

Variation in the Relation of Recurrent Laryngeal Nerve to the Inferior Thyroid Artery: A Cadaveric Study

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Abstract

Major complication of thyroid surgery is recurrent laryngeal nerve injury. Position of terminal branches of inferior thyroid arteries in relation to recurrent laryngeal nerve varies. The artery may lie posterior or anterior to the nerve or the main trunk of the nerve or its branches intermingle with the terminal branches of the inferior thyroid artery. *Aim:* To study the relation of inferior thyroid artery to recurrent laryngeal nerve. *Objectives:* To avoid the risk of nerve damage during thyroid surgery, a good knowledge of the variations of the recurrent laryngeal nerve is essential. The present study is an approach to objective to increase the information pool and help the clinicians and surgeons in their practice. *Material and Methods:* Present study includes total 100 thyroid glands from cadavers, embalmed with 10% formalin of known sex from Medical colleges. *Study Periods and Designs:* Between years Dec 2012 to Jan 2014. *Results:* Most common relation on right side was nerve intermingled with artery (NIA). Least common relation on right side was nerve posterior to artery (NPA). Most common relation on left side is nerve posterior to artery (NPA). Least common relation on left side was nerve intermingled with artery (NIA). When both sides were considered together, then the most common relation was nerve posterior to artery (NPA). Least common relation was nerve anterior to artery (NAA). *Conclusion:* If both sides of thyroid gland were considered together (n=200), the most common relation was nerve posterior to artery. Least common relation was nerve anterior to artery.

Keywords: Recurrent Laryngeal Nerve; Thyroid Gland; Inferior Thyroid Artery.

Introduction

Thyroid surgery requires a thorough knowledge of the neck anatomy and its anatomical variations. This is of utmost importance, since it is well known that there are variations of the recurrent laryngeal nerve [1]. The course of recurrent laryngeal nerve (RLN) is determined by the pattern of development of the arteries with which it becomes related, and the variations of this pattern will determine variations in the anatomical disposition of this nerve [2].

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Careful exploration and exact identification of the RLN reduce the risk of accidental nerve damage by 3 to 4 times. Most of the studies done regarding the anatomy of the RLN are cadaveric studies [3].

The vagus nerve is formed by the end of the fifth week of embryonic development and the branch that will originate the recurrent laryngeal nerve becomes apparent by the end of the sixth week. This branch of the vagus nerve is associated with the sixth branchial arch of the embryonic pharynx and it passes directly to the larynx. The embryo's system of aortic arches is associated with the pharynx. The vagus branch lies caudal to the aortic arches. With the embryo's development, the neck elongates, and the larynx moves cranially while the aortic arch and associated vessels remain in the thorax, and, with them, the vagus branch. This branch, reaching the larynx directly when first developed, now forms the adult's characteristic recurrent loop. Therefore the course of the recurrent laryngeal nerve is determined by the pattern of development of the arteries with which it becomes related, and the variations of this pattern

will determine variations in the anatomical disposition of this nerve [4].

If the recurrent laryngeal nerve develops without alterations, it will originate from the vagus nerve and on the right side surrounds the right subclavian artery and on the left side surrounds the aortic arch. Before reaching its point of penetration in the larynx, the recurrent laryngeal nerve ascends in the neck in the tracheoesophageal groove in most of the cases [5].

Recently surgeons advocate the routine identification and dissection of recurrent laryngeal nerve to reduce its injury risk to minimum, and for endocrine surgeons it is unacceptable if recurrent laryngeal nerve is not identified during thyroid surgery[6].

Material and Methods

The present study was carried out in the

Observation and Results

Table 1: Side wise distribution of relation of recurrent laryngeal nerve (rln) and inferior thyroid artery (ita)

RLN	Right	Left	Right & Left together n (%)
NAA	29(29%)	17(17%)	46(23%)
NPA	22(22%)	72(72%)	94(47%)
NIA	49(49%)	11(11%)	60(30%)
TOTAL	100	100	200

(RLN- Recurrent Laryngeal Nerve, ITA - Inferior Thyroid Artery, NAA- Nerve Anterior to Artery, NPA- Nerve Posterior to Artery, NIA - Nerve In Between Artery.)

Table 1 shows the distribution of relation of Recurrent Laryngeal Nerve (RLN) to Inferior Thyroid Artery (ITA) on right and left side and on both side together.

Most common relation on right side was, NIA

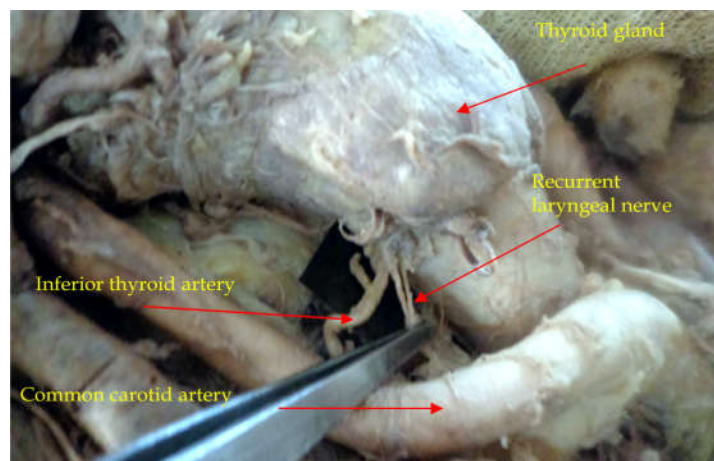
Department of Anatomy between years Dec 2012 to Jun 2014. The project was submitted to Independent Ethical committee of our college. After getting the approval letter from Independent Ethical Committee, the study was started. Present study includes total 100 thyroid glands from cadavers, embalmed with 10% formalin of known sex (62 Males and 38 Females) from GMC, IGGMC, LMMC, Nagpur.

Dissection method was employed for this study. The infrahyoid group of muscles were identified and reflected. The sternocleidomastoid muscle was displaced laterally and thyroid gland was exposed. The fascia was removed from the lobes of the thyroid gland, exposing its arteries and veins. The lower part of the gland was lifted up to expose the lateral surfaces of trachea and oesophagus with recurrent laryngeal nerve in the groove between them, along with the inferior thyroid artery. The relation between recurrent laryngeal nerve and inferior thyroid artery was noted and photographs were taken.

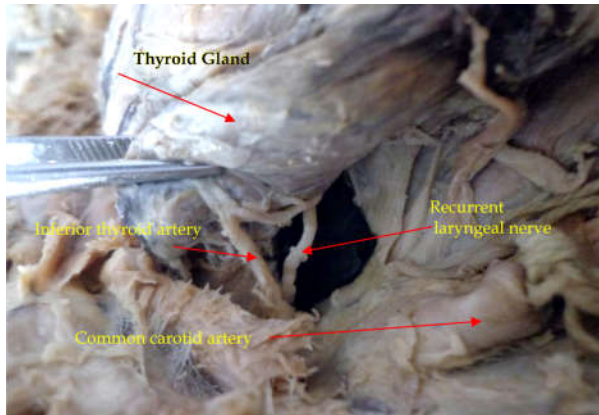
(n=49).Least common relation on right side was NPA (n=22).

Most common relation on left side is NPA (n=72). Least common relation on left side was NIA (n=11.)

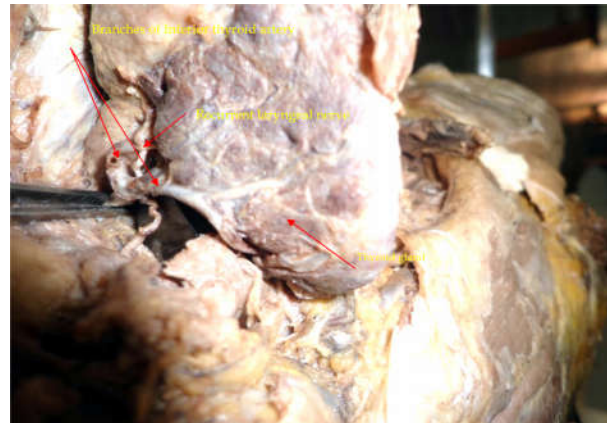
When both sides were considered together, (n=200). Then the most common relation of nerve artery was NPA (n=94). Least common relation was NAA (n=46).



Photograph 1: Recurrent laryngeal nerve anterior to inferior thyroid artery



Photograph 2: Recurrent laryngeal nerve posterior to inferior thyroid artery.



Photograph 3: Recurrent laryngeal nerve in-between branches of inferior thyroid artery. Recurrent laryngeal nerve

Discussion

Thyroid disorder is a common health problem among large number of endocrinopathies. About 5% of the world population is affected from various thyroid disorders. This requires medical and surgical intervention.

There is variation in the gross anatomy of the gland. Literature also replete with a large number of variations of the thyroid gland and relation between recurrent laryngeal nerve and inferior thyroid artery. Some conditions can cause recurrent laryngeal nerve (RLN) palsy [7,8]. Surgical injuries produce 11 to

32% of these [9,10]. Some procedures that may result in injury to the RLN are: thyroidectomies, parathyroidectomies, excision of Zenker’s diverticulum, esophagectomies, tracheoplasties, neck dissections, correction of a patent ductus arteriosum, mediastinoscopy [11].

Thyroidectomy is the surgery in which this injury occurs most frequently. The incidence of injury to the RLN in thyroidectomies ranges from 0 to 12% [12,13]. This injury occurs more frequently when a branch of the ITA is inadvertently sectioned. In an attempt to achieve hemostasis, the nerve is clipped and/or separated with the arterial branch [14,15].

Table 2: Comparison of relation of the right recurrent laryngeal nerve to inferior thyroid artery with other authors

Author	Year	Total No. of nerves studied	Nerve anterior to right inferior thyroid artery.	Nerve posterior to right inferior thyroid artery.	Nerve intermingled with the branches of right inferior thyroid artery.
Berlin D.D. & Lahey ¹⁶	1929	21	18	3	–
Berlin D. ¹⁷	1935	70	28	31	11
Weeks & Hinton ¹⁸	1942	18	11	7	–
Bachhuber C. A. ¹⁹	1943	52	18	33	1
Reed A.F. ¹⁵	1943	250	65	68	117
Armstrong & Hinton ²⁰	1951	50	20	16	14
Bowden ²¹	1955	28	8	9	11
Wade ²²	1956	93	16	37	40
Hunt, poole ²³ et al	1968	74	28	40	6
Hirata K. ²⁴	1992	392	127	105	160
Lekacos ²⁵ , et al	1992	109	19	52	38
Suresh N.M. ²⁶ et al	2008	50	15	9	26
Saadeldin ²⁷ et al	2013	82	52	22	8
Present study	2014	100	29	22	49

Table 2 present study showed that most common relation on right side was recurrent laryngeal nerve intermingled with the branches of the inferior thyroid artery (49%). Next common relation was nerve anterior to inferior thyroid artery (29%). The relation of nerve passing posterior to artery was relatively low. These finding seems to coincide with the work of

Hirata K [24] and Suresh N.M. [26] et al.

Table 3 Shows that on left side the relation of the recurrent laryngeal nerve posterior to the inferior thyroid artery was relatively high in present work (72%). Same findings were seen by Berlin [17], Bachhuber C.A [19]. Reed A.F. [15], Wade [22], Hunt & Pool [23] et al, Hirata k. [24], Lekacos [25] et al,

Table 3: Comparison of relation of the left recurrent laryngeal nerve to Inferior thyroid artery with other authors

Author	Year	Total No. of nerves studied	Nerve anterior to left inferior thyroid artery.	Nerve posterior to left inferior thyroid artery.	Nerve intermingled with the branches of left inferior thyroid artery.
Berlin D.D. & Lahey ¹⁶	1929	23	4	19	–
Berlin D ¹⁷	1935	70	17	44	9
Weeks & Hinton ¹⁸	1942	20	7	11	2
Bachhuber C.A. ¹⁹	1943	67	11	55	1
Reed A.F. ¹⁵	1943	253	29	130	94
Armstrong & Hinton ²⁰	1951	50	14	27	9
Bowden ²¹	1955	27	3	15	9
Wade ²²	1956	92	5	58	29
Hunt,poole ²³ et al	1968	68	16	47	5
Hirata K. ²⁴	1992	392	19	258	115
Lekacos ²⁵ ,et al	1992	82	12	45	25
Suresh N.M. ²⁶ et al	2008	50	3	33	14
Saadeldin ²⁷ et al.	2013	82	9	41	32
Present study	2014	100	17	72	11

Suresh N.M. [26] et al.

The next most common relation was the nerve anterior to artery. The least common relation was the nerve intermingled with the branches of the artery. This result correlates with result of Hunt [23] et al, Armstrong & Hinton [20], Bachhuber C A [19], Weeks & Hinton [18] et al ,Berlin D [17],Saadeldin et al. [27].

Conclusion

Most common relation on right side was recurrent laryngeal nerve intermingled with the branches of the inferior thyroid artery (49%).

Most common relation on left side was recurrent laryngeal nerve posterior to the inferior thyroid artery was relatively high in present work (72%).

If both sides (right and left) of thyroid gland were consider together (n=200), the most common relation of nerve to artery was nerve posterior to artery. Least common relation was nerve anterior to artery.

Most of the diseases affecting the thyroid gland e.g. goitre, thyrotoxicosis, adenoma, carcinoma etc. are usually associated with enlargement of the gland and require medical and surgical intervention. There are many variations in the shape, size and relative level of the thyroid gland. Therefore, knowledge of the variation in morphological and topographical anatomy is very important in the evaluation and management of the thyroid disorders in clinical practice.

To avoid the risk of nerve damage during thyroid surgery, a good knowledge of the variations of the recurrent laryngeal nerve is essential. The present study is an approach to objective to increase the information pool and help the clinicians and surgeons in their practice.

References

1. Ardito G, Revelli R, d'Alatri L, Lerro V, Guidi ML, Ardito F; Revisited anatomy of the recurrent laryngeal nerves. *Am J Surg.* 2004; 187: 249-253.
2. Uen YH, Chen TH, Shyu JF, Shyr YM, Su CH, Chen JY et al.; Surgical anatomy of the recurrent laryngeal nerves and its clinical applications in Chinese adults. *Surg Today.* 2006; 36(4): 312-315.
3. Sunanda H, Tilakeratne S, De Silva KPVR. Surgical anatomy of the recurrent laryngeal nerve; a cross-sectional descriptive study *Galle Medical Journal.* 2010 Sep; 15(1): 14-16.
4. Gray SW, Skandalakis JE & Akin JT. Embryological considerations of thyroid surgery: developmental anatomy of the thyroid, parathyroids and the recurrent laryngeal nerve. *Am Surg.* 1976; 42: 621-628.
5. Idris SA, Shalayel MH, Idris TA, Qurashi AM. Outcomes and complications of thyroid surgery among the Sudanese patients. *Sudan Medical Monitor.* 2008; 3: 143-148.
6. Chiang FY, Wang LF, Huang YF, Lee KW, Kuo WR. Recurrent laryngeal nerve palsy after thyroidectomy with routine identification of recurrent laryngeal nerve. *Surgery.* 2005; 137(3): 342-347.
7. Gardner E, Gray DJ & O'Rahilly R - *Anatomia: estudoregional do corpo humano.* 3a. ed. Rio de Janeiro, Guanabara Koogan. 1971.
8. Rowe - Jones JM, Leighton Sej & Rosswick RP - Benign thyroid disease and vocal cord palsy. *Ann R Coll Surg Eng.* 1993; 75(4): 241-244.
9. Premachandra DJ, Radcliffe GJ & Stearns MP - Intraoperative identification of the recurrent laryngeal nerve and demonstration of its function. *Laryngoscope.* 1990; 100: 94-96.
10. Titche LL - Causes of recurrent laryngeal nerve paralysis. *Arch Otolaryngol.* 1976; 102 : 259-261.

11. Eeckhaut JVD - The recurrent laryngeal nerve. *Acta Otorhinolaryngol Belg.* 1983; 37(3): 388-397.
 12. Karlan MS, Catz B, Dunkelman D et al. - A safe technique for thyroidectomy with complete nerve dissection and parathyroid preservation. *Head Neck Surgery.* 1984; 6: 1014-1019.
 13. Lahey FH & Hoover WB - Injuries to the recurrent laryngeal nerve in thyroid operations. *Ann Surg.* 1938; 108: 545-562.
 14. Lahey FH - Routine dissection and demonstration recurrent laryngeal nerve in subtotal thyroidectomy. *Surg Gynecol Obstet.* 1938; 66: 775-777.
 15. Reed AF - The relations of the inferior laryngeal nerve to the inferior thyroid artery. *Anatom Record.* 1943; 85:17-23.
 16. Berlin D.D. & Lahey. Dissection of the recurrent & superior laryngeal nerve. *Surg. Gynec. & Obst.* 1929; 49(7): 102-104.
 17. Berlin D. The recurrent laryngeal nerves in total ablation of the normal thyroid gland. An anatomical and surgical study. *Surg Gynecol Obstet.* 1935; 60: 19-26.
 18. Weeks C, Hinton JW. Extra laryngeal divisions of recurrent laryngeal nerve. Its significance in vocal cord paralysis. *Ann.Surg.* 1942; 116(8): 251-258.
 19. Bachhuber CA - Complications of thyroid surgery - anatomy of the recurrent laryngeal nerve, middle thyroid vein and inferior thyroid artery. *Am J Surg.* 1943; 60: 96-100.
 20. Armstrong WG, Hinton JW, Multipal division of recurrent laryngeal nerve. 1951; 62: 532-9
 21. Bowden REM - The surgical anatomy of the recurrent laryngeal nerve. *Brit J Surg.* 1955; 43: 153-163.
 22. Wade JSH - Vulnerability of the recurrent laryngeal nerves at thyroidectomy. *Brit J Surg.* 1956; 43: 164-180.
 23. Hunt PS, poole M, Reeve TS. A reappraisal of the surgical anatomy of the thyroid and parathyroid glands. *Brit.jn.Surg.* 1968; 55(1): 63-66.
 24. Hirata K - Relationship between the recurrent laryngeal nerve and the inferior thyroid artery in Japanese. *Kaibogaku Zasshi.* 1992; 67(5): 634-64.
 25. Lekacos NL, Tzardis PG, Sfikakis PG, Patoulis SD, Restos SD; Course of the recurrent laryngeal nerve relative to the inferior thyroid artery and the suspensory ligament of Berry. *Int Surg.* 1992; 77(4): 287-288.
 26. Suresh N.M. Jai Renukarya A.R.Raghupathy. Patterns of relationship between recurrent laryngeal nerve and inferior thyroid artery. *Anatomica Karnataka.* 2008; 3(2): 47-53.
 27. Saadeldin A, Idris, Qurashi M. Ali, Aamir A. Hamza Incidence and Variations in the Relationship Between the Recurrent Laryngeal Nerves to the Inferior Thyroid Arteries in Sudanese Subjects Scholars *Journal of Applied Medical Sciences Sch. J. App. Med. Sci.* 2013; 1(5): 575-580.
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