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Lateral approach contributes to shortened surgical time in video-assisted neck surgery (VANS) for thyroid nodule

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ABSTRACT

Background: Despite endoscopic thyroid surgery contributing to excellent cosmetic outcomes, it requires longer surgical time than open surgery. This study evaluates the factors associated with operative time in video-assisted neck surgery.

Methods: We retrospectively reviewed patients who underwent hemithyroidectomy by video-assisted neck surgery at a single hospital between 2017 and 2021. The clinical parameters were evaluated: age, sex, body weight, body mass index, coexistence of Hashimoto thyroiditis, side of operation, surgical approach to thyroid (midline approach or lateral approach), operation time, amount of blood loss during surgery, maximum tumor diameter and tumor volume, and postoperative complications. These parameters were compared to investigate the association of operative time and surgical approach.

Results: Seventy consecutive patients were enrolled in this study, the median age at operation was 50 years, and there were 6 (8.6%) men and 64 (91.4%) women. The median body weight and body mass index at operation were 56.6 kg and 21.5, respectively. Coexistence of Hashimoto thyroiditis was found in 17 (24.3%) patients. Significant differences were found between the groups with longer and shorter operation time than median 201 minutes in surgical approaches to the thyroid ($P < .001$) and the amount of bleeding during surgery ($P = .039$). There were no differences in other candidates between the groups. Median operation times were 242 minutes in midline approach and 131 minutes in lateral approach ($P < .001$).

Conclusion: The lateral approach of video-assisted neck surgery to the thyroid can contribute to shortened surgical time in the case of benign thyroid nodules.

INTRODUCTION

Surgery is the gold standard treatment of thyroid nodules. Collar incision over 5 cm is required in the neck for open thyroid surgery. Since Hüscher et al reported endoscopic right thyroid lobectomy from the right clavicle using low-pressure CO_2 insufflation in 1997 [1], various approaches including axilla, breast, postauricular, and oral methods have been tried, aiming to improve/resolve cosmetic problems [2–8].

Shimizu et al developed the endoscopic thyroid surgery described as video-assisted neck surgery (VANS) with gasless method in 1998 [9]. This unique VANS procedure creates a working space for surgery by lifting the skin without gas, successfully avoiding complications such as gas embolism and activating hemodynamics. VANS also provides better cosmetic outcomes with less blood loss for patients who had thyroid surgery than other approaches [10]. The procedure is more complicated than conventional surgery, however, and as with other endoscopic thyroid surgeries, operative time is significantly longer than that required for open conventional surgeries [10–12]. In this paper, we reported our surgical outcomes of VANS for thyroid nodules and identified the clinical factors associated with operative time of VANS.

Abbreviations: VANS, video-assisted neck surgery; RLNP, recurrent laryngeal nerve palsy.

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MATERIALS AND METHODS

Study Population. Clinical and pathological data were reviewed retrospectively from the medical records of consecutive patients who underwent hemithyroidectomy by VANS at Wakayama Medical University between April 2017 and March 2021. Preoperatively, all patients with hemithyroidectomy by VANS were considered as having benign thyroid nodule according to cytology test. When preoperative diagnosis suspected malignancy by cytology test, the patients were excluded from hemithyroidectomy of VANS.

Study Design. The following clinical parameters were evaluated: age, sex, body weight, body mass index (BMI), coexistence of Hashimoto thyroiditis, side of operation, surgical approach to thyroid (Fig 1), operation time, amount of blood loss during surgery, maximum tumor diameter and tumor volume as measured in preoperative imaging (either CT or ultrasonography), and postoperative complications. Postoperative recurrent laryngeal nerve palsy (RLNP) has been diagnosed by routine video laryngoscopy in all patients. When RLNP was observed after surgery, following video laryngoscopy has been performed at 1, 3, and 6 months. Then, we defined permanent if RLNP did not recover at 6 months or loss of contact. Hashimoto thyroiditis was defined positive of anti-thyroglobulin or thyroid peroxidase (TPO) antibody in preoperative blood test. The parameters were compared to investigate clinical features of operative time and surgical methods.

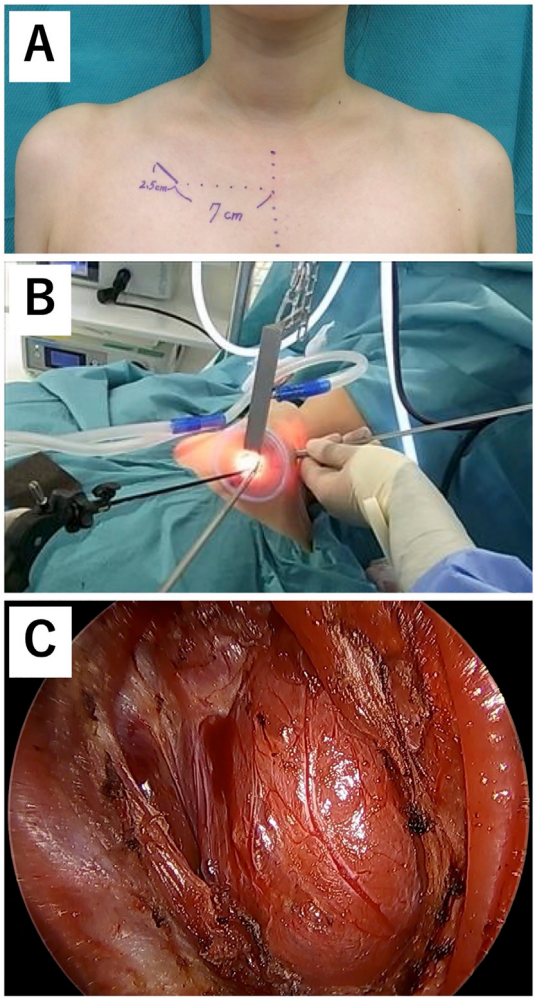

Fig 1. Operative settings. A, A small incision (approximately 25 mm) is designed on the tumor side of the chest wall beside approximately 70 mm from median. B, A mistless retractor creates the working space. C, The 5-mm endoscope with 0° can clearly visualize thyroid surface.

Ethical Statement. This observation study was approved by the Wakayama Medical University Institutional Review Board Ethics Committee (#3017), and all research was performed in accordance with the relevant guidelines and regulations. Informed consent was obtained in the form of an opt-out on the university website.

Operative Procedures of VANS. Under general anesthesia, the patient is placed supine position with slight extension of the anterior neck. The arms are positioned to the patient's sides. The operator stands on the tumor side, and the assistant holding the camera stands on the same side, at the patient's head. The scrub nurse is always located on the right side of the patient. The anesthesiologist stays beyond the patient's head area. The main endoscope monitor is positioned at the other side of operator, where it can be viewed easily and comfortably.

A small incision (approximately 25 mm) is designed on the tumor side of the chest wall, in the area that is usually covered by open V- or U-neck closure (Fig 1, A). The skin flap was made under the platysma toward the sternocleidomastoid muscle. A mistless retractor (Mist-less VANS retractor, Hakko, Tokyo), which can continuously suction mist during the operation, enables the operator to clearly observe the operating area and creates the working space (Fig 1, B). The 5-mm endoscope with 0° is inserted from the lateral neck at 1 cm lateral from the center position of the mistless retractor, and it can clearly visualize the thyroid surface (Fig 1, C). To expose the thyroid, the approach to the thyroid is divided between the bilateral sternothyroid muscle (midline approach) or between the sternothyroid muscle and omohyoid muscle (lateral approach), depending on our institutional preoperative conferences (Fig 2). After clamping the superior thyroid artery and vein by LIGACLIP (Ethicon, Somerville, NJ), the upper lobe of the thyroid is divided. The middle thyroid vein is cut with HARMONIC ACE (Ethicon, Somerville, NJ). Recurrent laryngeal nerve is identified under nerve integrity monitoring system (NIM 3.0 system, Medtronic, Jacksonville, FL). Lobectomy is then performed with preserving parathyroids. To close the wounds, the subcutis is tightly sutured with 4-0 absorbable multifilament sutures with atraumatic needle followed by fixing of the skin with 5-0 absorbable monofilament sutures and 6-0 nonabsorbable monofilament thread.

Statistical Analysis. Statistical analyses were performed using Fisher exact test for small values of less than 3, χ^2 test, or unpaired t test. After univariate analysis, candidate variables considered significant were analyzed by multivariable analysis of multiple logistic regression model. All analyses were performed using Excel (Microsoft, Redmond, WA) and GraphPad Prism version 8.0 for Mac OS X (GraphPad Software, La Jolla, CA).

RESULT

Patient Characteristics. Assessed in the study were 70 patients (Table 1), 6 men (8.6%) and 64 women (91.4). Median age at operation was 50 (interquartile range [IQR]: 40–65) years. Body weight and BMI at operation were 56.6 (IQR: 48.6–63.8) kg and 21.5 (IQR: 19.7–24.8), respectively. Hashimoto thyroiditis coexisted in 17 patients (24.3%). The distributions of tumor sides were 44 on the right (62.9%), 25 on the left (35.7%), and 1 within the isthmus (1.4%), respectively. The approach methods to thyroid were midline in 42 (60.0%) and lateral in 28% (40.0%). Median operative time was 201.5 minutes (IQR: 139–245), and the amount of blood loss during the operation was 15 mL (IQR: 10–25). The maximum diameter and volume of the tumor were 36.2 mm (IQR: 139–245) and 63.5 cm^3 (IQR: 27.0–44.0).

Regarding complications, RLNP was observed in 4 patients (3 transient, 1 permanent). Accidental device-induced skin burn occurred in 1 patient. There are no other complications such as hematoma, postoperative bleeding, or other wound complications (seroma etc). The postoperative pathological diagnosis was adenomatous goiter in 59 patients (84.3%), adenomatous goiter with

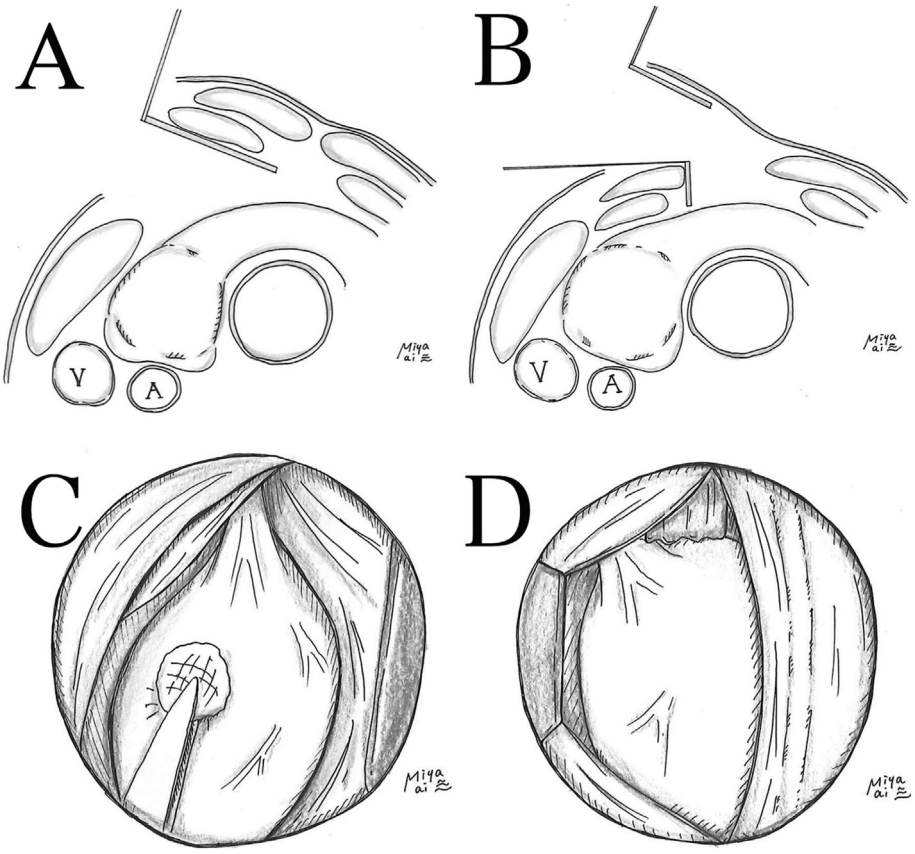

Fig 2. Approach method to the thyroid in video-assisted neck surgery (right side). A, Lateral approach. A retractor is set under the sternohyoid muscle on the affected side. V; inner jugular vein, A; common carotid artery. B, Midline approach. A retractor is set under the skin flap. V; inner jugular vein, A; common carotid artery. C, Endoscopic image of lateral approach. The upper pole of the thyroid is clearly observed. D, Endoscopic image of midline approach. An additional muscle hook may be required to expose the upper pole and recurrent laryngeal nerve.

incidental micropapillary carcinoma in 1 patient (1.4%), follicular adenoma in 5 patients (7.1%), follicular carcinoma in 2 patients (2.9%), and papillary carcinoma in 3 patients (4.3%).

Table 1
Clinical features ($n = 70$)

Age (years)	50.5 [40–65]
Sex, M:F	6 (8.6%):64 (91.4%)
Body weight (kg)*	56.6 [48.6–63.8]
BMI*	21.5 [19.7–24.8]
Hashimoto thyroiditis	17 (24.3%)
Tumor laterality	
Right	44 (62.9%)
Isthmus	1 (1.4%)
Left	25 (35.7%)
Approach	
Midline	42 (60.0%)
Lateral	28 (40.0%)
Bleeding (ml)*	15 [10–25]
Operation time (min)*	201.5 [139–245]
Tumor diameter (mm)*	36.2 [26.8–43.0]
Tumor volume (cm^3)*	63.5 [27.0–44.0]
Postoperative RLNP	4 (5.7%)
Accidental skin burns	1 (1.4%)
Histology	
Adenomatous goiter	59 (84.3%)
Adenomatous goiter with micropapillary carcinoma	1 (1.4%)
Follicular adenoma	5 (7.1%)
Follicular carcinoma	2 (2.9%)
Papillary carcinoma	3 (4.3%)
Hospital stays (d)*	4 [4–5]

M, male; F, female.
* Median [interquartile].

Clinical Factors Affecting Surgical Time. The clinical factors that affect surgical time were evaluated. Patients were divided into 2 groups depending on the operative times: patients with operation time ≤ 201 minutes and patients with operation time > 201 minutes (Table 2). Univariate analysis showed significant difference in approach method to the thyroid ($P < .001$) and amount of bleeding during operation ($P = .039$) between the 2 groups. There was no difference in age, sex, body weight, BMI, existence of Hashimoto thyroiditis, side, tumor diameter, tumor volume, postoperative RLNP, and skin burns. In multivariate analysis, midline approach method to the thyroid was an independent risk factor of longer operation time ($P < .001$). Volume of blood loss during surgery was not influenced by operation times.

Factors Associated With Surgical Approaches. To confirm if the approach to the thyroid was associated with certain operative factors, we further evaluated the difference in clinical features of the patients between midline approach and lateral approach (Table 3). Median operation time is significantly shorter in the lateral approach than in the midline approach (242 minutes [IQR: 185–300] in midline, 131 minutes [IQR: 102–188] in lateral approach) ($P < .001$). There was no difference in age, sex, body weight, BMI, coexistence of Hashimoto thyroiditis, side, amount of blood loss during operation, tumor diameter, tumor volume, postoperative RLNP, or accidental skin burns.

DISCUSSION

The innovation of endoscopic surgery including VANS has contributed to excellent cosmetic outcomes for patients with thyroid nodules but also raised novel clinical problems [13]. A meta-analysis comparison of video-assisted thyroidectomy and conventional thyroidectomy in 7

Table 2
Comparisons of operation time

Variables	*≤ 201 min (n = 34)*	*Operation time > 201 min (n = 35)*	*Univariate P value*	*Multivariate P value*
Age (years)*	50 [43–69]	50 [38–64]	.145	–
Sex				
Male	2 (5.9%)	4 (11.4%)		
Female	32 (94.1%)	31 (88.6%)	.673	–
Body weight (kg)*	53 [47–59]	59 [49–65]	.191	–
BMI*	21.0 [19.6–24.8]	21.8 [20.4–24.7]	.674	–
Hashimoto thyroiditis	5 (14.7%)	11 (31.4%)	.192	–
Laterality				
Right	22 (64.7%)	12 (34.3%)		
Left	12 (35.3%)	13 (37.1%)	.199	–
Approach				
Midline	11 (32.4%)	31 (88.6%)		
Lateral	23 (67.6%)	4 (11.4%)	*<.001*	*<.001*
Bleeding (ml)*	10 [5–15]	20 [15–35]	*.039*	.2350
Tumor diameter (mm)*	33.9 [27.4–40.0]	38.2 [26.3–47.7]	.403	–
Tumor volume (cm^3)*	77.0 [33.5–104.6]	84.1 [39.3–141.7]	.212	–
Postoperative RLNP				
Temporally	2 (5.9%)	1 (2.9%)	.614	–
Permanent	0 (0%)	1 (2.9%)	1.000	–
Accidental skin burns	0 (0%)	1 (2.9%)	1.000	–

Italic indicates statistical significance.
* Median [interquartile].

Table 3
Comparisons of approach method.

Variables	*Midline approach (n = 42)*	*Lateral approach (n = 27)*	P *value*
Age (m)*	52.5 [38–67]	49 [41–67]	.877
Sex			
Male	3 (7.1%)	3 (11.1%)	
Female	39 (92.9%)	24 (88.9%)	.568
Body weight (kg)*	56 [49–61]	57 [47–65]	.405
BMI*	21.4 [19.7–24.5]	22.0 [19.5–25.4]	.726
Hashimoto thyroiditis	11 (26.2%)	5 (18.5%)	.558
Laterality			
Right	27 (64.3%)	17 (63.0%)	
Left	15 (35.7%)	10 (37.0%)	.911
Bleeding (ml)*	20 [10–38]	7 [5–15]	.057
Operation time (min)*	242 [185–300]	131 [102–188]	*<.001*
Tumor diameter (mm)*	35.8 [26.3–45]	36.5 [27.4–50.0]	.443
Tumor volume (cm^3)*	81.7 [27.9–141.2]	76.1 [29.4–140.1]	.969
Postoperative RLNP			
Temporally	2 (4.8%)	1 (3.7%)	1.000
Permanent	0 (0%)	1 (3.7%)	.391
Accidental skin burns	1 (2.4%)	0 (0%)	1.000

Italic indicates statistical significance.
* Median [interquartile].

studies revealed that operative times in VANS were significantly extended compared with those of conventional surgery [11]. Furthermore, Shimizu et al showed that VANS took a mean of 96.8 minutes (range: 54–220 minutes), whereas the most recent 20 conventional surgeries only took 65 minutes [10]. We also needed a long surgical time (median 201.5 minutes [IQR: 139–245]). The long operative time is a source of surgical stress for patients and surgeons [14,15], and will incur high cost in health economics [16]. Identification of surgical parameters in shortening operative time in VANS is therefore very important. We first identified how the side of approach contributes to shortening operative times in VANS for hemithyroidectomy. Previously, Nomura et al reported on a midline approach with a mean surgical time of 130.5 minutes in VANS for hemithyroidectomy of benign thyroid nodules [12]. Maegawa et al also took 183 minutes (range: 121–329) by the same midline approach in VANS for hemithyroidectomy, which is a longer operation time than that by the conventional open thyroidectomy in their institute [17]. Elsewhere, Shimizu et al performed hemithyroidectomy by lateral approach in VANS [9,18]. The gold standard approach for thyroid in VANS is therefore still a matter of controversy. According to our observations, we strongly suggest that the lateral approach should be selected to shorten surgical time for hemithyroidectomy in this VANS.

Intraoperative bleeding may also be associated with extended operative time for VANS. Previously, Shimizu et al reported large tumor size >50 mm was associated with both intraoperative bleeding and operative time extension in endoscopic thyroid surgery [10]. In our cases, intraoperative bleeding was associated with long surgical time in univariate analysis ($P = .039$). Intraoperative bleeding is also known to be a risk factor of postoperative RLNP for conventional open thyroid surgery [19]. Taken together, we suggest that the lower volume of intraoperative bleeding in VANS will contribute to shortening of operative times and improving safety by ensuring a clear surgical space.

Nomura et al reported large tumor diameter associated with long operative time in VANS via a midline approach [12]. Tumor diameter in patients with operation time > 201 minutes (median 38.2 mm) was larger than that in patients with operation time ≤ 201 minutes (median 33.9 mm) in our patients, but the difference was not significant ($P = .403$). BMI also contributes to extended operative time. Yap et al reported prolonged surgical times in patients with BMI > 30 kg/m^2 for robotic transaxillary thyroidectomy [20]. BMI did not, however, seem to affect operative time in the present study ($P = .674$). The result may have been affected by our patients having an average BMI of 21.5 (IQR: 19.7–24.8), which is relatively low compared with that of the patients in previous reports. So far, there is no report that greater BMI associates prolonged surgical times in VANS.

Furthermore, we reviewed complications of our patients in VANS. Postoperative RLNP is the most common complication in thyroid surgery; the reported incidence ranges between 1.4% and 6.3% [21–24]. In our series, RLNP was noted in 4 patients (5.7%) including permanent palsy in 1 case (1.4%); the incidence ratio was considered to be no different from reports of conventional surgery, which is considered about 3% to 6% [19]. Recently, Noda et al used a continuous nerve monitoring system for VANS to reduce the risk of postoperative RLNP [23], although their findings have not yet been confirmed in subsequent reports. Once RLNP has occurred, 70% of patients recover within 3 months, and 90% of patients recover within 6 months in conventional surgery [19]. Although 3 of our cases of RLNP recovered spontaneously, 1 patient did not recover during the observation period. Accidental skin burns at the skin flap occurred in 1 case (1.4%), and a previous report also reported skin burns in 1 case (0.6%) [12]. Surgeons should be wary of the possibility of skin burns in VANS; this necessitates wider skin flaps than those in conventional thyroid surgery.

Our study has several limitations; it comprised observation at single institute. The results may be affected by sample bias, and the number of patients is insufficient to make comprehensive conclusions. Further studies should clarify the best approach to hemithyroidectomy in VANS.

In conclusion, the lateral approach to the thyroid will contribute to shortened surgical time in VANS for benign thyroid nodule.

Author Contribution

Saori Takeda†:Writing - original draft, Formal analysis, Investigation, Data curation, Keisuke Enomoto: Writing – original draft, Writing – review & editing; Masanobu Hiraoka: Investigation, Data curation, Writing – review & editing; Naoko Kumashiro: Investigation, Data curation; Mai Miyamoto: Writing for figure; Shun Hirayama: Investigation, Data curation; Takahito Kimura: Investigation, Data curation; Shunji Tamagawa: Writing – review & editing; Masamitsu Kono: Writing – review & editing; Gen Sugita: Writing – review & editing; Makiko Ohtani: Writing – review & editing; Muneki Hotomi: Writing – review & editing, Supervision.

All authors have read and agreed to the publication of this version of the manuscript.

Conflict of Interest

The authors declare no conflicts of interest.

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Institutional Review Board Statement

The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Wakayama Medical University Institutional Review Board Ethics Committee (#3017).

Informed Consent Statement

Informed consent was obtained in the form of an opt-out on the hospital website.

References

[1] Hüscher CS, Chiodini S, Napolitano C, Recher A. Endoscopic right thyroid lobectomy. Surg Endosc. 1997;11:877.
[2] Bärlehner E, Benhidjeb T. Cervical scarless endoscopic thyroidectomy: axillo-bilateral-breast approach (ABBA). Surg Endosc. 2008;22:154–7.
[3] Benhidjeb T, Wilhelm T, Harlaar J, Kleinrensink G-J, Schneider TA, Stark M. Natural orifice surgery on thyroid gland: totally transoral video-assisted thyroidectomy (TOVAT): report of first experimental results of a new surgical method. Surg Endosc. 2009;23:1119–20.
[4] Lee KE, Kim HY, Park WS, Choe J-H, Kwon MR, Oh SK, et al. Postauricular and axillary approach endoscopic neck surgery: a new technique. World J Surg. 2009;33:767–72.
[5] Nakajo A, Arima H, Hirata M, Mizoguchi T, Kijima Y, Mori S, et al. Trans-oral video-assisted neck surgery (TOVANS). A new transoral technique of endoscopic thyroidectomy with gasless premandible approach. Surg Endosc. 2013;27:1105–10.
[6] Miccoli P, Materazzi G, Berti P. Natural orifice surgery on the thyroid gland using totally transoral video-assisted thyroidectomy: report of the first experimental results for a new surgical method: are we going in the right direction? Surg Endosc. 2010;24:957–8.
[7] Tori M. Hybrid-type endoscopic thyroidectomy (HET: Tori's method) for differentiated thyroid carcinoma including invasion to the trachea. Surg Endosc. 2014;28:902–9.
[8] Shimazu K, Shiba E, Tamaki Y, Takiguchi S, Taniguchi E, Ohashi S, et al. Endoscopic thyroid surgery through the axillo-bilateral-breast approach. Surg Laparosc Endosc Percutan Tech. 2003;13:196–201.
[9] Shimizu K, Akira S, Tanaka S. Video-assisted neck surgery: endoscopic resection of benign thyroid tumor aiming at scarless surgery on the neck. J Surg Oncol. 1998;69:178–80.
[10] Shimizu K, Tanaka S. Asian perspective on endoscopic thyroidectomy — a review of 193 cases. Asian J Surg. 2003;26:92–100.
[11] Zhang P, Zhang HW, Han XD, Di JZ, Zheng Q. Meta-analysis of comparison between minimally invasive video-assisted thyroidectomy and conventional thyroidectomy. Eur Rev Med Pharmacol Sci. 2015;19:1381–7.
[12] Nomura K, Katayama A, Takahara M, Nagato T, Kishibe K, Ueda S, et al. Video-assisted thyroidectomy (VANS method) for benign thyroid nodule: summary of 182 cases in a single institution. JOURNAL OF JAPAN SOCIETY FOR HEAD AND NECK SURGERY. 2017;27:45–52.
[13] Sahm M, Otto R, Pross M, Mantke R. Minimally invasive video-assisted thyroidectomy: a critical analysis of long-term cosmetic results using a validated tool. The Annals of The Royal College of Surgeons of England. 2019;101:180–5.
[14] Anaya DA, Cormier JN, Xing Y, Koller P, Gaido L, Hadfield D, et al. Development and validation of a novel stratification tool for identifying cancer patients at increased risk of surgical site infection. Ann Surg. 2012;255:134–9.
[15] Rosenberg AJWP, Van Cann EM, van der Bilt A, Koole R, van Es RJJ. A prospective study on prognostic factors for free-flap reconstructions of head and neck defects. Int J Oral Maxillofac Surg. 2009;38:666–70.
[16] Takura T. Management performance and medical resource productivity of anesthesia and surgery. THE JOURNAL OF JAPAN SOCIETY FOR CLINICAL ANESTHESIA. 2019;39:335–44.
[17] Maegawa A, Kanno M, Takabayashi T, Kato Y, Tsutsumiuchi T, Ninomiya T, et al. Video-assisted neck surgery (VANS) vs. conventional open thyroidectomy. JOURNAL OF JAPAN SOCIETY FOR HEAD AND NECK SURGERY. 2021;31:19–23.
[18] Shimizu K, Shimizu K, Okamura R, Igarashi T, Nagaoka R, Sanada M, et al. Video-assisted neck surgery (VANS) using a gasless lifting procedure for thyroid and parathyroid diseases: "the VANS method from A to Z". Surg Today. 2020;50:1126–37.
[19] Enomoto K, Uchino S, Watanabe S, Enomoto Y, Noguchi S. Recurrent laryngeal nerve palsy during surgery for benign thyroid diseases: risk factors and outcome analysis. Surgery. 2014;155:522–8.
[20] Yap Z, Kim WW, Kang SW, Lee CR, Lee J, Jeong JJ, et al. Impact of body mass index on robotic transaxillary thyroidectomy. Sci Rep. 2019;9:8955.
[21] Patel KN, Yip L, Lubitz CC, Grubbs EG, Miller BS, Shen W, et al. The American Association of Endocrine Surgeons guidelines for the definitive surgical management of thyroid disease in adults. Ann Surg. 2020;271:e21–93.
[22] Miccoli P, Fregoli L, Rossi L, Papini P, Ambrosini CE, Bakkar S, et al. Minimally invasive video-assisted thyroidectomy (MIVAT). Gland Surg. 2020;9:S1.
[23] Noda T, Ishisaka T, Okano K, Kobayashi Y, Shimode Y, Tsuji H. Experience with the use of intraoperative continuous nerve monitoring in video-assisted neck surgery and external cervical incisions. Laryngoscope Investig Otolaryngol. 2021;6:346–53.
[24] Heikkinen M, Mäkinen K, Penttilä E, Qvarnström M, Kemppainen T, Löppönen H, et al. Incidence, risk factors, and natural outcome of vocal fold paresis in 920 thyroid operations with routine pre-and postoperative laryngoscopic evaluation. World J Surg. 2019;43:2228–34.