

Thyroid tubercle of Zuckerkandl: anatomical and surgical experience from 79 thyroidectomies

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Abstract

Objective: To highlight a poorly known anatomical variation of the lateral lobe of the thyroid gland, which can be useful in identifying the recurrent laryngeal nerve during thyroid surgery.

Materials and methods: We performed a three-year prospective study of 79 thyroid surgery patients. Great attention was paid to anatomical variations of the thyroid gland (i.e. the presence or absence of a distinct tubercle of Zuckerkandl), the recurrent laryngeal nerve and the location of the parathyroid glands.

Results: A total of 71 right lobectomies and 74 left lobectomies were performed. Five tubercles of Zuckerkandl were identified (7.04 per cent of cases) and were useful in detecting the recurrent laryngeal nerve (but only on the right side).

Conclusion: The tubercle of Zuckerkandl is a poorly known and variable anatomical feature of the thyroid gland which may not, in fact, be so rare. It arises for embryological reasons, and it can be a reliable anatomical landmark for identifying the recurrent laryngeal nerve during thyroid surgery. It should be included in the *Nomina Anatomica* as the ‘processus posterior glandulae thyroideae’ described by Zuckerkandl.

Key words: Thyroid Surgery; Thyroidectomy; Recurrent Laryngeal Nerve; Anatomy

Introduction

Safeguarding the recurrent laryngeal nerve is an essential issue in thyroid surgery. However, the recurrent laryngeal nerve is not delicate, and some contact is permissible during careful dissection. The ‘danger of seeing it’ (held for many years as justification for the nerve’s non-dissection) is no longer accepted by the majority of surgeons. Moreover, the identification and complete dissection of the recurrent laryngeal nerve during surgery are obligatory when seeking to preserve its function.¹

However, the anatomical path of the recurrent laryngeal nerve is variable. To aid its identification, numerous relevant anatomical landmarks have been described and numerous surgical techniques reported.^{1–18} In almost all cases, identification of the nerve at its crossing point with the inferior thyroid artery is the preferred first-line technique and is used by the majority of authors. This technique is relatively simple and is reliable in the great majority of cases.^{1,2,6,9,13,16}

Other anatomical landmarks have also been described, such as the inferior cornu of the thyroid cartilage¹⁷ and the tubercle of Zuckerkandl.^{3–5,7,8,10,14}

Here, we report on our personal surgical experience, from 79 thyroidectomies, of the thyroid

tubercle of Zuckerkandl, with a view to clarifying and specifying this particular anatomical landmark.

Materials and methods

This was a prospective study performed from January 2004 to June 2007 in 79 patients undergoing thyroid surgery (performed by a single, senior surgeon).

Population

The study population comprised 55 females and 24 males (average age, 50.53 years; range, 16 to 84 years; median, 53 years).

Pre-operative data

The surgical interventions were as follows: 64 total thyroidectomies, 11 unilateral lobectomies (seven on the left and four on the right) and four reoperations (two total thyroidectomies and two unilateral lobectomies).

Concerning the 64 total thyroidectomies, the surgical indications were as follows: 49 multinodular, benign goitres (11 cervicothoracic goitres and six combined with biological hyperthyroidism); six cases of Grave’s disease; two cases of Hashimoto’s

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thyroiditis with multinodular progression; and seven cases of papillary carcinoma (including one of microcarcinoma).

Concerning the 11 unilateral lobectomies, the surgical indications were as follows: two cases of one single nodule (over 30 mm); five cases of two unilateral nodules; two cases of unilateral, multinodular, benign goitre; one case of unilateral, multinodular, malignant goitre (metastasis of a rectal cancer); and one case of unilateral, toxic adenoma.

Concerning the four reoperations, the surgical indications were as follows: one case of right, multinodular, benign goitre; one case of left, multinodular, benign goitre; and two cases of bilateral, multinodular, benign goitre.

Surgical procedures

A 5- to 10-cm, cutaneous, cervical incision was made centred below the protrusion of the cricoid cartilage, with a superior concavity, parallel with the lower cervical skin fold or, when possible, within this fold.

Dissection and penetration into the thyroid region were performed according to standard thyroid surgical techniques. When penetrating into the thyroid region, we systematically exposed the anterior and lateral surfaces of the thyroid gland, from the thyroid incisura to the upper edges of the clavicle and the sternum. The infrahyoid muscle section was avoided in first-line treatment, if possible. Section and ligation of the middle and inferior thyroid veins were performed. Section and ligation of the pyramidal lobe and its vessels were also performed, together with isthmotomy when possible. Then, careful section of Berry's ligament close to the gland was undertaken in order to more easily release the lateral lobe from its tracheal attachments.

The cricothyroid space was then penetrated, dissecting close to the cricothyroid muscle without harming it, ensuring that dissection was capsular. The branches of the superior thyroid artery were identified, sectioned and ligated close to the gland. In a more posterior position, the superior thyroid veins were also sectioned and ligated close to the gland. When identified, the external laryngeal nerve was not touched.

Next, thyroid lobectomy was performed in a caudocranial direction by capsular dissection, after first identifying the recurrent laryngeal nerve at its crossing point with the inferior thyroid artery.

Throughout the procedure, particular attention was paid to anatomical landmarks and variations of the thyroid lobe, notably the presence or absence of the tubercle of Zuckerkandl, and the location of the inferior laryngeal nerve and inferior thyroid artery.

Motor nerve monitoring (using a Neurosign[®] 400 nerve monitor (Neurosign 400, INOMED, Teningen, Germany)) was always used during surgery.

Results

Identification of recurrent laryngeal nerve

The recurrent laryngeal nerve was identified in all patients.

In 66 patients, the recurrent laryngeal nerve was identified, as expected, at its crossing point with the inferior thyroid artery (by using an inferior/lateral approach).

In eight patients, the inferior laryngeal nerve was sighted at its laryngeal penetration because of huge goitres, preventing good exposure for the standard inferior/lateral approach.

In five patients, a posterior, lateral thyroid tubercle of Zuckerkandl was identified, but only on the right side; as suspected, the inferior laryngeal nerve was found immediately beneath it. These five cases involved very large, cervical, multinodular goitres, which complicated an inferior/lateral approach and prevented exposure of the thyroid artery. The nerve was unambiguously identified using this atypical anatomical landmark, saving a great deal of time.

Functional results

In the five cases with a right-sided tubercle of Zuckerkandl, no vocal problems were noted after surgery.

Voice disorders. Within the total group of 79 patients, we encountered post-operatively one case of transient left inferior laryngeal nerve palsy (recovery over three months) and one case of definitive right inferior laryngeal nerve palsy (unchanged after six months' follow up). The latter palsy concerned a 54-year-old woman who had a particular posterior, inferior, multinodular, benign goitre. On the right side, the inferior laryngeal nerve was exposed in an anterior aspect due to a large, underlying nodule. Although this problem was identified early on by the nerve monitor, and despite the fact that a correct electrical response of 2 mA was obtained at the end of the operation, definitive inferior laryngeal nerve palsy was nevertheless observed, probably because of irreversible disruption of the nerve's posterior microvasculature.

A 57-year-old woman displayed pre-operative right inferior laryngeal nerve palsy due to a malignant, metastatic, right goitre. The nerve was not sacrificed. Paradoxically, this patient's voice quality improved after surgery, although the palsy remained.

Definitive hypoparathyroidism. A 28-year-old woman (with benign, multinodular goitre combined with hyperthyroidism) displayed post-operative definitive hypoparathyroidism (after two years' follow up).

Discussion

Safeguarding the recurrent laryngeal nerve is an essential, prime issue in thyroid surgery. Identification and complete dissection of the inferior laryngeal nerve during surgery are obligatory in order to preserve the latter's function, as has long been accepted in the medical literature.¹⁵ Several surgical techniques and anatomical landmarks have been described for identification of the recurrent laryngeal nerve.^{1,2,6,9,12,13,16-18} The nerve's location at its crossing point with the inferior thyroid artery is the most reliable and useful landmark in a great majority of

cases; our surgical experience confirms this point.^{1,2,6,13,16}

History

However, some quite recent papers^{3–5,7,8,10,14} have reported the existence of an (unchanging?) posterior, lateral tubercle arising from the thyroid's lateral lobe. This tubercle was first described in 1867 as 'the posterior horn of the thyroid' by Madelung (cited by Mirilas),¹⁰ and then in 1902 as 'the processus posterior glandulae thyroideae' by Zuckerkandl (cited by Mirilas).¹⁰ In 1938, Gilmour (cited by Mirilas)¹⁰ also described the tubercle's anatomical relationship to the recurrent laryngeal nerve and the superior parathyroids. However, anatomists and surgeons then forgot about this anatomical feature for approximately 60 years.¹⁰

Embryology

Embryologically,^{10,11} the thyroid gland develops from two anlagen: the larger median anlage (an epithelial thickening in the ventral pharyngeal wall) and the paired, smaller lateral anlage (from the ventral portion of the fourth pharyngeal pouch). The tubercle of Zuckerkandl may correspond to these lateral anlagen, which may become the posterior and lateral parts of the thyroid lobes. The recurrent laryngeal nerve branches off the vagus nerve in the mesenchyme between the fourth and fifth pharyngeal pouches. It rejoins the pharyngeal cartilages running around the fourth aortic arch and is immediately covered by the thyroid tissue arising from the lateral anlagen of the fourth branchial pouch; this explains the constant anatomical relationship between the recurrent laryngeal nerve (which is predominantly situated under the thyroid tissue) and the tubercle of Zuckerkandl.

Anatomy

The existence of a tubercle arising from the lateral lobe of the thyroid gland is poorly described in the anatomical literature and is even absent from some works. However, in 1998, Pelizzo 're-discovered' this tubercle as a reliable, almost constant anatomical surgical landmark for identifying the recurrent laryngeal nerve.¹⁴ Pelizzo considered the tubercle of Zuckerkandl to be a constant landmark, and proposed a four-grade classification system according to the size of this anatomical feature.

Surgical considerations

Only grade three and four tubercles of Zuckerkandl (i.e. over 1 cm in size) are truly identifiable and useful in thyroid surgery, since the recurrent laryngeal nerve should constantly be situated immediately under the tubercle, for the embryological reasons described above. Moreover, the tubercle theoretically separates the parathyroid glands into the superior parathyroids (P IV; located in cranial and posterior positions) and the inferior parathyroids (P III; located in caudal and anterior positions). In the

present study, we did not find any correlation between the parathyroids and the tubercle of Zuckerkandl.

The extent to which a tubercle of Zuckerkandl is positively identified differs greatly in the few series reported in the medical literature, being: 14 per cent for Pelizzo,¹⁴ 17 per cent for Gesemjäger,⁴ 45 per cent for Gauger³ and 55 per cent for Hisham.⁵ In our series, five right tubercles of Zuckerkandl were distinctly recognised in 71 right lobectomies (i.e. 7 per cent of right-sided cases) and were very useful for locating the inferior laryngeal nerve situated just beneath.

In our opinion, these differences in the frequency of discovery of a clearly visible tubercle of Zuckerkandl can be explained by several factors.

The first factor is the state of awareness of the thyroid surgeon, as the tubercle of Zuckerkandl is poorly described in the standard anatomical literature.

The second factor is the surgical procedure itself. The exposure and identification of a tubercle of Zuckerkandl is possible when the lateral lobe is exposed laterally after complete ligation of the superior pedicle, which was always our first-line procedure. In such cases, when the lobe is medially displaced, the tubercle will appear as a small nodule, visibly distinct from the thyroid parenchyma. Cautious capsular dissection of the tubercle will then reveal the inferior laryngeal nerve immediately underneath (the nerve sometimes adheres slightly to the tubercle). For lobectomies performed in the craniocaudal direction, with final ligation of the superior pedicle, the tubercle may not be clearly identified.

The third factor is related to the fact that, in our opinion, a well individualised tubercle of Zuckerkandl is not found as frequently as one might think. Moreover, in our experience, the tubercle was found only on the right side, whereas in theory it should be found bilaterally.

The fourth and final factor is that the existence of this tubercle also depends on the goitre itself. When a hypertrophic nodule involves the tubercle itself, the latter is particularly prominent.

- **The tubercle of Zuckerkandl is a poorly known and variable anatomical feature of the thyroid gland**
- **It arises for embryological reasons, and can be a reliable anatomical landmark for identifying the recurrent laryngeal nerve during thyroid surgery**
- **It should be included in the *Nomina Anatomica* as the 'processus posterior glandulae thyroideae' described by Zuckerkandl**

Overall, we consider that the thyroid surgeon should be aware of the existence of the tubercle of Zuckerkandl, which can simplify identification of

the recurrent laryngeal nerve in certain, quite rare cases. However, we must not lose sight of the fact that the best first-line method of finding the recurrent laryngeal nerve is to locate the point at which it crosses the inferior thyroid artery.

Lastly, we believe that the tubercle of Zuckerkandl should be described when teaching the anatomy and embryology of the thyroid gland. We also recommend that the anatomical term chosen by Zuckerkandl – i.e. the ‘processus posterior glandulae thyroideae’ – be included in the *Nomina Anatomica*. The “*Nomina anatomica*” is the classification system which standardises the anatomical terminology all around the world. It was designed by the International Anatomical Nomenclature Committee of the International Federation of Associations of Anatomists. It is published as a book.

Conclusion

The tubercle of Zuckerkandl is a poorly known anatomical variation of the thyroid gland which may not, in fact, be so rare. For embryological reasons, it can be a reliable anatomical landmark for identifying the recurrent laryngeal nerve during thyroid surgery. Identification of the tubercle depends on several factors, especially the type of thyroid surgery procedure. This structure should be included in the *Nomina Anatomica* as the ‘processus posterior glandulae thyroideae’.

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