



A STUDY ON RELATIONS OF RECURRENT LARYNGEAL NERVE WITH TRACHEA AND INFERIOR THYROID ARTERY

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ABSTRACT Recurrent Laryngeal nerve is the nerve of larynx providing sensory, motor and parasympathetic innervation. Variations in relations of the nerve with adjacent structures are of great significance in evaluating clinical conditions and in surgical procedures of neck and thorax.

AIM: To study the anatomy of recurrent laryngeal nerve with respect to its relations to trachea and inferior thyroid artery.

MATERIALS AND METHODS: Both sides of trachea and larynx of 50 human cadavers by dissection method.

RESULT: Recurrent laryngeal nerve lies either in the tracheo esophageal groove or outside and the nerve passes either anterior, posterior or between the branches of inferior thyroid artery

KEYWORDS : Recurrent laryngeal nerve, tracheo esophageal groove, inferior thyroid artery,

INTRODUCTION

Clinically, physicians have known for two millennia that the recurrent laryngeal nerves (RLN) must be identified and protected during thyroid surgery to avoid deinnervating the patient's larynx. Despite this long history of knowledge and study, injury to the RLNs is still one of the most common complications from thyroid surgery.

Due to its relative long course, the nerve may be damaged in surgeries of the cervical and upper thoracic regions¹. Paralysis of the left vocal cord has been reported 1.4-2.5 times more than on the right side.

Variations in origin, course, relations and branching patterns of recurrent laryngeal nerve are relevant in situations like thyroidectomy, parathyroidectomy, esophagectomy, excision of Zenker's diverticulum, tracheoplasty, correction of patent ductus arteriosus, mediastinoscopy, etc

Recurrent laryngeal nerve

The recurrent laryngeal nerve differs in its origin and course on both sides of the body. On the right side, it arises from the vagus nerve (10th cranial nerve) at the root of the neck anterior to the first part of right subclavian artery. It winds around the vessel and ascends further obliquely dorsal to the common carotid artery. Then passes cranially in the groove between trachea and oesophagus². Above the level of inferior border of cricoid cartilage, the nerve is known as Inferior Laryngeal Nerve. The RLN gives branches to trachea and oesophagus and to deep cardiac plexus³. Near the lower pole of thyroid gland, the nerve is always intimately related to the inferior thyroid artery.

On the left side, it arises from the vagus nerve to the left of arch of aorta and winds below the arch immediately distal to the attachment of ligamentum arteriosum to the concavity of the arch, then ascends to the side of the trachea. The nerve ascends within or near the groove between trachea and oesophagus and is intimately related to the thyroid gland, it then passes under the lower border of inferior constrictor muscle and enters the larynx behind the articulation of inferior cornu of thyroid cartilage with the Cricoid cartilage. The Recurrent laryngeal nerve gives branches to all the muscles of the larynx except the cricothyroid².

During development, the recurrent laryngeal nerves are dragged down by the lowest persisting aortic arches. On the right side the recurrent laryngeal nerve recurs around the fourth arch, which is the subclavian artery. On the left side the inferior laryngeal nerve recurs around the sixth arch, which is the ligamentum arteriosum. Therefore, nonrecurrence of the RLN always associated with vascular anomaly during embryonic development of the aortic arches⁴

AIM AND OBJECTIVES

AIM

The study was conducted to find out the variations in origin and course

of recurrent laryngeal nerve and its relation with trachea and inferior thyroid artery

OBJECTIVES

To find out

- 1) The occurrence of non recurrent laryngeal nerve
- 2) The relation of recurrent laryngeal nerve to trachea
- 3) The relation of recurrent laryngeal nerve to inferior thyroid artery

MATERIALS AND METHODS

The present study was a descriptive observational study done by dissection method in 100 heminecks of adult cadavers. Variations were documented and analyzed. Qualitative data were quantified according to frequencies.

Dissection was carried out as described in the Cunningham's manual of Practical Anatomy 15th Edition volume two⁵ and three⁶. In the thorax, after cutting, the anterior chest wall was opened. The left vagus nerve was identified on the aortic arch. The RLN was traced beneath the concavity of the arch where it was found postero-inferior to ligamentum arteriosum. In the neck, skin incisions were made as per dissection manual. Structures of anterior triangles were traced. Infra hyoid muscles were identified. Sternocleidomastoid and superior belly of omohyoid were displaced laterally. Sternothyroid was incised near its lower end and turned it upward to the thyroid cartilage with its nerve supply. Fasciae of the thyroid gland were removed and its arteries and veins were exposed. Lower part of the gland was lifted to expose lateral surfaces of trachea and esophagus with the RLN in the groove between them. On the left side, thoracic duct was identified on the esophagus. Both RLN and thoracic duct were traced upwards from thorax. Upper part of thyroid gland was pulled laterally and external branch of superior laryngeal nerve to the cricothyroid muscle was traced. Trachea and esophagus were exposed completely and the structures adjacent to them were located. On the right side, fat, lymph nodes and carotid sheath were removed from common carotid artery and internal jugular vein. They were separated and the vagus nerve was exposed. RLN was found arising from the vagus as it crosses subclavian artery and it was followed to the tracheo esophageal groove.

RESULTS

Recurrent Laryngeal Nerve was found to be arising from the vagus at the level of arch of aorta on the left side and at the level of subclavian artery on the right side in all the specimens. The nerve was in the tracheo esophageal groove in 78% and 22% outside the tracheo esophageal groove. Recurrent Laryngeal Nerve was seen posterior to inferior thyroid artery in 74%, anterior to artery in 16% and between the branches of inferior thyroid artery in 10%.

Occurrence of non recurrent laryngeal nerve (NRLN)

Out of 100 heminecks studied, non recurrent laryngeal nerve was not found even in a single specimen since this variation is very rare

,possibility to get NRILN in such a small sample size was less.

Origin of recurrent laryngeal nerve

Among the 100 sides of neck, no one was having abnormal origin of recurrent laryngeal nerve. On the left side the nerve originated from vagus in the thorax and winded around the arch of aorta posterior to the ligamentum arteriosum. The relation of nerve to ligamentum arteriosum was constant and no variations were found. Hence the ligamentum arteriosum can be taken as a landmark to identify RLN in thoracic surgeries

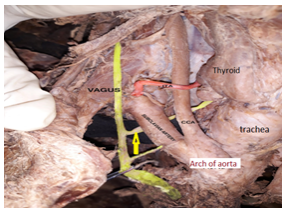


FIGURE 1: Normal course of RLN (recurrent laryngeal nerve) on the right side. Yellow arrow indicates RLN

Relation of RLN to tracheoesophageal groove (TEG)

Among 100 RLN dissected, 78 nerves were found inside the tracheoesophageal groove. On the left side 88% (44/50) of nerves were inside the groove. On the right side, only 68% (34/50) were in the TEG. Remaining nerves were located either lateral (paratracheal) or anterolateral to trachea.

Table 1: Classification of recurrent laryngeal nerve outside the trachea oesophageal groove

Outside the TEG	Right Side	Left Side
Anterior	-	-
Anterolateral	-	1
Lateral	16	5
Posterior	-	-

In the present study, only one nerve was found in the antero-lateral position on the left side (figure 2) and the nerve was unbranched.

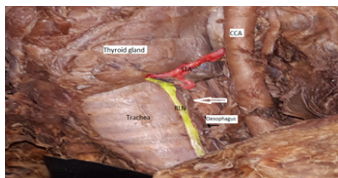


FIGURE 2: RLN in the antero-lateral position of TEG on the left side. White arrow indicates tracheo oesophageal groove (TEG). CCA-common carotid artery

Relation of RLN to inferior thyroid artery

In the present study, the anatomical relationship between the recurrent laryngeal nerve and the inferior thyroid artery on 100 heminecks were analyzed. On the left side, the nerve passed anterior to the artery in 18% (9/50), posterior to it in 72% (36/50), and between the branches of the artery in 10% (5/50). On the right side, the nerve was found coursing anterior to the artery in 14% (7/50), posterior to it in 76% (38/50) and between the branches in 10% (5/50). So out of 100 nerves, 16 were anterior to artery, 74 were posterior and 10 nerves were lying in between the branches of ITA

Table 2: Relation between recurrent laryngeal nerve (RLN) and inferior thyroid artery (ITA) with frequencies

Relation of RLN to ITA	RIGHT	LEFT	Total no of specimens
RLN anterior to artery	7%	9%	100
RLN posterior to artery	38%	36%	100
Between the branches of artery	5%	5%	100



FIGURE 3 shows RLN with bifurcation anterior to artery on the left side. Yellow arrow shows bifurcation. ITA-inferior thyroid artery. RLN-recurrent laryngeal nerve



FIGURE 4 : RLN with bifurcation in the retrovascular position.

1-inferior thyroid artery, 2-recurrent laryngeal nerve. CCA-common carotid artery

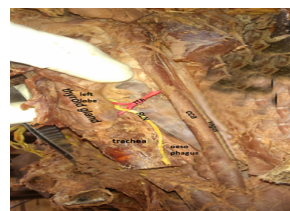


FIGURE 5 : Unbranched RLN passing between the branches of inferior thyroid artery.

CCA-common carotid artery. ITA-inferior thyroid artery. RLN-recurrent laryngeal nerve

DISCUSSION

RELATION OF NERVE TO TRACHEA.

Relation of nerve to tracheo oesophageal groove is analyzed and it is compared with similar studies.

Table 3: Relation of recurrent laryngeal nerve with tracheo oesophageal groove : comparison of present study with previous studies

Study	Number of nerves	Nerve within TEG	
		Right (%)	Left (%)
Present study	100	68	88
Uen et al ⁷	120	78.3	91.3
Roshan et al ⁸	100	88	92
Sailaja K ⁹	50	40	40

In all the cases, the weightage for nerve to be in the TEG is more on the left compared to right. This can be explained by the thoracic origin and long course of left RLN

RELATION OF NERVE TO INFERIOR THYROID ARTERY

Relation of nerve to inferior thyroid artery was studied. In the present study 3 types were obtained and compared with results obtained in other studies. In the present study the most common type of relation between RLN and ITA was retrovascular course, which was 74%. Studies of Anitha et al¹⁰ and Sailaja K⁹ showed similar proportions with nerve between the branches of artery as least common type. The least common type was the course of RLN passing between branches of inferior thyroid artery. In this regard, the findings of Sailaja K and Anitha et al and that of present study are almost similar

Table 5: Relation of recurrent laryngeal nerve to inferior thyroid artery: Comparison of present study with previous studies

Study	Number of nerves	Relation of nerve to inferior thyroid artery		
		Anterior (%)	Posterior (%)	Between branches of ITA (%)
Present study	100	16	74	10
Anitha et al ¹⁰	216	30	59	11
Zada et al ¹¹	398	55.7	34.67	10.05
Joshi et al ¹²	66	12.12	87.88	-

Eventhough it is a known fact that the non-RLN is a rare variant and if present, most are observed on the right side, we searched for it out of academic and clinical interest. It is highly predisposed to injury during thyroidectomy due to misidentification.

Toniato and his colleagues reported 31 cases (0.51%) of non-RLN in 6,000 thyroidectomies, and all were observed on the right side¹³. In the present study no non-RLN identified. The study sample was very less compared to the incidence rate

Conclusion

The detailed knowledge of anatomical variations associated with recurrent laryngeal nerve would be of great use to the clinician, especially to surgeons during various surgical procedures of thorax and neck.

This study was carried out in the Department of Anatomy, Government Medical College, Kozhikode, Kerala in 100 heminecks of cadavers. The variations in the origin, course and relations of recurrent laryngeal nerve with trachea and inferior thyroid artery were observed. We looked specifically for non recurrent laryngeal nerve, but none were observed. Relation to trachea and esophagus was variable. The nerve lies either in the tracheo esophageal groove or outside, with the former as the commonest one. Nerve lies anterior, posterior or between the branches of inferior thyroid artery. In the present study retrovascular position of nerve was the commonest and between the branches of artery was the least common type

Keeping in mind such possible variations, the surgeon should be careful during thyroid surgeries. The gold standard for preservation of the recurrent laryngeal nerve during thyroid surgery is still visual anatomical identification. Proper dissection and anatomical identification of the RLN and all its branches is very important prior to the clamping of the ITA and all its branches. Other techniques which aim to preserve the RLN may be used only as an adjunct to the gold standard. In a setting where advances in technology are not readily available, the surgeon must be knowledgeable about the variations in the neurovascular anatomy of the thyroid gland to prevent complications of surgery¹⁴.

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