish departments of ENThead and neck surgery. Eur. Arch. Oto-Rhino-Laryngol. Soc. **266**(12), 1945–1952 (2009). https://doi.org/10.1007/s00405-009-0949-0
19. H. Yan, Y. Wang, P. Wang, Q. Xie, Q. Zhao, "Scarless" (in the neck) endoscopic thyroidectomy (SET) with ipsilateral levels II, III, and IV dissection via breast approach for papillary thyroid carcinoma: a preliminary report. Surg. Endosc. **29**(8), 2158–2163 (2015). https://doi.org/10.1007/s00464-014-3911-1
20. M.J. Campbell, K.L. McCoy, W.T. Shen, S.E. Carty, C.C. Lubitz, J. Moalem, M. Nehs, T. Holm, D.Y. Greenblatt, D. Press, X. Feng, A.E. Siperstein, E. Mitmaker, C. Benay, R. Tabah, S.C. Oltmann, H. Chen, R.S. Sippel, A. Brekke, M.R. Vriens, L. Lodewijk, A.E. Stephen, S. Nagar, P. Angelos, M. Ghanem, J.D. Prescott, M.A. Zeiger, P. Aragon Han, C. Sturgeon, D.M. Elaraj, I.J. Nixon, S.G. Patel, S.W. Bayles, R. Heneghan, P. Ochieng, M. A. Guerrero, D.T. Ruan, A multi-institutional international study of risk factors for hematoma after thyroidectomy. Surgery **154**(6), 1283–1289 (2013). https://doi.org/10.1016/j.surg.2013.06.032.
21. S.N. Karamanakos, K.B. Markou, K. Panagopoulos, D. Karavias, C.E. Vagianos, C.D. Scopa, V. Fotopoulou, A. Liava, K. Vagenas, Complications and risk factors related to the extent of surgery in thyroidectomy. Results from 2043 procedures. Hormones. **9**(4), 318–325 (2010)
22. P.G. Calo, G. Pisano, G. Piga, F. Medas, A. Tatti, M. Donati, A. Nicolosi, Postoperative hematomas after thyroid surgery. Ann. Ital. Chir. **81**(5), 343–347 (2010)