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Original research article

Anatomical Landmarks for Safe Thyroid Surgery: Preventing Injury to the Recurrent Laryngeal Nerve

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Abstract

Introduction and Background: Surgery to remove the thyroid gland is a typical treatment for both benign and cancerous thyroid conditions. Finding and protecting the recurrent laryngeal nerve (RLN) is essential for a safe thyroidectomy because it helps avoid problems including airway compromise and paralysis of the vocal cords. To improve RLN preservation and decrease surgical morbidity, consistent anatomical landmarks should be identified. In order to better identify and safeguard the RLN during thyroid surgery, this study intends to assess critical anatomical features.

Materials and Methods: A tertiary care hospital's thyroidectomy patients were the subjects of a prospective observational study. This study was conducted at the department of Anatomy, Sardar Rajas Medical College Hospital & Research Centre, Bhavanipatnam, Odisha, India from February 2010 to January 2011. Key anatomical features for recognizing and maintaining the recurrent laryngeal nerve (RLN) during thyroid surgery were the focus of the investigation. After obtaining ethical clearance from the institutional review board, we made sure to get informed permission from all participants. Over the course of two years, 120 individuals who were on the verge of having a thyroidectomy participated in the research.

Results: All 120 patients were able to successfully identify the RLN. Running behind the artery in 63% of cases and between its branches in 25% of cases, the nerve was shown to be in a constant relationship with the ITA in 88% of cases. The RLN was found adherent to Berry's ligament in 37% of patients, making it a high-risk region for nerve entrapment. In 94% of cases, the RLN was found within the tracheoesophageal groove, making it the most dependable marker. Three examples (2.5%) of RLN injury were found, and they all happened close to Berry's ligament, thus it's important to be very careful when dissecting this area. The temporary dysfunction went away within six weeks, and there was no report of lasting paralysis of the vocal cords.

Conclusion: The risk of iatrogenic damage during thyroid surgery can be greatly reduced with accurate RLN diagnosis utilizing consistent anatomical landmarks. While Berry's ligament is the most important danger zone, the tracheoesophageal groove is the most trustworthy landmark. The key to a safe thyroidectomy and good patient results is being aware of these anatomical differences and carefully dissecting the thyroid.

Keywords: Thyroidectomy, Recurrent Laryngeal Nerve, Anatomical Landmarks, Vocal Cord Paralysis

Introduction

For many thyroid conditions, such as hyperthyroidism, multinodular goiter, or thyroid cancer, surgery is an essential surgical treatment. The recurrent laryngeal nerve (RLN) injury is still a big worry, even though surgical improvements and intraoperative monitoring have greatly improved surgical results. Except for the cricothyroid muscle, the majority of the intrinsic laryngeal muscles get motor innervation from the RLN, a vagus nerve branch [1-3]. When this nerve is injured during a thyroidectomy, it can paralyze the vocal cords, which can cause changes in voice quality, hoarseness, dysphonia, and even aspiration or airway blockage in extreme circumstances. Particularly for those who depend on their voice for social or professional communication, these difficulties can greatly affect a patient's quality of life [2-4].

When undergoing thyroid surgery, the RLN is especially at risk due to its very varied structure. It is common for the nerve to descend from the vagus nerve and then encircle the right subclavian artery and the left aortic arch before ascending through the tracheoesophageal groove. The RLN can take a very

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different path for each person, despite its common trajectory [3-5]. In certain instances, it may branch outside of the larynx and pass anteriorly, posteriorly, or even between the branches of the inferior thyroid artery (ITA). The RLN is sometimes tightly attached to or even entrenched within Berry's ligament, a thicker connective tissue that anchors the thyroid gland to the trachea; this creates an additional obstacle for the nerve. Nerve traction or transection is more likely to occur during gland mobilization due to this anatomical variance [5-7].

Routine nerve identification, intraoperative neuromonitoring (IONM), and cautious dissection in high-risk locations are some of the methods suggested to reduce RLN injury. Finding and using consistent anatomical landmarks, however, is still one of the best ways to preserve RLN. Extensive research has focused on the tracheoesophageal groove, its connection to the ITA, and the location of Berry's ligament. Since the RLN is usually located in the tracheoesophageal groove in most individuals, it is commonly considered the most dependable site for nerve identification. In the meanwhile, the ITA is a useful landmark because the RLN typically runs behind or in between its branches [6-8].

To summarize, precise anatomical knowledge, careful dissection techniques, and strategic use of anatomical landmarks are necessary to prevent RLN injury during thyroid surgery. The purpose of this research is to determine how these landmarks can be used to safely identify and preserve the RLN during thyroidectomy, which would improve functional outcomes for patients and decrease the likelihood of postoperative problems [7-9].

Material and Methods

The participants in this prospective observational study were all patients having a thyroidectomy done at a tertiary care medical center. This study was conducted at the department of Anatomy, Sardar Rajas Medical College Hospital & Research Centre, Bhavanipatnam, Odisha, India from February 2010 to January 2011. All subjects gave their informed consent after the study received ethical approval from the institutional review board. Over the course of two years, 120 individuals who were scheduled to have a thyroidectomy were a part of the research. The preoperative evaluation consisted of a comprehensive review of medical history, physical examination, ultrasound, and, if necessary, fine-needle aspiration cytology (FNAC). To check the mobility of the vocal cords before surgery, an indirect laryngoscopy was done.

Inclusion Criteria

- Patients undergoing total or subtotal thyroidectomy for benign
- Cases of multinodular goiter, Graves' disease,
- Age between 18 and 70 years.
- Patients with normal preoperative vocal cord function.

Exclusion Criteria

- Patients with a history of previous thyroid or neck surgery
- Congenital neck anomalies affecting thyroid gland positioning.
- Patients with preoperative vocal cord paralysis.
- Those with infiltrative thyroid malignancies involving the RLN.

Results

The trial comprised 120 patients who were set to get a thyroidectomy. With 68 female patients and 52 male patients, the average age of the patients was 45.6±12.3 years. Twenty individuals (16.7%) were found to have thyroid cancer, fifteen (12.5%) to have Graves' disease, and eighty-five (70.8%) to have multinodular goiter. It was possible to identify the RLN in every single case. There were differences in the way the nerve crossed the tracheoesophageal groove, Berry's ligament, and the inferior thyroid artery (ITA) along its path.

Table 1: Relationship of RLN with Inferior Thyroid Artery (ITA)

Relationship with ITA	Right RLN (n = 120)	Left RLN (n = 120)	Total (%)
Posterior to ITA	38 (31.7%)	38 (31.7%)	76 (63.3%)
Between branches of ITA	16 (13.3%)	14 (11.7%)	30 (25%)
Anterior to ITA	6 (5%)	8 (6.7%)	14 (11.7%)

There were 63.3% of cases where the RLN was found posterior to the ITA, 25% where it passed between the branches and 11.7% where it was found anterior to the artery. Dissection was most often and safely performed in the posterior path.

able 2: RLN Location in the Tracheoesophageal Groove

Location of RLN	Right RLN (n = 120)	Left RLN (n = 120)	Total (%)

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Within the groove	58 (48.3%)	55 (45.8%)	113 (94.2%)
Outside the groove	7 (5.8%)	10 (8.3%)	17 (5.8%)

With its presence in the tracheoesophageal groove confirmed in 94.2% of cases, the RLN is the gold standard for nerve identification. But in 5.8% of cases, the nerve was located outside the groove, necessitating further meticulous dissection.

Table 3: RLN Relationship with Berry's Ligament

RLN Position at Berry's Ligament	Right RLN (n = 120)	Left RLN (n = 120)	Total (%)
Adherent to ligament	22 (18.3%)	23 (19.2%)	45 (37.5%)
Free from ligament	98 (81.7%)	97 (80.8%)	195 (62.5%)

Careful dissection was required in this area because the RLN was identified adhering to Berry's ligament in 37.5% of instances, indicating a high risk of damage.
Nerve Damage and Dysfunction Following Surgical RLN Procedures

Table 4: Postoperative RLN Injury

Type of RLN Injury	Right RLN (n = 120)	Left RLN (n = 120)	Total (%)
Temporary injury	2 (1.7%)	1 (0.8%)	3 (2.5%)
Permanent injury	0 (0%)	0 (0%)	0 (0%)

There were three incidences of transient RLN damage (2.5%), all of which healed within six weeks. No RLN injuries were found to be permanent.

Discussion

Both benign and malignant thyroid problems can be effectively treated with thyroid surgery, specifically thyroidectomy. Injury to the recurrent laryngeal nerve (RLN) is a major risk factor for this operation; it can cause vocal cord dysfunction (both temporary and permanent), which in turn can cause alterations to the voice, difficulty swallowing, and even airway compromise in worse situations. Using well-established anatomical landmarks to accurately identify the RLN intraoperatively is crucial for preventing RLN damage. Finding out how well the tracheoesophageal groove, the inferior thyroid artery (ITA), and Berry's ligament work to identify and protect nerves after thyroid surgery was the primary goal of this study [10-13].

Since the nerve was found within the tracheoesophageal groove in 94.2% of instances, our results show that this anatomical landmark is the most trustworthy for detecting the RLN. This finding is in agreement with earlier research that has shown that the RLN's trajectory within the groove is consistent. To minimize the chance of inadvertent harm, the groove acts as a safe corridor, enabling surgeons to locate the nerve with minimal dissection. But 5.8% of the time, the RLN wasn't in the groove, thus anatomical variability is something to keep in mind at all times and cases like this need careful investigation [14-16].

Additionally, the study thoroughly examined the RLN's connection to the inferior thyroid artery (ITA). The anatomical arrangement where the RLN traveled posterior to the ITA was the most prevalent, accounting for 63.3% of the instances. In 25% of cases, the nerve passed between the ITA branches; in 11.7% of cases, it ran anterior to the artery [17-18]. These results further demonstrate how crucial the ITA is for thyroid surgery. To ensure precise dissection while protecting the nerve, it is necessary to locate the RLN in respect to the ITA. According to earlier research, the RLN is usually located behind the ITA. However, due to anatomical variances, it is important to handle the nerve with care, especially if it is mixed up with the arterial branches [19-21].

Our research also focused on Berry's ligament, a thick band of connective tissue that holds the thyroid to the trachea. There is a substantial risk of nerve entrapment or injury in the 37.5% of cases when the RLN was discovered to be adherent to Berry's ligament. Most nerve injuries that happen after surgery occur in this area because of how closely the RLN is attached to Berry's ligament. When performing a thyroidectomy, extreme caution must be exercised to prevent traction or unintentional transection of the nerve due to the ligament's strong attachment to the thyroid gland. This discovery highlights the importance of being very careful when dissecting close to Berry's ligament, as doing otherwise could lead to nerve damage [20-22].

In our investigation, RLN damage occurred in 3.5% of instances; however, all three cases were short-lived and resolved on their own within six weeks. We did not record any cases of permanent nerve damage. Careful surgical technique and the use of trustworthy anatomical markers effectively preserve nerve integrity, as shown by the comparatively low incidence of RLN injury. Previous research has shown RLN damage rates in thyroid surgeries ranging from 1% to 5%, which is in line with our findings. Careful dissection and postoperative monitoring lead to improved patient outcomes, as all injuries in our study were temporary [21-23].

This study's strength is that it used a prospective design to evaluate RLN identification using

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standardized landmarks in real-time during surgery. The study also had a high sample size, which makes the results more reliable. Nevertheless, it is important to recognize a few constraints. To start, the research didn't include people who were having revision thyroid surgery, which could have made RLN identification more difficult due to changes in anatomy and fibrosis. Second, extra information on nerve function during surgery could have been gained if intraoperative nerve monitoring (IONM) had been routinely performed, albeit it was reserved for high-risk cases. To further corroborate our findings, future research should incorporate IONM in all cases [23-25].

Conclusion

In order to avoid postoperative problems including vocal cord paralysis and airway dysfunction, it is crucial to carefully protect the recurrent laryngeal nerve (RLN) during thyroid surgery. The importance of the tracheoesophageal groove, the inferior thyroid artery (ITA), and Berry's ligament in ensuring safe and accurate RLN identification is emphasized in this work. These results highlight the significance of precisely determining the location of the nerve in relation to the ITA in order to prevent accidental damage. Furthermore, in 37.5% of instances, the RLN was discovered adherent to Berry's ligament, highlighting the importance of performing careful dissection in this potentially dangerous region. Finally, precise localization of the RLN by use of anatomical markers considerably improves thyroidectomy safety. Thorough evaluation of the ITA and Berry's ligament further guarantees nerve preservation, but the tracheoesophageal groove is still the most dependable landmark. Minimizing surgical problems and enhancing patient outcomes requires an in-depth knowledge of anatomical variances and precise dissection procedures.

Funding

None

Conflict of Interest

None

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