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SURGICAL ENDOSCOPY
and Other Interventional Techniques

Endoscopic thyroidectomy and parathyroidectomy by the axillary approach

A preliminary report

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Abstract
Background: The use of endoscopic procedures leads to a reduction in the size of the surgical scar, making it more inconspicuous. In this paper, we evaluated the merits and limits of endoscopic neck surgery.
Methods: Between August 1999 and July 2000, 102 patients underwent neck surgery in our department for thyroid or parathyroid disease. Twenty-eight of them were treated by the axillary. A 12-mm and two 5-mm trocars were inserted through the skin of the axilla. Carbon dioxide was then insufflated up to 4 mmHg, and the endoscopic surgery was performed.
Results: Endoscopic procedures were performed successfully in 26 cases (19 thyroidectomies and seven parathyroidectomies). There were two conversions to open procedures. The mean operating times for the thyroidectomies and parathyroidectomies were 212 and 171 min, respectively. No evidence of injury to the recurrent laryngeal nerve was observed in any of the cases. The postoperative cosmetic status of the patients was excellent.
Conclusion: We believe that endoscopic thyroidectomy and parathyroidectomy by the axillary approach will find a role in the treatment of endocrine diseases in the neck.

Key words: Axillary approach — Endocrine surgery — Endoscopic surgery — Thyroidectomy — Parathyroidectomy

Thyroidectomies and parathyroidectomies using a direct approach through the neck are effective, well-tolerated, and safe. However, they require transverse incisions through the skin of the neck. Diseases of the thyroid and parathyroid glands are more common in women, so a reduction in the size of the incision in the skin of the neck or its elimination is often desired. Gagner described the first endoscopic subtotal parathyroidectomy with constant gas insufflation for hyperparathyroidism in 1996 and obtained good clinical and cosmetic results [1]. However, a few patients still objected to the small and inconspicuous scar in the neck, and there was some complication from the gas insufflation [2]. As a result, alternative techniques were devised to further improve the results of endoscopic surgery [3, 5, 6, 8, 10, 11]. We have already reported on a novel technique for endoscopic neck surgery by the axillary approach [4]. Here we evaluate the merits and limits of our endoscopic procedure.

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Patients and methods

Between August 1999 and July 2000, 102 patients underwent neck surgery for thyroid or parathyroid diseases at our hospital. Twenty-eight of them (27%) (24 women and four men) were treated using endoscopic neck surgery by the axillary approach. Nineteen thyroidectomies (15 total thyroid lobectomies and five partial lobectomies) were performed for tumors with a single thyroid nodule, and eight unilateral neck explorations were performed for primary hyperparathyroidism. The preoperative diagnosis of the thyroid tumors was made using fine-needle aspiration and high-resolution ultrasonography. Indications for endoscopic thyroidectomy included the presence of a follicular tumor that was < 4 cm in largest diameter by preoperative ultrasonography. After a learning period, these eligibility criteria were followed less strictly, and after the first nine patients, patients with a large follicular tumor < 6 cm in largest diameter by preoperative ultrasonography were selected for endoscopic thyroidectomy. In patients with hyperparathyroidism, endoscopic parathyroidectomy by the axillary approach was adopted if a solitary parathyroid adenoma located above the clavicle in the neck had been identified using high-resolution ultrasonography and sestamibi scintigraphy. Postoperative evaluation of vocal cord motility was done by laryngoscopy in all cases.

Surgical technique

The patient was placed in a supine position while under general anesthesia. The neck was slightly extended, and the arm on the side of the lesion was raised to fully expose the axilla. A 30-mm incision was then made in the skin of the axilla, and the lower layer of the platysma muscle was dissected to expose the upper layer of the pectoralis major muscle (Fig. 1). The

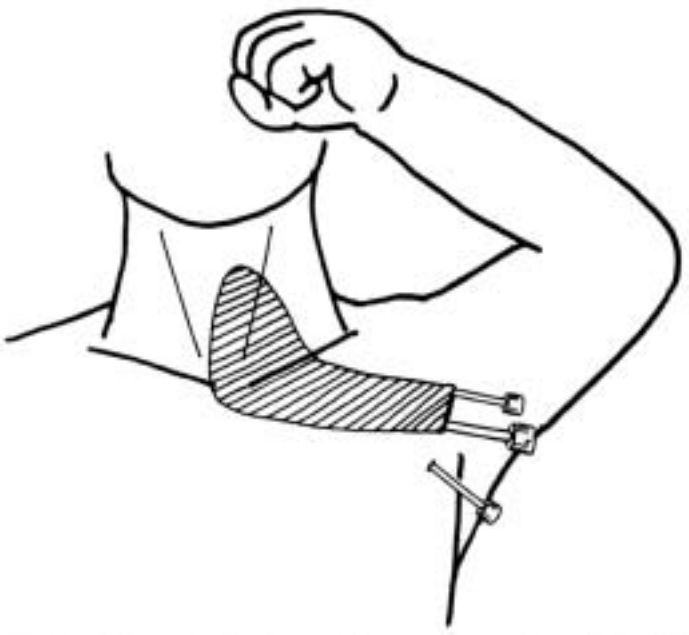

Fig. 1. Schematic drawing of the anterior neck area from the axilla. The excoriated layer is indicated by oblique lines. A 12-mm and a 5-mm trocar are inserted through the 30-mm skin incision in the axilla, and one more 5-mm trocar is inserted near the incision.

incision was extended beneath the skin using a Vein Harvest (Johnson & Johnson Medical, Cincinnati, OH, USA).

A 12-mm and a 5-mm trocar were inserted through the incision, and a pursestring suture was made to prevent gas leakage and stop the trocar from slipping out of the wound. Carbon dioxide was insufflated up to a pressure of 4 mmHg. A flexible laparoscope (EL2-TF410; Fuji Photo Optical, Tokyo, Japan) was then inserted through the 12-mm trocar. A space was created after adequate dissection, and a second 5-mm trocar was inserted near the 30-mm skin incision in the axilla under endoscopic guidance. Endoscopic scissors were used for blunt and sharp dissection to enlarge the subplastymal space. The anterior border of the sternocleidomastoid muscle was dissected from the sternohyoid muscle, and a space was created.

Thyroidectomy. The thyroid gland was exposed by dividing the sternothyroid muscle using a Harmonic Scalpel (HS), (Johnson & Johnson Medical). The upper pole was thoroughly explored, grasped, drawn toward the operator, and resected in the thyroid gland to avoid injuring the external branch of the superior laryngeal nerve. When the external branch of the superior laryngeal nerve was identified around the superior thyroid artery, the artery was divided with clips to avoid injuring the nerve (Fig. 2). The lower pole was then drawn upward and dissected from the adipose tissue and cervical thymic tissue to avoid injuring the inferior parathyroid gland. The gland was retracted medially, and the perithyroidal fascia was incised using endoscopic scissors. In doing so, care was taken to avoid injuring the laryngeal recurrent nerve. The laryngeal recurrent nerve can usually be located between the trachea and the carotid artery. The superior parathyroid gland was identified during the dissection and left intact. The thyroid gland was then dissected from the trachea, and the isthmus was resected using the HS. In this manner, a total hemithyroidectomy was performed.

Parathyroidectomy (unilateral neck explorations). The thyroid gland was exposed by splitting the sternothyroid muscle. The superior or inferior pole of the thyroid gland was then rotated forward to reveal one of the parathyroid glands. The perithyroid fascia was carefully cut so that the parathyroid adenoma protruded, and the adenoma was dissected using endoscopic scissors or the HS (Fig. 3). The other ipsilateral parathyroid gland was also explored. If the parathyroid gland appeared normal, a biopsy was performed. If the gland appeared to be enlarged, it was dissected and removed using the endoscopic scissors or the HS.

During both surgical procedures, the specimen was extracted through the incision in the skin. Prior to concluding the operation, a 3-mm closed suction drain was placed under the platysma at the site of the inferior 5-mm trocar in the axilla. The wounds were closed with 3-0 absorbable thread sutures after the subcutis had been tightly sutured using a 4-0 absorbable monofilament thread and an atraumatic needle. Tape was used to approximate the skin.

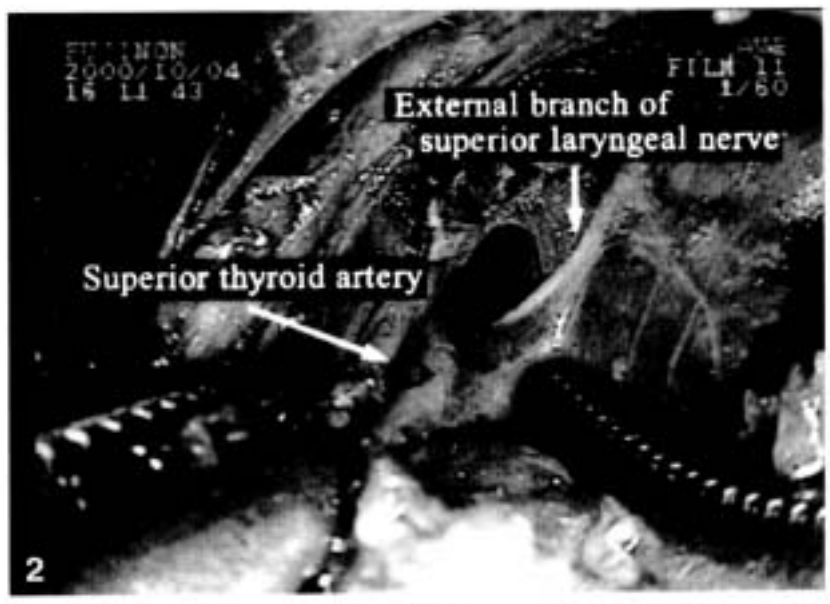

Fig. 2. After the external branch of the superior laryngeal nerve is identified around the superior thyroid artery, the artery is divided with clips to avoid injuring the nerve.

Fig. 3. The parathyroid adenoma is dissected with endoscopic scissors.

The following data were collected prospectively in all patients: age, gender, operation time, blood loss, size of the resected thyroid, and weight of the resected thyroid and parathyroid adenoma. Data are presented as mean ± standard error of mean (SEM).

Results

Endoscopic procedures were performed successfully in 26 patients (19 thyroidectomies and seven parathyroidectomies). Patient characteristics and details of the endoscopic thyroidectomies and parathyroidectomies are presented in Tables 1 and 2, respectively.

During the first 2 months, four thyroidectomies and two parathyroidectomies were performed. The operation times from skin incision to skin closure required for thyroidectomy and parathyroidectomy were 293 and 203 min, respectively. After this early phase of the learning curve, the time quickly dropped to 148 and 150 min respectively, in the next 2 months. After the first nine patients, patients with a large follicular tumor < 6 cm in largest diameter by preoperative ultrasonography were selected for endoscopic thy-

Table 1. Patient data for thyroidectomy (n = 19)

	Mean ± SEM	Range
Age (yr)	45.1 ± 2.5	25–58
Men/women	2/17	
Operating time (min)	212 ± 18	60–350
Blood loss (g)	76 ± 23	10–306
Tumor size (mm)	37.0 ± 2.9	15–55
Weight of resected thyroid (g)	20.1 ± 3.6	12–70

SEM, standard error of the mean

Table 2. Patient data for parathyroidectomy (n = 7)

	Mean ± SEM	Range
Age (yr)	59.7 ± 6.3	26–73
Men/women	1/6	
Operating time (min)	171 ± 17	115–235
Blood loss (g)	30 ± 12	10–80
Weight of adenoma (g)	308 ± 44	200–450

SEM, standard error of the mean

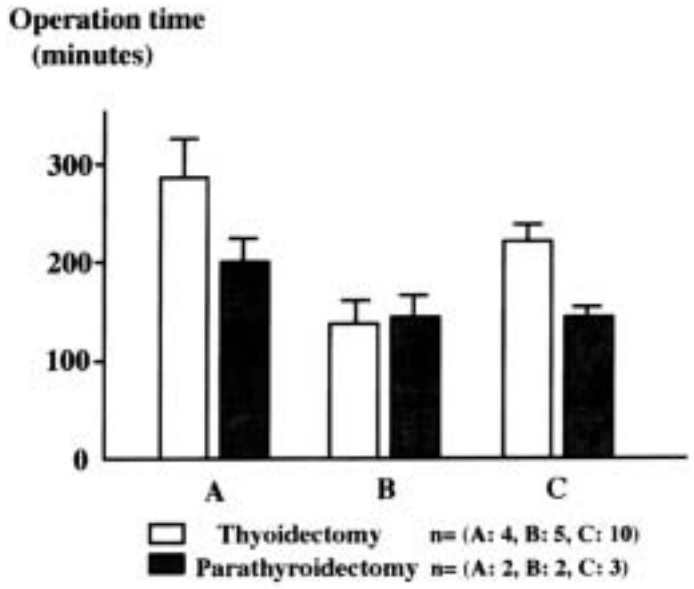

Fig. 4. Changes in the mean (SEM) operating times for thyroidectomy and parathyroidectomy. The indication for endoscopic thyroidectomy, in terms of the lesion's size by preoperative ultrasonography, changed over the course of our experience. (**A** first 2 months, **B** second 2 months, **C** last 8 months.

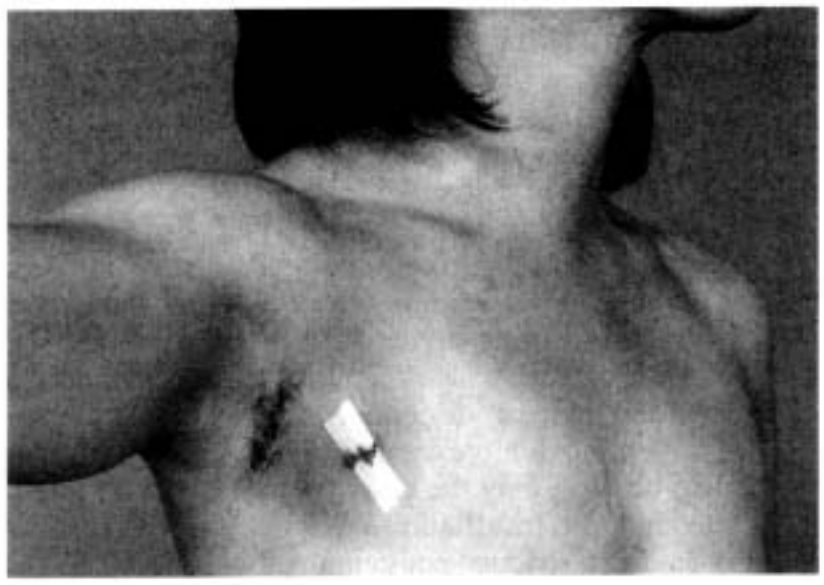

Fig. 5. Photograph of the neck and axilla region 2 weeks after endoscopic thyroidectomy by the axillary approach.

roidectomy. Therefore, the mean operation time for the next 10 patients—including three cases < 4 cm, one 4-cm case, and six cases 4–6 cm in largest diameter by preoperative ultrasonography—lengthened again to 210 min (Fig. 4).

There were two conversions to an open procedure, one for bleeding of the sternocleidomastoid muscle during a thyroidectomy and another due to the presence of a thymic parathyroid adenoma. None of the patients developed hypercapnia at any time. No complications of facial subcutaneous emphysema were observed. Subcutaneous emphysema in the neck and anterior chest resolved within the postoperative period. There were no injuries to the recurrent laryngeal nerve. The postoperative cosmetic results were excellent (Fig. 5), and the patients experienced minimal pain, hypesthesia, and paresthesia: in the neck. However, some patients complained of discomfort in the anterior chest wall, especially in the subclavicle region where the skin flap was excoriated.

The drainage tube was removed within 2 days after surgery, and all patients were discharged during the first 4 postoperative days.

Histologic examination revealed that 11 thyroid tumors were benign follicular adenomas, seven were benign adenomatous nodules, and one was microcarcinoma. In the parathyroidectomy cases, all specimens confirmed the diagnosis of parathyroid adenoma. During follow-up examinations, the serum calcium and parathyroid hormone levels were normal in the patients who underwent thyroidectomy, and serum calcium and parathyroid hormone levels returned to their normal range in the patients with hyperparathyroidism. Discomfort in the anterior chest wall disappeared within 3 months.

Discussion

Endoscopic operations in the neck region can be classified into two types—"pure" endoscopic procedures characterized by constant gas insufflation [1, 3, 8, 11] and procedures using video-assisted gasless techniques [5, 6, 10]. Each of these approaches has its own advantages and disadvantages. The pure endoscopic procedure is performed by remote control. The cosmetic result with this approach is superior to that of video-assisted gasless techniques because a small incision can be made far from the neck region. For this reason, we have adopted a "pure" endoscopic surgical approach and developed methods for performing endoscopic thyroidectomies and parathyroidectomies by the axillary approach [4].

Using our technique, the trocars are inserted through the axilla. This approach leaves no scars in the skin of the neck or anterior chest wall. The small scar left in the axilla is completely covered by the patient's arm when the arm is in its natural position. In addition, the thyroid gland is visualized laterally using our method, and the perithyroid fascia is carefully cut, providing an operative field of view equivalent to that of open surgery. This lateral view allows us to easily identify the recurrent laryngeal nerve and the parathyroid glands.

Furthermore, a sufficiently large working space is created without sectioning the sternohyoid muscle. Actually, no injuries to the recurrent laryngeal nerve or the parathyroid gland are made, and discomfort of the neck region is minimal.

The disadvantages of our technique include the time required for surgery, the invasiveness as a result of the extensive exploration from the axilla to the neck, the risk of complications from sustained carbon dioxide absorption, and the impossibility of identifying the contralateral thyroid lobe and parathyroid glands.

During the first 2 months, the operation times required for thyroidectomy and parathyroidectomy were 293 and 203 min, respectively. Thereafter, the operation time quickly shortened to < 150 min as the surgeons acquired more experience with the procedure during the second 2 months. However, in the thyroidectomy, the mean operation time lengthened again because larger tumors were added to our indications for thyroidectomies (Fig. 4). We believe that the operation time will gradually become shorter for the extraction of large thyroid tumors as we gain more experience. But an operation time of > 200 min was too long for thyroidectomy, considering that the time required for the standard open procedure was ~ 90 min at this center. Therefore, the indication for our technique seems to be cases with lesions < 4 cm in largest diameter by preoperative ultrasonography. The area of dissection from the axilla to the neck created some patient discomfort and led to a need for drainage. However, the discomfort disappeared after ~ 3 months, and the drainage tubes were removed within 2 days after surgery. In the follow-up period for ambulatory treatment, nearly all of our patients said that the cosmetic advantages outweighed the transient discomfort.

The carbon dioxide pressure used in our approach was < 4 mmHg because only the platysma needed to be lifted. Thanks to this low insufflation pressure, hypercapnia, respiratory acidosis, subcutaneous emphysema, and air emboli sms were minimized [7, 9]. However, the contralateral region of the thyroid and parathyroid gland and the substernal or subclavicular ectopic parathyroid glands were extremely difficult to resect using this approach.

In conclusion, endoscopic neck surgery by the axillary approach allows patients to obtain excellent cosmetic results, along with minimal pain, hypesthesia, and paresthesia in the neck. With further testing, it may become the procedure of choice for well-selected patients with thyroid and parathyroid disease. Indications for our procedure include the presence of a single thyroid nodule measuring < 4 cm in largest diameter by preoperative ultrasonography and a single parathyroid adenoma with primary hyperparathyroidism that is detected above the clavicle in the neck using high-resolution ultrasonography and sestamibi scintigraphy.

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