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Non-recurrent inferior laryngeal nerve in thyroid surgery: report of three cases and review of the literature

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Abstract

The non-recurrent inferior laryngeal nerve (NRILN) is a nerve anomaly that can be associated with an increased risk of vocal fold paralysis. The purpose of this study was to report three new cases of this anomaly, underline the necessity of recognizing its possibility for the prevention of intra-operative nerve damage and a review of the literature.

Three cases of thyroid surgery associated with right NRILN are reported.

Two patients underwent bilateral thyroidectomy for a multinodular goitre and for a toxic multinodular goitre respectively. The third patient had a right lobectomy and isthmectomy for a thyroid nodule. All patients had identification of the recurrent laryngeal nerve on the left side and NRILN on the right side. The diagnosis of the NRILN was made per-operatively on all cases. A post-operative computed tomography (CT) scan in two patients, showed a retrooesophageal aberrant right subclavian artery. Post-operatively, all patients had normal vocal fold function on laryngoscopy.

The NRILN is a rare anomaly but overlooking its possibility may lead to severe operative morbidity. This is an additional argument in favour of systematic dissection of the recurrent inferior laryngeal nerve during thyroid surgery.

Key words: Vocal Cords; Laryngeal Nerve; Anatomy; Thyroidectomy

Introduction

The major complication of thyroid surgery is hoarseness resulting from vocal fold paralysis. Identification and preservation of the recurrent inferior laryngeal nerve (RILN) during surgery is fundamental in preventing this complication.[1,2]

The non-recurrent inferior laryngeal nerve (NRILN), which goes into the larynx without recurring at the artery within the thoracic cavity, is a relatively rare anatomical variant without functional repercussions.[1] However, during cervicotomy this aberrant nerve may become inadvertently damaged, causing permanent ipsilateral vocal fold paralysis. In most cases, the NRILN originates from an aberrant development of the subclavian artery, the so-called a. lusoria.[1,3] This anomaly has been observed clinically since Stedman first reported it in 1823.[1–14] It is recommended that surgeons be aware of the possibility of an NRILN, when the RILN is not found in the periphery of the tracheoesophageal groove,[7,10,11] because the risk of injury in the presence of this anatomical variant is high, even for experienced surgeons.[12]

Case 1

A 45-year-old woman, without a medical history, presented at our institution for a toxic multinodular goitre. On physical examination, the patient had an enlarged, firm, irregular thyroid gland predominately on the right side. The initial laboratory findings showed a serum TSH US at 0.02 mIU/mL (N: 0.3–4) and FT4 at 1.1 ng/dL (N: 0.85–1.86). Iodine thyroid scanning showed bilateral multiple hyperfunctional areas. The patient had pre-operative preparation for six weeks. She underwent total thyroidectomy by cervicotomy under general anaesthesia. Per-operatively, she had a left recurrent inferior laryngeal nerve in the tracheoesophageal groove with a right non-recurrent inferior laryngeal nerve which ran transversally at the level of the thyroid isthmus. Post-operatively, she had normal vocal function at laryngoscopy. Review of the pathological specimen demonstrated the presence of multiple thyroid nodules without malignancy.

Case 2

A 37-year-old woman complaining of a right anterior neck mass, which was enlarging progressively, causing dyspnoea and dysphagia. No family thyroid

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FIG. 1
Cervical CT scan revealed retro-oesophageal aberrant right subclavian artery.

disease was noted. Physical examination revealed a 5 cm right anterior neck painless and firm mass, that moved with swallowing. The thyroid ultrasound confirmed the diagnosis of a thyroid nodule of the right lower lobe measuring 5.5 cm in diameter. The percutaneous fine-needle aspiration cytology was indeterminate. Thyroid scanning showed a 'cold' nodule. The mass stayed the same size despite suppression therapy with thyroid hormones. She underwent right lobectomy and isthmectomy. Per operatively, a right non-recurrent inferior laryngeal nerve was noted. Post-operatively, she had normal vocal function at laryngoscopy. The pathologic analysis showed a thyroid nodule with no signs of malignancy. Post-operative CT scan showed an aberrant right subclavian artery (Figure 1).

Case 3

A 65-year-old woman presented with a slow growing lump in her neck. History did not reveal any prior neck radiation. Physical examination revealed a smooth, well-defined 4 cm round firm mass, moving with swallowing. Laboratory tests showed a normal serum thyroid hormone concentration. A cervical ultrasound confirmed the presence of a thyroid nodule of 4.5 cm in the right upper lobe and multiple small nodules bilaterally. A total thyroidectomy was performed; a normal left recurrent laryngeal nerve was noted with right non-recurrent inferior laryngeal nerve that runs to the larynx at the level of thyroid isthmus. Post-operatively, she had normal vocal function at laryngoscopy. The pathologic analysis showed colloid thyroid nodules with no signs of malignancy. A post-operative cervical CT scan revealed the presence of an aberrant right subclavian artery behind the oesophagus (Figure 2).

Discussion

Systematic search for and careful dissection of the RILN during thyroidectomy is necessary to avoid surgical damage. The existence of anatomical variants in the course of the RILN is an additional reason for its systematic peri-operative identification. One of the potential variants is NRILN; this variant originates from an aberrant embryological origin of the subclavian artery.[1–3] The NRILN has been reported in 0.52 to 0.7 per cent of cases making it a relatively rare anomaly. Although the NRILN is a rare occurrence, it results in dramatic consequences if damaged during cervicotomy.[7]

The NRILN can be explained by the course of RILN development during the embryological stage. In the embryo, both the right and the left inferior laryngeal nerves supply the sixth branchial arches. With the descent of the heart, the nerves pass beneath the sixth aortic arch and ascend to the larynx. On the right side, the distal portion of the sixth aortic arch and the fifth aortic arch disappear, and the recurrent nerve moves up to lie beneath the fourth arch, which forms a portion of the subclavian artery. Occasionally, the right fourth aortic arch and proximal right dorsal aorta are obliterated, and the origin of the subclavian artery becomes anomalous. Its final origin is just below that of the left subclavian artery; it reaches the right side by crossing the midline behind the oesophagus; very rarely, it may also cross the midline by passing between the trachea

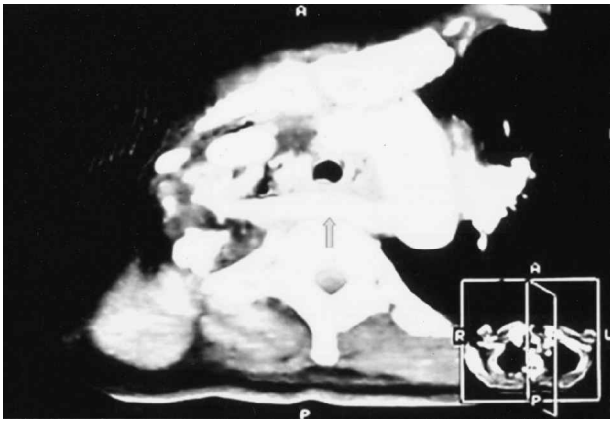

FIG. 2
Cervical CT scan with reconstruction showing the aberrant right subclavian artery behind the oesophagus.

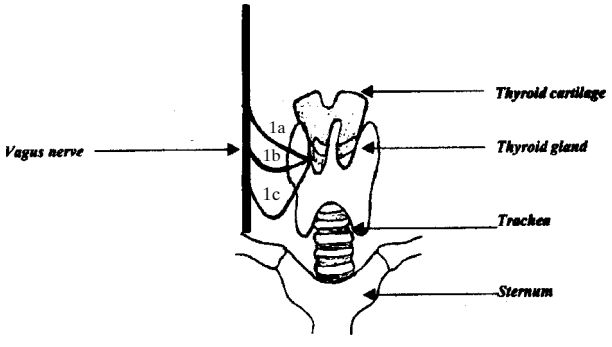

FIG. 3
Schematic presentation of the three types of non-recurrent laryngeal nerve. Type 1(a) – the nerve is horizontal and at the level of the superior thyroid pole. Type 1(b) – the nerve runs transversally at the thyroid isthmus. Type 1(c) – the nerve makes a downward curve to the inferior thyroid pole.

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and oesophagus. Because the normal right subclavian artery is absent, the right RILN will move further cranially during elongation of the neck, passing more or less directly from the vagal nerve to the larynx. Three types of NRILN have been distinguished (Figure 3): in type IA, the nerve shows a straight course at the level of the upper thyroid pole; in type IB (the most common), the nerve runs transversally at the level of the thyroid isthmus; in type II, the nerve makes a downwards curve, eventually reaching the lower pole of the thyroid gland.[1,3,7]

Because of its anatomical position, the NRILN is not only at risk of being damaged during thyroidectomy but also during other surgical procedures such as neck dissection, parathyroidectomy, oesophagectomy, and carotid endarterectomy.[3,15,16]

No reliable clinical symptoms or signs indicate the possibility of a NRILN pre-operatively.[2,3] It is difficult to identify a NRILN by pre-operative imaging of any type.[14] An aberrant subclavian artery is almost always associated with the NRILN, however, so pre-operatively identifying the aberrant subclavian artery would be tantamount to diagnosing the NRILN. In nearly all reports, the association of an aberrant subclavian artery and a NRILN is confirmed after the detection of a NRILN during surgery, either by exploring the subclavian artery or by post-operative angiography.[8,10,17] Before operation, the diagnosis of the nervous anomaly may be made only if the corresponding vascular anomaly is suspected. Diagnosis of the aberrant subclavian artery has been based on dysphagia lusoria on swallowing; an impression observed on the oesophagogram from the left to the upper right of the oesophagus;[18] an anomalous right subclavian artery origin observed at the right of the peak of the aorta arch on the anterior plain chest roentgenogram; an anomalous right subclavian artery traversing behind the oesophagus and trachea; or by digital substraction angiography[8] and/or magnetic resonance angiography findings.[3] Whether the dysphagia lusoria is actually the result of a thyroid tumour or an aberrant subclavian artery is hard to determine, however, and diagnosis from the plain chest roentgenogram has been reported in approximately 58 per cent of cases. In one series,[1] retrospective diagnosis was possible on a plain roentgenogram in only one case of the six cases treated. The CT scan diagnosis of an a. lusoria is firm, being based on the direct identification of an aberrant vessel passing behind the oesophagus. Many patients in some institutions have a CT study of the neck before thyroid surgery to evaluate the anatomical relationships between the thyroid gland and the surrounding structures.[1] Thus, the presence of an a. lusoria can be reliably established without the need for an additional investigation.[3] Dorsal position of the subclavian artery virtually assures a NRILN. This may enable prevention of vocal fold paralysis, the most frequent serious post-operative complication of thyroid surgery.

- **Three cases where non-recurrent inferior laryngeal nerves were encountered at thyroidectomy are reported**
- **The differing types of non-recurrent nerve and their embryology are discussed and illustrated**

It is well known that even experienced surgeons may have difficulties retrieving the RILN.[3,19] When performing cervicotomy, some authors[7] recommend that surgeons systematically and promptly locate the RILN as low in the neck as possible, but always below the trunk and branches of the inferior thyroid artery. If the recurrent nerve is not found at its usual place, the RILN should be sought more or less transversally between the carotid artery and the larynx. It is relatively easy to check for the vascular underlying anomaly simply by noting the absence of the innominate artery. The throbbing from the aberrant artery can be felt in front of the vertebral plane by slipping the index finger along the edge of the oesophagus.[1]

Conclusion

The non-recurrence of the inferior laryngeal nerve always results from vascular anomaly during embryological development of the aortic arches. It can be suspected pre-operatively from signs associated with the vascular anomaly such as dysphagia lusoria and thoracic X-ray imaging. If such signs are noted, a CT scan or magnetic resonance image (MRI) were justified. Nonrecurrence of the RILN is a rare anomaly but overlooking its possibility may lead to severe operative morbidity. This is an additional argument in favour of the systematic dissection of RILN during thyroid or parathyroid surgery.

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