Original Article

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Assessment of Relation between External Branch of Superior Laryngeal Nerve & Thyroid Gland- A Cadaveric Study

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Abstract

Background: The thyroid gland is essential for normal growth of the body. This study assessed relation of external branch of superior laryngeal nerve to the superior pole of the thyroid gland. **Subjects and Methods:** This study was conducted on 25 human cadavers having 50 superior thyroid poles of both genders. Cadavers were classified based on age groups, group I was those with age less than 39 years and group II cadavers were those with age more than 40 years of age. Various measurements were performed on cadavers. **Results:** 14 cadavers were I group I and 11 were in group II. The mean mass was 67.2 Kgs in group I and 59.5 Kgs in group II, time elapsed after death was 481.5 minutes in group I and 476.4 minutes in group II, mean height was 1.74 meters in group I and 1.69 meters in group II, mean BMI found to be 22.3 kg/m^2 in group I and 20.1 kg/m^2 in group II. Height found to be significant between both groups ($P< 0.05$). The mean distance from EBSLN to cranial point of the thyroid gland was 6.66 mm in group I and 8.96 mm in group II. The mean transverse distance from superior thyroid artery to EBSLN was 3.55 mm in group I and 5.12 mm side in group II. The mean distance of the crossing point between the most cranial point of the thyroid lobe was 6.40 mm in group I and 11.47 mm in group II. The mean distance from the EBSLN to the midline of the neck was 19.80 mm in group I and 18.58 mm in group II. The mean distance from the EBSLN to the midline of the neck on the most cranial point of the cricoid cartilage was 18.77 mm in group I and 17.80 mm in group II. **Conclusion:** Authors found variation in measurements in left and right side in both group I and group II.

Keywords: Cadaver, Superior laryngeal nerve, Thyroid gland

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Introduction

The thyroid gland is present in neck. It is very important gland essential for normal growth of the body. It is closely linked with multiple anatomic landmarks in the neck which comprise of cervical part of esophagus, the recurrent laryngeal nerve, superior laryngeal nerve and parathyroid glands. [1] As these structures are in close harmony with each other, any injury to these during surgery can be harmful. Hence a thorough knowledge of anatomy of neck is essential to carry out surgical procedures. [2]

Vagus nerve gives rise to superior laryngeal nerve which in turn terminates as internal and external branch of superior laryngeal nerve (EBSLN). The external branch of superior laryngeal nerve lies close to superior thyroid vessel. [3] It has been observed that there are chances of palsy of cricothyroid muscle during injury to the external branch of the superior laryngeal nerve (EBSLN). Due to palsy of cricothyroid muscle, the normal production of sound is altered. Vocal cords fail to maintain tension during phonation. Patients may experience difficulty in swallowing. [4]

There is looping of superior laryngeal nerve having connections between the cervical sympathetic chains located near to the superior pole of the thyroid gland. Chances of injury to EBSLN are more are the distance between it and superior pole of the thyroid gland is less. Thus there is need to assess the nerve carefully before planning surgery of thyroid gland. [5]

As reported by Kokocharov et al, [6] EBSLN lie medial to superior thyroid artery and vein. By passing in relation to the anterior surface of the inferior pharyngeal constrictor muscle it ultimately reaches cricothyroid muscle. Hence whenever somebody is planning to do dissection during thyroid surgery, a distance of atleast 15 mm- 20 mm should be kept between superior thyroid artery and vein and thyroid capsule and to minimize the risk to injury to EBSLN.

It is suggested that with the advancement of the age because of deposition of body fat there is increase in distance between the superior thyroid artery and the EBSLN. Wilmore & Costill,[7] suggested that other useful factors leading to extra body fat with age may be less physical work, excessive food intake, and minimum capacity of the body to mobilize fat reserves and significant decrease in the amount of bone and muscle. The present study was conducted to determine relation of external branch of superior laryngeal nerve to the superior pole of the thyroid gland.

Subjects and Methods

This study was initiated in the department of Anatomy after obtaining ethical clearance from the concerned ethical committee of the institute. We recruited 25 human cadavers having 50 superior thyroid poles of both genders. The inclusion of the cadavers was above 18 years of age, death occurred due to extra cervical reasons and dissection performed within 24 hours of death. We classified cadavers based on age groups, group I was those with age less than 39 years and group II cadavers were those with age more than 40 years of age.

The dissection of neck was performed by following all the anatomical landmarks by single researcher by determining the EBSLN, superior thyroid artery and the thyroid gland. Neck dissection was performed by expert with 5 years of experience. Neck was thoroughly washed with acetic acid and the neck was hyper-extended. Following this, necropsy incision line was followed for making a longitudinal incision. Thyroid gland was dissected through its superior pole. Vagus nerve as well as superior thyroid artery was looked for and the internal jugular vein and the carotid artery were identified on both sides. Following this, superior laryngeal nerve and its external branch was dissected carefully.

We did measurements on the dissected part of the neck. First measurement performed was the distance from the most cranial point of the thyroid gland lobe to the EBSLN was calculated, second the transverse distance from the superior thyroid artery to the EBSLN was measured, third the crossing point between the most cranial point of the thyroid lobe, EBSLN and the superior thyroid artery was calculated. Fourth the distance from the EBSLN to the midline of the neck was measured. Fifth the distance from the EBSLN to the midline of the neck on the most cranial point of the cricoid cartilage was calculated. Both left and right side measurements were made.

Statistical Analysis

Data was expressed as mean± SD and entered in MS excel sheet for statistical analysis. We used SPSS version 20. Pearson's correlation coefficient was used for comparison between different variables. The student t test was also used in this study. Level of significance was labeled as significant with $p< 0.05$.

Table 1: Distribution of cadavers

Groups	Group I	Group II
Age (years)	Less than 39 years	More than 40 years
Number	14	11

Table 2: Assessment of parameters

Parame	Group I		Group II		P value
	Mean	SD	Mean	SD	
Mass (Kg)	67.2	7.4	59.5	7.2	0.12
Time (mins)	481.5	135.7	476.4	114.8	0.91
Height (m)	1.74	1.04	1.69	1.01	0.05
BMI (kg/m2)	22.3	2.5	20.1	3.7	0.17

Table 3: Measurement from EBSLN to cranial point of the thyroid gland on both sides

Side	Group I		Group II		P-value
	Mean	SD	Mean	SD	
Left	6.89	2.41	9.51	7.51	0.02
Right	6.43	2.75	8.42	7.43	0.06
Total	6.66	2.58	8.96	7.47	

Table 4: Measurement from transverse superior thyroid artery distance to EBSLN on both sides

Side	Group I		Group II		P-value
	Mean	SD	Mean	SD	
Left	3.86	2.56	4.58	2.14	0.08
Right	3.24	1.72	5.67	3.40	0.09
Total	3.55	2.14	5.12	2.77	

Results

[Table 1] shows that group I and group II had 14 and 1 cadavers respectively.

[Table 2] shows that mean mass was 67.2 Kgs in group I and 59.5 Kgs in group II, time elapsed after death was 481.5 minutes in group I and 476.4 minutes in group II, mean height was 1.74 meters in group I and 1.69 meters in group II, mean BMI found to be 22.3 kg/m^2in group I and 20.1 kg/m^2in group II. Height found to be significant between both groups (P<

Table 5: Distance of the crossing point between the most cranial point of the thyroid lobe on both sides

Side	Group I		Group II		P value
	Mean	SD	Mean	SD	
Left	7.52	3.51	12.52	4.65	0.01
Right	5.29	4.17	10.43	4.16	0.02
Total	6.40	3.84	11.47	4.40	

Table 6: Measurement of the distance from the EBSLN to the midline of the neck

Side	Group I		Group II		P value
	Mean	SD	Mean	SD	
Left	20.45	3.2	19.02	3.8	0.82
Right	19.16	3.8	18.14	2.4	0.76
Total	19.80	3.5	18.58	3.1	

Table 7: Measurement of distance from the EBSLN to the midline of the neck on the most cranial point of the cricoid cartilage

Side	Group I		Group II		P value
	Mean	SD	Mean	SD	
Left	18.82	2.74	18.34	4.42	0.75
Right	18.73	3.72	17.26	3.96	0.83
Total	18.77	3.23	17.80	4.19	

0.05).

[Table 3 & Figure 1] shows that on left side the mean distance from EBSLN to cranial point of the thyroid gland was 6.89 mm and on right side was 6.43 mm in group I and on left side was 9.51 mm and on right side was 8.42 mm in group II. The difference was significant (P< 0.05).

[Table 4] shows that in group I, on left side, mean transverse distance from superior thyroid artery to EBSLN was 3.86 mm and on right side was 3.24 mm and in group II on left side was 4.58 mm and on right side was 5.67 mm. We obtained a non-significant (P> 0.05) difference.

[Table 5] shows that mean distance of the crossing point between the most cranialpoint of the thyroid lobe on left side was 7.52 mm and on right side was 5.29 mm in group I and 12.52 mm on left side and 10.43 mm on right side in group II. The difference between both groups was significant (P< 0.05).

[Table 6] shows that mean distance from the EBSLN to the midline of the neck on left side was20.45 mm and on right side was 19.16 mm in group I and 19.02 mm on left side and 18.14 mm on right side in group II. The difference between both groups was non- significant (P> 0.05).

[Table 7] shows that mean distance from the EBSLN to the midline of the neck on the most cranial point of the cricoid cartilage on left side was 18.82 mm and on right side was 18.73 mm in group I and 18.34 mm on left side and 17.26 mm on right side in group II. The difference between both groups was non-significant (P> 0.05).

Discussion

It is evident that the branches as well as superior laryngeal nerve itself have greatly been ignored as compared to the recurrent laryngeal nerve during thyroid surgeries. The reason for this may be a lot of experience and thorough knowledge of localized anatomy is obligatory to recognize injury to the branches of the superior laryngeal nerve and its branches. [8] The work of Clader et al, [9] in their study revealed that there was risk of injury of EBSLN in 68 % of cases, in 12% risk and 20% were not at risk. They revealed that during ligation of STA, chances of injury to EBSLN are relatively high owing to its close location to the artery. In this study we tried to assess relation of external branch of superior laryngeal nerve to the superior pole of the thyroid gland.

In present study 14 cadavers were in group I and 11 were in group II. Group I comprised of cadavers of patients less than 39 years of age and group II comprised of patients above 40 years of age. We found that the mean mass was 67.2 Kgs in group I and 59.5 Kgs in group II, time elapsed after death was 481.5 minutes in group I and 476.4 minutes in group II, mean height was 1.74 meters in group I and 1.69 meters in group II, mean BMI found to be 22.3 kg/m2 in group I and 20.1 kg/m2 in group II. Williams et al, [10] demonstrated that EBSLN passes at back to the sternothyroid muscle next to the superior thyroid artery. The internal branch is bigger than EBSLN.

We found that mean distance from EBSLN to cranial point of the thyroid gland on left side was 6.89 mm and on right side was 6.43 mm in group I and 9.51 mm on left side and 8.42 mm on right side in group II. Estrela et al, [11] conducted a study which comprised of 22 human cadavers to evaluate relation between thyroid gland, superior thyroid artery and EBSLN. Authors found that the mean distance from the superior pole of the thyroid gland and EBSLN was 7.68 ±3.07 mm. A value of 4.24 ±2.67 mm was obtained from the EBSLN and STA. A value of 9.53 ±4.65 mm was found by measuring the distance that extends from EBSLN to the superior pole of the thyroid gland. The distance between most caudal point of the thyroid cartilage to the EBSLN was 19.70 ±2.82 mm. A distance from the most cranial point of the cricoid cartilage to the RENLS was 18.35 ±3.66 mm.

We observed that the mean distance from EBSLN to cranial point of the thyroid gland on left side was 6.89 mm and on right side was 6.43 mm in group I and 9.51 mm on left side and 8.42 mm on right side in group II. The total mean value of left and

right side in group I was 6.66 mm and on right side was 8.96 mm. The mean transverse distance from superior thyroid artery to EBSLN on left side was 3.86 mm and on right side was 3.24 mm in group I and 4.58 mm on left side and 5.67 mm on right side in group II. The total mean value of left and right side in group I was 3.55 mm and on right side was 5.12 mm. Sun & Chang, [12] assessed 120 sides in 60 cadavers revealed that there was variation in position of the EBSLN. As revealed by authors, there were significant looping of lateral sympathetic chain and the superior laryngeal nerve. Authors further found that the lateral portion of these loops were posterior and lateral to the superior thyroid artery.

In present study it was found that mean distance of the crossing point between the most cranial point of the thyroid lobe on left side was 7.52 mm and on right side was 5.29 mm in group I and a total value in group I was 6.40 mm. In group II, 12.52 mm on left side and 10.43 mm on right side in group II and a total value in group II was 11.47 mm. Poyraz & Çalguner, [13] observed that in 71.9% of cases, the EBSLN was found medial to the superior thyroid artery and in 28.1% it coursed between the branches of the superior thyroid artery.

We found that mean distance from the EBSLN to the midline of the neck on left side was 20.45 mm and on right side was 19.16 mm in group I and 19.02 mm on left side and 18.14 mm on right side in group II. A total mean value in group I was 18.77 mm in group I and in group II was 17.80 mm. Williams et al, [10] in their study revealed that the EBSLN passes posterior to the superior thyroid artery at a deeper plane.

We found that mean distance from the EBSLN to the midline of the neck on the most cranial point of the cricoid cartilage on left side was 18.82 mm and on right side was 18.73 mm in group I and 18.34 mm on left side and 17.26 mm on right side in group II.

Small sample size was our one of the limitations.

Conclusion

Authors found that there was variation in measurements in left and right side in both group I and group II.

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