

Research Article

A study on internal laryngeal nerve-its variation in the course, branching, anastomosis and relation to inferior thyroid artery

Sailaja K.*

Department of Anatomy, Government Medical College, Kozhikode, Kerala, India

Received: 04 January 2016

Accepted: 06 February 2016

***Correspondence:**

Dr. Sailaja K,

E-mail: sailajakrishna@rediffmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: Recurrent laryngeal nerves sometimes may not follow the classically describe course. It does not always lie in the tracheo-oesophageal groove. The relations of the nerve to inferior thyroid artery may vary. Therefore, the present study was undertaken to study the variation in the relations and branches of recurrent laryngeal nerve.

Methods: The present study was undertaken in postmortem specimen from Forensic department and cadavers in the dissection hall after the ethical clearance. The specimens were collected enbloc including tongue, oesophagus and trachea. Also, the specimens were used for modified Sihler's technique. Specimen was dissected and recurrent laryngeal nerve was identified. Its relation and branches were noted. The data regarding the number of branches, level of branching, anastomoses were expressed as percentages.

Results: The nerve was seen passing posterior to the cricothyroid joint to enter the larynx. In 56% of specimens, artery was anterior to the nerve on both sides, nerve was anterior to the artery on both sides in 19%, nerve and artery was found to be ascending in the same plane side artery lateral and nerve medial in 6%, nerve divides before entry into the larynx on both sides in 68%, nerve does not divide in 75%, Division of the nerve was observed about 4cm below the joint in 6% of specimen, 3cms below the joint in 19% of specimens, 2cm below the in 19% of specimens and 1cm below the joint in 38% of specimens.

Conclusions: It was found that, the nerve was lying posterior to the artery more commonly. There no significant difference between right and left sides. The division of the nerve into anterior and posterior branches before entering the larynx was observed. In half of the specimens, nerve divided before entry into the larynx.

Keywords: Anastomosis, Branches, Cricothyroid, Recurrent laryngeal nerve, Relations

INTRODUCTION

Recurrent laryngeal nerve also known as nerve of Galen, after its discovery by Galen of Pergamon. It was called so because the nerve recurs or loops back to supply the laryngeal muscles. It is a best known branch of vagus, from its origin it turns dorsally around the subclavian artery and aortic arch, and its cranial pathway until it reaches its terminal organs in the neck.^{1,2} Recurrent laryngeal nerves sometimes may not follow the classically described course. It does not always lie in the

tracheo-oesophageal groove. It may be slightly anterior to it, or markedly lateral to the trachea. The relations of the nerve to inferior thyroid artery may vary. On the right side, the nerve may be either anterior or posterior or intermingled with branches of the artery. But on the left side it will be usually posterior to the artery.³

Because of the relations of the nerve to thyroid gland and inferior thyroid artery, the nerve is vulnerable to injury during surgical procedures, the most common being thyroidectomy. Nerve can also be injured during surgery

in the carotid region; injury causes morbidity like hoarseness, recurrent aspiration and pneumonia. Temporary aphonia or disturbance of phonation can occur. Even laryngeal spasm may occur.^{4,5}

During thyroid surgery iatrogenic injury is very common. This could be avoided by a deep knowledge of anatomy of thyroid region combined with meticulous surgical technique. Bruising of the nerve can occur due to pressure of accumulated blood or serous exudates after operation. Therefore it is important to identify the recurrent laryngeal nerve before removing thyroid gland.⁶ Surgeons have to visualize the nerve and follow its course to the larynx. If the nerve cannot be identified, then a non-recurrent nerve must be considered.

Although various methods of localizing recurrent laryngeal nerve has been described, surgeons should be aware of the variations and acquire a thorough knowledge of its normal anatomy. This will ensure the integrity and safety of recurrent laryngeal nerve in thyroid surgery.⁷ Anatomical variation may be minor degree, but it is of great importance as it may affect the outcome of surgery and quality of life of the patient.

Therefore, in the present study, an attempt is made to get detailed knowledge about course of the nerve, variations in the course, branching pattern, anastomoses of the nerve with branches of internal laryngeal nerve and the relation of the nerve with inferior thyroid artery.

METHODS

The present work was carried out on specimens collected from Department of Forensic Medicine of tertiary care hospital attached to Medical College and also from the cadavers in the Anatomy dissection hall after the institutional ethical clearance. The specimens were subjected to dissection and modified Sihler's technique to identify the nerve.

Sixteen specimens were collected from the bodies brought to the Forensic department of autopsy. The cases where post-mortem was done within 6 hours of death were included in the present study. Specimens from bodies where post-mortem is done after 6 hours following death, specimens from bodies where there were severe neck injury and specimens from cases where death occurred due to hanging were excluded.

Tongue, larynx, pharynx, upper part of trachea and upper part of the oesophagus were removed enblock. After washing in tap water to remove blood clots the specimens were put in 10% formalin for 2 days to fix the tissues. After 2 days they were taken out and dissection was carried out. Care was taken to preserve the branches of recurrent laryngeal nerve and also the branches of inferior thyroid artery. Dissection was done on right and left sides. Pharynx was opened by dividing the inferior constrictor muscle in the midline from the posterior

aspect. Oesophagus was also cut in the midline. This was done to expose the larynx. Branches of nerve were traced into the larynx. Anastomoses between different branches of internal laryngeal nerve were noted. Modified Sihler's technique for the identification of the nerve was carried out through various processes like fixation, maceration, decalcification, staining, destaining, clearing and trimming.

Statistical analysis

The data regarding the number of branches, level of branching, anastomoses were expressed as percentages.

RESULTS

In the present study, the nerve found lateral to trachea in 12 specimens on both sides. Nerve lies in the tracheo-oesophageal groove in 10 specimens on both right and left sides. In 3 specimens, nerve was lying lateral to trachea on the right side and in the tracheo oesophageal groove on the left side. Nerve was seen passing posterior to the cricothyroid joint to enter the larynx (Figure 1).

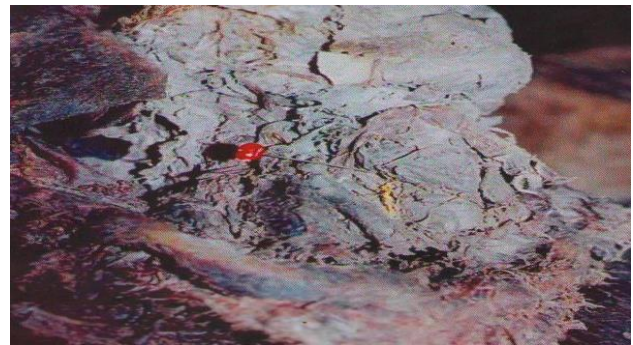


Figure 1: Relation of the nerve to trachea. Nerve was seen passing posterior to the cricothyroid joint to enter the larynx.



Figure 2: Relation of the nerve to inferior thyroid artery. The artery was anterior to the nerve on both sides in 56% of specimens.

In 56% of specimens, artery was anterior to the nerve on both sides (Figure 2). In 19% of specimens, nerve was anterior to the artery on both sides (Figure 3). In 6% of

specimen, nerve and artery was found to be ascending in the same plane artery lateral and nerve medial (Figure 4).



Figure 3: Relation of the nerve to inferior thyroid artery. The nerve was anterior to the artery on both sides in 19% of specimens.

In 68% of specimens, nerve divides before entry into the larynx on both sides (Figure 5). In 75% of specimens, nerve does not divide (Figure 6).



Figure 4: Relation of the nerve to inferior thyroid artery. Nerve and artery was found to be ascending in the same plane side artery lateral and nerve medial in 6% of specimens.



Figure 5: Extralaryngeal division of nerve. In 68% of specimens, nerve divides before entry into the larynx on both sides.

Division of the nerve was observed about 4cm below the joint in 6% of specimen, 3cms below the joint in 19% of specimens, 2cm below the in 19% of specimens and 1cm below the joint in 38% of specimens (Figure 7).



Figure 6: The internal laryngeal nerve. In 75% of specimens, nerve did not show the divisions on either side.



Figure 7: The level of division of internal laryngeal nerve. The division was 4 cm (6%), 3 cm (19%), 2 cm (19%) and 1 cm (38%) below the cricothyroid joint.



Figure 8: The number of branching of internal laryngeal nerve. There were 2 branches in 56%, 3 branches in 13%, and more than 3 branches in 6% of specimens.

Branches before entering the larynx were found to be 2 branches in 56%, 3 branches in 13%, and more than 3 branches in 6% of specimens (Figure 8). The relation and branches of the nerves are presented in a tabular form (Table 1).

Table 1: Relation and branches of the nerves are presented in a tabular form.

Number of branches	Percentage of specimen
2	75%
3	9%
>3	8%
0	8%

DISCUSSION

The results of the present study confirm that iatrogenic injury to the recurrent laryngeal nerve or its branches might be better avoided by searching, identifying and exposing the nerve itself and following its course with care. We believe that deep knowledge of anatomy of thyroid region and the awareness of varying course of the recurrent laryngeal nerve and inferior thyroid artery and their relation would be of great help to the surgeons. The anatomy of nervous distribution can supply data for the operation of selective nervous re-innervation.

The nerve found lateral to trachea in 12 specimens on both sides. Nerve lies in the tracheo- oesophageal groove in 10 specimens on both right and left sides. In 3 specimens, nerve was lying lateral to trachea on the right side and in the tracheo- oesophageal groove on the left side.

In the present study nerve was seen passing posterior to the cricothyroid joint to enter the larynx. This agrees with the work of Berlin who also observed the left recurrent laryngeal nerve in the tracheo- oesophageal groove more often 64.28% than the right one.⁸ This could be explained by its site of origin. The left recurrent laryngeal nerve arises at the more posterior plane than the right one and more close to the median plane. It must be kept in mind by those who are doing surgery on the neck to identify the recurrent laryngeal nerve on the right side rather than the left because the left nerve is in a more protected position.⁹

The artery was anterior to the nerve on both sides in 56% of specimens. The nerve was anterior to the artery on both sides in 19% of specimens. Nerve and artery was found to be ascending in the same plane - artery lateral and nerve medial in 6% of specimens. The present work agrees with the work of Taquchi, Fowler and Hanson who also observed the same relation.¹⁰

As is seen in the present study, the above worker also did not observe any change in relation between the right side and the left side. Since the nerve arises in a more posterior plane than the artery the nerve must pass posterior to the artery which is an indirect branch of subclavian.^{10,11}

Many of the anomalies are associated with the artery. The congenital anomalies of the nerve are less common. Reed observed that, the nerve posterior to the artery in 40% and nerve anterior in 20% and between the branches in 35%.¹²

In 68% of specimens, nerve divides before entry into the larynx on both sides. In 75% of specimens, nerve did not show the divisions on either side. The division was 4 cm (6%), 3 cm (19%), 2 cm (19%) and 1 cm (38%) below the cricothyroid joint. The level of division occurred below the point of entry into the larynx. The division

occurred between 1cm and 4cm. hence this must be kept in mind by those who are doing neck surgery and carefully look for branches up to 4cm below the larynx so as to preserve all the branches. This does not agree with the work of Weeks and Hinton who stated that only 5% of the nerves do not divide.¹³

The level of division according to Morrison is up to 0.5cm below the point of entry; here nearest level of division is 1cm.¹⁴ The number of branches also showed a variation in number. Majority of the nerves had only 2 divisions. There were 2 branches in 56%, 3 branches in 13%, and more than 3 branches in 6% of specimens.

Modified Sihler's technique was done to find out such anastomoses. Relation of the nerve to the thyroid gland also varies.¹⁵ At the level of 2 or 3 tracheal ring the thyroid gland is attached to larynx. At this level the recurrent laryngeal nerve is in close connection with the thyroid gland and may lie against its posterior surface or may pass through the adherent zone or even penetrate the gland. In this study also the nerve was seen adherent to the capsule of the gland in 7 numbers. The nerve has not been seen piercing the capsule.

Congenital variation of the nerve was not observed. The non-recurrent laryngeal nerve described in the literature is a developmental anomaly which is not seen in this study. The only one congenital anomaly observed in this study was a direct branch from the common carotid artery which was seen crossing anterior to the nerve, piercing the trachea.¹⁶

It is not supplying the thyroid gland. It is important that the surgeons must be aware of such an anomaly also. Common carotid artery usually has no branches but sometimes any of the branches of external carotid may arise from it. But the branch seen in this study is not described in the literature. This artery must be remnant one of the arch arteries probably fourth or sixth.

CONCLUSION

The important findings are, the recurrent laryngeal nerve does not always lie in the tracheo-oesophageal sulcus. It lies lateral to trachea. This relation is found more on the right side than on the left side. The relation of the nerve to inferior thyroid artery was considered.

It was found that, the nerve was lying posterior to the artery more commonly. There is no significant difference between right and left sides. The division of the nerve into anterior and posterior branches before entering the larynx was observed. In half of the specimens, nerve divided before entry into the larynx. In most cases, the level of division was 1 cm below the cricothyroid joint. In few specimens, it varied from 2 to 4 cm. The terminal branches, before entry into the larynx, were two twigs in most of the specimen. Anastomoses with branches of internal laryngeal nerve were found in 38.46% specimen.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Bacchi G1, Pizzolitto S. An anastomatic loop between the recurrent nerves – an anatomical description. *Acta Otorhinolaryngol Ital.* 1992;12(1):23-32.
2. Brauckhoff M, Walls G, Brauckhoff K, thanh PN, thomusch O, dralle H. identification of the non-recurrent inferior laryngeal nerve using intraoperative neurostimulation. *Langenbecks Arch Surg.* 2002;386(7):482-7.
3. Brok HA, copper MP, stroeve RJ, ongerboer de visser BW, venker-van haagen AJ, schouweenburg PF. Evidence for recurrent laryngeal nerve contribution in motor innervations of the human circopharyngeal muscle. *Laryngoscope.* 1999;109(5):705-8.
4. Furstenberg AC. an anatomical and clinical producing paralysis of the larynx. *Ann Otol Rhin & laryng* 46:39,1937.
5. Hammond CS, Davenport PW, Hutchison A, Otto RA. Motor innervations of the circopharyngeus muscle by the recurrent laryngeal nerve. *J Appl physiol.* 1997;83(1):89-94.
6. Desaki J, kawakita S, yagamata T. occurrence of capillaries with fenestrae in the intrinsic laryngeal muscles of the guinea pig after unilateral denervation. *J Electron microsc (Tokyo).* 1997;46(6):491-5.
7. Dovas A, lucchi ML, bortolami R, grandis A, palladino AR, banelli E, et al. collaterals of recurrent laryngeal nerve fibres innervate the thymus: fluorescent in the rat brainstem. *Brain res.* 1998;809(2):141-8.
8. Berlin DD, Lahey FH. dissection of the recurrent and superior laryngeal nerves. The relations of the recurrent to the inferior thyroid artery and the relation of the superior to abductor paralysis. *Surg., gynec. & obst.* 1929;49:102.
9. Hornung TS, Nicholson IA, nunn GR, hawker RE. Neonatal ductus arteriosus aneurysm causing nerve palsies and airway compression: surgical treatment by decompression without excision. *Pediatr cardiol.* 1999;20(2):158-60.
10. Taguchi K. die lage des nervus recurrences nervi vagi zur arteria thyroidea inferior. *Arch Anat Physiol Wissen Med.* 1889;309-25.
11. Fowler CH, Hanson WA surgical anatomy of the thyroid gland with special reference to the relations of the recurrent laryngeal nerve. *Surg gynec & obst.* 1929;49:59.
12. Reed AF. The relation of the inferior laryngeal nerve to the inferior thyroid artery. *Anat Rec.* 1943;85:17-23.
13. Hogg RP, Kuo MJ, Olliff J, Das Gupta AR. Invasion of the recurrent laryngeal nerve by adenoid cystic carcinoma. An unusual cause of true vocal fold paralysis. *J Laryngol Otol.* 1999;113(3):260-2.
14. Morrison LF. Bilateral paralysis of abductor muscles of the larynx: report on seven patients treated by the method outlined by Dr. Brient t. king. *Arch Otolaryng.* 1943;37:54.
15. Al-salihi AR, Dubbegh AW. Anatomy of the recurrent laryngeal nerve in normal Iraqis. *Acta Anat (Basel).* 1989;135(3):245-7.
16. Nagayama I, Okabe Y, Katoh H, Furukawa M. importance of pre-operative recognition of the nonrecurrent laryngeal nerve. *J laryngol otol.* 1994;108(5):417-9.

Cite this article as: Sailaja K. A study on internal laryngeal nerve-its variation in the course, branching, anastomosis and relation to inferior thyroid artery. *Int J Res Med Sci* 2016;4:4602-6.