Modified equipment for facilitating the transoral vestibular approach to endoscopic thyroidectomy

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Abstract

Objectives: The objectives of the study were to investigate the improvement in operation time for thyroid surgery gained using a modified endobag and suture and to accelerate the learning process for novice endoscopic surgeons.

Materials and Methods: A retrospective study was conducted between 2 June 2015 and 1 November 2018. Medical records of patients who underwent transoral endoscopic thyroidectomy vestibular approach (TOETVA) were retrieved and analysed. Comparisons of operative time with or without the use of modified equipment were calculated by the unequal variance t-test in lobectomy and isthmectomy groups.

Results: Medical records of 102 patients (mean age: 39.1 years) were analysed. The size of thyroid nodule averaged 4.0 cm (range: 1.0–13.0 cm). TOETVA was applied for right lobectomy (57.8%), left lobectomy (34.3%), isthmectomy (3.9%) and total thyroidectomy (3.9%). Early in our experience, TOETVA required 168 min, whereas following the introduction of the modified endobag and extracorporeal suture, operative time was reduced to 30 min ($P > 0.05$).

Conclusions: The use of modified equipment permitted shorter operation times. The time difference was not statistically significant but does represent a significant time-saving. The use of the modified equipment will simplify and speed up the learning process for novice endoscopic surgeons.

Keywords: Endoscopy, equipment, thyroidectomy

INTRODUCTION

The open approach for thyroid surgery is the standard technique known to be effective, well-tolerated and safe. Unfortunately, the transverse incision on the neck produces an undesirable scar. Endoscopic thyroidectomy was first introduced by Hüschet et al.\textsuperscript{[1]} to achieve a better cosmetic outcome by avoiding obvious scarring. Various alternative approaches to the thyroid were developed by changing the site of the incision to hidden parts of the body including the axilla,\textsuperscript{[2‑7]} breast,\textsuperscript{[8‑12]} and retroauricular region.\textsuperscript{[13‑18]} However, these techniques still left a scar on the skin. To prevent...
this, transoral endoscopic thyroidectomy approaches have been developed. Two forms of this are the trans-sublingual approach \cite{19-21} and the transoral endoscopic thyroidectomy vestibular approach (TOETVA). \cite{22-34} The trans-sublingual approach had a high rate of complications, whereas minimal complications were observed in TOETVA. The latter technique is still regarded as novel and is unfamiliar to many surgeons. Furthermore, some technical elements of the procedure, including specimen extraction with an endobag and the reapproximation of strap muscles, require a learning process by novice surgeons. Therefore, we developed and modified equipment to accelerate this learning process.

**MATERIALS AND METHODS**

**Study design**

The study was conducted at Srinagarind Hospital and Mukdahan Hospital, Thailand, between 2 June 2015 and 1 November 2018. We wished to investigate the benefits of using a modified endobag and extracorporeal knot suture. All medical records of patients who underwent TOETVA were retrieved and analysed to obtain data on operative findings, operative time and complications. Each surgery was performed by one primary surgeon (P. B. or P. K. or K. M. or S. T.) and one assistant surgeon (resident doctor or nurse) for holding the endoscope. The study was approved by the Ethics Committee of Khon Kaen University (HE611534) and Mukdahan Hospital (MEC18/61).

**Modified equipment**

**Modified endobag**

We used a regular size of endobag (3 cm × 5 cm) with a drawstring suture at its mouth [Figure 1a]. However, we adjusted the size of the endobag depending on the size of the tumour. Furthermore, we rolled the mouth of the bag over a rubber band 5 cm in diameter to make it easy to identify and to stretch the mouth for easy insertion of the specimen [Figure 1b].

**Extracorporeal sliding knot suture** [Figure 2]

It is difficult for novice endoscopic surgeons to tie intracorporeal knots; therefore, we developed an extracorporeal sliding knot suture to assist in reapproximating the strap muscles. The suture had a loop of about 7 cm; if the loop was longer, it was difficult to control while reapproximating muscles. A suture of this length allowed three or four stitches to be made, enough to reapproximate the muscles. The suture was made from Vicryl 3-0, a material that allowed easy sliding of the knot for tying in the first stitch.

**Surgical technique**

The transoral endoscopic approach was identical to that reported in a previous study. \cite{24,25} The patient was placed in a supine position with neck extension under general anaesthesia with nasotracheal intubation. Antibiotic prophylaxis was administered before the incision was made. Two 5-mm laparoscopic ports were placed at the junction between the canine and first premolar teeth. Another port was placed in the midline with a 10-mm laparoscopic port. These ports were inserted under the lower lip at the vestibular region. A 10-mm 30° lens allowed a surgical view. The ultrasonic scalpel and monopolar were used for creating a surgical corridor down to the sternal notch with the lateral border at the sternocleidomastoid muscles on both sides. The strap muscles were separated in the midline and retracted laterally with 2/0 silk. We passed 2/0 silk through the skin into the corridor and passed it around the strap muscles and back out through the skin for holding the strap muscles laterally. If the working corridor was not wide enough, external hanging of subcutaneous tissue with 2/0 silk could be used to provide good exposure. However, the use of 2/0 silk was not necessary in most cases when the thyroid nodule was smaller than 4 cm in diameter. The thyroid isthmus was divided in the midline, and the superior pole was dissected and superior thyroid vessels controlled. Dissection of the thyroid lobe with preservation of the recurrent laryngeal nerve was performed down and parallel to the trachea. After complete resection of the thyroid gland, the modified endobag with a rubber mouth and drawstring suture was inserted through the 10-mm laparoscopic port. At this point, the mouth of

**Figure 1:** The endobag (3 cm × 5 cm) was modified by rolling the mouth of the bag over the rubber band (a) to make it easy to identify and to stretch the mouth of endobag for easy insertion of the specimen (b).

**Figure 2:** The extracorporeal knot sliding suture was created with a loop of about 7 cm for reapproximating strap muscles.
the endobag was easily identified due to the colour of the rubber. We used grasping forceps to hold the mouth of the endobag. Another hand used forceps to put the specimen in the endobag, which was then removed through the midline wound in the oral cavity. Suturing of strap muscles was done using the absorbable extracorporeal knot suture. The sliding knot made it possible to approximate the strap muscles in the midline. After passing a suture through the strap muscle as the first stitch, we passed the suture back through the suture loop to hold the strap muscle in the midline. Subsequently, three or four stitches were made with a continuous suturing technique. For the last stitch, we sutured in a backward direction through muscles or continuous with a lock to secure muscles that were not reserparated. After the last stitch was tied, the pin was back out through the skin. Finally, the vestibular incision in the oral cavity was sutured.

RESULTS

Medical records of 102 patients (mean age: 39.1 years) were analysed. The size of thyroid nodule averaged 4.0 cm (range: 1.0–13.0). Thyroid lobectomy was the most common operation in our series. Pathology revealed benign nodule (82.4%), malignancy (14.7%) and thyroiditis (2.9%). The operative time averaged 140 min. The mean of intraoperative bleeding was 30 ml. Early in our experience, a radivac drain was used in three patients. Regarding hospital stay, all patients must be admitted the day before surgery for anaesthetic assessment. After surgery, our patients were observed clinically for 24 h. If they were stable and no serious complications, they would be discharged. The average hospital stay was 3.5 days. Complications were nine cases of vocal paresis, one vocal cord paralysis, one surgical site infection and two patients who required open surgery for controlling intraoperative complications [Table 1].

Furthermore, we developed the modified endobag and extracorporeal suture that could simplify learning process for the novice endoscopic surgeon and reduce operative time. Therefore, we compared operative times in 96 patients undergoing thyroid lobectomy and isthmectomy, with or without the use of our modified techniques. Early in our experience, we used simple endobags and sutures in eight patients. These operations lasted for 168 min, whereas operations using the modified endobag and extracorporeal suture were 30 min shorter (P > 0.05) [Table 2].

DISCUSSION

Recently, the TOETVA has been growing in popularity for the management of thyroid neoplasm. Because no visible scar is left, this approach has the best cosmetic satisfaction. Good candidate patients are those fit for surgery with no previous neck irradiation or surgery, thyroid volume ≤45 ml by ultrasound, thyroid diameter ≤10 cm and non-malignant nodule up to 5 cm in diameter.[34] In our series, thyroid surgery through TOETVA was attempted in 102 patients. The series included 92.1% lobectomies, 3.9% isthmetomy and 3.9% total thyroidectomies. The maximum nodule size in our series was 13 cm, located in the right thyroid lobe. Despite the limited dimensions

| Characteristics | Numbers | 95% CI |
|-----------------|---------|-------|
| Age (year), mean±SD | 39.1±11.3 | 39.9-41.3 |
| Nodule size (cm), mean±SD | 3.9±0.2 | 3.4-4.3 |
| Nodule size (cm), range | 1.0-13.0 |
| Operative time (min), mean±SD | 141.1±4.9 | 131.4-150.8 |
| Operation, n (%) | 1 (12.5) |
| Right lobectomy | 49 (57.8) | 48.1-67.6 |
| Left lobectomy | 35 (34.3) | 24.9-43.7 |
| Isthmectomy | 4 (3.9) | 0.1-7.8 |
| Total thyroidectomy | 4 (3.9) | 0.1-7.8 |
| Pathology, n (%) | | |
| Thyroiditis | 3 (2.9) | 1.0-8.3 |
| Benign nodule | 84 (82.4) | 74.8-89.9 |
| Malignant nodule | 15 (14.7) | 7.7-21.7 |
| Blood loss (ml), mean±SD | 95% CI: 29.4±8.4 | 4.7-15.9 |
| Hospital stay (day), mean±SD | 3.4±0.1 | 3.2-3.6 |
| Complication, n (%) | | |
| Vocal cord paresis | 9 (8.8) | 4.7-15.9 |
| Vocal cord paralysis | 1 (1.0) | 0.2-5.4 |
| Surgical site infection | 1 (1.0) | 0.2-5.4 |
| Converted technique to open surgery | 2 (2.0) | 0.5-6.9 |

SD: Standard deviation, CI: Confidence interval

| Characteristics | Modified endobag and extracorporeal suture (n=96) | P |
|-----------------|-----------------------------------------------|---|
| Age (year), mean±SD | 49.8±3.5 | 38.3±1.2 | 0.005 |
| Nodular size (cm), mean±SD | 4.8±1.5 | 3.8±0.2 | 0.545 |
| Operative time (min), mean±SD | 168.4±28.3 | 138.4±24.9 | 0.329 |
| Operation | | | |
| Right lobectomy | 3 (37.5) | 55 (62.5) | 0.178 |
| Left lobectomy | 4 (50.0) | 30 (34.1) |
| Isthmectomy | 1 (12.5) | 3 (3.4) |
| Pathology | | | |
| Thyroiditis | 1 (12.5) | 2 (2.3) | 0.205 |
| Benign nodule | 7 (87.5) | 73 (83.0) |
| Malignant nodule | 0 | 13 (14.8) | 95% CI: 8.8-23.7 |

SD: Standard deviation, CI: Confidence interval
of the corridor, this resection was successful. Extraction of the specimen through the midline wound in the oral cavity was a problem because the specimen was bigger than the wound, requiring the specimen to be brought out piecemeal in endobags. Fortunately, no complications were observed in this patient. Following a pathologist’s report of malignancy, ten patients were required to undergo complete thyroidectomy for iodine ablation. In these patients, we opted for conventional open surgery because of severe fibrosis formation following the previous surgery. In our institutes, the pathological report was done at 2 weeks after surgery; therefore, extensive fibrosis may have occurred.

Novice endoscopic surgeons often find it difficult and time-consuming to put the specimen in the endobag. We, therefore, modified the endobag to simplify identifying and stretching its mouth. Another manoeuvre difficult for a novice was reapproximating the strap muscles with a simple continuous suture. We modified the suture method and material used. Although barbed sutures, permitting reduced operative time, have recently become commercially available, they are very expensive. We developed an extracorporeal sliding knot suture as another option for this field. This kind of suture may help the novice to learn the skill faster. Certainly, operation time for thyroid lobectomy and isthmectomy was shorter when the modified equipment was used.

Demographic data between the two groups (with or without the use of modified equipment) seemed similar ($P > 0.05$), except for the age of patients; those in the latter group were younger ($P < 0.005$). Prior to the use of modified equipment, operations required an average time of 168 min but 30 min less than this when modified equipment was used. Although the time difference was not statistically significant ($P = 0.329$), it represents a substantial time-saving.

Complications of our series included vocal cord paresis, vocal cord paralysis and surgical site infection. Most of the patients with vocal paresis recovered within 6 weeks after surgery. The cause of paresis may be the heat from the ultrasonic scalpel; the surgeon should pause regularly while using the ultrasonic scalpel near the recurrent laryngeal nerve. In only one case, the vocal cords had not recovered after 6 months. This patient underwent speech rehabilitation. Surgical site infection was observed in one patient. The patient complained about redness, tenderness and swelling along the anterior neck. Antibiotic was administered for 7 days and the clinical symptoms improved.

Two patients experienced serious intraoperative complications including tearing of the internal jugular vein and of the tracheal wall. We reverted to open surgery to manage these complications. The site of massive bleeding from the internal jugular vein in one case was identified and repaired. In the other case, the tracheal wall could not be repaired with a simple suture; therefore, we performed a tracheostomy after removing the thyroid. Six days after surgery, the patient was stable and the tracheostomy tube was removed.

TOETVA is now performed in many institutes around the world with excellent patient satisfaction. We believe that the cosmetic benefit offered by TOETVA will lead to it becoming the standard for endoscopic thyroid surgery, but it cannot replace the conventional open approach. The endoscopic surgeon should know both techniques (endoscopic and open approach) in case the operation approach needs to be changed to deal any serious complication.

CONCLUSIONS

TOETVA is an alternative minimally invasive technique for thyroid surgery that provides good cosmetic satisfaction. The modified equipment that we have described will speed up the learning process for novice endoscopic surgeons. The reduced operation time achieved, although not a statistically significant improvement, was nonetheless an important time-saver.

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Conflicts of interest

There are no conflicts of interest.

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