

A Cross Sectional Study on the Anatomical Relationship of Inferior Thyroid Artery with Recurrent Laryngeal Nerve During Thyroidectomy in South Indian Population

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ABSTRACT

Imperative attitude during thyroidectomy is to identify the structure during the procedure before dividing any. Variable course of the recurrent laryngeal nerve constitutes challenges in its recognition and thus its preservation. Appropriate recognition of the nerve and preservation intraoperatively prior to the ligation of any structure averts complications.

A prospective cross-sectional study was done on 77 patients from South India who underwent thyroidectomy in a single centre. The course of **recurrent laryngeal nerve (RLN)** and its relation to **inferior thyroid artery (ITA)** and parathyroid glands were studied on both sides during thyroidectomy.

A total of 139 nerves were studied from 77 patients. On the right side; 74 nerves (RLN) were studied of which 25.67%(n=19) was noted anterior to ITA, 24.32%(n=18) was noted posterior to ITA and 50%(n=37) was seen in between the branches of ITA. On the left side; 65 nerves (RLN) were studied of which 15.38%(n=10) was noted anterior to ITA, 50.67%(n=33) was noted posterior to ITA and 33.84%(n=22) was seen in between the branches of ITA.

A total of 139 nerves were studied from 77 patients in which >50% of recurrent laryngeal nerve (RLN) was seen located in between the branches of inferior thyroid artery (ITA) on the right side. On the left side, 50% of RLN was located posterior to the ITA.

Key words: anatomy, recurrent laryngeal nerve, thyroidectomy, inferior thyroid artery.

INTRODUCTION

Recurrent laryngeal nerve (RLN) was first described by Galeno, the anatomist from Pergamo in the 2nd century as a cranial nerve branch¹. The cranial nerve X, Vagus originates from the neural crest cells of the hind brain; third and fourth epibranchial placodes which courses through the jugular foramen into the carotid sheath of the neck². At the jugular foramen, vagus gives off meningeal and auricular branches from the superior ganglion while the inferior ganglion gives off pharyngeal branches, carotid branches, Superior laryngeal nerve, Recurrent laryngeal nerve and cardiac branches. RLN is a nerve of sixth pharyngeal arch which primarily supplies all the intrinsic muscles of larynx except cricothyroid and gives off cardiac branches, branches to the trachea, oesophagus and inferior constrictors of pharynx³. There is significant variation in the course of RLN in respect to right and left sides. On the right side, RLN passes below the subclavian artery and obliquely ascends into the

tracheoesophageal groove. RLN, on the left side hooks around the aortic arch and takes more vertical and medial course to reach the tracheoesophageal groove. The nerve is non recurrent in about 2% on the right side and is very rarely non-recurrent on the left side³. RLN courses closer to the trachea in its ascent on left than on the right side and it courses posteriorly on left when compared to that on the right side⁴. RLN is observed to be intimately in relation to the inferior thyroid artery (ITA) on both sides. The inferior thyroid artery originates as a branch of subclavian artery from the thyrocervical trunk and passes along the anterior scalene muscle to reach the common carotid medially approaching the inferior pole of the thyroid lateral lobe to supply the thyroid gland and the parathyroid glands⁵.

The incidence of RLN injury depends on diverse components such as anatomical variations, disease process, surgeon factors and is higher in case of completion thyroidectomy⁶. RLN injury can be due to complete transection, partial transection, traction, contusion, crush, burn, misplaced ligature or impaired blood supply. The injury to RLN is an undesired complication varying from hoarseness to respiratory distress causing respiratory, phonatory and psychological issues to the patient⁷. This can be averted by recognition of the nerve prior to ligation of any structure and avoiding mass ligatures during thyroidectomy. Intraoperative recognition of the nerve is imperative which warrants thorough expertise in anatomy and identification of landmarks such as tracheoesophageal groove, parathyroid glands, inferior thyroid artery and tubercle of Zuckerkandl⁸. The anatomical variations of the nerve between right and left side and its affiliation with the landmarks demand a comprehensive study to prevent complications post thyroidectomy.

The aim of this study was to learn the anatomical variations and relationship of inferior thyroid artery (ITA) with recurrent laryngeal nerve (RLN) in patients undergoing thyroidectomy.

METHODOLOGY

A prospective cross-sectional study was done on geodemographically selected sample patients. 77 patients undergoing thyroidectomy were selected as the study sample. The sample size computation was based on a study conducted by “Saadeldin A. Idris, Qurashi M. Ali and Aamir A. Hamza on incidence and variations in the relationship between RLN and ITA in Sudanese subjects”⁹. The values were calculated by the formula $n = 4pq/l^2$ with p value= 63.4, q value= 36.6, $l^2=160.78$ and the sample size was taken as 58. With 12-32% outbreak of 77 patients comprising of 65 nerves on left side and 74 nerves on right side were studied and compared. The study was commenced after Institutional Ethical Committee approval (1609/IEC/2019 dated 27/02/2019) and informed consent was obtained from all patients selected for the study sample. The duration of the study was 20 months between March 2019 to October 2020. Patients of South Indian population, hailing from Tamilnadu undergoing thyroidectomy (total thyroidectomy, subtotal thyroidectomy and hemithyroidectomy) were included in the study with no gender or age predilection. Patients with advanced malignant thyroid disease and previous neck surgeries were excluded from the study. Intraoperatively, the recurrent laryngeal nerve (RLN) was classically identified in the Simon triangle which is bounded by esophagus medially, common carotid artery laterally and superiorly by the inferior thyroid artery and traced to note its association with inferior thyroid artery (ITA).

STATISTICAL ANALYSIS

The data collected was analyzed using Statistical Software Package -21. Pearson chi square test was the test of significance used and p-value of <0.05 was considered as statistically significant.

RESULTS

The study included 77 patients undergoing thyroidectomy of which 89.62% were females and 10.38% were males. 53.21%(n=41) were in the age group 21 to 40 years. 37.68%(n=29) were between the age group 41 to 60 years. 7.9%(n=6) were aged over 61 years and 1.3% (1 patient) was below 20 years as seen in table 1.

Age in years	Frequency	Percent	Range	Mean±S.D
≤20 years	1	1.3	16-77Years	41.19±12.31
21-40years	41	53.21		
41-60years	29	37.68		
≥61years	6	7.9		
Total	77	100.0		

Table 1: Age distribution of the study population.

The indications for thyroidectomy in the study population included multinodular goiter (71.43%), right solitary nodule thyroid (15.59%), left solitary nodule thyroid (6.49%), papillary carcinoma thyroid (3.89%), Hashimotos thyroiditis (1.29%) and Hurthle cell adenoma (1.29%) as shown in figure 1.

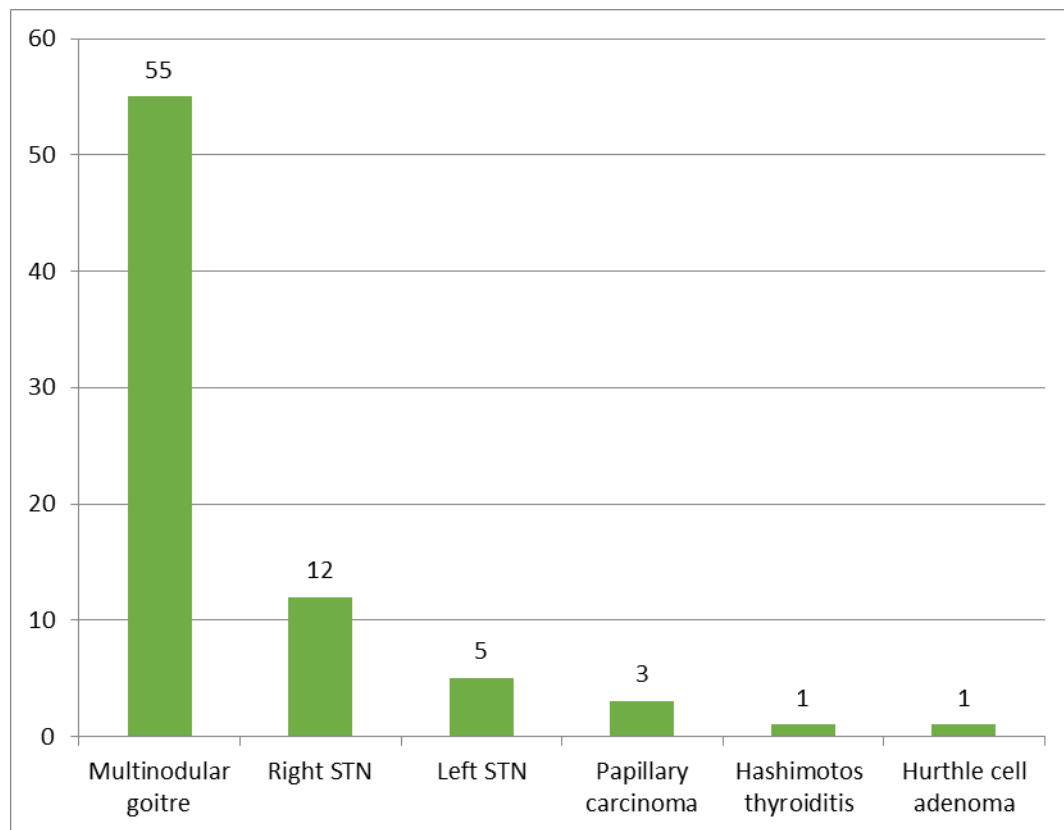


Figure 1: Diagnosis of the study population.

80.52% (62 patients) underwent total thyroidectomy, 15.59% (12 patients) underwent right hemithyroidectomy and in 3.89% (3 patients) underwent left hemithyroidectomy as shown in table 2.

Surgery	Frequency	Percentage
Total thyroidectomy	62	80.52
Left hemithyroidectomy	3	3.89
Right hemithyroidectomy	12	15.59
Total	77	100

Table 2: Types of Surgery done in the study population.

During thyroidectomy, the recurrent laryngeal nerve (RLN) and its course in relation to inferior thyroid artery (ITA) was studied. On the right side; 74 nerves (RLN) were observed

of which 25.67%(n=19) was noted anterior to ITA, 24.32%(n=18) was noted posterior to ITA and 50%(n=37) was seen in between the branches of ITA as shown in table 3.

Side	Right (n)	%
Anterior	19	25.67
Posterior	18	24.32
Inbetween branches	37	50
Total	74	100

Table 3: Relationship of RLN to ITA on right side.

On the left side; 65 nerves (RLN) were observed of which 15.38%(n=10) was noted anterior to ITA, 50.67%(n=33) was noted posterior to ITA and 33.84%(n=22) was seen in between the branches of ITA as shown in table 4.

Side	Left (n)	%
Anterior	10	15.38
Posterior	33	50.67
In-between the branches	22	33.84
Total	65	100

Table 4: Relationship of RLN to ITA on left side.

The variations in course of RLN between the left and right sides were compared. The course of RLN anterior to ITA was significant with a p value of 0.03 when compared with respect to right and left sides. The course of RLN posterior to ITA was significant with a p value of 0.05 when compared with respect to right and left sides. The position of RLN in between the branches of ITA was significant with a p value of 0.006 when compared with respect to right and left sides as depicted in figure 2.

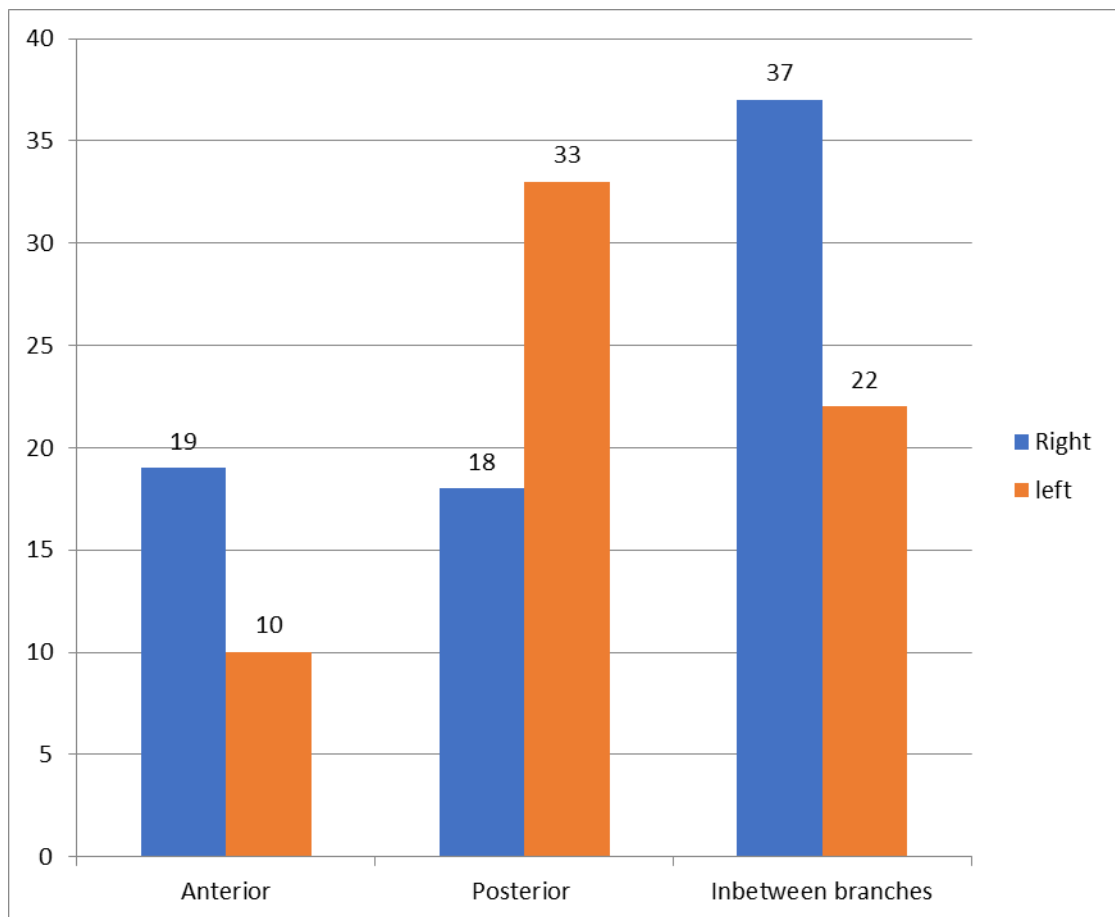


Figure 2: Relationship of RLN to ITA.

There were no major or permanent complications observed in any of the patients in study population. Neuropraxia was observed in 3 patients who experienced hoarseness of voice postoperatively. All 3 patients recovered to normal voice within 6 weeks with the help of steroid and speech therapy.

DISCUSSION

Thyroidectomy in the 19th century was considered to be a morbid surgery due to its dreaded complications. With the evolution of aseptic precautions, general anesthesia and profound understanding of the anatomical structures with its variations, the morbidity in the current era is reduced to less than 1%¹⁰. Identification of the RLN during the surgery reduces the risk of injury by five times^{11,12}. The variable anatomy of the RLN renders identification difficult for the surgeon.

In the past, majority of research on the anatomical relationship between the RLN and ITA were cadaveric studies¹³⁻¹⁵. Adrian F Reed was the first to describe RLN to ITA in 28 types in cadaver studies in 1943. He studied 506 nerves in 253 cadavers to note that on the right side in 26.9% (n=68) the nerve was seen to be passing posterior to ITA followed by 25.7% (n=65) in which the nerve was found passing anterior to ITA. On the left side; 51.4% (n=130) nerves were noted posterior to that of ITA¹⁷. In a meta-analysis by Brandon M Henry; 14269 nerves were studied which included both cadaveric and intraoperative studies of which 60 were cadaveric studies and 18 were intraoperative studies. Among the intraoperative studies, 26.4% of RLN were found to be on the anterior aspect of ITA, 57.8% on the posterior aspect

of ITA and 15.9% transvascularly concluding posterior location of the RLN to be the commonest.

In our study, we compared the course of right and left RLN with its relationship to ITA. On the right side, the present study shows 50% location of RLN in between the branches of ITA followed by 25.67% location anterior to ITA and 24.32% location posterior to ITA. Among the studies done intraoperatively in past, most of the nerves (RLN) on the right side were noted posterior to the ITA^{1,6,7,18} with exemption to the studies by Wen-Jing Tang in 2011 done in China and the study by A-R.ngoNyeki done in Central African population in 2012. Tang noted 75% of them passing anterior to the ITA and Nyeki observed that 53.1% of the nerves were passing in between the branches of the ITA^{19,20}. Our findings were similar to the study conducted by Nyeki et al. On the left side; 50.67% of RLN was noted posterior to ITA, 33.84% was seen in between the branches of ITA and 15.38% was seen anterior to ITA. Studies by Ardito et al, Nyeki et al, Yin-HueiUen et al noted that the RLN predominantly courses posterior to ITA which was similar to this study^{1,19,12}.

139 nerves were studied from 77 patients of South Indian origin who formed the study population. We observed that the relationship of RLN to ITA in respect to sides were slightly different from the literature. We found RLN commonly located in between the branches of ITA on the right side and posterior to ITA on the left side.

Limitations

This study does not include conditions like large goitres and invasive malignancies wherein the dissection is more troublesome with higher risk of nerve injury.

CONCLUSION

A total of 139 nerves were studied from 77 patients in which >50% of recurrent laryngeal nerve (RLN) was seen located in between the branches of inferior thyroid artery (ITA) on the right side. On the left side, 50% of RLN was located posterior to the ITA.

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Consents of patients- Obtained

Funding sources- Nil

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