Student's Journal of Health Research Africa
Vol. 4 No. 9 (2023): September 2023 Issue
https://doi.org/10.51168/sjhrafrica.v4i9.652
Original article

ANATOMICAL VARIATION OF RECURRENT LARYNGEAL NERVE ENCOUNTERED DURING THYROID SURGERIES IN TRIBAL POPULATION OF JHARKHAND. A PROSPECTIVE ANALYSIS.

Kumar Gaurav, Dipayan Roy, Rajiv Rajak, Asad Hashmi, Zahid Mustafa Khan*
Department of ENT, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand, India

Abstract.

Introduction:
The anatomy side and front of the neck, the pharynx, the laryngeal structures, and any anatomical variations in the persistent nerve must be understood before performing thyroid surgery. Both the surgeon and the patient find thyroid surgery challenging due to the architecture of the lower laryngeal nerve. Due to the consequent diversity of anatomical changes, identification and dissection are challenging and delicate. These changes are causes of the persistent nerve's susceptibility. The various anatomical differences that have been described in the literature are related to the nerve itself and the path that it takes around nearby organs.

Method:
During thyroid surgeries, RLN encountered patients attending the OPD in RIMS, Ranchi from August 2022 to July 2023 duration. All patients underwent standard electrocardiography, lung ventilation function testing, clinical biochemistry, hematologic, and coagulation function assessments. All of the included patients' clinically significant vocal cord impairments were ruled out by preoperative laryngoscopy.

Results:
In total, 100 individuals who had thyroid surgery on time were included in the research. The median age of the 55 women and 45 men who participated in this prospective study was 45.0 years (range, 13-81 years). 120 RLNs, including 65 left- and 55 right-side nerves, were dissected; 65 individuals underwent unilateral exposure, and 35 underwent bilateral exposure.

Conclusion:
The recurrent nerve has several different anatomical variations, and the discovery is frequently made intraoperatively. During thyroid surgery, the operator should always be aware of anatomical variance. Regardless of the initial strategy, the surgeon's vigilance and skill prevent the recurrence of injury even when the recurrent nerve has unexpected anatomical changes.

Recommendation:
RLN should be exposed routinely and routine dissection for exposure of RLN needs to be performed especially for patients who are receiving second or numerous surgeries.

Keywords: Thyroid, Recurrent laryngeal nerve, Sternocleidomastoid muscle, Submitted: 2023-09-05
Accepted: 2023-09-08

1. INTRODUCTION.

A part of the vagus nerve, the recurrent laryngeal nerve (RLN) delivers motor, sensory, and parasympathetic fibers to the larynx. Before ascending behind the lower constrictor to the nerve's entry location into the larynx, the RLN is invariably present superior to the inferior thyroid artery. This connection is a significant landmark for its discovery during thyroid surgery. However, one well-known risk factor for RLN injury in thyroid surgery is anatomical abnormalities of the RLN. With symptoms ranging from practically imperceptible hoarseness in unilateral lesions to stridor and abrupt airway obstruction in bilateral damage, RLN injury can result in RLN paralysis [1,2]. About 3-8% of post-operative RLN paralysis patients result in temporary paralysis, while 0.3-3% of cases result in permanent paralysis [3-5]. To protect the nerve and its function during surgery, it is crucial to recognize the anatomical variations of the RLN.

The sides and front of the neck, the pharynx, the laryngeal structures, and any anatomical variations in the persistent nerve must all be understood anatomically before performing thyroid surgery [1]. Both the surgeon and the patient find thyroid surgery challenging due to the architecture of the lower laryngeal nerve [2]. Due to the consequent diversity of anatomical changes, identification and dissection are challenging and delicate. These changes are causes of the recurrent nerve's sensitivity [2]. The various anatomical differences that have been described in the literature are related to the nerve itself and the waythat it runs alongside nearby organs [1] [2] [3]. These include the nerve's recurrent non-recurrent division, connection directing to the inferior thyroid artery, and extra laryngeal divisions. Thyroid pathology may potentially be connected to these differences.

The best method for RLN identification is still visual damage avoidance, despite new monitoring developments allowing throughout surgery, neuromonitoring to lower the frequency of RLN harm.[6]. Having a thorough grasp of the RLN's anatomical differences could make RLN dissection safer, quicker, and more accurate for surgeons. Consequently, it is crucial to know the RLN's anatomical position before performing thyroid surgery.

To investigate RLN variants and contrast them with those described in Western patients, this study aimed to investigate RLN's anatomical differences in a significant cohort of patients having thyroid surgery.

2. PATIENTS AND METHODS.

2.1. Patient.

In OPD of RIMS, Ranchi, Aug 2022 - July 2023 all patients who underwent an elective thyroidectomy for benign or malignant thyroid conditions were included in this prospective cross-sectional study. Age of 18 years or older, diagnosis of a surgically indicated thyroid disease, such as thyroid cancer suspected on ultrasound or diagnosed through fine-needle aspiration biopsy, unidentified single or multiple solid nodules at the maximum size over 30mm, goiter of any kind compressing the trachea, or retrosternal goiter, were the inclusion criteria. Pregnancy, breastfeeding, a history of prior neck surgery or radiation, a pre-existing RLN impairment on preoperative laryngoscopy, and aggravating significant cardiac, hepatorenal, and coagulation disorders were the exclusion criteria.

2.2. Intraoperative identification of the RLN.

All patients underwent standard electrocardiography, lung ventilation function testing, clinical biochemistry, hematologic, and coagulation function assessments. All of the included patients' clinically significant vocal cord impairments were ruled out by preoperative laryngoscopy. The same assigned surgical team, which also included resident surgeons, anesthesiologists, radiologists, clinical pathologists, otolaryngologists, surgical nurses, and research personnel, carried out each

* Corresponding author.
Email address: drzahidmk@gmail.com (Zahid Mustafa Khan)

operation. The team's leader was a board-certified general surgeon. Under general endotracheal anesthesia, the patients were sedated. A conventional thyroid collar incision of 6 to 8 cm was made right above the sternocleidomastoid muscle, and 2-3 cm above the sternal notch and clavicles. Berry's ligament was split, and the superior pedicle was ligated. After separating the strap muscles from the thyroid gland, the isthmus of the thyroid gland was transected, followed by the removal of the middle thyroid vein and mobilization of the superior pole. The superior pole's branches were separated, tied, and then gradually cut. The RLN was located in a triangle bounded inferiorly by the thyroid lobe, medially by the trachea, and laterally by the common carotid artery. The exposure started when the RLN entered the larynx, and the entire area was dissected along with the RLN fibers. The anterior borders of the sternocleidomastoid muscles were mobilized for those that were firmly attached, and the RLN was located using a "back door" method after medial reflection of the sternothyroid muscle. The nerves were separated from fat and connective tissue and tracked along the whole course of the RLN to the level of entry into the larynx beneath the cricothyroid muscle along the trachea-esophageal groove. The left-side RLN was located close to the middle or lower pole and along the left-side tracheoesophageal groove. The right-side tracheoesophageal groove, the middle pole, and the right-side RLN were all medially exposed to the common carotid artery. To identify and characterize RLN anatomical differences using macroscopy, the whole length of the RLN was painstakingly dissected.

The position of the nerve, the number of branches, the distance in millimeters between the inferior border of the cricothyroid and the site of bifurcation, and the distance between the point of bifurcation and the entry into the larynx were all operational information that was gathered prospectively.

2.3. Statistical analysis.

For statistical analysis, SPSS 16.0 (SPSS Inc., Chicago, IL, USA) was utilized as the statistical software program. All categorical data were compared using the Chi-Square test and presented as n (%). A difference was deemed statistically significant if the P value was less than 0.05.

3. RESULTS.

In total, 100 individuals who had thyroid surgery on time were included in the research. At the initial stage, several 200 patients were examined for eligibility, however, 100 patients were excluded from this study due to not being eligible. The median age of the 55 women and 45 men who participated in this prospective study was 45.0 years (range, 13-81 years). 120 RLNs, including 65 left- and 55 right-side nerves, were dissected; 65 individuals underwent unilateral exposure, and 35 underwent bilateral exposure.

The RLNs identified anatomical variations in patients. There was no discernible difference in laterality among the 63 (52.5%) RLNs that showed anatomical variation, including 42 (64.6%) left- and 38 (69.1%) right-side RLNs (P=0.080).

The RLN of type I underwent bifurcation (diverging entry and converging entry), trifurcation (diverging entry and converging entry), and quadrifurcation (quadruplication) before accessing the larynx. Before entering the larynx, Type II was a fan-shaped RLN. The nerve trunk of type III entered the larynx distant from the cricothyroid joint, which was a characteristic of the condition. More than 5 mm separated the entry from the back of the cricothyroid joints. Only elderly patients above the age of 60 were found to have Type IV, a deteriorated RLN. Adipopexis was visible in the degenerative RLN, which thickened. The nonrecurrent laryngeal nerve (NRLN), which is part of type V, reaches the larynx straight from the neck's vagus nerve rather than the aortic arch. Type VI was distinguished by the upward branch's entrance into the skull coming before its entrance into the larynx. The upward-leading RLN of Type VII was convoluted.

These changes were categorized as variations in extra laryngeal structures in order of decreasing frequency.

In the left-side RLN, the type I variant was found substantially more frequently (P=0.012). While the left-side RLN had more instances of the type III variation (P=0.039), the right-side RLN saw more instances of the type II variation (P 0.002). The older patients who had the type IV variant showed apparent adipose accumulation and thickness of the RLN, although there was no significant change in laterality (P= 0.250). The only RLN on the right side that showed the type V variation was. Only the right-side RLN revealed the type VI variant, and there was no discernible difference in laterality between the type VI and type VII variations (P= 0.460).

4. DISCUSSION.

The current study is the first extensive prospective investigation of the RLN anatomical differences in population. Three different forms of RLN anatomical variants have been described in previous investigations, including extra laryngeal divergence variations (type I), fan-shaped divergence before the entry to the larynx variations (type II), and the infrequently occurring NRLN variations (type V) [7–10]. We discovered four additional morphological variants of the RLN in thyroid illness patients in addition to these variants that were found in Western and Middle Eastern populations. The type III variation, in which the RLN has a laryngeal opening placed more than 5 millimeters away from the cricothyroid joint, was previously reported by our group [11] and is one of these four variants. The last three variants—intracranial branching (type VI), a convoluted upward-leading RLN (type VII), and the presence of a degraded RLN in the elderly—are discovered in patients for the first time.

One frequent anatomical abnormality seen during thyroid surgery that contributes to greater surgical morbidity is the RLN's extra laryngeal branching. According to certain studies, the RLN can branch into two or more divisions on one or both sides, with extra laryngeal branching occurring in up to 36% of cases [12-14]. Similar findings on the frequency of the RLN bifurcation have been made by other researchers [15, 16]. A significant series revealed that roughly 72% of RLNs branch before reaching the larynx. In contrast to the percentages reported in other studies, the rate of bifurcation, trifurcation, and quadrifurcation of the RLN in this study was 11.5%.

Despite being uncommon, the NRLN is an essential anatomical variant to be aware of during thyroidectomy as well as other surgical procedures because if mistakenly ligated, it might cause vocal cord paralysis.

This study looked at the prevalence of NRLN and discovered that it only occurred in 0.5% of instances.

On the left, the RLN originates from the vagus nerve at the aortic arch, travels beneath the ligamentum arteriosum, hooks around the aortic arch, and then returns to the neck within the transoesophageal groove before entering the larynx posterior to the inferior constrictor. It starts at the level of the first subclavian artery on the right and loops below the transoesophageal groove before entering the larynx. Studies have found a variety of configurations in terms of the laterality of the variation [13, 17]. In the current investigation, we found that the right RLN experienced much more anatomical variation than the left RLN. Compared to the left RLN, which almost always tends to lay in the trachea-oesophageal groove, the right RLN is more variable in its position relative to the inferior thyroid artery and also tends to be more anterolateral. The RLN's embryological origin may be able to explain this.

The current study has some restrictions. First, we chose patients undergoing thyroid surgery; as a result, there were 1:3 more male patients than female patients. As a result, we noticed the RLN's structural variations in more women. Future research must determine the anatomical variances of the RLN in additional male subjects. Second, despite the vast number of patients included in the study, the sample size was somewhat modest for some particular RLN structural abnormalities, such as kinds IV-VII. Third, there is little information available addressing the elevated risk of harm linked to the anatomical diversity of the RLN.

Future multi-institutional research is required

to determine whether patient populations with more common RLN structural variants suffered higher rates of RLN damage.

5. CONCLUSION.

The recurrent nerve has several different anatomical variations, and the discovery is frequently made intraoperatively. During thyroid surgery, the operator should always be aware of anatomical variance. Regardless of the initial strategy, the surgeon's vigilance and skill prevent the recurrence of injury even when the recurrent nerve has unexpected anatomical changes.

6. LIMITATIONS.

The limitations of this study include a small sample population who were included in this study. The findings of this study cannot be generalized for a larger sample population. Furthermore, the lack of a comparison group also poses a limitation for this study's findings.

7. RECOMMENDATION.

RLN should be exposed routinely and routine dissection for exposure of RLN needs to be performed especially for patients who are receiving second or numerous surgeries.

8. ACKNOWLEDGEMENT.

We are thankful to the patients and their caring parents without them the study could not have been done. We are thankful to the supporting staff of our hospital who were involved in the patient care of the study group.

9. LIST OF ABBREVIATIONS.

RLN- Recurrent Laryngeal Nerve
OPD- Outpatient Department
SPSS- Statistical Package for Social Sciences
NRLN- Nonrecurrent laryngeal nerve

10. Source of funding.

The study was not funded.

11. Conflict of interest.

The authors report no conflicts of interest in this work.

12. Publisher details:

Publisher: Student's Journal of Health Research (SJHR)
(ISSN 2709-9997) Online
Category: Non-Governmental & Non-profit Organization
Email: studentsjournal2020@gmail.com
WhatsApp: +256775434261
Location: Wisdom Centre, P.O.BOX. 148, Uganda, East Africa.

13. REFERENCES.

1. Erbil, Y. et al. Predictive factors for recurrent laryngeal nerve palsy and hypoparathyroidism after thyroid surgery. Clinical otolaryngology 32, 32–37 (2007).
2. Jeannon, J. P., Orabi, A. A., Bruch, G. A., Abdalsalam, H. A. & Simo, R. Diagnosis of recurrent laryngeal nerve palsy after thyroidectomy: a systematic review. International journal of clinical practice 63, 624–629 (2009).
3. Chan, W. F. & Lo, C. Y. Pitfalls of intraoperative neuromonitoring for predicting postoperative recurrent laryngeal nerve function during thyroidectomy. World journal of surgery 30, 806–812 (2006).
4. Lo, C. Y., Kwok, K. F. & Yuen, P. W. A prospective evaluation of recurrent laryngeal nerve paralysis during thyroidectomy. Archives of surgery 135, 204–207 (2000)

5. Serpell, J. W., Yeung, M. J. & Grodski, S. The motor fibers of the recurrent laryngeal nerve are located in the anterior extralaryngeal branch. Annals of surgery 249, 648–652 (2009)
6. Page, C., Monet, P., Peltier, J., Bonnaire, B. and Strunski, V. (2008) Non-Récurrent Laryngeal Nerve Related to Thyroid Surgery: Report of Three Cases. The Journal of Laryngology & Otology, 122, 757-761. htt ps://doi.org/10.1017/S0022215107008389
7. Shao, T.-L., Qiu, W.-H., Shen, B.-Y. and Yang, W.-P. (2015) New Variation of Right Recurrent Laryngeal Nerve: Cases Report. Indian Journal of Surgery, 77, 38-39.
8. Page, C., Peltier, J., Charlet, L., Laude, M. and Strunski, V. (2006) Superior Approach to the Inferior Laryngeal Nerve in Thyroid Surgery: Anatomy, Surgical Technique and Indications. Surgical and Radiologic Anatomy, 28, 631-636. https://doi.org /10.1007/s00276-006-0141-9.
9. Page, C., Monet, P., Peltier, J., Bonnaire, B. & Strunski, V. Non-recurrent laryngeal nerve related to thyroid surgery: report of three cases. The Journal of laryngology and otology 122, 757–761 (2008).
10. Ardito, G. et al. Revisited anatomy of the recurrent laryngeal nerves. American journal of surgery 187, 249–253 (2004)
11. Makay, O., Icoz, G., Yilmaz, M., Akyildiz, M. & Yetkin, E. The recurrent laryngeal nerve and the inferior thyroid artery–anatomical variations during surgery. Langenbeck's archives of surgery/Deutsche Gesellschaft fur Chirurgie 393, 681–685 (2008).
12. Mirilas, P. & Skandalakis, J. E. Benign anatomical mistakes: the correct anatomical term for the recurrent laryngeal nerve. The American surgeon 68, 95–97 (2002).
13. Toniato, A. et al. Identification of the nonrecurrent laryngeal nerve during thyroid surgery: 20-year experience. World journal of surgery 28, 659–661 (2004).
14. Shao, T. et al. A newly identified variation at the entry of the recurrent laryngeal nerve into the larynx. Journal of investigative surgery 23, 314–320 (2010)
15. Beneragama, T. & Serpell, J. W. Extralaryngeal bifurcation of the recurrent laryngeal nerve: a common variation. ANZ journal of surgery 76, 928–931 (2006)
16. Kaisha, W., Wobenjo, A. & Saidi, H. Topography of the recurrent laryngeal nerve in relation to the thyroid artery, Zuckerkandl tubercle, and Berry ligament in Kenyans. Clinical anatomy 24, 853–857 (2011)
17. Tang, W. J., Sun, S. Q., Wang, X. L., Sun, Y. X. & Huang, H. X. An applied anatomical study on the recurrent laryngeal nerve and inferior thyroid artery. Surgical and radiologic anatomy: SRA 34, 325–332 (2012)

Author biography

Kumar Gaurav Junior Resident, Department of ENT, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand, India

Dipayan Roy Junior Resident, Department of ENT, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand, India

Rajiv Rajak Junior Resident, Department of ENT, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand, India

Asad Hashmi Junior Resident, Department of ENT, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand, India

Zahid Mustafa Khan Associate Professor, Department of ENT, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand, India