The Journal of Laryngology & Otology (2014), ***128***, *368–371*.

doi:10.1017/S0022215114000358

MAIN ARTICLE

Relationship of the recurrent laryngeal nerve to the superior parathyroid gland during thyroidectomy

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Abstract

Design: The relationship of the recurrent laryngeal nerve to the superior parathyroid gland during consecutive thyroidectomies was prospectively evaluated. When one structure was noted, careful dissection was performed to locate the other structure, to preserve their natural anatomical relationship.

Patients: In total, 103 consecutive thyroid lobectomies were performed on 73 patients. The distance from the superior parathyroid gland to the recurrent laryngeal nerve was recorded.

Results: In 88 cases (88.9 per cent), the superior parathyroid gland was identified within 5 mm of the recurrent laryngeal nerve. In 62 cases (62.6 per cent), the gland was within 1 mm of the recurrent laryngeal nerve. The height of the thyroid lobe was positively associated with the distance between the two structures ($p = 0.001$), as was the incidence of cancer ($p = 0.033$). The incidence of recurrent laryngeal nerve paresis was less than 4 per cent.

Conclusion: In most cases, the recurrent laryngeal nerve was found in close proximity to the superior parathyroid gland. In a thyroid gland with a large height, or in a cancerous lobe, this relationship is less reliable.

Key words: Recurrent Laryngeal Nerve; Diagnosis; Anatomy; Parathyroid Gland; Thyroidectomy

Introduction

Identification of the recurrent laryngeal nerve (RLN) should be paramount in any surgery where the nerve is at risk, the most common of which is thyroid surgery. Proper identification and preservation of the nerve reduces the incidence of post-operative paresis of the ipsilateral vocal fold, keeping the airway unobstructed and voice quality intact.[1] Furthermore, glottic closure will remain unhindered, keeping the risk of aspiration low. Injury to the nerve is a main cause of malpractice associated with thyroid surgery;[2] thus, improved identification and preservation should lead to decreased malpractice suits, a practical concern for any surgeon.

Currently, there are many documented approaches to identify the RLN. The three main methods of identification during thyroid surgery were described by Richer and Randolf in 2009. These are: the lateral approach, where the nerve is identified at the thyroid midpole level by medial retraction of the thyroid and lateral retraction of the strap muscles; the inferior approach, where the nerve is found at the point it crosses the inferior thyroid artery; and finally, the superior approach, where the nerve is found at its laryngeal entry point, after dissection of the superior pole of the thyroid.[3] Some literature also indicates the cricothyroid joint (or inferior cornu of the thyroid cartilage) as a superior landmark.[4]

In our review of the literature, we found very few descriptions emphasising identification of the superior parathyroid gland as a means of localising the RLN. The superior parathyroid gland has a relatively constant location compared with the inferior parathyroid gland, and is often just millimetres away from the RLN.

In this era of evidence-based medicine, this study attempted to objectively measure the relationship of the RLN to the superior parathyroid gland.

Materials and methods

A prospective study was conducted of 103 consecutive thyroid lobectomies performed on 73 patients by one surgeon at NYU Langone Medical Center, Bellevue Hospital in New York City. Each patient underwent either a thyroid lobectomy, a total thyroidectomy or a lobectomy that was converted to a total thyroidectomy intra-operatively. Variables studied included: patients' age and sex, thyroid pathology, weight of the thyroid gland, dimensions of the thyroid gland (i.e. height, width and depth), and distance between the RLN and the superior parathyroid gland.

The patients ranged in age from 22 to 81 years. Approximately 17 per cent of the thyroid lobes

Accepted for publication 24 June 2013 First published online 25 March 2014

operated on were in men and 83 per cent were in women. The thyroid pathology was both benign and malignant. Thyroid weight and other dimensions were recorded from the pathological specimen report. In cases of total thyroidectomy where there was no individual weight per lobe, the total weight was divided in half.

Various methods of identifying the RLN were utilised, including those described above. If the RLN was identified prior to the superior parathyroid gland, it was subsequently dissected to determine the nerve's closest relationship to the superior parathyroid gland. If the superior parathyroid gland was identified first, careful attempts were made to expose the nerve in its vicinity. Blood supply to the superior parathyroid gland was preserved by grasping its capsule and dissecting it bluntly on its medial surface. The RLN, when identified, was always deep and slightly lateral to the superior parathyroid gland. The moment the RLN was positively identified, dissection was halted and care was taken to preserve the natural distance between the RLN and superior parathyroid gland. The distance of the RLN from the superior parathyroid gland was measured in millimetres with a ruler and recorded. Of note, none of the operations were performed endoscopically.

The recorded distance between the RLN and superior parathyroid gland was put into one of three categories: 0–5 mm (group A), 6–10 mm (group B) and over 11 mm (group C). If the RLN was not identified, it was assumed to be greater than 11 mm from the superior parathyroid gland and included in group C.

There were no patients excluded from this study. The data analysis was based on 73 patients, 43 of whom had only one thyroid lobe removed. Five of the 30 patients with both lobes removed underwent separate operations for each lobe. There were 55 left thyroid lobes removed and 48 right lobes. Table I shows the group data as averages.

Linear regression analysis was conducted to examine the association between the aforementioned secondary measures and the distance between the RLN and superior parathyroid gland. The selection of variables for the regression analysis was guided by Akaike information criterion. We also assessed the incidence of permanent post-operative vocal fold paralysis, defined as paralysis lasting longer than six months after surgery, as determined by fibre-optic laryngeal examination. All patients were followed up for more than one year and RLN paralysis was reported as a permanent outcome.

Results

The RLN was identified during removal of 99 of the 103 thyroid lobes (96 per cent of cases). There were 88, 8 and 7 patients in groups A, B and C respectively. In 88.9 per cent of thyroid lobectomies, the RLN was identified within 5 mm of the superior parathyroid gland (group A), and in 62.6 per cent of cases it was found within 1 mm of the superior parathyroid gland. This relationship was consistent on the right and the left sides. The RLN was found between 6 and 10 mm from the superior parathyroid gland (group B) in 8.1 per cent of cases. The RLN was 11 mm or more from the superior parathyroid gland, or not identified, (group C) in 3.0 per cent of cases. Table II shows the frequency of distances between the structures.

For linear regression analysis with distance as the response variable, Akaike information criterion prompted the use of a statistical model that included the following predictor variables: patients' sex, thyroid side, cancer indicator, thyroid weight and thyroid height. The results are summarised in Table III. Two variables were found to be significantly associated with the distance between the RLN and the superior parathyroid gland. Specifically, the distance between the structures tended to be greater when a thyroid lobe was cancerous ($p = 0.033$) and when the height of the thyroid was larger ($p = 0.001$). No other significant associations were found. Furthermore, we did not take into account the size or location of the cancerous nodule.

Four patients developed RLN paresis post-operatively. In one of these patients, the superior parathyroid

TABLE I
GROUP DEMOGRAPHIC AND THYROID DATA

Parameter	Group		
	A	B	C
Patient age (mean (SD); y)	45.0 (13.1)	47.1 (9.5)	54.9 (8.2)
Females/males (*n**)	73/15	7/1	5/2
Thyroid height (mean (SD); cm)	5.6 (2.2)	6.5 (3.8)	8.1 (3.3)
Thyroid weight (mean (SD); g)	33.6 (62.5)	49.9 (80.4)	97.9 (128.5)
VF paralysis (%)	2.3	12.5	14.3

*Refers to number of procedures. SD = standard deviation; y = years; VF paralysis = permanent post-operative vocal fold paralysis

TABLE II
DISTANCES BETWEEN RLN AND SUPERIOR PARATHYROID GLAND*

Distance (mm)	Patients		Cumulative	
	n	%	*n*	%
0	49	49.49	49	49.49
1	13	13.13	62	62.63
2	7	7.07	69	69.70
3	9	9.09	78	78.79
4	7	7.07	85	85.86
5	3	3.03	88	88.89
6	4	4.04	92	92.93
7	1	1.01	93	93.94
10	3	3.03	96	96.97
11	2	2.02	98	98.99
15	1	1.01	99	100.00

*$n = 99$ (4 patients omitted because of lack of distance measurements). RLN = recurrent laryngeal nerve

https://doi.org/10.1017/S0022215114000358 Published online by Cambridge University Press

TABLE III
LINEAR REGRESSION ANALYSIS RESULTS*

Predictor variable	Estimate	SE	*p*
Sex (female)	−1.2092	0.8150	0.1416
Side (left)	−0.5880	0.6017	0.3312
Cancer (yes)	1.3795	0.6352	0.0327†
Weight	−0.0051	0.0067	0.4463
Height	0.5659	0.1677	0.0011†

*For association with distance as the response variable. †Significant, α = 0.05. SE = standard error

gland was avulsed prior to identification of the nerve (group C). Of the remaining patients with post-operative paresis, two were in group A and one was in group B.

Discussion

It is important to identify the RLN during thyroid surgery so as to avoid the significant morbidity of nerve paralysis or paresis. It has been shown that in expert hands, permanent injury to the nerve can occur in up to 1.4 per cent of thyroidectomies, with temporary paralysis occurring in up to 5.4 per cent of cases.[5] However, proper identification of the nerve during surgery is reported to decrease the rate of RLN injury.[6]

There are many methods of finding the RLN during thyroid surgery, but there is little in the literature quantitatively documenting the relationship of the superior parathyroid gland to the RLN. A consistent relationship exists between the RLN and the superior parathyroid gland, bilaterally. Our results showed that the RLN was located between 0 and 5 mm from the superior parathyroid gland in the majority of patients undergoing thyroid surgery (89 per cent of cases). This is without regard to patients' sex or age, or thyroid weight, width or depth. Interestingly, the data showed that the distance between the structures significantly differed with regard to thyroid height and pathology; in longer lobes (in the superior–inferior dimension) and cancerous lobes, the distance between the RLN and the superior parathyroid gland was likely to be farther than average. Hence, the pre-operative assessments of lobe size and pathology could be important factors for the surgeon to consider if this approach to RLN identification is appropriate.

It is important for the surgeon to have knowledge of common and uncommon surgical techniques in order to provide the best care with the least amount of morbidity possible. A statistically significant relationship between the RLN and the superior parathyroid gland has been demonstrated. Using the superior parathyroid gland as a means of localising the RLN in thyroidectomy allows identification of the RLN and is part of routine procedure for sparing the parathyroid gland. This technique does not therefore increase operation time or morbidity risk. The findings of this study support the anatomical proximity between the superior parathyroid gland and the RLN. This has implications for surgeons performing parathyroid surgery, which could result in a safer procedure. This method can also be used for endoscopic approaches to the thyroid gland.

- **Identification and preservation of the recurrent laryngeal nerve (RLN) reduces the incidence of ipsilateral vocal fold post-operative paresis**
- **Injury to the RLN is a main cause of malpractice associated with thyroid surgery**
- **There are three main approaches to the RLN; few studies have described the anatomical relationship of the superior parathyroid gland to the RLN**
- **In 103 consecutive thyroid lobectomies, the RLN was found within 5 mm of the superior parathyroid gland in most cases (often within 1 mm)**

Of course, unlike other approaches, this technique requires the identification of the superior parathyroid gland, which can be difficult. Thus, identification of the RLN using the superior parathyroid gland should only be used when the patient has an intact superior parathyroid gland. It should be noted that the authors of this study did not observe aberrant anatomy during data collection, and so cannot comment on the anatomical relationship between the two structures in patients with anatomical anomalies such as a poorly migrated parathyroid gland or non-RLN. Conversely, during explorations for parathyroid glands (i.e. four-gland parathyroid exploration), the RLN can be used to identify the normal superior parathyroid gland.

Conclusion

The superior parathyroid gland can be used as a landmark for finding the RLN bilaterally. In this study, 88.9 per cent of RLNs were found within 5 mm of the superior parathyroid gland, usually posterior and always lateral to it. The location of the RLN was most often affected by the vertical height of the thyroid gland and the malignancy of the gland. This represents another method of localising the RLN to supplement the methods already in use. Furthermore, this method is part of the parathyroid-sparing technique used during thyroidectomy, and so it does not increase risk or operation time. The method is amenable to endoscopic techniques too. Finally, in four-gland parathyroid explorations, localisation of the RLN may aid identification of the superior parathyroid gland. The relatively high level of RLN injury in our study probably represented an unusual level of difficulty in dissection of this particular patient subset, not in the technique used.

References

1 Jatzko GR, Lisborg PH, Müller MG, Wette VM. Recurrent nerve palsy after thyroid operations--principal nerve identification and a literature review. *Surgery* 1994;**115**:139–44

https://doi.org/10.1017/S0022215114000358 Published online by Cambridge University Press

2 Abadin SS, Kaplan EL, Angelos P. Malpractice litigation after thyroid surgery: the role of recurrent laryngeal nerve injuries, 1989–2009. *Surgery* 2010;**148**:718–22
3 Richer SL, Randolph GW. Management of the recurrent laryngeal nerve in thyroid surgery. *Oper Tech Otolaryngol Head Neck Surg* 2009;**20**:29–34
4 Shindo ML, Wu JC, Park EE. Surgical anatomy of the recurrent laryngeal nerve revisited. *Otolaryngol Head Neck Surg* 2005; **133**:514–19
5 Lo CY, Kwok KF, Yuen PW. A prospective evaluation of recurrent laryngeal nerve paralysis during thyroidectomy. *Arch Surg* 2000;**135**:204–7
6 Zakaria HM, Al Awad NA, Al Kreedes AS. Recurrent laryngeal nerve injury in thyroid surgery. *Oman Med J* 2011;**26**:34–8

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Dr D Myssiorek takes responsibility for the integrity of the content of the paper
Competing interests: None declared

https://doi.org/10.1017/S0022215114000358 Published online by Cambridge University Press