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The Cricothyroid Space: a Guide for Successful Thyroidectomy

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OBJECTIVE: The frequent complications of thyroid surgery are mostly related to the anatomy of the region. This stimulated us to look for a starting point that makes exploration of the region easier and consequently reduces complications. We aimed to explore and define the anatomy of the cricothyroid (CT) region from cadaveric dissection and to present the outcome of 73 consecutive thyroidectomies starting from a space in the CT region.

METHODS: Dissection in the thyroid gland region and creating a space in the CT region was performed on five cadavers (10 spaces), followed by 73 consecutive thyroidectomies through a standard approach beginning from the CT space.

RESULTS: In all cadavers, a space was easily created in the CT region. Vessels, nerves and the parathyroid glands were identified. Standard thyroidectomy starting from the CT space was performed on 73 patients. The external laryngeal nerve was seen in 40% of the cases. The recurrent laryngeal nerve was identified and preserved in all patients. Six patients had temporary hypocalcaemia and eight had a temporary voice change. None of the patients had permanent hypoparathyroidism or recurrent laryngeal nerve palsy.

CONCLUSION: The CT space is an avascular space medial to the thyroid lobe and is a good starting point for thyroidectomy that allows easy and safe exploration of the region. (*Asian J Surg* 2002;25(3): 226–31)

Introduction

Several surgical techniques for thyroidectomy have been described,[1,2] even dating as far back as Albucasus in 952 AD.[3,4] These techniques require skill and sound knowledge in surgical anatomy and in the variations in structures in the thyroid territory. These techniques are associated with specific complications such as injury to the recurrent laryngeal nerves, the external branches of the superior laryngeal nerves and the parathyroid glands. Such complications are attributed to the difficulty in identifying these structures in the relatively small and crowded field of surgery.

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In this paper, we describe the cricothyroid area which, if identified at an early step in thyroid surgery followed by ligation of the superior thyroid vessels and dissection of the superior parathyroid glands, can lead to dramatic improvement in thyroid surgery and marked reduction in complications. In addition, we present our results following a standard approach for thyroidectomy starting from the cricothyroid area and schematic pictures taken for the space created at an early step in surgery.

Materials and Methods

This was a prospective study in which the thyroid area was dissected on cadavers before the implementation of the procedure on patients.

Cadavers

Five formalin-embalmed bodies were used (10 sides). They were all male, aged 35–55 years (average, 39 yr). The thyroid gland was exposed through a transverse neck

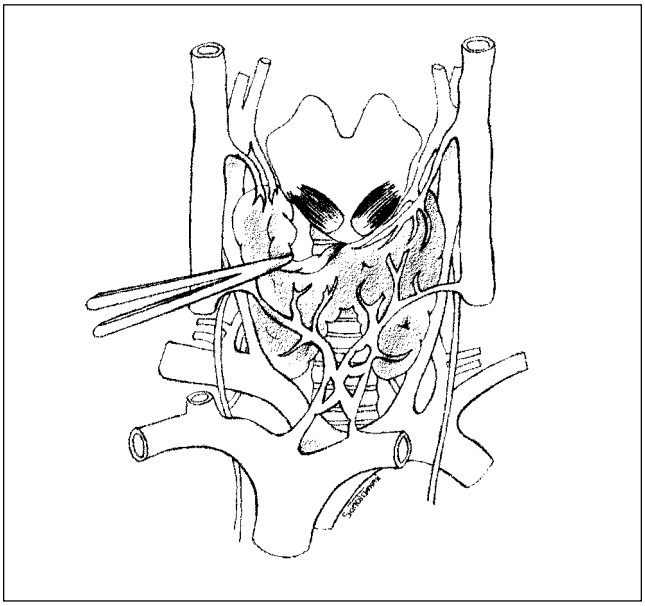

Figure 1A. The upper pole of the thyroid is retracted downward and laterally by a Kelly clamp to expose the cricothyroid space.

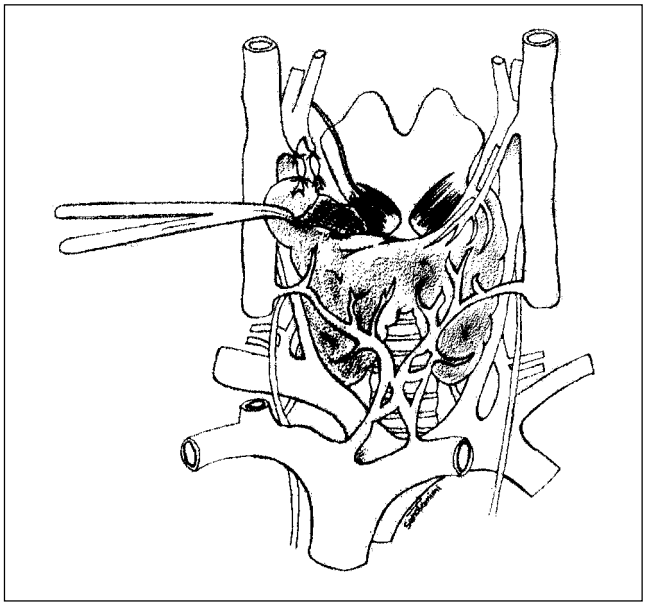

Figure 1C. The external branch of the superior laryngeal nerve might be encountered at this step in 40% of cases. Vicryl sutures are used to ligate the superior pole vessels.

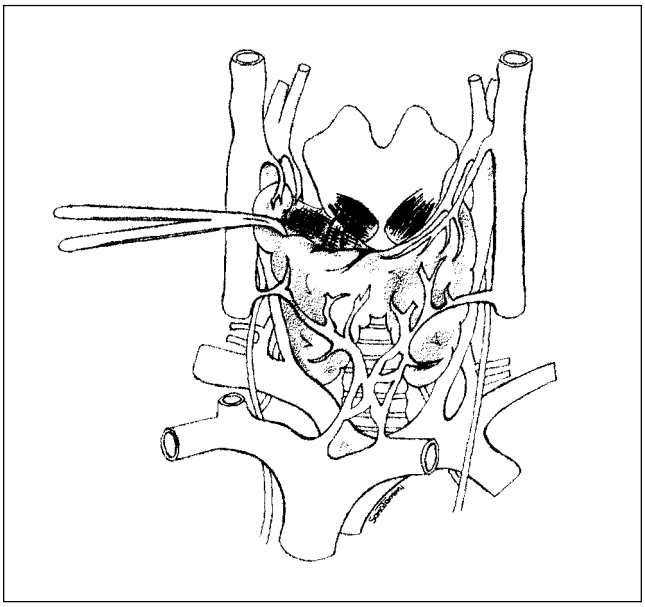

Figure 1B. A window is created between the superior pole of the thyroid pole and the cricothyroid muscle using a right angle clamp.

incision. The steps followed in dissection were the same as those for thyroidectomy described below. Photographs were then taken and drawn to illustrate the space between the cricothyroid muscle and the lobe of the thyroid gland.

Operative Technique

Following the cranial/same-side approach, a collar skin incision was performed and skin flaps were raised. The middle thyroid veins were ligated at an early step to help mobilize the thyroid gland easily. Using a Kelly clamp, the thyroid gland was retracted inferolaterally (Figure 1A).

A window was created between the superior pole of the thyroid and the cricothyroid muscle using a right angle dissector (Figure 1B), followed by ligation of the vessels crossing the overlying area. Dissection was in the direction of the superior pole vessels on the surface of the thyroid gland (Figure 1C). The superior pole vessels on the thyroid gland were secured using (2/0) thread. Dissection continued along the superior pole towards the superior parathyroid territory (Figure 2A). After identifying the superior parathyroid, dissection proceeded backward in a clockwise direction towards the isthmus of the thyroid. The subisthmus plane was identified from above and from below. An artery forceps was used to elevate the isthmus (Figure 2B). Dissection continued in a clockwise direction from the lower pole of the thyroid, and the inferior thyroid vessels were ligated in a subcapsular way.

In approximately 75% of the cases, the inferior parathyroid gland could be identified and separated from the thyroid gland. Searching for the recurrent laryngeal nerve was done while slowly moving along the capsule of the

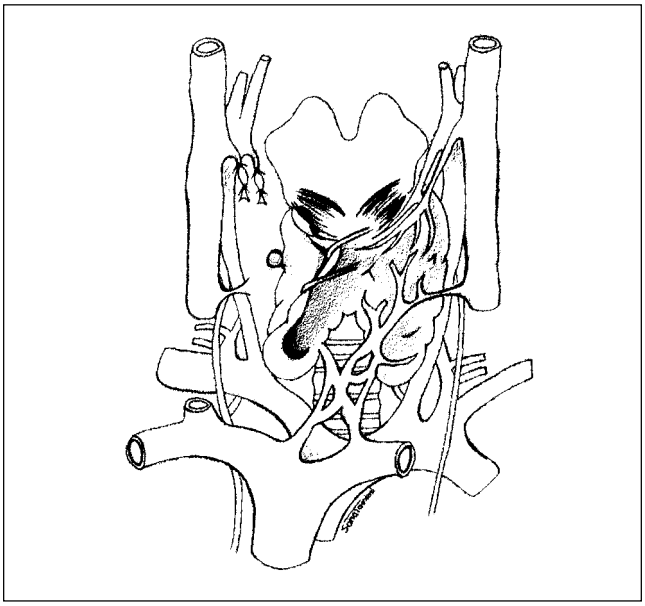

Figure 2A. Dissection continues along the superior pole of the thyroid towards the superior parathyroid territory. The superior parathyroid gland is not removed at this stage, as it is recommended to leave it as a landmark for the area of the recurrent laryngeal nerve.

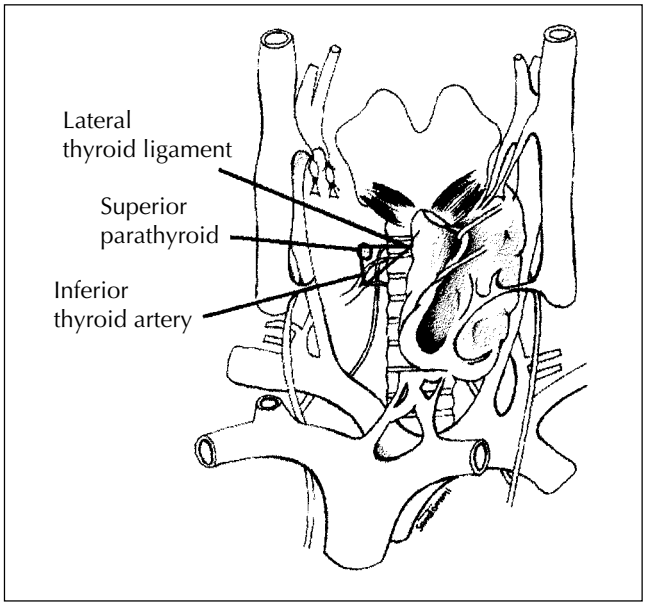

Figure 2C. A triangular area is created between the superior parathyroid gland, the lateral suspensory ligament (of Berry) and the inferior thyroid vessels (the recurrent laryngeal nerve triangle).

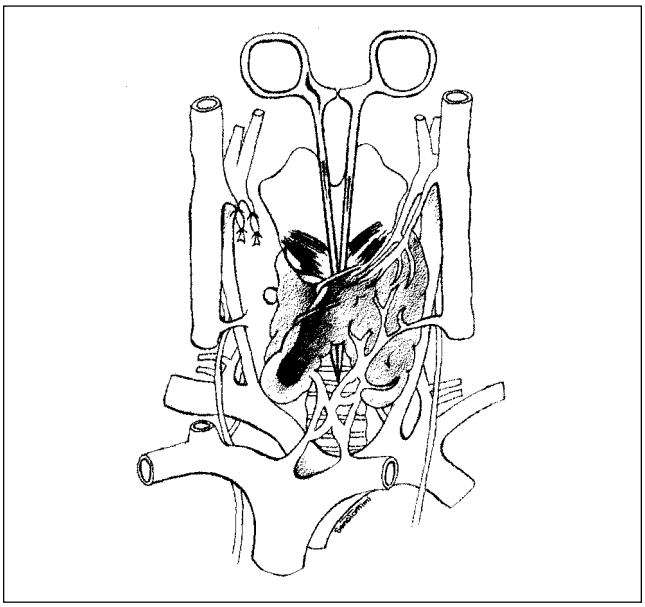

Figure 2B. The subisthmus space is identified and elevated using artery forceps.

thyroid gland and ligating the vessels subcapsularly. Placing artery forceps in the subisthmus space helped identify the trachea as a reference point and narrowed the area in which to search for the nerve (Figure 2C). At this stage, the nerve was found in a triangular area bounded superiorly by the superior parathyroid gland, medially by the lateral suspensory ligament of the thyroid and inferiorly by the inferior thyroid artery or its branches. Once the nerve was identified, it was separated from the thyroid using the unroofing technique. Then, the superior parathyroid gland was dissected and separated from the thyroid safely.

Results

Anatomical study

Retraction of the thyroid lobe inferolaterally revealed a diamond-shaped avascular space filled with loose areolar connective tissue that was easily dissected. The space was bound medially by the lamina of the thyroid cartilage above and the cricoid cartilage covered by the cricothyroid muscle below. Posteromedially, the space was limited by the lateral thyroid ligament, while inferiorly it was limited by the junction between the lobe and isthmus. The roof of the area was traversed by one or two small veins that were easily ligated.

Surgery

The cricothyroid area was used as a starting point for thyroidectomy in all 73 patients, as described previously. There were 10 men and 63 women whose mean age at the time of diagnosis was 44.1 years. The goitre in 89.9% of

Table 1. Demographics

	n	%
Mean age, 44.1 years		
Sex		
Male	10	14
Female	63	86
Position		
Cervical	65	89
Substernal	8	11
Presentation		
Solitary nodule	42	57.5
Multinodular goitre	21	28.8
Diffuse goitre	10	13.7
Clinical feature		
Euthyroid	62	84.9
Toxic	10	13.7
Hypothyroid	1	1.4

Table 2. Indications for surgery

	n	%
Compression	23	31.5
Risk of malignancy	23	31.5
Thyrotoxicosis	10	13.7
Substernal goitre	3	4.1
Cosmesis	12	16.4
Autonomous nodule	2	2.7
Completion for previous cancer	1	1.4
Recurrent goitre	2	2.7

the patients was cervical in location (Table 1). The most common indications for surgery were compression and the risk of malignancy, accounting for 62% (Table 2). The extent of surgery is shown in (Table 3). Six patients had temporary hypocalcaemia that responded to oral calcium supplements and improved in 2 to 4 weeks after surgery. Eight patients had temporary voice changes that improved in 2 to 6 weeks after surgery. Two patients had preoperative recurrent laryngeal nerve injury which continued postoperatively. Two patients had minor wound infections that responded to antibiotics — they did not require further surgery (Table 4).

Discussion

There is a lack of original work on the anatomy of the cricothyroid area. Anatomy textbooks give detailed accounts on the relations, blood supply and innervation of the thyroid gland. They describe the medial surface of the thyroid lobe to be adapted to the larynx and trachea, separated from the latter inferiorly by the cricothyroid muscle. The external laryngeal nerve is related to this surface. However, none of the anatomy books mention any space in relation to the thyroid gland, particularly in relation to its medial surface.[5–8] From the surgical perspective, Abdullah et al described the cricothyroid area as an important landmark in thyroid surgery.[9] In the present study, we confirmed the existence of a space in cadaveric specimens and described a standard thyroidectomy starting from this point with no permanent complications. Strands of loose connective tissue were found in this space that could be easily dissected allowing the space to be widely opened; an important step that helps in protecting the external branch of the superior laryngeal nerve, which can be seen in 40% of cases.[10,11] Furthermore, it allows easy access to secure ligation of the superior pole vessels on the surface of the thyroid gland. The superior parathyroid glands are located at the posterior aspect of the cricothyroid junction in 77% of cases, while in 22%, they are situated behind the upper pole of the thyroid.[12] In these locations they are easily accessible from the cricothyroid space, but it is not recommended to separate them at this point because they are used as a landmark to locate the recurrent laryngeal nerve.

The subisthmus plane is another landmark in this operation. If the pyramidal lobe is present, it can be divided from the surrounding fibrous tissue and the upper border of the isthmus can be dissected off the trachea by dividing the superior suspensory ligament with its vessels, and the midline identified. The lower border of the isthmus is identified with division of any midline-located inferior thyroid veins. We recommend elevating the isthmus using a medium-sized artery clamp, as it helps in retracting the lobe and also marks the midline.

Using the technique of capsular dissection,[13,14] the inferior parathyroid gland is usually identified at this step and dissected from the thyroid gland. The tertiary branches of the inferior thyroid vessels are individually ligated and divided, proceeding posteriorly towards the region of the inferior thyroid artery and the recurrent laryngeal nerve. The recurrent laryngeal nerve is then encountered in the region between the superior parathy-

Table 3. Types of surgery

	n	%
Total thyroidectomy	34	46.6
Hemithyroidectomy	30	41.1
Total lobectomy and subtotal thyroidectomy	4	5.5
Total thyroidectomy + neck dissection	5	6.8

roid gland, the inferior thyroid artery or its branches and the lateral thyroid ligament. This is a triangular area created by the sequence of steps in the operative technique. The recurrent laryngeal nerve is seen in this triangle in almost all cases (Figure 2C).

Good thyroid surgery requires sound knowledge of normal anatomy of the thyroid region and its variations together with technical ability, and if we are to avoid complications, teaching proper surgical technique is essential. With proper surgery, complications should not exceed 1%. Injury to vital structures around the thyroid gland represents a failure of thyroid surgery. Lennquist stated four principles for thyroid surgery in his description of thyroidectomy and emphasized the value of identification of vital structures during the procedure.[15,16] Other endocrine surgeons have also emphasized this point.[17] The cricothyroid space acts as a leading point to vital structures around the thyroid and should be considered as an important landmark in teaching the art of thyroid surgery with little or no complications. The cricothyroid space and the subisthmus plane create a triangular area between the superior parathyroid gland, the lateral thyroid ligament and the inferior thyroid artery or its branches to look for the recurrent laryngeal nerve.

In conclusion, we describe the anatomy of the cricothyroid space and a technique for thyroidectomy starting from this point. The cricothyroid space is an excellent starting point in thyroid surgery because it allows secure ligation of superior thyroid vessels without injuring the external branch of the superior laryngeal nerve and identifies the superior parathyroid gland. The subisthmus plane is another landmark in this technique because it narrows the area in which to search for the recurrent laryngeal nerve, minimizing the risk of injuring it during dissection.

Table 4. Complications

Temporary hypocalcaemia	6
Permanent hypoparathyroidism	0
Transient vocal cord dysfunction	8
Recurrent laryngeal nerve paresis	0
Haematoma	2
Wound infection	2

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