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ORIGINAL SCIENTIFIC REPORT

Outcome Comparison between Endoscopic Transoral and Bilateral Axillo-Breast Approach Thyroidectomy Performed by a Single Surgeon

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Abstract

Background The transoral approach and the bilateral axillo-breast approach (BABA) are remote access approaches for endoscopic thyroidectomy. Both follow a symmetric design and use CO_2 insufflation to maintain the working space. The outcome differences between the techniques are rarely compared in the literature.

Methods All patients who underwent endoscopic transoral (n = 72) and BABA (n = 63) thyroidectomy between October 2018 and August 2020 by a single surgeon were retrospectively reviewed. The following peri-operative data were collected and compared: operative time, blood loss, postoperative drainage amount, hospital stay, pain score, number of retrieved lymph nodes, and complications.

Results Patients in the transoral group were younger (44.7 vs. 49.3 years, p = 0.022) and had smaller tumors (2.4 vs. 2.8 cm, p = 0.020) than those in the BABA group. The operative times were significantly longer in the transoral group than in the BABA group (lobectomy, 194.1 vs. 177.0 min, p = 0.026; total thyroidectomy, 246.0 vs. 214.3 min, p = 0.042). Nevertheless, the time difference became insignificant after completing the initial 20 cases of transoral thyroidectomy. The drainage fluid collected after the surgery was serosanguinous, and a lower drainage volume was observed in the transoral group than that in the BABA group (64.9 vs. 78.5 ml, p = 0.017). However, there was no significant difference regarding the blood loss, hospital stay, postoperative pain score, and lymph nodes retrieved. The rate of postoperative complications, such as hypoparathyroidism and vocal cord palsy was comparable between the two groups.

Conclusions Transoral approach and BABA are comparable with regard to surgical outcomes. Selected patients may choose either technique based on their preferences.

Introduction

The transoral approach and the bilateral axillo-breast approach (BABA) are techniques used to perform remote access thyroidectomy, with some common characteristics [1, 2]. First, both approaches are symmetrically designed so as to enable easy bilateral thyroidectomy. This is in marked contrast to the transaxillary and retroauricular approaches, both of which have laterality and make it difficult to manage thyroid lesions located on the opposite side of the skin incision [3, 4]. Second, the transoral approach and BABA rely on CO_2 insufflation to maintain the working

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space. Only small incisions are required to accommodate trocar insertion. Therefore, the cosmetic outcome with the transoral approach and BABA is better than with the transaxillary and retroauricular approaches, both of which require larger incisions for metallic retractor insertion to lift the roof of the working space [5].

However, the transoral approach and BABA are significantly different in many aspects. The transoral approach leaves no scar on the body surface, whereas BABA results in four incisions, one in each axilla and breast. The transoral approach has a shorter distance to the neck and requires less dissection than BABA. Less dissection and tissue destruction may imply less postoperative pain. However, it is more challenging to operate using the transoral approach given the reduced working space in the oral vestibule that may result in instrument collision. In contrast, BABA operates through working ports in the axilla and breast areola. The distance between the two working ports is much wider, usually exceeding 10 cm [6]. In addition, the operative view in the transoral approach is in the cranial to caudal direction. It is the opposite of the view available during open surgery and BABA (caudal to cranial). The instrument collision and unfamiliar view may imply longer operative time and more potential complications.

Until now, few reports have compared the surgical outcomes between the transoral approach and BABA; these studies focused primarily on robotic surgery [7, 8]. In this study, we aimed to describe our experience of endoscopic thyroidectomy using these two approaches. We hypothesized that the transoral approach may cause less postoperative pain but have a longer operative time than BABA.

Materials and methods

Patients

All patients who underwent endoscopic thyroidectomy via the transoral approach or BABA for benign or malignant thyroid disease in the Kaohsiung Veterans General hospital between October 2018 and August 2020 were retrospectively reviewed. All operations were performed by a single surgeon (T. J. L.). BABA thyroidectomy was actively performed since 2016, and the first transoral thyroidectomy was performed since this study period. The study was approved by the institutional review board of the author's affiliation.

The indications of endoscopic transoral and BABA thyroidectomy were the same, including benign thyroid nodule less than 5 cm in diameter and well-differentiated thyroid cancer less than 2 cm in diameter without clinical lymph node metastasis in the preoperative image studies. Graves' disease and thyroiditis were not considered contraindications. The patients who met the surgical indications were all informed about the details of the two endoscopic operative procedures as well as conventional open thyroidectomy. The final choice of procedure was based on the patient's own preference.

Operative method

Transoral thyroidectomy via the vestibular approach was performed following the technique established by Dr. Angkoon Anuwong [1] (Fig. 1). The BABA was performed using a technique similar to the original version developed by Korean surgeons [2], except for two modifications described in our previous publications [6, 9] (Fig. 2). In short, we applied the fabric adhesive tape to lift the breast and facilitate the thyroid dissection process; this is referred to as the X-shaped breast lift [6]. In addition, the working space was created using our novel technique: single biaxillary tunneling, to eliminate the extent of blunt dissection and the associated injury [9].

We routinely placed one surgical drain in both transoral and BABA thyroidectomies which were removed before the patient was discharged or if the daily drainage amount was less than 30 mL.

Postoperative management

An oral analgesic with acetaminophen and flurbiprofen was prescribed routinely after either of these surgeries. Additional intravenous analgesics were administered on patient request. In the transoral group, intravenous amoxicillin/clavulanic acid was administered intraoperatively

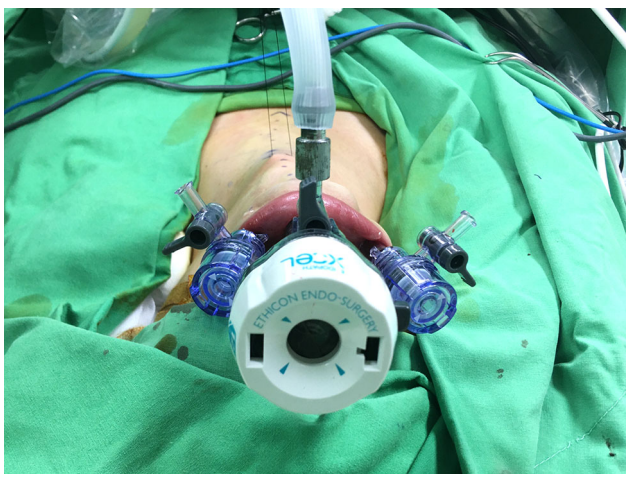

Fig. 1 Transoral endoscopic thyroidectomy. Three trocars are inserted in the oral vestibule and are very close to each other, which often leads to collisions

Fig. 2 The bilateral axillo-breast approach (BABA) for endoscopic thyroidectomy. Two 12-mm trocars and two 5-mm trocars are placed in the axilla and breast areola, respectively

and continued until the patient was discharged. In the BABA group, only a single dose of cefazolin was administered as the prophylactic antibiotic.

Outcome evaluation

The postoperative drainage amount in the first 2 days was summed and compared between the two groups. Postoperative pain was evaluated using the visual analog scale (VAS), scores of which range from 0 (no pain) to 10 (worst pain). Incidental parathyroidectomy was defined as identification of parathyroid tissue in the permanent section examined by the pathologist, and hypoparathyroidism was described as postoperative serum calcium level < 8 mg/dL with hypocalcemic symptoms. Calcium supplements were administered. Prolonged use of oral calcium and vitamin D supplement to maintain normocalcemia for more than 6 months was classified as permanent hypoparathyroidism. If the patient experienced hoarseness, laryngoscopy was performed to evaluate the vocal cord mobility. Recovery of vocal cord movement within 6 months was defined as transient vocal cord palsy.

Statistics

Continuous variables were expressed as mean ± standard deviation analyzed using the Mann–Whitney U test. Categorical parameters were analyzed using Chi-square or Fisher's exact test based on sample size. To depict the learning curve of transoral thyroidectomy, a moving average of order 5 was used to calculate the operative time [10]. The statistical software used was the SPSS version 20 (IBM Co., Armonk, NY). A value of $p < 0.05$ was defined as statistically significant.

Results

Patients in the transoral group were younger (44.7 ± 12.0 vs. 49.3 ± 11.3 years, $p = 0.022$) and had smaller tumors (2.4 ± 1.0 vs. 2.8 ± 1.3 years, $p = 0.020$) than those in the BABA group. Other clinical features, including sex, body mass index, type of operation, pathologic diagnosis, hyperthyroidism, and thyroiditis, were comparable between the two groups (Table 1).

Regarding the surgical outcomes, the transoral group required a significantly longer operative time than the BABA group, both for lobectomy (194.1 ± 35.1 vs. 177.0 ± 40.8 min, $p = 0.026$) and total thyroidectomy (246.0 ± 37.4 vs. 214.3 ± 40.8 min, $p = 0.042$) (Table 2). The operative time was longer in the transoral group mainly because initial cases of transoral thyroidectomy were enrolled. The difference became insignificant between the transoral approach and BABA after excluding the 20 first cases in the transoral group (188.3 ± 32.7 vs. 177.0 ± 40.8 min, $p = 0.177$). Figure 3 shows the operative time of transoral lobectomy, and notable time reduction was observed after the initial 23 cases.

In all patients, the drainage fluid collected after the surgery was serosanguinous. No chylous or purulent drainage fluid was detected in this study. Less postoperative drainage amount (64.9 ± 29.1 vs. 78.5 ± 35.3, $p = 0.017$) was noted in the transoral group. Nevertheless, no statistical differences were observed in blood loss, postoperative pain score, and the need for additional intravenous analgesic. Hospital stay, the number of retrieved lymph nodes, and the rate of postoperative complications, such as hypoparathyroidism and vocal cord palsy, were also similar between the two groups.

In the transoral group, three patients (3/72 = 4.2%) reported significant sensory loss in the chin and lower lip, which were indicative of mental nerve injury. However, all of their symptoms resolved within 6 months. In the BABA group, about one-third of patients reported mild discomfort or paresthesia over the upper chest area that was previously blunt-dissected with a vascular tunneler. However, their sensory impairment resolved or became merely perceivable after 3 months.

Discussion

We compared the surgical outcomes of two endoscopic approaches for thyroidectomy. There were no significant differences in complications and hospital stay between the

Table 1 Clinicopathological features of the patients

Characteristics	Transoral (n = 72)	BABA (n = 63)	p value
Age (y)	44.7 ± 12.0	49.3 ± 11.3	0.022
Sex (F:M)	64:8	57:6	0.763
Body mass index (kg/m^2)	22.8 ± 3.1	23.7 ± 3.2	0.131
Tumor size (cm)	2.4 ± 1.0	2.8 ± 1.3	0.020
Type of operation			0.100
Lobectomy	58 (80.6%)	43 (68.3%)	
Total Thyroidectomy	14 (19.4%)	20 (31.7%)	
Pathologic diagnosis			0.563
Benign	39 (54.2%)	38 (60.3%)	
Papillary carcinoma	30 (41.7%)	21 (33.3%)	
Follicular carcinoma	3 (4.2%)	4 (6.3%)	
Hyperthyroidism	4 (5.6%)	6 (9.5%)	0.380
Thyroiditis	19 (26.4%)	10 (15.9%)	0.138

Values were expressed as mean ± standard deviation or N (%)

BABA, bilateral axillo-breast approach

Table 2 Surgical outcomes

Characteristics	Transoral (n = 72)	BABA (n = 63)	p value
Operative time (min)			
Lobectomy	194.1 ± 35.1	177.0 ± 40.8	0.026
Total thyroidectomy	246.0 ± 37.4	214.3 ± 40.8	0.042
Blood loss (mL)	24.8 ± 32.0	28.8 ± 55.8	0.610
Drainage amount for 2 d, (mL)	64.9 ± 29.1	78.5 ± 35.3	0.017
Hospital stay (day)	3.9 ± 0.6	3.9 ± 0.8	0.693
Pain score (VAS)			
Day 0	2.4 ± 0.9	2.5 ± 0.8	0.826
Day 1	1.9 ± 0.5	2.1 ± 0.8	0.140
Day 2	1.7 ± 0.5	1.8 ± 0.7	0.603
Require analgesic injections	12 (16.7%)	11 (17.5%)	0.903
Retrieved lymph nodes[a]	0.8 ± 1.2	2.0 ± 3.1	0.061
Incidental parathyroidectomy	12 (16.7%)	8 (12.7%)	0.517
Hypoparathyroidism[b]			
Transient	6 (42.9%)	10 (50.0%)	0.681
Permanent	0 (0%)	0 (0%)	N.A
Vocal cord palsy			
Transient	1 (1.4%)	1 (1.6%)	0.999
Permanent	0 (0%)	0 (0%)	N.A
Wound infection	0 (0%)	0 (0%)	N.A
Bleeding	0 (0%)	0 (0%)	N.A
Skin flap perforation	0 (0%)	0 (0%)	N.A

Values were expressed as mean ± standard deviation or N (%)

BABA, bilateral axillo-breast approach; N.A., not applicable; VAS, Visual Analogue Scale (0–10)

[a]Retrieved lymph nodes was evaluated in patients with papillary thyroid carcinoma

[b]Hypoparathyroidism was evaluated in total thyroidectomy cases only

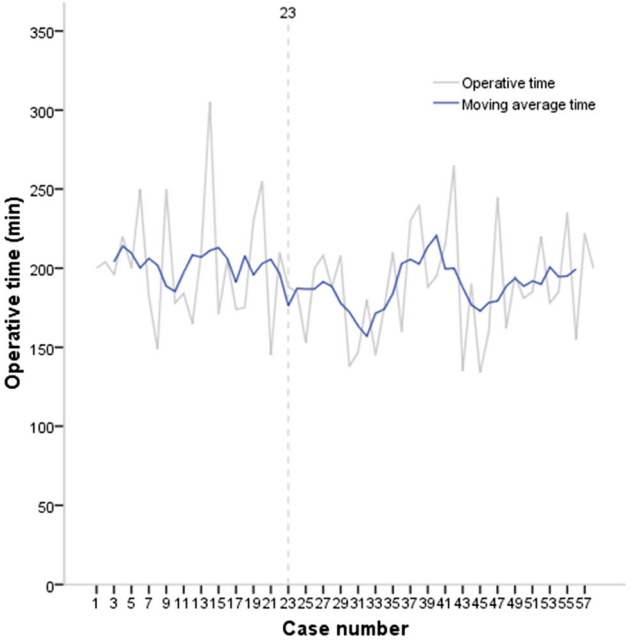

Fig. 3 The operative time of transoral lobectomy. The operative time is depicted in gray, and the moving average curve is depicted in blue. The operative time decreased after passing the skill acquisition period, which is about 23 cases (dashed gray line)

BABA and transoral approach, except for longer operative times and less postoperative drainage amount in the transoral group. To our knowledge, this is currently the largest series comparing these two endoscopic approaches. Our study provides comprehensive and practical views for surgeons who are interested in endoscopic thyroidectomy.

In our study, the required operative time was significantly longer in the transoral group. The main reason was because initial cases of transoral thyroidectomy were included. The difference in operative time became insignificant after passing the learning curve of transoral thyroidectomy. Previous studies demonstrated that 11–40 cases were required to achieve technique proficiency of transoral thyroidectomy [10–12]. Our data of 23 cases are comparable to those results. Further shortening of operative time is anticipated after accumulating more surgical experience.

Another possible explanation for the longer operative time was that in the transoral approach, only three trocars are used, which is one trocar less than that in the BABA. The additional trocar in BABA is usually used for countertraction. It widens the working space and facilitates the dissection process, especially when dealing with the recurrent laryngeal nerve and parathyroid gland, where precise and meticulous dissection is of utmost importance. Moreover, all three trocars in the transoral approach were in the small oral vestibule and close to each other (Fig. 1). This is similar to performing single-incision or single-port surgery, which is more technically demanding and may require more time.

Chai et al. [8] compared the initial outcome of robotic transoral versus BABA thyroidectomy by a single surgeon. They found that the operative time for lobectomy was similar in both groups; however, the operative time for total thyroidectomy was less in the robotic transoral group [8]. The authors attributed the time reduction in the transoral approach to the significant experience that the operator gained from performing > 300 cases of robotic BABA thyroidectomy. This was likely because the BABA and transoral approach share many similarities, such as working space creation, midline operative view, and thyroid dissection techniques. These "know-how" techniques can be applied to the transoral approach as well.

Moreover, surgeons routinely place an additional fourth trocar in the axilla when performing robotic transoral thyroidectomy [7, 8]. The extra working port may be helpful for reducing the operative time in the robotic transoral approach.

Theoretically, the flap dissection area in the BABA is larger than that in the transoral approach. More flap dissection may be associated with more tissue damage. Patients undergoing BABA thyroidectomy may feel more pain than those undergoing transoral thyroidectomy [7]. In our study, more postoperative drainage amount was observed in the BABA group, which may indicate more tissue damage caused by larger flap dissection. However, the pain score, requirement for additional intravenous analgesic injection, and blood loss showed no significant difference between the two approaches. There are three possible explanations for this. First, we have modified the working space creation technique (single biaxillary tunneling) in our BABA thyroidectomy patients to minimize blunt dissection and associated trauma [9]. Second, the pain after endoscopic thyroidectomy was mild, the pain score being approximately 2 as per the VAS. Thus, an extremely large number of patients may be required to show the small difference in the severity of the pain. Third, despite the dissection area being smaller in the transoral approach, the manipulating area involved the jaw, which is part of the human face, which may therefore have a higher perception of pain than the chest area.

One of the major differences between the BABA and transoral approach is the direction of instrument insertion. In BABA, the instruments are inserted from the breast and axilla and pointed toward the neck area, in a caudal to cranial direction (Fig. 2). We used a straight endoscopic instrument; hence, there may be some difficulty in dissecting the lower part of the thyroid and lymph node in the pretracheal or upper mediastinal area. Some surgeons have suggested the use of a robotic system to overcome this

limitation [13–15]. In contrast, the instruments used in the transoral approach were inserted through working ports in the oral vestibule and down toward the neck, in a cranial to caudal direction (Fig. 1). If the thyroid tumor is located in a high-riding upper pole, this direction of the instruments would make it very difficult to remove it adequately and completely [7].

Since both approaches have similar complications and hospital stay, individualized therapy may be considered for each patient. For example, BABA may be more suitable for a patient whose tumor is in the upper pole or a patient with protruding jaw or a prominent thyroid cartilage. In these anatomical situations, thyroid dissection is more difficult to perform if the transoral approach is used. In contrast, the transoral approach may be more appropriate for patients with lower pole tumor or patients with a history of breast cancer treatment, as this could hinder endoscopic access via the axilla and breast areola.

This study had two limitations. First, the surgeon who worked on all the cases had more experience of BABA than of the transoral approach before the study period. This is hardly avoidable when comparing these two surgical methods because the BABA technique was developed in the early 2000s, and the transoral approach gained popularity only after Dr. Angkoon Anuwong published his first case series in 2016 [16, 17]. For more accurate comparison, all surgeries were performed by a single surgeon to eliminate the inter-surgeon bias, and the surgical indications were the same for each group. Second, the patients' clinical characteristics were not all the same between the two groups. In our study, patients in the transoral group were 5 years younger than patients in the BABA group. Since this was a retrospective study, patients were free to choose their preferred procedure. Young patients might have higher cosmetic concern and tend to choose surgeries that leave no scar in the body surface, which is the transoral approach [7]. In addition, young patients were usually more open-minded to accept novel techniques and did not consider oral cavity as a prohibited area for surgery.

Conclusions

The current study shows comparable results in surgical outcomes between the transoral approach and BABA. If patients are selected carefully, the surgery method can be chosen based on their preferences.

Compliance with Ethical Standards

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

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

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