SCIENTIFIC PAPER

Endoscopic Total Thyroidectomy

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ABSTRACT

Background and Objective: Endoscopic neck surgery for the thyroid and parathyroid is being tested as an alternative to open thyroidectomy. The aim of this study was to determine the safety and feasibility of endoscopic transaxillary total thyroidectomy (ETTT).

Methods and Results: Twenty-two consecutive patients from January 2006 to September 2008 underwent ETTT. No conversions to open were necessary. Mean age was 49.3±12.9 years, 20 were female, and 2 were male. Mean operating time was 238 minutes±72.7. Mean blood loss was 40mL±28.3mL. Mean weight of the gland was 137.05g±129.21g. The recurrent laryngeal nerve was identified with no permanent injury. Six patients developed hoarseness of the voice for a mean of 15.1±8.01 days. No patient developed tetany or hypocalcemia requiring treatment. Six patients experienced transient numbness in the anterior chest wall lasting 2 weeks in 5 patients and 2 months in one. All patients were discharged within 24 hours of admission.

Conclusion: ETTT requires additional operative time compared with the open approach, but is cosmetically favorable. Visualization of the nerve and parathyroid is much better. Although the learning curve is steep, with experience the operative time will decrease. ETTT is different but safe and feasible.

Key Words: Minimal, Invasive, Endoscopic, Thyroidectomy, Transaxillary.

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INTRODUCTION

Whenever a new surgical technique is developed, until and unless it matches up to the current gold standard in terms of safety, complications, and feasibility, it is not accepted and is relegated to the "also ran" bin. Since the days of Billroth and Kocher, thyroidectomy through a skin crease incision has proven to be a safe and effective way of treating thyroid pathology. However, these patients still have a scar in the neck that in some patients heals with hypertrophy. Twenty-five percent of patients will have neck or anterior chest pain after the operation, and 75% will experience some neck discomfort.[1] Most of these patients are women concerned about the cosmetic appearance of a scar on the neck.

Since the advent of laparoscopic cholecystectomy, the benefits of smaller scars, less postoperative pain, and faster recovery have attracted development of minimally invasive surgical techniques in all surgical specialities, and it would be fair to say that laparoscopic surgery has slowly begun to replace conventional abdominal and thoracic procedures. Gagner[2] introduced the first endoscopic subtotal parathyroidectomy in 1996, obtaining good results clinically and cosmetically. This aroused interest at many different institutions and in many surgeons who since have started performing thyroidectomies and parathyroidectomies as either endoscopic-assisted or pure endoscopic procedures.[3] In comparison with laparoscopy, endoscopic procedures in the neck are a minimal access but maximally invasive approach (MAMIA). However, an endoscopic approach provides better, magnified views of the recurrent laryngeal nerve and the parathyroid, secondary to the superior and enhanced video-optics as well as high definition monitors, resulting in fewer complications, which combined with a cosmetically superior result is quite an attractive proposition.

We have already reported our experience with endoscopic thyroid lobectomies and isthmectomy.[4]

We decided to extrapolate this experience into doing total thyroidectomies endoscopically to determine its safety and feasibility.

We now report our experience with endoscopic transaxillary total thyroidectomies.

METHODS

The transaxillary technique approaches the gland from a remote lateral site. Because it is a lateral approach, historically it has been used in the treatment of unilateral thyroid and parathyroid disease.[1] This unit had already done endoscopic transaxillary thyroid lobectomies in 32 patients between August 2003 and August 2005.[4] But can we use this approach to dissect and remove both sides of the gland. To test this, we performed a safety and technical feasibility study first utilizing a porcine model and then 3 human cadavers. After IRB approval, 3 female patients then underwent near total thyroidectomy, which was found to be feasible and extremely safe.[5]

From January 2006 to September 2008, we used the ETTT approach on 22 consecutive patients. The patients included 20 women and 2 men. Age ranged from 32 to 72 years (mean 49.3 years). All patients had clinical assessment and ultrasonography of the thyroid gland. No patients were excluded. The maximal diameter of the largest nodule ranged from 1cm to 4.8cm (mean, 2.85). The results of fine-needle aspiration cytology were Hurthle cell in 2 patients, follicular neoplasia in 1, and papillary neoplasia in another patient. Sixteen patients had compressive symptoms secondary to an enlarging multinodular goiter. Two patients had thyrotoxicosis refractory to medical management.

Operative Technique

The patient was placed on the operating table in the dorso supine position. After satisfactory induction of general anesthesia, the neck was slightly extended and the patient's right arm was placed at a 90-degree angle to the axis of the body exposing the axilla. The medial borders of the sternocleidomastoids, the midline, and the sternal notch were marked to aid identification perioperatively. The ipsilateral axilla, neck, and chest wall was prepped and draped in the usual fashion for exposure of the neck and thyroid region.

Then using a sharp skin knife, a small incision was made in the axilla. A tumescent solution of 1mL of 1:1 000 000 epinephrine with 50mL of 1% Xylocaine in 1L of Ringers lactate solution was used to infiltrate the soft tissue between the anterior pectoral fascia and the platysma muscle from the lateral border of pectoralis major to the ipsilateral sternocleidomastoid. This facilitates hemostasis and enhances postoperative pain control.[4] After 10 minutes, the tissue plane between the pectoralis major muscle and the platysma was bluntly dissected. A 10-mm port was then inserted, keeping it above the pectoralis major at all times, directing it towards the neck. A Covidien extra view balloon dissector was then introduced through this port, and the balloon was inflated just as you would in an inguinal hernia operation under vision. This space was then insufflated to 8-mm Hg to 10-mm Hg carbon dioxide pressure to maintain visualization with a 10-mm 45-degree endoscope. Two more 5-mm incisions were then placed in the axilla to allow 5-mm ports to be introduced under vision for aiding the introduction of operative instruments (**Figures 1 and 2**). Sharp dissection with scissors and electrocautery were used to dissect the avascular plane between the platysma and the pectoralis major muscle. The ipsilateral sternocleidomastoid muscle was identified and retracted downward to expose the thyroid gland tracking down in a substernal fashion. The sternothyroid muscle covering the thyroid gland was identified and transected by using the Harmonic ace scalpel (Ethicon, Somerville, NJ). The sternohyoid muscle was retracted cephalad to expose the ipsilateral lobe of the thyroid. The middle thyroid vein was identified and taken down using the Harmonic scalpel. We then proceeded to the inferior pole where the inferior thyroid artery was dissected and divided using the Harmonic scalpel. The recurrent laryngeal nerve was then identified (**Figure 3**) and care was taken to avoid injury to this structure. The parathyroid gland was also identified and protected. Once the inferior thyroid pole was freed, the gland was then dissected off the trachea up to the ligament of Berry. The Harmonic scalpel was used to transect the ligament of Berry to free up the majority of the isthmus of the thyroid gland. The superior pole was approached, and again the external branch of the superior laryngeal nerve was identified as was the superior parathyroid gland, and both of these

Figure 1. Surface marking.

Figure 2. Axillary ports.

Figure 3. Ipsilateral recurrent laryngeal nerve.

structures were protected. The superior thyroid artery and vein were taken with the Harmonic scalpel freeing up the entire lobe of the thyroid gland.

Once the ipsilateral gland was freed, we then turned our attention to the contralateral lobe. By using the Harmonic scalpel, the body of the thyroid was freed from the trachea. The inferior pole was identified. Prior to transection of the inferior contralateral thyroid vessels, the recurrent laryngeal nerve **(Figure 4)** was identified and protected. The parathyroid gland was also identified and preserved. The gland was then dissected off the trachea, always keeping the recurrent laryngeal nerve in view. The 45-degree endoscope makes this very much possible. The superior pole was taken by transecting the superior thyroid vessels.

Figure 4. Contralateral nerve.

After the total gland was transected and freed from the trachea, hemostasis was obtained, and the gland extracted using an Endocatch (Ethicon, Somerville, NJ) impermeable bag through the 10-mm port. Rarely is extension of incision needed to allow for retrieval of a larger gland. A 10-mm Blake's drain was placed and brought out through the trocar site. The area was desufflated, and the wounds closed with interrupted 4–0 Monocryl suture. Ice packs were placed on the neck and anterior chest wall intermittently for 2 hours. The drain was removed the next day, and the patients were discharged.

RESULTS

All patients had successful completion of total thyroidectomy via the endoscopic transaxillary approach. Seven patients had nodular hyperplasia on histopathological examination (**Table 1**). Six patients had follicular adenoma, 4 patients had papillary carcinoma, 3 patients had colloid lesions within a nodular goiter, and 2 patients had Hürthle

Table 1.
Histopathological Findings

Histopathology	Number (%)
Nodular Hyperplasia	7 (31.81%)
Follicular Adenoma	6 (27.27%)
Papillary Carcinoma	4 (18.18%)
Colloid Lesions Within a Nodular Goitre	3 (13.63%)
Hürthle Cell Change	2 (9.09%)

cell change. The papillary cancers were 1 cm, 1.5 cm, 2 cm, and 2.7 cm in size on pathological sectioning. The patient with 2.7 cm papillary cancer had multifocal involvement.

Mean operating time was 238 minutes (range, 110 to 360). Mean blood loss was 40mL (range, 10 to 120). Most of this bleeding was from the blunt dissection of the anterior chest wall. There was negligible blood loss in the area of the neck mainly due to the Harmonic scalpel. Mean weight of the gland was 137.05 g (range, 30 to 520). The recurrent laryngeal nerve was identified bilaterally in all patients with no permanent injury to this structure. There were no major issues with postoperative pain control with all patients receiving oral opioids for pain relief immediately after surgery. Six patients developed hoarseness of the voice postoperatively lasting for a mean of 15.1 days (range, 7 to 21). No patient had symptomatic tetany or hypocalcemia requiring treatment. Six patients experienced transient numbness in the anterior chest wall, lasting 2 weeks in 5 patients and 2 months in one (**Table 2**). The length of stay for all patients was <24 hours. All patients were extremely satisfied with the cosmetic results achieved.

DISCUSSION

A new surgical technique when developed has to face up to its conventional standard and be comparable when it comes to results achieved, complications, safety, technical feasibility, and cost to benefit ratio. A considerable recent surge has occurred in the development of minimally invasive techniques in thyroid surgery.

Gagner[2] developed endoscopic surgery for the neck in 1996. Huscher et al[6] reported the first endoscopic thyroidectomy using a transcervical approach to treat a 3-mm papillary micro carcinoma in 1997. Since then, several approaches have been developed to endoscopically treat diseases of the thyroid and parathyroid.[1,7–10] There is no doubt that the endoscopic technique in the neck achieves much better cosmesis compared with the open method.[1] The incisions are in a location far away from the neck. However, to call the endoscopic approach a minimally invasive technique may be a misnomer. It involves quite extensive tissue dissection in the anterior chest region to achieve a plane anterior to the pectoral muscles that it is actually maximally invasive in the chest area but definitely minimally invasive in the neck.

Table 2.
Postoperative Findings in 22 Patients Who Underwent Endoscopic Transaxillary Total Thyroidectomy

	Mean	Range
Max Diameter Nodule (cm)	2.85	1–4.8
Resected Gland Weight (g)	137.05	30–520
Operative Time (min)	238	110–360
Blood Loss (mL)	40	10–120
Hoarse Voice	6 pts	7–23 days
Transient Numbness Anterior Chest Wall	6 pts	14–60 days

In our series, we used infiltration of tumescent fluid combined with a local anesthetic prior to dissection in the chest, and our patients had better pain control.[4] Pain and discomfort in the anterior chest area usually were controlled with oral analgesics and subsided within a week with patients returning to normal activity in about 6.2 days.

The transaxillary approach requires carbon dioxide insufflation to achieve great lateral views of the thyroid. In this article, we report on a modification in technique by using balloon dissectors used in the laparoscopic inguinal TEPP approach to dissect tissue anterior to the pectoral muscle and achieve a subplatysmal plane in the neck, which provides a working area with adequate insufflation and helps in subsequent dissection. Although complications have been described with CO_2 insufflation, such as subcutaneous emphysema and hypercarbia,[2] we have had no issues in any of our patients. We used pressures between 8mm Hg and 10mm Hg.[11] Cardio-respiratory dynamics were stable and $ETCO_2$ was normal.

Visualization of the anatomy in the neck is definitely superior compared with the open method, because of enhanced fiberoptics and magnification. The lateral view of the thyroid gives better views of the recurrent laryngeal nerve and the parathyroid. Demonstration of this precise anatomic detail enhances patient safety and causes a reduction of 1% to 3% in the incidence of recurrent laryngeal nerve injury.[12–14] In our series, 25% of patients developed transient hoarseness of the voice. This is significantly higher than in standard patient groups undergoing open thyroidectomy. This was because this subset of patients had large glands, which were being constantly manipulated around the nerve in a confined space. It is imperative that the recurrent laryngeal nerve is identified before use of the scalpel near that area due to lateral spread of energy of the Harmonic scalpel. Although sufficient care was taken to keep the Harmonic scalpel more than a few millimeters away from the nerve at all times, lateral spread of energy may have been a factor as well.

Although in the literature conversion rates are reported to be 0% to 13%, we did not have any conversions. This directly relates to the prior endoscopic experience of the main surgeon in endoscopic thyroid surgery with formal training attained in Japan as well as his own experience with previous thyroid lobectomies. As is the case with open surgery, exposure to a high volume of cases enables one to be comfortable with the surgical anatomy.

Bleeding in the neck is almost nil secondary to the use of the Harmonic scalpel. In most cases, bleeding is secondary to tissue dissection in the chest, and we find that tissue grinders used in liposuction to break the fat planes minimize injury in the chest.

We remove the thyroid gland through the 10-mm port with an Endopouch to minimize the risk of seeding. Rarely, the incision needs to be lengthened to accommodate a larger gland.

Different indications or inclusion criteria for this technique have been reported in the literature depending on tumor size and the size of the thyroid gland.[1] We did not exclude any patients in our series (**Figure 5**). Most patients in our practice were referred to us by endocrinologists and had already been informed of the potential risks of the procedure, which was reinforced during the initial consultation. Although potential risks of seeding and local recurrence have not been evaluated, we believe use of the Endopouch reduces that risk. None of our patients have had local recurrence or seeding. The longest follow-up to date was 22 months.

The only factor in our series that does not compare favorably with the open procedure is the time factor. In the review done by Slotema et al,[14] endoscopic total thyroidectomy averaged 280 minutes. The average time in our series compares favorably with 238 minutes. The following factors need to be considered. In the initial few patients, the operating time of the main surgeon was quite high, but with experience, the time in the middle period was down to about 110 minutes in one case. This unit participates in a minimally invasive surgical fellowship, and for the latter part of the series mostly fellows have contributed under the supervision of the main surgeon, which has resulted in increased operative times. In spite of the above fact, our average is about 42 minutes lower. We sincerely believe that the operative time can be further decreased with repetition and practice, as is the case with all operative procedures.

Figure 5. Large resected specimen.

CONCLUSION

The 2 current published reviews on endoscopic thyroid surgery done in 2008 confirm that although it is not possible to make a recommendation based on evidence due to the paucity of numbers and randomized controlled trials, there exists a general agreement that endoscopic thyroid surgery is a safe and valid option.[3,14]

Our series is another pointer in that direction. ETTL is different from standard open conventional treatment but is a safe and feasible option. Although superiority to open procedures may not have been demonstrated, it is in no way inferior.

Although this study reflects good early results, we do not advocate thyroid operations to be done endoscopically in a community hospital setting where there is a low volume of thyroid surgery. Going by the principal surgeon's own experience, it takes at least 25 endoscopic thyroid lobectomies initially to be conversant with the surgical anatomy on view. Beginners should avoid taking on large goiters endoscopically, and in the initial stages one should have a low threshold to covert to open.

With centralized training in endoscopic thyroid surgery and increased operative experience, operative times will decrease.

Randomized controlled trials done at a centralized high-volume endocrine center by surgeons skilled in endoscopic thyroid surgery will provide the required evidence.

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