



TO STUDY THE VARIATIONS OF RECURRENT LARYNGEAL NERVE IN THYROID SURGERY

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ABSTRACT **Background** – Trauma to RLN in thyroid surgery is a fearful deadly complication which can be avoided by having knowledge about various anatomical variations that the nerve has. **Material and Methods** – The present hospital based prospective study was conducted over 50 cases undergoing thyroid surgery, those who were admitted under Department of Otorhinolaryngology at Maharani Laxmi Bai Medical College, Jhansi (U.P.) of both sex. **Aim** -The study aimed at determining the variations of recurrent laryngeal nerve in thyroid surgery. **Result** –RLN can have various branching pattern, variable position, course of nerve and tracheal deviation. All these variations increases the incidence of trauma to RLN. **Conclusion** - In this study, we conclude that the chances of damage increases if patient has one or more than one of these variations. So the preoperative knowledge of these variations will help to avoid damage to RLN.

KEYWORDS :

INTRODUCTION

Thyroid gland is located in lower central part of neck, anterior to trachea. It has two lobes and an isthmus which joins them and straddles the midline, and in some cases a pyramidal lobe which arises from the upper border of the isthmus.

The recurrent laryngeal nerve (RLN) is a branch of the Vagus nerve. It carries both sensory and motor fibres. All intrinsic muscles of larynx are supplied by RLN except cricothyroid, which receives its innervation via the external laryngeal nerve. The RLN has a different course on the left and right side of the body. The right recurrent laryngeal nerve takes its origin from right vagus, hooks around subclavian artery and ascends upward in the neck into the tracheoesophageal groove forming an angle with TEG at the level of cricothyroid joint. The left recurrent laryngeal nerve arises from the left vagus nerve in the lower part of the neck, looping around the arch of aorta and then ascends upward in the neck into the tracheoesophageal groove same as opposite side, but it does not enter the TEG forming an angle. On both sides, after ascending in the tracheoesophageal groove, the RLN enter into the larynx at the cricothyroid joint.

Injury to RLN is one of the most fearful iatrogenic injury in thyroid surgery. By knowing the variation of RLN one can avoid post op complications after thyroidectomy. In the present study our main focus was on anatomical variations of RLN, which can be seen in terms of extralaryngeal branching of RLN, position of RLN in relation to ITA, position of RLN in relation to tracheoesophageal groove, position of RLN in beahrs and simon's triangle and non-recurrent laryngeal nerve (non-RLN), play an important role in the occurrence of nerve injury that can be caused by visual misidentification. Pre operative knowledge of percentage/incidence of anatomical variation about number, absence, distance of RLN from TEG and course will help to identify the nerve and avoid injury to it during thyroid surgery.

AIMS AND OBJECTIVES

- The study aimed at determining the variations of recurrent laryngeal nerve in thyroid surgery.

MATERIAL AND METHODS

The present hospital based prospective study was conducted over 50 cases undergoing thyroid surgery, those who were admitted under Department of Otorhinolaryngology at Maharani Laxmi Bai Medical College, Jhansi (U.P.) of both sex after obtaining the consent from the patient or their relatives were studied during the period of study from Feb. 2020 to Oct. 2021.

The selected patients were subjected to detailed history taking including present and past history of same types or any other kind of

procedure involving anterior neck region. Any relevant history noted followed by thorough examination of the patients along with investigation like routine blood investigation, thyroid profile, FNAC, radiological investigation including ultrasound, x-ray neck, indirect laryngoscopy. Cases with thyroid swelling who were euthyroid and having normal RLN function were included in study. The clinical data given by patients were then complemented with information on diagnosis of the disease, the treatment administered (present and/or past), adverse effects reported.

OBSERVATION AND RESULT

In our study we included 50 patients out of which 42 (84%) patients were female & 8 (16%) patients were male. They were belonging in the age group from 13 to 54 years with maximum 31 (62%) patients were between 21-40 age group, followed by 14 (28%) patients above 40 age group and 5 (10%) were in the age group of less than 20. Out of 50 cases, in 30 (60%) cases right lobe was involved and 20 (40%) cases had left lobe involvement. On clinical examination, it was observed that in majority 38 (76%) cases consistency of tumour on palpation was firm, in 8 (16%) cases consistency of tumour on palpation was found to be soft and in 4 (8%) cases tumour was hard on palpation. On the basis of FNAC and it was observed that majority 26 (52%) cases had colloid nodule, followed by 9 (18%) cases having adenoma on FNAC, 5 (10%) had colloid cyst, 3 (6%) cases had multi-nodular goitre and remaining i.e., cystic nodule over thyroid, follicular lesion, follicular adenomatous nodule had 1 (2%) cases each. Position of trachea on x-ray neck was observed and in majority 44 (88%) cases trachea was at midline followed by 6 (12%) in which trachea was deviated from midline. Size of tumour i.e transverse diameter of tumour was measured on USG neck and it was observed that majority 21 (42%) cases had tumour size 2-4 cm, followed by 20 (40%) cases having tumour size greater than 4 cm and least 9 (18%) cases had tumour size less than 2 cm.

Out of total 50 cases only 6 patient had deviation of trachea from midline intra-operatively which is same as seen in xray. In those 6 patient, 5 patients had size of tumour > 4 cm, followed by 1 patients having size between 2-4 cm and no patient having size < 2cm showed deviation of trachea.

Table 1 : According to USG & x-ray neck - relation of deviated trachea with size of tumour

Size of Tumour	Deviated trachea (no. of cases)	Non-Deviated trachea (no. of cases)	Total
<2cm	0	9	9
2-4 cm	1	20	21
>4 cm	5	15	20

Intra-operatively relation of RLN with Inferior thyroid artery was observed, it is seen that in 33 (66%) cases RLN was posterior to ITA, followed by 11 (32%) cases in which RLN was anterior to ITA and 12% cases having RLN in between the branches of ITA.

Table-2: Distribution of cases according to relation of RLN with inferior thyroid artery (per-operative finding)

Relation of RLN with inferior thyroid artery	Number of cases	Percentage
Anterior to ITA	11	32%
Posterior to ITA	33	66%
In between the branches of ITA	6	12%

Extralaryngeal branching of RLN on right and left side was seen separately intraoperatively. It was observed that at Right side, 15 (50%) patients showed single extralaryngeal branching of RLN, followed by 11 (36.66%) patients showing bifurcation and 4 (13.33%) patients showed trifurcation/multiple. At left side, 11 (55%) patients showed single extralaryngeal branching of RLN, followed by 7 (35%) patients showing bifurcation and 2 (10%) patients showed trifurcation/multiple.

Table-3: Distribution of cases according to extralaryngeal branching of RLN (per-operative finding)

Extralaryngeal branching of RLN	Number of cases	Percentage	Total	
Right Side	Single	15	50.0%	30
	Bifurcation	11	36.67%	
	Trifurcation/Multiple	4	13.33%	
Left Side	Single	11	55.0%	20
	Bifurcation	7	35.0%	
	Trifurcation/Multiple	2	10.0%	

Position of RLN above inferior thyroid artery was noted intra-operatively and it was observed that at right side 26 (86.67%) cases had RLN in TEG followed by 4(13.33%) cases having RLN away from TEG . On left side, it was observed that 18 (36%) cases had RLN in TEG, followed by 2 (10%) cases having RLN away from TEG.

Table-4: Distribution of cases according to position of RLN above inferior thyroid artery (per-operative finding)

Position of RLN above Inferior Thyroid Artery	Number of cases	Percentage	Total	
Right Side	In Tracheoesophageal Groove (TEG)	26	86.67%	30
	Away from TEG	4	13.33%	
Left Side	In TEG	18	90.0%	20
	Away from TEG	2	10.0%	

Course of RLN in simons triangle (per-operative finding) was observed that at right side, 30 (100%) patients had oblique course of RLN in simons triangle. At left side, 20 (100%) patients had vertical course of RLN in simons triangle.

Table 5: Distribution of cases on basis of course of RLN in simons triangle (per-operative finding)

Course of RLN in simons triangle	No. of cases	Percentage	Total	
Right Side	Oblique	30	100.0%	30
	Vertical	0	0.0%	
Left Side	Oblique	0	0.0%	20
	Vertical	20	100.0%	

DISCUSSION

In our study,60.0% of patients have right thyroid lobe swelling whereas in 40.0% patients left lobe was involved who underwent hemithyroidectomy i.e. unilateral exposure. As the right lobe involvement is greater than left lobe so the variations which we get on both side cannot be compared due to unequal involvement of both thyroid lobe. Shao T et al¹ conducted a study on total 3,275 RLNs, including 1,576 left- and 1,699 right-side nerves, were dissected, with unilateral exposure in 1,533 patients and bilateral exposure in 871 patients. In Saldanha M et al² study a total of 49 patients underwent total thyroidectomy, 33 hemithyroidectomy, and 9 completion

thyroidectomy. Lee M et al³ in their study reported that a total of 70 embalmed cadavers were investigated, including 34 male and 36 female cadavers between the ages of 38 and 96 years at death.

The position of trachea on x-ray neck AP view was at midline in 88.0% cases and deviated in 12.0% cases. The size of the tumori.e the transverse diameter of the tumour was measured by USG neck. Transverse diameter was in between 2-4 cm in the majority of the non-deviated trachea cases (20/44) and it was more than 4 cm in deviated trachea cases (5/6). Overall the size of tumor was 2-4 cm in 42.0% cases and more than 4 cm in 40.0% cases. It can be said that deviation of trachea could be because of the size of tumour pushing trachea to one side. Because of deviation of trachea position of RLN varies, it may be pushed alongwith the trachea to one side or remains at its position and trachea moves away. No study available at present, we need more study for correlation.

Saldanha M et al² quoted that in their study 65.0% patients were having nodular colloid goiter followed by follicular adenoma (10.0%). In our study, FNAC findings of thyroid swelling revealed that swelling are colloidal nodule in 26 (52%) cases, followed by adenoma in 9 (18%) cases, colloid cyst in 5 (10%) cases, multi-nodular goitre in 3 (6%) cases and rest follicular lesion, follicular adenomatous nodule and cystic nodule over thyroid consist of 1 (2%) case each.

Relation of RLN with inferior thyroid artery - In a study conducted by Hisham AN and Lukman MR⁴ observation was that RLN was passing posterior to or in between branches of the ITA in 83.8% and anterior to ITA in 16.2%. Thomas AM et al⁵ in their study reported that in relation to the ITA, 67.9% of right RLNs were related anteriorly, while 32.1% were related posteriorly and 3.6% of nerves crossed in between branches of the ITA. The opposite values were true for the left side, with 67.9% of the RLNs related posteriorly and 32.1% related anteriorly and 5.4% of left RLNs were found crossing between branches of the ITA. In the present study relation of RLN with inferior thyroid artery was found anterior to ITA in 32.0% cases whereas posterior to ITA in 66.0% cases and in between the branches of ITA it was in 12.0% cases. A similar observation was made by Ardito G et al⁵ where 61.0% of the cases had ITA superficial to RLN, 12.0% were deep, and 27.0% between the branches on the right side while on the left side ITA was superficial to RLN in 77.0%, deep in 1.9%, and 27.0% between the branches. Sturniolo G et al⁶ noticed that 22.0% had ITA superficial to RLN on the right side, while 36.0% had deep to RLN on the left. Steinberg JL et al⁹ reported that the RLN traverses between the branches of the ITA in about 6.5%, deep in 61.5%, and superficial in 32.5%.

Extralaryngeal branching of RLN - Thomas AM⁷ et al findings indicated that on the right side, 89.1% demonstrated anywhere between 2-5 extra-laryngeal branches, and 74.6% demonstrated branching on the left side. Yin C et al⁸ reported on right side, 69.8%, 25.8% and 4.4% cases were identified with 1,2 and 3 bifurcations of RLN to larynx entry, respectively. On the left side, 68%, 25.6% and 6.4% of cases were found with 1,2, and 3 bifurcations of RLN to larynx entry respectively. In our study single branching was in 50.0% of the right side followed by bifurcation in 36.67% and multiple branching in 13.33% whereas at left side single branching was in 55.0% cases followed by bifurcation 35.0% and multiple 10.0%. Wojtczak⁹ B. et al in their study found that RLN bifurcation was observed in 33.33% on the right side and in 19.35% on the left side. On both sides, the most common bifurcation observed was the RLN subdividing into two branches (70% of the bifurcations on the right and 67% on the left) but as many as five branches were noted. The branching pattern vary in different studies, this might be due to different geographic study group.

Relation of RLN with tracheoesophageal groove - In present study, we found that the position of RLN above inferior thyroid artery, was in the TEG in 86.67% and away from TEG in 13.33% at right side whereas at left side RLN was in TEG in 90.0% cases and away from TEG in 10.0% and it was noted that in all the cases which had RLN away from TEG had deviation of trachea from midline and tumour size > 2cm. The Position of RLN below inferior thyroid artery, was away from TEG in 100.0% and none were in TEG at right side and on left side RLN was away from TEG in 90.0% and in TEG in 10.0%. Henry BM et al¹⁰ reported that it was most commonly (73.9%) located lateral to the TEG in their cadavers, but most RLNs outside the TEG (45.7%) were found anteriorly in the meta-analysis. Ardito⁵ et al in their study on 2626 nerves, reported that 61.4% right side nerve were located in the TEG, 37.8% were located lateral to the trachea, 0.6% were located

anterolateral to the trachea. On left side 67.3% were located in the TEG, 31% were located lateral to the trachea and 1.6% were located anterolateral to the trachea. Hunt11 et al quoted that on the right side the RLN is located in the TEG in 65% cases and lateral to trachea in 33% cases. On left side 77% RLN was seen in the TEG and 22% lateral to trachea. Shindo ML et al¹² reported that the nerve on the left side was found in the area below 30° with a frequency of 76.8%, and the nerve on the right side was found in the area between 15° and 45° with a frequency of 77.9%. Moreover, the findings persists in reports investigating the relative location of the RLN to the TEG in the upper, middle and lower third of the thyroid gland, which indicates that the nerve in the upper and middle third of the thyroid gland ascends along the TEG on both sides, but the nerve in the lower third of the thyroid gland ascends more closely to the TEG on the left side than on the right side.

Course of RLN in simons triangle - In the present study Course of RLN in simons triangle was oblique in 100.0% cases on right side and 100.0% vertical on left side.No study available at present, we need more study for correlation.

CONCLUSION

Thyroid surgery is a common surgery in day to day practice. The recurrent laryngeal nerve is at risk for iatrogenic injury during thyroid surgery. A thorough knowledge of normal anatomy and variations in the course of the nerve is essential to ensure the integrity and safety of the RLN. Trauma to RLN during thyroid surgery is common complication which increases with the presence of anatomical variations of nerve. For example deviation of trachea results in shifting of RLN from its normal anatomical position. There are so many methods to identify recurrent laryngeal nerve while performing surgery in literature, still there are high chances of damage to the nerve. In this study, we conclude that RLN can have various branching pattern, variable position, course of nerve and tracheal deviation. All these variations increases the incidence of trauma to RLN. The chances of damage increases if patient has one or more than one of these variations. So the preoperative knowledge of these variations will help to avoid damage to RLN.

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