

Research Article

An observational study on variation in the relations and branches of recurrent laryngeal nerve

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Received: 15 April 2016

Accepted: 09 May 2016

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ABSTRACT

Background: Recurrent laryngeal nerve is one of the most important nerves because; it is subjected too much variation in its site, branches and relation with the branches of inferior thyroid artery and to thyroid gland. 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: Recurrent laryngeal nerve does not always lie in the trachea-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.

Conclusions: The variation in the position is more common on the right side. Branches may arise from the nerve about 4cm below the cricothyroid joint. It lies posterior to the inferior thyroid artery more frequently.

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

INTRODUCTION

Recurrent laryngeal nerve, generally called as the inferior laryngeal nerve is one of the most serious concerns in thyroid surgery. Paralysis of vocal cord is common sequelae of thyroidectomy. It represent a serious complication including when bilateral, serious function sequelae such as phonatory, respiratory and psychological problems, that limit working capacities and social relationship of patients.¹

Injury to recurrent laryngeal nerve may occur as a complication of surgery in neck or chest. It may also

occur from the placement of endotracheal tube or during positioning of head and neck prior to placement of such a tube.² Any damage in the central or peripheral nervous system involving motor neurons or the axons of recurrent laryngeal nerve can cause unilateral recurrent laryngeal nerve palsy.

Surgical trauma is the principal aetiology, with thyroidectomy being the most frequent. The relative frequency of the different causes seems to have changed during the past 30 years. Importance of recurrent laryngeal nerve is the fact of that it is a nerve which is subjected to much variation in its site, branches and

relation with the branches of inferior thyroid artery and to thyroid gland.³

Recurrent laryngeal nerve is a branch of vagus nerve origin from the vagus differs on the right and left side. It runs upward more or less in the groove between trachea and oesophagus supplying branches to these structures. It is related to inferior thyroid artery and thyroid gland. Upper end of recurrent laryngeal nerve is called as inferior laryngeal nerve which is a branch of inferior thyroid artery.³ The point of entry is behind the joint between inferior corner of thyroid cartilage and passes beneath lower border of cricopharyngeus muscle.

Nerve divides into 2 branches either before or after entry into the larynx. Branches may be multiple. Anterior branch supplies lateral cricoarytenoid muscle thyroarytenoid, vocalis and aryepiglotticus. Posterior branch supplies posterior cricoarytenoid, transverse and oblique arytenoids. This branch may anastomose with the descending branch of superior laryngeal nerve.⁴ The nerve has sensory supply to the mucosa of larynx below the vocal cords pharynx upper end of oesophagus and trachea. It also carries afferent fibres from laryngeal stretch receptors.

METHODS

The present work was carried out on specimens collected from Department of Forensic Medicine of Calicut Medical College 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.

The cases where postmortem is done within 6 hours of death were included in the present study. Specimens from bodies where postmortem 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. Anastomosis between different branches of internal laryngeal nerve was 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

The present study on recurrent laryngeal nerve was conducted on 25 specimens on both right and left sides. The course of the nerve, the relation of the nerve to trachea, division of nerve into terminal branches before entering into the larynx, the level of division in relation to cricothyroid joint, the anastomoses of the nerve with the branches of internal laryngeal nerve into the interior of larynx and the relation of the nerve to inferior thyroid artery were noted.

Relation of the nerve to trachea varies slightly. In the present study nerve was lying in the trachea esophageal groove more on the left side (Table 1). Relation of the nerve is inferior thyroid arteries vary very much. The artery may cross the nerve either anteriorly or posteriorly or the nerve may be surrounded by its branches. Sometime the nerve may divide and one or more branch may pass anteriorly and other branches posteriorly (Table 2).

Table 1: Relation of the nerve to trachea on left and right side (N=25).

	Right (n=25)		Left (n=25)	
	N	%	N	%
Nerve lying in the trachea oesophageal groove	10	40	13	52
Nerve lying lateral to trachea	15	60	12	48

Table 2: Relation of the recurrent laryngeal nerve to inferior thyroid arteries (N=25).

	Anterior to the artery	Posterior to the artery	Side by side
Relation of the nerve to the artery	21%	75%	4%

The level of division and the number of branches of the nerve is also subject to variation. The level of division and branches given off by a nerve usually do not have a common pattern. However the present work showed that branching has occurred only in 44% (Table 3). The level of division occurred below the point of entry in to the larynx between 1cm and 4cm (Table 4). The number of

branches also showed a variation in number. Majority of the nerves had only 2 divisions (Table 5).

Table 3: The site of branching of recurrent laryngeal nerve (N=25).

	Before entering the larynx	After entering the larynx	Do not divide
Branching of the nerve	44%	48%	8%

Table 4: The level of branching of recurrent laryngeal nerve (N=25).

Below point of entry	Percentage
1cm	54.54%
2cm	27.27%
3cm	27.27%
4 cm	4%

Table 5: Branching of recurrent laryngeal nerve (N=25).

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

DISCUSSION

The term recurrent laryngeal nerve has been adopted by Nomina Anatomia in 1989) and Terminologia Anatomica in 1998 to describe this best known branch of vagus, from its origin it turn dorsally around the subclavian artery and aortic arch, and its cranial pathway until it reaches its terminal organs in the neck. However, sometimes may not follow the classically described course.

In the present study, we observed the relation of the nerve to trachea, which varies slightly. The nerve may not always lie in the trachea esophageal groove. The nerve was lying in the trachea esophageal groove more on the left side. This agrees with the work of Berlin who also observed the left recurrent laryngeal nerve in the trachea esophageal groove more (64.28%) than the right.⁵ This could be explained by its site of origin. The left recurrent laryngeal nerve arises at the more posterior plane then 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.

Relation of the nerve with inferior thyroid arteries vary very much. The artery may cross the nerve either anteriorly or posteriorly or the nerve may be surrounded

by its branches. Sometime the nerve may divide and one or more branch may pass anteriorly and other branches posteriorly.

The present work agrees with the work of Taguchi, Fowler and Hanson who also observed the same relation.^{6,7} As is seen in the present study, the above worker s 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.

Many of the anomalies associated with the artery. The congenital anomalies of the nerve are less common. Reed also observed the nerve posterior to the artery in 40% and nerve anterior in 20% and between the branches in 35%.⁸

The level of division and the number of branches of the nerve is also subject to variation. The level of division and branches given off by a nerve usually do not have a common pattern. During development a near muscle is supplied by a nearby nerve, even when the muscle migrates the original nerve supply is maintained. Hence division and the branches do not have any significance other than that of developmental. However the present work showed that branching has occurred only in 44%.

The level of division occurred below the point of entry in to 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.⁹ The level of division according to Morrison is up to 0.5cm below the point of entry; here nearest level of division is 1cm.¹⁰ The number of branches also showed a variation in number. Majority of the nerves had only 2 divisions which agree with the study conducted by Lang J et al.¹¹

Anastomoses between internal laryngeal nerve and inferior laryngeal nerve were observed only in 5 cases (20%). Same observations were made by Sato and Shimada.¹² Sub typing of the anastomoses were also done by them which was not possible in this study. Anastomoses between a sensory nerve and a mixed nerve are seen in face also. The function of these anastomoses is to carry proprioceptive sensations from the muscle. The recurrent nerve contains afferent fibers also as noted above. If afferent fibers were absent, than all the nerves should have exhibited such anastomoses. This study show such anastomoses only in 20%. It may mean that anastomoses develop only in situations where the afferent fibers in the recurrent laryngeal nerve or few or absent.

Relation of the nerve to the thyroid gland also varies. 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 relation 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. 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 conclusion that is arrived at the end of the study is that variation in the position is more common on the right side. And the nerve is not lying in the tracheo-oesophageal groove on the right side. Branches may arise from the nerve about 4cm below the cricothyroid joint. The nerve lies posterior to the inferior thyroid artery more frequently. The present work is a preliminary study and it will be continued. Due to lack of time the size is small. The work has to be correlated with the actual findings in thyroid and laryngeal surgeries. We hope the present work will be a useful guide to the surgeons especially ENT surgeons.

Funding: No funding sources

Conflict of interest: None declared

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

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Cite this article as: Sailaja K. An observational study on variation in the relations and branches of recurrent laryngeal nerve. Int J Res Med Sci 2016;4: 2328-31.