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Prospective Anatomical Study To Determine the Site of Insertion of Recurrent Laryngeal Nerve Into the Larynx

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Abstract

Objectives: Determine whether the insertion site of the recurrent laryngeal nerve (RLN) occurs at a predictable distance from the midline trachea, to help guide safe dissection during thyroid surgery.

Design: Prospective clinical trial. At the inferior edge of the cricoid cartilage, we measured the distance from midline trachea to the RLN insertion site.

Setting: Single institution.

Participants: 50 consecutive patients undergoing thyroid surgery.

Main outcome measures: Distance from midline trachea to laryngeal insertion of RLN.

Results: The study population included 36 women and 14 men, with 72 total nerves measured. The average distance-to-midline + standard deviation (range) of the RLN was 20.7 + 2.3 (17–26) mm in women compared to 26.3 + 2.1 (22–32) mm in men.

Conclusion: The insertion point of the RLN into the larynx at the level of inferior border of the cricoid cartilage can be reliably predicted, to facilitate early identification of the RLN during thyroid surgery.

Introduction

With increased incidence of thyroid nodules, there has been a commiserate rise in the volume of thyroid surgery in the United States. Injury to the recurrent laryngeal nerve is one of the major complications of thyroid surgery, and early identification of the recurrent laryngeal nerve may prevent accidental injury, especially when managing locally advanced tumors. We hypothesized that the insertion of the recurrent laryngeal nerve exists at a reliable distance away from the midline of the trachea, to facilitate identification of the RLN during thyroid surgery.

Materials and Methods

This was a prospective anatomical study performed at a single tertiary referral cancer center between September and November of 2018. We prospectively measured the distance between the midline of the trachea at the inferior edge of the cricoid cartilage (Figure 1) in 50 consecutive patients undergoing thyroid lobectomy or total thyroidectomy. A silk suture was clamped with two microclamps, and the distance from the midline to the point of insertion of the RLN on the inferior border of the cricoid cartilage was measured using the silk suture. This measurement was performed after ligation of superior pole vessels, division of the thyroid isthmus, and RLN was identified. Patient height and weight data were collected from the medical record.

Results

The study population included 36 women and 14 men, with 72 total nerves measured. The women in our study ranged from 145 cm to 174 cm in height, with a mean height to 162 cm. Their weight ranged from 41.5 kg to 122.5 kg, with a mean weight of 74.3 kg. The men in our study ranged from 165 to 185 cm in height, with a mean height of 174 cm. Their weight ranged from 74.8 kg to 135.9 kg, with a mean weight of 96.5 kg.

The average distance-to-midline standard deviation of the RLN was 20.7 2.3 mm in women, with a range of 17–26 mm. The average distance-to-midline in men was 26.3 2.1 mm in men, with a range of 22–32 mm. See Figure 2. In women there was no difference in distance-to-midline between right-sided vs left-sided RLNs (21.0 vs 20.3 mm, $p=0.26$). There was also no difference between right and left RLN from midline in men (26.0 vs 26.5 mm, $p=0.52$). Among the 22 patients that underwent total thyroidectomy, 11 patients had symmetrical distance-to-midline (difference from left versus right 0 or 1 mm). The average difference between left and right distance-to-midline was 1.4 mm, ranging from 0–5 mm.

Height and weight were weakly correlated with RLN distance-to-midline, with pearson correlation coefficients of 0.565 and 0.565 respectively.

Discussion

Synopsis of Key Findings.

Our study helps narrow the field of dissection when attempting to identify the recurrent laryngeal nerve. Regardless of patients' height and weight, the recurrent laryngeal nerve can be found between 18.4–23 mm from the midline of the trachea in 68% of female patients (1 standard deviation), and between 16.1–25.3 mm from midline in 95% of female patients (2 standard deviations). Similarly, in men, the recurrent laryngeal nerve can be found between 24.2–28.4 mm from the midline in 68% of male patients, and between 22.1–30.5 mm in 95% of patients. In half of patients, the distance to midline was the same bilaterally, with no patients having an absolute difference of more than 5 mm comparing right to left.

Comparisons with Other Studies.

Previous studies observed the RLN traveling posterior to the artery three-quarters of time. [1, 2] Otherwise, the nerve traverses anterior to the inferior thyroid artery (12–25%) or between its branches (3–25%). Another frequently used anatomical reference point is the tubercle of Zuckerkandl, which is known to “point” to the RLN. The tubercle is identified in roughly 69–83% of the time.[2, 3] Identification of the tubercle and the tubercle’s relationship to the RLN may be challenging when there are large, bulky central compartment lymph nodes or in locally advanced cancers; the cases when identification of the early RLN is the most needed. Finally, additional studies also mapped the angle of insertion of the RLN and as expected, a higher proportion of left-sided RLNs have a more acute angle of insertion compared to right-sided RLNs.[4] Neither side has a predictable angle of insertion. The degree of variability in these anatomic relationships is not ideal for facilitating safe dissection of the RLN.

Practical Application.

We identify and dissect the RLN following pre-tracheal dissection of the Delphian node and division of the middle thyroid vein and superior pole vessels. First, we mark the midline of the inferior border of the cricoid cartilage, then use a ruler to estimate the insertion of the RLN: 20 mm away in women and 26 mm away in men. The soft tissue overlying the estimated insertion site is marked. We trace the estimated path of the RLN from insertion site to the thoracic inlet, with a gradual arc towards the carotid artery. Dissection is directed along this marked path (Figure 3).

Conclusions.

The insertion of the recurrent laryngeal nerve at the inferior border of the cricoid cartilage can be reliably predicted by measuring the distance from the midline of the trachea. The average distance is approximately 2 cm in women, 2.6 cm in men. In half of patients, this distance will vary by 1 mm or less from left to right. This does not vary with patient’s height and weight.

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The authors have stated explicitly that there are no conflicts of interest in connection with this article

Ethical considerations. The study was reviewed by our institutional review board, and determined to be exempt given that we were collecting measurements during routine operations without additional dissection.

Data Availability Statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Key Points

1. At the level of the cricoid cartilage, the RLN inserts into the larynx at a reliable distance from the midline trachea (21 mm in women, 26 mm in men).
2. In half of patients, distance of RLN insertion to midline trachea was symmetrical from left to right.
3. No correlation between distance of RLN insertion to midline trachea and patients' height and weight.

Figure 1. Measurement of distance from midline on inferior border of cricoid cartilage (arrow tail) to the point of nerve insertion into the larynx (arrow head). C; cricoid cartilage. RLN; recurrent laryngeal nerve.

Figure 2.
Box-Whisker Plot of Distance-to-Midline by Gender and Laterality, Center: Median, Box: Interquartile Range (IQR), Whisker: 1.5 times IQR, Outliers Marked

Figure 3. Estimating path of RLN to facilitate dissection. Inferior edge of carotid is marked with blue ink, path of RLN is estimated from predicted point of insertion, curving towards carotid artery at the thoracic inlet. C; cricoid cartilage. RLN; recurrent laryngeal nerve (end of probe).