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ANATOMICAL RELATIONSHIP BETWEEN RECURRENT LARYNGEAL NERVE AND INFERIOR THYROID ARTERY IN THYROIDECTOMY PATIENTS

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Background: Thyroid surgery is performed very frequently now a day. Previously it was used to be associated with high morbidity especially hoarseness. This complication is now almost negligible as most of the surgeons are well acquainted with the anatomical knowledge of the nerves in relation to the gland. The objective of this study was to find out variable anatomical relationships between Recurrent Laryngeal Nerve and Inferior Thyroid Artery in patients undergoing thyroid surgery. **Methods:** This cross-sectional retrospective study was conducted in Government Lady Reading Hospital Peshawar and Abasyn Hospital (Private) Peshawar from May 2010 to June 2014. Patients undergoing surgery for benign goiters, T1, T2 well differentiated thyroid cancers without lymph node involvement was included. Data on various types of relationships between RLN and ITA were recorded. **Results:** In total 271 patients operated and included in the study, 117 were male and 154 were female. Total of 398 RLNs were identified in 416 sides operated. In 55.27% cases the nerve was found to be anterior to inferior thyroid artery while it was posterior to the artery in 34.67% cases. In the remaining 10.05% cases the nerve was observed passing within the branches of inferior thyroid artery. **Conclusions:** The anatomical relationship between Recurrent Laryngeal Nerve RLN and Inferior Thyroid Artery ITA is highly variable. For all head and neck surgeons to perform safe surgery on thyroid, it is necessary to have sound anatomical knowledge of these variable relationships between recurrent laryngeal nerve and inferior thyroid artery.

Keywords: Recurrent Laryngeal Nerve (RLN), Inferior Thyroid Artery (ITA), Relationships, Thyroid surgery

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INTRODUCTION

Due to lack of asepsis and meticulous dissection technique, thyroid surgery used to be associated with high mortality rates in the early nineteenth century. Due to this the French Academy of Medicine had to ban thyroid surgery in 1850.[1] Injury to recurrent laryngeal nerve (RLN) is a major complication of thyroid surgery.[2] Hoarseness, aspiration and even respiratory difficulty due to vocal cord palsy are the major sufferings of thyroid surgery to the patient. Anatomical knowledge about relevant important structures in the vicinity is crucial especially the RLN pathway, its relationship to inferior thyroid artery (ITA) and its extra laryngeal branching patterns. The knowledge of the relationships between the RLN and the ITA is also important for the delivery of the thyroid lobe.[3] All these brought down morbidity to a much controlled level. Routine exposure of the RLN in its entire route and saving it can minimize the chances of trauma to the nerve.[4] Today thyroid surgery is considered to be a relatively safe procedure.[5] There are many studies available in the international literature which describes the anatomical relationship of the RLN to inferior thyroid artery. But most of these studies have been carried out in cadavers.[6] In local literature no studies are available to highlight this anatomical detail.

In the present study we analysed anatomical variations in position and pathway of RLN and its relation to inferior thyroid artery

MATERIAL AND METHODS

This case series descriptive study was carried out in the department of Otolaryngology Head and Neck Surgery PGMI Lady Reading Hospital Peshawar and Abasyn Hospital Private Dabgari Gardens Peshawar from April 1st 2010 to March 31st 2014. A total of 271 Thyroid surgeries were performed all by the primary author during this time period. Patients with fine needle aspiration biopsy (FNAB) proven benign goitres and stage 1 and 2 well differentiated thyroid cancers were included in the study. Patients with Medullary Thyroid Carcinoma MTC, advanced stage and other forms of thyroid malignancies were not included in this study. Surgeries performed by other surgeons were also not included. Surgeries performed on thyroid as emergency procedure to relieve respiratory obstruction were also excluded from the study.

Charts of the patients both male and female in the age range from 16 to 71 years were reviewed and

operation notes analysed. Required data regarding exploration of RLN and its relationship to ITA were retrieved. Data thus obtained were analysed using SPSS-16 for testing the significance of data, Pearson chi square was used as test of significance. A *p*-value of <0.05 was considered statistically significant.

RESULTS

Out of total 271 patients operated, 117 were male and 154 were female. The age range of the patients was 16–71 years with a standard deviation of 11.47**.** The age groups of patients are shown in table-1**.** Procedures performed were total thyroidectomies in 145 cases and hemi thyroidectomies in 126 patents**.** The gender wise type of surgeries performed is shown in table-2. A total of 416 sides, 214 right and 202 left sides were included. Out of 126 hemi thyroidectomies right sided were 69 and left sided were 57. A total of 398 RLNs were explored and identified while in the remaining 18 cases RLN couldn't be identified. Out of total 398 RLNs identified, the nerve was found to be anterior to inferior thyroid artery in 220 (55.27%) cases while it was posterior to the artery in 138 (34.67) % cases. In the remaining 40 (10.05%) cases the nerve was seen to be traversing a route within the branches of inferior thyroid artery. The positions of the right and left recurrent laryngeal nerves with respect to the inferior thyroid artery are shown in table 3 & 4 respectively. Statistical analysis showed that there was no significant difference in position of the recurrent laryngeal nerves with respect to both the right and left sides (*p*-value 0.88)**.**

Table-1: Age group of the study participants

Ag in years	Frequency	Percent
Less than 30	101	37.3
31–45	118	43.5
46–60	42	15.5
61+	10	3.7
Total	271	100.0

Table-2: Gender wise type of surgery

			Type of surgery			Total %
			Total thyroidectomy	Rt Hemithyroidectomy	Lt Hemithyroidectomy	
Gender	M	Count	64	28	25	117
		%	54.7%	23.9%	21.4%	100.0
	F	Count	81	41	32	154
		%	52.6%	26.6%	20.8%	100.0
Total		Count	145	69	57	271
		%	53.5%	25.5%	21.0%	100.0

Table-3: Right RLN position with respect to ITA

	Frequency	Percentage
Side not operated	57	21.0
Anterior to ITA	115	42.4
Posterior to ITA	66	24.4
Between brs of ITA	26	9.6
Nerve not visualized	7	2.6
Total	271	100.0

RLN: Recurrent laryngeal Nerve,ITA: Inferior Thyroid artery

Table-4: Left RLN position with respect to ITA

		Frequency	Percentage
Valid	**Side not operated**	69	25.5
	Anterior to ITA	105	38.7
	Post to ITA	72	26.6
	Between brs of ITA	14	5.2
	Nerve not visualized	11	4.1
	Total	271	100.0

RLN: Recurrent laryngeal Nerve,ITA: Inferior Thyroid arter

Table-5: Relationship between RLN and ITA considering right and left side together in other studies

Author	Year	Country	Number of nerves visualized	RLN anterior to ITA (%)	RLN posterior to ITA (%)	RLN between branches of ITA(%)
Berlin[10]	1935	USA	140	32.14	53.57	14.29
Reed[9]	1943	USA	506	18.6	30.1	36.5
Simon[15]	1943	USA	86	17.44	75.58	6.98
Bowden[4]	1955	UK	58	18.97	41.38	34.48
Wade[5]	1955	UK	200	10.5	47.5	34.5
Chang-Chien[7]	1980	Taiwan	100	24	56	20
Hirata[16]	1992	Japan	784	18.65	46.25	35.1
Lekacost *et al*[13]	1992	Greece	191	16	51	33
Costa *et al*[12]	1997	brazil	98	37.76	93.08	22.44
Sturniolo *et al*[17]	1999	Italy	280	31.1	43.2	25.7

DISCUSSION

Due to high rate of associated morbidity and mortality, thyroid surgery was limited to very few indications in the initial years of nineteenth century.[7] With time evolution occurred and general anaesthesia and antiseptic measures were introduced. Also anatomical knowledge about the vital structures related to the gland improved. This brought down the complication rate associated with thyroid surgery. The morbidity of thyroid surgery has decreased to less than 1%.[5,6] Most of the studies on the laryngeal nerve anatomy are cadaveric studies.[8] However, this study demonstrates the anatomy as seen during live surgery of pathologically enlarged thyroid glands. We described the course of RLN and its relation to inferior thyroid artery in live thyroid surgeries. A total of 398 nerves were studied and its anatomical relation described. To this end, the ITA functions as a fixed reference point for the location of the RLN.

The relationship of the RLN to the ITA can vary. In our patients in 34.67% RLN is deep to the ITA, in 10.05 % it passes in between the branches of ITA, and in the remaining 55.27%cases its route is superficial to the artery.

Reed described 28 different types of relationships between the RLN and the ITA, classifying them in to 3 main types.[9] Most authors,

recognize 3 types of relationships between the RLN and the ITA, as follows:[1,3,10]

a) RLN anterior to ITA
b) RLN posterior to ITA
c) RLN between branches of ITA.

The relationship of the RLN and inferior thyroid artery has shown a regional variation.[11] A study from China showed that 80% of right and 91.5% of left RLNs to travel posterior to inferior thyroid artery.[12] A Brazilian study observed that in most instances RLN travel through the branches of inferior thyroid artery.[13] Furthermore, absent inferior thyroid artery was detected in 4% instances[14].

Simon, after cadaveric dissection of 86 nerves in 43 corpses, concluded that the common relationship 61% is the one in which the RLN establishes by passing posteriorly to ITA. Less commonly 24% the nerve passes anterior to the artery and rarely 9% it passes between the arterial branches.[15] Analysing 17 studies which reported this relationship, when considering both sides as a set, 16 showed that the RLN is more frequently located posterior to the ITA (between 39.08–75.58% of the case). Considering right and left sides separately, differences appear. On the left, in 15 analysed works, 14 showed the predominance of the posterior position of the nerve in relation to the artery.[3–5,9,11]

On the right, the variation is larger. Analysing the same 15 works, 8 showed that the RLN passes more frequently between the branches of the ITA. In 5, the RLN passed posterior to the ITA in most cases, and in only 2 studies was it placed anterior to the artery with higher frequency.[1–5,9,12] Reed[9] in the U.S.A., found different relationships on the two sides in 17% of the cases. Hirata[16] in Japan found the same relationship on the two sides in 40% of male corpses and in 28.6% of female ones. Sturniolo[17] in Italy found the same relationship on both the sides in 51.2% of the cases. The same author found a different relationship between the two sides 48.8% of the time. In the sample presented here, only in 37.32% of the cases did the orientation found on one side occur again in the opposing side.

Flament *et al*[18] in France, found the RLN between the branches of the ITA in most cases, both on the right and on the left side. In the sample presented here, we found similar results to those of the French author: the RLN lay between the branches of the ITA in 46.86%, anterior to the branches in 27.97%, and posterior to the branches in 24.47% of the cases when considering both sides. On the left side, the RLN lay between branches of the ITA in 44.45%, posterior in 37.05%, and anterior to the arterial branches in 18.05% of the cases. On the right, the RLN lay between branches of the ITA in 49.3%, anterior in 38.04%, and posterior in 11.26% of the cases. In 1 case, on the right, the RLN branched off before crossing the ITA, and it surrounded one of its branches. In the works in which this variation was found, it occurred from 1–5.4% of the cases, when considering both sides.[3,9,16] The most frequent combinations in our study were: the RLN between the branches of the ITA on the right and on the left (23.88% of the cases); and the RLN between the branches of the ITA on the right and posterior on the left (19.4% of the cases).

Hirata[16] in Japan found a significant difference in the percentile distribution of the 3 types of relationships of the RLN with the ITA between the two sides. He did not find a significant difference between males and females. This author found that the difference between the two sides could be attributed to the difference in the anatomical course of the RLN on the right and on the left. In the present sample, the results of this analysis are similar to the ones of the Japanese author. The difference between the two sides (right and left) of the orientation of the RLN in relationship to the ITA was. The factors that determine these observed differences in the anatomical variations of the RLN are still not established. Steinberg *et al*[14] in South Africa, dissected 180 nerves in 90 corpses that were not embalmed. Among the corpses, 80% were of black race, 12% were of Caucasian race, and 8% were of Asian race. The authors found, regarding its relationship with the ITA, the RLN had divided into 2 main branches in 68% of the cases. In a small percentage, one of these branches was also subdivided. In 75% of the dissections, the branches of the RLN interdigitated with the branches of the ITA. There was no such thing as a constant relationship between these two structures.

A comparison of results of various relationships of the RLN to ITA considering the right and left together is illustrated in the table-5.

CONCLUSIONS

The RLN exploration in its entire route from inferior thyroid artery to its entry into the larynx at the cricothyroid junction and saving it along with its branches if it has can prevent the troublesome complication of hoarseness, aspiration and respiratory difficulty. Thorough knowledge of the anatomical variations in position of RLN and its relationship with inferior thyroid artery enable the surgeon dealing with thyroid gland to have safe surgery and reduce the morbidity to minimum.

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