Biological and Clinical Sciences Research Journal
eISSN: 2708-2261; pISSN: 2958-4728
www.bcsrj.com
DOI: https://doi.org/10.54112/bcsrj.v2024i1.1208
*Biol. Clin. Sci. Res. J., Volume, **2024**: 1208*
Original research article

ANATOMICAL VARIATIONS IN RECURRENT LARYNGEAL NERVES IN THYROID SURGERY

NAEEM MM*, ANWAR MI, KHAWAR A, AFSAR B, SIKANDAR S, GHAFFAR H

Sheikh Zayed Hospital Lahore, Pakistan
**Correspondence author email address:* muqt995@gmail.com

(Received, 07th September 2024, Revised 10th October 2024, Published 26th October 2024)

Abstract: *The recurrent laryngeal nerve (RLN) is a critical structure encountered during thyroid surgery, with its injury posing risks of complications such as vocal cord paralysis and hoarseness. Anatomical variations in the RLN are known to occur, making it crucial for surgeons to understand and anticipate these variations to avoid inadvertent nerve injury. This study aims to identify and document the anatomical variations in RLNs in patients undergoing thyroid surgery to enhance surgical safety and outcomes.* ***Objective:*** *To identify the anatomical variations of the recurrent laryngeal nerves (RLNs) in patients undergoing thyroid surgery and assess their clinical relevance in preventing postoperative complications.* ***Methods:*** *A prospective observational study was conducted in the General Surgery Department of Sheikh Zayed Hospital, Lahore, from August 2023 to August 2024. A total of 100 patients undergoing total or subtotal thyroidectomy or right/left lobectomy for conditions including thyroid cancer, multinodular goiter, and solitary adenoma were included. Macroscopic examination of the RLN's original structure, bifurcations, and directional variations was performed during surgery. Lateral, inferior, and superior dissection of the RLNs was conducted under general anesthesia. The study's primary outcomes were the incidence of different anatomical variations in the RLN and their bifurcations to the larynx. Postoperative complications such as dyspnea and hoarseness were also monitored.* ***Results:*** *Of the 100 patients studied, 107 RLNs were identified, with variations categorized into six types. Type I RLNs were observed in 66.9% of cases, with 50.5% on the right side and 49.5% on the left. Type II RLNs were noted in 26.3% of cases, evenly distributed between right and left sides (50% each). Type III nerves were predominantly left-sided (62.5%) compared to right-sided (37.5%). Types IV, V, and VI were only observed on the right side. No significant difference in variation patterns was observed between the right and left sides ($p>0.05$). Importantly, none of the patients developed postoperative complications such as dyspnea or hoarseness.* ***Conclusion:*** *The study identified six distinct types of anatomical variations in the recurrent laryngeal nerve during thyroid surgery, with variations involving one or more branches. Awareness of these variations is crucial for surgeons to avoid nerve injury and ensure better surgical outcomes. Vigilance during dissection, particularly in recognizing these variants, is essential in preventing postoperative complications.*

Keywords: Laryngeal nerves, Recurrent laryngeal nerves, Surgery, Thyroid.

Introduction

Injury of the recurrent laryngeal nerve is a common and fatal surgical complication in thyroid surgeries.(1) It occurs in almost 3-7% of patients and can cause serious conditions like vocal cord paralysis, shortness of breath, and hoarseness.(2) A poor quality of life is obtained after extubation as in some cases, patients develop a stridor. Thus, appropriate identification of RLN is important during surgery.

Most surgeons experience difficulty in identifying the nerve due to unawareness of its anatomy, increasing the risk of injury. Permanent palsy has been reported in 1-2% of patients while transient palsy occurs in 5-6% of patients(3). According to guidelines, RLNs must be identified during thyroid procedures along with any bifurcations. Lateral, inferior, and superior approaches to dissection are recommended for this purpose.

Anatomical variations of RLNs such as non-recurrent RLN, extra-laryngeal branches, intertwined branches of RLN and thyroid artery, and distorted nerve are usually misidentified and are damaged by clamping, ischemia, transection, stretching, ligation, and electrothermal injury. (4, 5) Transection of RLN or its branches leads to permanent vocal cord paresis. (6) This study was conducted to identify the anatomical variations in RLNs in patients undergoing thyroid surgery.

Methodology

A prospective study was conducted in the General Surgery Department of Sheikh Zayed Hospital, Lahore from August 2023 to August 2024. A total of 100 patients undergoing total or subtotal thyroidectomy and right or left lobectomy for thyroid cancer, multinodular goiter, and solitary adenoma were included in the study. Patients with neck radiation or vocal cord impairment were excluded. All patients provided their informed consent. The ethical committee of the hospital approved the study.

Laryngoscopy was performed in all patients preoperatively. The original structure and bifurcations of the nerve were checked macroscopically and noted. Lateral, inferior, and superior dissection of RLNS were performed under anesthesia. The main outcome was the incidence of the original direction of the nerve, anatomical variations, and bifurcations to the larynx.

For dissection of RLNs during the surgery, after isolation of sternothyroid muscle from the endocrine gland, transection of the isthmus was performed to free it to Berry's posterolateral ligament level. The thyroid gland artery/vein

was superiorly ligated and transection was Berry's ligament was done through cricothyroid space. The Cephalad branch of the vagus nerve was located with a superior approach. Inferior branches were dissected separately and RLNs in transesophageal grooves were located. Middle branches were dissected separately. Bifurcation along the cervical trunk to the larynx was exposed and dissected, and those connected to the larynx entry were observed. The anatomical variations were divided into types as shown in Figure I.

All data was analyzed by SPSS version 24. Quantitative data was presented as frequency and percentage. Left and right-sided RLN variations were compared by x2 test. A p-value less than 0.05 was taken as significant.

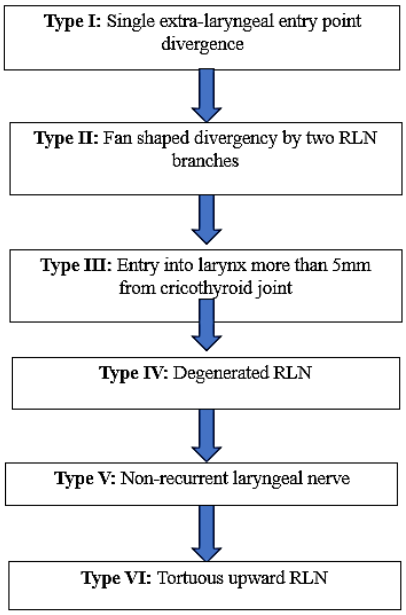

Figure I: Classification of Anatomical Variants of RLNs

Results

A total of 100 patients were included in the analysis among which 82 (82%) were females and 18 (18%) were males. The average age was 50 years with a minimum age of 14 and maximum age of 84. A total of 160 RLNs were dissected among which 75 (47.9%) were located on the left and 85 (53.1%) were located on the right (Table I).

The types of anatomical variations are described in Table II. 107 (66.9%) were type I with right-sided nerve in 54 (50.5%) on the right side and left-sided nerve in 53 (49.5%). Type II was found in 42 (26.3%) with right sides in 21 (50%) and left-sided in 21 (50%). Type III was 62.5% left-sided and 37.5% right-sided (p>0.05). Type IV-VI were only right-sided. None of the patients developed postoperative complications such as dyspnea or hoarseness.

Table I: Patients' characteristics

Characteristics	N (%)
Gender	
Male	18 (18%)
Female	82 (82%)
Location of RLNs (n=160)	
Left	75 (47.9%)
Right	85 (53.1%)
Exposure	
Unilateral	20 (20%)
Bilateral	40 (40%)
Type of tumour	
Benign	46 (46%)
Malignant	54 (54%)
Procedure	
Hemithyroidectomy	30 (30%)
Subtotal thyroidectomy	15 (15%)
Total thyroidectomy	55 (55%)

[Citation: Naeem, M.M., Anwar, M.I., Khawar, A., Afsar, B., Sikandar, S., Ghaffar, H., (2024). Anatomical variations in recurrent laryngeal nerves in thyroid surgery. *Biol. Clin. Sci. Res. J.*, **2024***: 1208*. doi: https://doi.org/10.54112/bcsrj.v2024i1.1208]

Table II: Types of anatomical variation of RLNs

Types	N (%)	Right-sided	Left-sided
Type I	107 (66.9%)	54 (50.5%)	53 (49.5%)
Type II	42 (26.3%)	21 (50%)	21 (50%)
Type III	8 (5%)	3 (37.5%)	5 (62.5%)
Type IV	1 (0.6%)	1 (100%)	-
Type V	1 (0.6%)	1 (100%)	-
Type VI	1 (0.6%)	1 (100%)	-

Discussion

This study was conducted to evaluate the anatomical variations in recurrent laryngeal nerves in thyroid surgery. We identified six types of variations in the RLNs among which type I was most prevalent (67%). Previous literature agrees with these results. (7-9) This is in contrast to previous studies where only three variants were reported however, in these studies RLN branches extending to the larynx were not classified. (10, 11)

In our study, 31.3% of patients had two or more RLN branches entering the larynx which is higher than the incidence reported by Gaurav et al.(12) Only two patients had non-recurrent RLNs. We identified two additional types; IV and V which are not commonly reported in Western and Middle Eastern patients. (13) However, identification of these changes is important as surgical morbidity can significantly increase by the presence of two main RLN branches.

RLNs were more commonly found on the right side but the difference between locations of nerves was not significant ($p>0.05$) due to limited sample size. No RLNs penetrated Berry's ligament in our study which is similar to Randolph et al and in contrast to Berlin et al.(14, 15) RLNs were found in thyroid gland tumours where the Zuckerkandl tubercle was used as a landmark for identification, indicating a significant relation between them. (16) We used various approaches to identify the RLNs, with NRLNs, and inferior type IV and V located by superior approach, and type I-III and superior type IV and V located by inferior approach. The junction of type IV and V was approached laterally. Thus, the combination approach was successful with no complications in any patient. (17, 18)

Our study has some limitations. The majority of the population was female due to which we could not establish a relationship between anatomical variations and male gender. Secondly, patients with type IV-VI variants were limited. Thirdly, we could not establish a clear relationship between the presence of RLNs and anatomical landmarks. Lastly, we did not assess iatrogenic injuries caused by these variations.

Conclusion

We identified six types of anatomical variations in recurrent laryngeal nerves during thyroid surgery involving one or more branches. Surgeons need to be vigilant and aware of these variants to prevent injuries and complications.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate.
Approved by the department concerned. (IRB-NHM-04/23)

Consent for publication
Approved

Funding
Not applicable

Conflict of interest

The authors declared an absence of conflict of interest.

Authors Contribution

MUHAMMAD MUQEET NAEEM (PGR General Surgery)
Final Approval of version
MUHAMMAD IMRAN ANWAR (Professor)
Revisiting Critically
AMNAH KHAWAR (House Officer)
Data Analysis
BILAL AFSAR (PGR general surgery)
Drafting
SHEHROZ SIKANDAR (PGR general surgery) & HASEEB GHAFFAR (PGR general surgery)
Concept & Design of Study

References

1. Gunn A, Oyekunle T, Stang M, Kazaure H, Scheri R. Recurrent laryngeal nerve injury after thyroid surgery: an analysis of 11,370 patients. Journal of Surgical Research. 2020;255:42-9.
2. Tian H, Pan J, Chen L, Wu Y. A narrative review of current therapies in unilateral recurrent laryngeal nerve injury caused by thyroid surgery. Gland surgery. 2022;11(1):270.
3. Huang T-Y, Yu W-HV, Chiang F-Y, Wu C-W, Fu S-C, Tai A-S, et al. How the severity and mechanism of recurrent laryngeal nerve dysfunction during monitored thyroidectomy impact on postoperative voice. Cancers. 2021;13(21):5379.
4. Islam MR, Begum T, Islam N, Islam MM. Anatomical Variation of Recurrent Laryngeal Nerve with Inferior Thyroid Artery: A Cross-Sectional Study in Bangladeshi People. Journal of Science Foundation. 2020;18(1):7-12.
5. Al-Hakami H, Al Garni M. Incidence and risk factors for recurrent laryngeal nerve injury after thyroid surgery. The Egyptian Journal of Otolaryngology. 2024;40(1):92.
6. Kumar V. Retrospective Analysis of Recurrent Laryngeal Nerve Injury in Thyroid Surgery and its Risk Factors. Thyroid.9:18.36.
7. Yin C, Song B, Wang X. Anatomical variations in recurrent laryngeal nerves in thyroid surgery. Ear, Nose & Throat Journal. 2021;100(10_suppl):930S-6S.
8. Thomas AM, Fahim DK, Gemechu JM. Anatomical variations of the recurrent laryngeal nerve and implications for injury prevention during surgical procedures of the neck. Diagnostics. 2020;10(9):670.
9. Kostek M, Caliskan O, Yanar C, Cakir Y, Uludag M. The most common anatomical variation of recurrent laryngeal

nerve is extralaryngeal branching. The Medical Bulletin of Sisli Etfal Hospital. 2021;55(3):294.
10. Bastien AJ, Ho AS. Anatomical Variations of the Recurrent Laryngeal Nerve During Thyroid Surgery and the Dangers of Nerve Injury. Clinical Thyroidology. 2022;34(1):35-7.
11. Liddy W, Wu C-W, Dionigi G, Donatini G, Giles Senyurek Y, Kamani D, et al. Varied recurrent laryngeal nerve course is associated with increased risk of nerve dysfunction during thyroidectomy: results of the surgical anatomy of the recurrent laryngeal nerve in thyroid surgery study, an international multicenter prospective anatomic and electrophysiologic study of 1000 monitored nerves at risk from the international neural monitoring study group. Thyroid. 2021;31(11):1730-40.
12. Gaurav K, Roy D, Rajak R, Hashmi A, Khan ZM. ANATOMICAL VARIATION OF RECURRENT LARYNGEAL NERVE ENCOUNTERED DURING THYROID SURGERIES IN TRIBAL POPULATION OF JHARKHAND. A PROSPECTIVE ANALYSIS. Student's Journal of Health Research Africa. 2023;4(9):6-.
13. Moradi A, Hajian A. The intracranial branch; A rare anatomical variation of the recurrent laryngeal nerve; Case report. International Journal of Surgery Case Reports. 2021;78:9-11.
14. Randolph GW, Kamani D, Wu C-W, Schneider R. Surgical anatomy and monitoring of the recurrent laryngeal nerve. Surgery of the thyroid and parathyroid glands: Elsevier; 2021. p. 326-59. e10.
15. dos Santos Menezes Siqueira GV, dos Santos Rodrigues MH, Santos CNN, Goncalves PE, Garcao DC. Anatomical variations of recurrent laryngeal nerve: a systematic review and meta-analyses. Surgical and Radiologic Anatomy. 2024;46(3):353-62.
16. Noussios G, Chatzis I, Konstantinidis S, Filo E, Spyrou A, Karavasilis G, et al. The anatomical relationship of inferior thyroid artery and recurrent laryngeal nerve: a review of the literature and its clinical importance. Journal of Clinical Medicine Research. 2020;12(10):640.
17. Gkrinia E, Nana P, Spanos K, Fiska A, Hajiioannou J, Skoulakis C, et al. Anatomical variations of the recurrent laryngeal nerve according to the inferior thyroid artery and their clinical impact in patients undergoing thyroidectomy. The Journal of Laryngology & Otology. 2023;137(6):673-7.
18. Le VQ, Ngo QD, Ngo XQ. Nonrecurrent laryngeal nerve in thyroid surgery: Frequency, anatomical variations according to a new classification and surgery consideration. Head & neck. 2019;41(9):2969-75.