Indian Journal of Clinical Anatomy and Physiology 2024;11(2):71–74

Content available at: https://www.ipinnovative.com/open-access-journals

Indian Journal of Clinical Anatomy and Physiology

Journal homepage: https://www.ijcap.org/

Original Research Article

Exploring the anatomical relationship between the recurrent laryngeal nerve and the inferior thyroid artery: insights from cadaveric dissections

Pooja Dadwani[1]*, **Ila Suttarwala**[2], **Jaikumar B Contractor**[3]

[1]*Dept. of Anatomy, Pramukhswami Medical College, Bhaikaka University, Anand, Gujarat, India*
[2]*Baroda Medical College, Vadodara, Gujarat, India*
[3]*Dept. of Anatomy, GMERS Medical College, Godhra, Gujarat, India*

ARTICLE INFO

Article history:
Received 08-06-2024
Accepted 19-06-2024
Available online 20-07-2024

Keywords:
Thyroid gland disorders
Thyroidectomy
Recurrent laryngeal nerve injury
Anatomical variation
Surgical dissection

ABSTRACT

Background: Injury to Recurrent Laryngeal Nerve (RLN) is the most common complication of surgical interventions for thyroid gland disorders. This makes a thorough anatomical knowledge of RLN with variations in its branching pattern and relationship with Inferior Thyroid Artery (ITA) of vital importance for surgeons.

Aims & Objectives: The current study was aimed to establish the relationship of RLN with Inferior Thyroid Artery (ITA) as well as its implications on thyroid surgeries.

Materials and Methods: We studied the 73 RLN during routine dissection and autopsy examinations through a lateral approach and observations were tabulated using descriptive statistics and relational statistics, Chi-square test, for analysing significance.

Results: The results showed statistically significant differences in RLN branching patterns as well as in its positions relative to ITA between the right and left RLN. Extra-laryngeal terminal bifurcations were the most common finding and posterior positioning of RLN with respect to ITA was predominant. More so, bifurcations occurred more frequently on the right side (75.67%) than on the left side (30.55%) ($P < 0.05$). The nerve was observed posterior to the ITA in 78.08%, anterior in 24.65% and in-between in 5.47% specimens.

Conclusion: The potential consequences of such RLN variations on surgical outcomes emphasize the risk of iatrogenic injuries and associated symptoms. We also noted discrepancies in findings compared to a previous few studies, but these may be attributed to the embryological and racial differences. The study underscores the importance of understanding RLN anatomy for safe thyroid surgeries and warrant further research to elucidate RLN variations and their impact on surgical procedures contributing valuable insights into RLN anatomy to optimize surgical outcomes and reduce complications in thyroid surgeries.

1. Introduction

Thyroid gland disorders rank as the second most prevalent endocrine conditions, closely following diabetes mellitus.[1] Approximately 42 million people in India are estimated to be suffering from thyroid diseases and of these benign as well as malignant swellings of thyroid often warrant surgical interventions ranging from hemi-thyroidectomy to sub-total or even a near-total thyroidectomy depending on the involvement of the thyroid tissue.[2] While the advancements in diagnostic techniques and surgical safety are making the procedure increasingly safe, injury to the Recurrent laryngeal nerve (RLN) account for nearly half of all the complications leading to hoarseness, dyspnea and even stridor or glottal obstruction.[3,4]

* *Corresponding author*.
E-mail address: poojadadwanihb@gmail.com (P. Dadwani).

https://doi.org/10.18231/j.ijcap.2024.016

Moreover, Thyroid surgeries are often guided by anatomical landmarks such as the location of recurrent laryngeal nerve, its proximity to the inferior thyroid artery, its position in the trachea-oesophageal groove, identification lateral to the ligament of Berry and its posterior placement relative to the tubercle of Zuckerkandl, when present.[5] Hence, a thorough consideration of the surgical anatomy of recurrent laryngeal nerve and its potential complications is of vital importance considering the complexity of thyroid surgeries.

Recurrent laryngeal nerve, a branch of the vagus nerve, supplies sensory, motor, as well as parasympathetic fibres to the laryngeal structures. Right and Left RLN have different embryonic origins with anatomical variations of the recurrent laryngeal nerve occurring more frequently on the right side than on the left. Moreover, in contrast to the right RLN, the left RLN has a longer thoracic course, increasing its susceptibility to trauma-related injury. Also, the right RLN follows a more anterior and lateral path compared to the left, traversing within the trache-oesophageal groove that carry significant surgical implications.[6,7] These make the precise understanding of its anatomy, recognition of the landmarks and awareness of potential variations in the course of RLN essential to prevent nerve damage.

The current study was aimed to establish the relationship of RLN with Inferior Thyroid Artery (ITA) as well as its implications on thyroid surgeries.

2. Materials and Methods

The current descriptive observational study was conducted on 32 embalmed cadavers during the routine dissection and 08 post-mortem examinations (06 were female and 34 were male corpses) at Baroda Medical College and S.S.G Hospital, Vadodara as well as Pramukhswami Medical College and Shree Krishna Hospital, Bhaikaka University, Karamsad. The study was submitted and approved according to the ethical and legal standards of Institutional Ethics Committee-2 Bhaikaka University, Karamsad Anand, Gujarat (EC Reg No.: IEC/BU/2023/Ex.34/189/2023, Dated:July 03,2023). Study was conducted over a period of one year from July 2023 to June 2024. The recurrent laryngeal nerve was dissected using the lateral approach,[8] routinely used by the surgeons for uncomplicated thyroid surgeries. The approach involves a longitudinal incision in the midline of the neck along with a curved transverse incision. Here the thyroid gland was approached postero-laterally between the anterior border of sternocleidomastoid and strap muscles and was retracted antero-medially. The RLN was identified at the mid-polar level in the para-tracheal area and was further dissected at its crossing point with the Inferior thyroid artery (ITA).

During dissection, 7 RLN were unilaterally injured with 3 injuries on the right side and 4 on the left side and were excluded from the study leading to a total of 37 Right RLN and 36 Left RLN. We classified the RLN based number of branches and anastomoses as well as on its relative position to the ITA. Results were tabulated using descriptive statistics and relational statistics, Chi-square test, for analysing significance. P value < 0.05 was considered significant.

3. Results

We studied a total of 73 (right = 37 and left = 36) RLN in 40 cadavers. Out of these extra-laryngeal terminal bifurcations as well trifurcations were observed in 49 (67.12%) of the cadavers. More so, bifurcations occurred more frequently on the right side (75.67%) than on the left side (30.55%) ($P < 0.05$). Trifurcations, though less common, were observed in 18.91% on the right side and 2.77% on the left side ($P < 0.05$). We also found multiple branches ($\geq$4 branches) on the left side in two cadavers and no branches on the right side in one of the cadaver. (Table 1)

The RLN was also classified based on its relative position to the ITA. We observed that the relationship between the RLN and ITA varied with the RLN appearing either anteriorly or osteriorly to ITA, and occasionally even in between. The nerve was observed posterior to the ITA in 78.08%, anterior in 24.65% and in-between in 5.47% specimens. (Table 2)

4. Discussion

The frequency distribution for the branching pattern of right and left RLN indicated that the values were statistically significant ($P<0.05$). Similarly, the frequency distribution for the relative position of RLN with ITA was more in posteriorly to the ITA followed by anterior and in-between.

Similar studies for branching pattern of RLN and relative position of RLN to ITA have also been reported by Thomas AM. et al.,[9] Gurleyik E.,[10] Uludag M. et al,[11] Campos & Henriques,[12] Sailaja K,[13] Poyraz M & Çalgüner E[14] as represented in Table 3 and Table 4 respectively. The comparison shows wide discrepancies in the branching pattern as well as the position of the RLN in respect to the ITA and while bifurcations in branching pattern and posterior position of the RLN with respect to ITA are relatively common findings the other positions and branching pattern have significant distribution as well.

Such anatomical variations in the branching pattern as well as position can lead to iatrogenic injuries, especially in the branching nerves, not only due to misidentification but also due to their narrower diameter and fragility.[15] These branches have previously been reported to innervate the trachea, oesophagus or the inferior constrictor muscles of pharynx and injury can cause symptoms like dyspnoea, dysphagia, dysphonia amongst others. The variations can also significantly impact the approach in neck surgeries and while there is an accepted consensus in the surgical

Table 1: Frequency distribution of branching pattern of recurrent laryngeal nerve

Branching pattern	Right side (n = 37)		Left side (n = 36)	
	Frequency	%	Frequency	%
Bifurcation	28	75.67	11	30.55
Trifurcation	7	18.91	1	2.77
Multiple branches	–	–	2	5.55
No branches	1	2.70	–	–

Table 2: Relative position of RLN to ITA

	Frequency	%
Anterior	18	24.65%
Posterior	57	78.08%
In-between	4	5.47%

Table 3: Comparison of RLN branching in different studies

Study	Our study		Thomas AM et al.		Gurleyik E		Uludag M et al		Sailaja
Ethnicity	Indian		Caucasian		Turks		Turks		Indians
Side	Right	Left	Right	Left	Right	Left	Right	Left	—
Sample size	37	36	55	55	146	146	196	182	16
Bifurcation	75.67	30.55	40	27.27	33	57	40	44	75
Trifurcation	18.91	2.77	27.27	34.55	–	–	–	–	9
Multiple branches	–	5.55	21.82	12.73	–	–	–	–	8
No branches	2.70	–	10.91	25.45	–	–	–	–	8

All values represented in percentage

Table 4: Comparison of relative position of RLN to ITA in different studies

Study	Our study	Thomas et al.		Campos BA & Henriques PR		Sailaja	Poyraz M & Çalgüner E	
Sample size	73	55	55	76	76	16	23	25
Side	—	Right	Left	Right	Left	—	Right	Left
Anterior	24.65%	67.92	32.08	38.04	18.05	19	30.4	4
Posterior	78.08%	32.08	67.92	11.26	37.05	56	30.4	44
In-between	5.47%	3.57	5.36	49.3	44.45	6	39.2	52

All values represented in percentage

community[16,17] our data also suggests that the observed variations in branching were more common on the left side than on the right. Also, posterior relation of the RLN to ITA was more common to other relations.

One reason for these variations could be the difference in embryological development of the right and left RLN. RLN is a nerve of the 6^{th} pharyngeal arch and developmentally it enters below the 6^{th} aortic arch artery to enter the 6^{th} pharyngeal arch. However, on the right side, the 5^{th} and 6^{th} arch artery disappear leaving the RLN below the 4^{th} arch artery but on the left side the ductus arteriosus retains its original position as ligamentum arteriosum and hence the nerve winds around it.[18] Another reason that could contribute to such variations is the racial differences in the neuro-vascular structures.

The authors acknowledge that the analysis was performed on dissected as well autopsied cadavers and not during surgical intervention which could significantly impact the results. Also, we could not perform statistical analysis of RLN based on gender because of the significant difference of the sample in male and female cadavers. However, the results of the study certainly indicate towards potential variations of the RLN and emphasize the need for further studies in this regard.

5. Conclusion

The study highlights the significant anatomical variations in the branching pattern and position of the recurrent laryngeal nerve (RLN) with respect to the inferior thyroid artery (ITA) which can have considerable implications on thyroid surgeries as they increase the risk of iatrogenic injury and associated complications. The findings underscore the importance of a thorough understanding of RLN anatomy and its relationship with surrounding structures to mitigate surgical risks as well as the importance of on-going research in this area to improve surgical outcomes and patient safety in thyroid surgeries.

6. Sources of Funding

None.

7. Conflict of Interest

None.

References

1. Tunbridge WM, Evered DC, Hall R, Appleton D, Brewis M, Clark F, et al. The spectrum of thyroid disease in a community: the Whickham survey. *Clin Endocrinol (Oxf)*. 1977;7(6):481–93.
2. Unnikrishnan AG, Menon UV. Thyroid disorders in India: an epidemiological perspective. *Indian J Endocrinol Metab*. 2011;15(Suppl2):78–81.
3. Ready AR, Barnes AD. Complications of thyroidectomy. *Br J Surg*. 1994;81(11):1555–6.
4. Friedrich T, Steinert M, Keitel R, Sattler B, Schönfelder M. The incidence of recurrent laryngeal nerve lesions after thyroid surgery: a retrospective analysis. *Zentralbl Chir*. 1998;123:25–9.
5. Valenzuela-Fuenzalida JJ, Baeza-Garrido V, Navia-Ramírez MF, Cariseo-Ávila C, Bruna-Mejías A, Becerra-Farfan A, et al. Systematic Review and Meta-Analysis: Recurrent Laryngeal Nerve Variants and Their Implication in Surgery and Neck Pathologies. *Life (Basel)*. 2023;13(5):1077.
6. Kulekci M, Batıoglu-Karaaltın A, Saatci O, Uzun I. Relationship between the Branches of the Recurrent Laryngeal Nerve and the Inferior Thyroid Artery. *Ann Otol Rhinol Laryngol*. 2014;121:650–6.
7. Haller JM, Iwanik M, Shen FH. Clinically relevant anatomy of recurrent laryngeal nerve. *Spine*. 2012;37:97–100.
8. Kocher T. Text-book of operative surgery. Adam and Charles Black; 1903.
9. 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 (Basel)*. 2020;10(9):670.
10. Gurleyik E. Surgical anatomy of bilateral extralaryngeal bifurcation of the recurrent laryngeal nerve: similarities and differences between both sides. *N Am J Med Sci*. 2014;6(9):445–9.
11. Uludag M, Yazici P, Aygun N, Citgez B, Yetkin G, Mihmanli M, et al. A Closer Look at the Recurrent Laryngeal Nerve Focusing on Branches & Diameters: A Prospective Cohort Study. *J Invest Surg*. 2016;29(6):383–8.
12. Campos BA, Henriques PR. Relationship between the recurrent laryngeal nerve and the inferior thyroid artery: a study in corpses. *Rev Hosp Clin Fac Med Sao Paulo*. 2000;55(6):195–200.
13. Sailaja K. A study on internal laryngeal nerve-its variation in the course, branching, anastamosis and relation to inferior thyroid artery. *Int J Res Med Sci*. 2016;4:4602–6.
14. Poyraz M, Çalgüner E. Bilateral investigation of the anatomical relationships of the external branch of the superior laryngeal nerve and superior thyroid artery, and also the recurrent laryngeal nerve and inferior thyroid artery. *Okajimas Folia Anat Jpn*. 2001;78(2-3):65–74.
15. Rihn JA, Kane J, Albert TJ, Vaccaro AR, Hilibrand AS. What is the incidence and severity of dysphagia after anterior cervical surgery? *Clin Orthop Relat Res*. 2011;469(3):658–65.
16. Miscusi M, Bellitti A, Peschillo S, Polli FM, Missori P, Delfini R. Does recurrent laryngeal nerve anatomy condition the choice of the side for approaching the anterior cervical spine? *J Neurosurg Sci*. 2007;51(2):61–4.
17. Jung A, Schramm J. How to reduce recurrent laryngeal nerve palsy in anterior cervical spine surgery: A prospective observational study. *Neurosurgery*. 2010;67(1):10–5.
18. Gleeson MJ, Clarke RC. Anatomy of the Larynx and Tracheobronchial Tree. In: Scott-Brown's Otorhinolaryngology and Head and Neck Surgery; 2008. p. 2130–1.

Author biography

Pooja Dadwani, Tutor https://orcid.org/0000-0003-4274-2259

Ila Suttarwala, Assistant Professor https://orcid.org/0009-0005-0577-1415

Jaikumar B Contractor, Associate Professor https://orcid.org/0000-0003-4915-4097

Cite this article: Dadwani P, Suttarwala I, Contractor JB. Exploring the anatomical relationship between the recurrent laryngeal nerve and the inferior thyroid artery: insights from cadaveric dissections. *Indian J Clin Anat Physiol* 2024;11(2):71-74.