Section: Anatomy

Original Research Article

ANATOMY OF SUPERIOR THYROID ARTERY AND EXTERNAL LARYNGEAL NERVE IN RELATION TO THE THYROID GLAND – A HUMAN CADAVERIC STUDY FROM TAMIL NADU, INDIA

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ABSTRACT

Background: There is increased rate of complications of thyroid surgery due to the damage to the superior thyroid artery and external laryngeal nerve. This may affect the quality of life of people undergoing thyroid surgery. Objectives: The study was conducted to find the variations of superior thyroid artery and external laryngeal nerve in relation to the thyroid gland- A Human cadaveric study.

Materials and Methods: This is a cross-sectional study and about 50 cadaveric specimens were dissected and studied.

Results: Out of 50 specimens dissected, the superior thyroid artery was found to take origin from external carotid artery in 41 specimens, from the common carotid artery in 6 specimens and from the bifurcation of common carotid artery in 3 specimens. In all the specimens, the external branch of superior laryngeal nerve was found to pass medial to the superior thyroid artery to the apex of the thyroid gland.

Conclusion: Variations of superior thyroid artery and external laryngeal nerve are common in respect to the thyroid gland, as well as to the origin and course. Hence these should be carefully analyzed before surgery to reduce the post-operative complications as to improve the quality of life of patients.

Keywords: Superior thyroid artery, External laryngeal nerve, Variations in relation to apex of thyroid gland

INTRODUCTION

Thyroid gland is a butterfly shaped structure located in the visceral compartment of the neck which is bounded by pretracheal fascia, which plays an important role in regulating the metabolic rate of the body. Anatomical position of the gland is C5-T5 vertebra. It consists of 2 lobes right and the left connected by a central isthmus which are wrapped around the cricoid cartilage and superior rings of trachea.[1]

Superior thyroid artery and inferior thyroid arteries are the main arterial supply of the thyroid gland. Superior thyroid which is one of the main arterial supplies, is branched from the anterior surface of external carotid artery first below the greater cornu of hyoid bone. It is closely related to the external branch of superior laryngeal nerve. It pierces the thyroid fascia and then divides into anterior and posterior branches supplying the anterior, lateral and medial surfaces of the gland. Superior laryngeal nerve is in close relation to the superior thyroid artery at the upper pole of the lateral lobe of the thyroid gland. The external laryngeal nerve innervates the cricothyroid muscle which is the only tensor muscle of the larynx which aids with phonation. Hence any damage to the superior thyroid artery leads to hemorrhage and damage to the external laryngeal nerve leads to hoarseness of voice.

Disorders of the thyroid gland are common worldwide and in India too which includes thyroid cancer, nodules, goiter, hyperthyroidism. Projection from several studies on thyroid disease shows that about 42 million people suffer due to thyroid diseases in India.[2] Thyroidectomy remains as one

of the viable treatment options for various thyroid disorders. However, complications during and after the surgery remain a matter of concern even now. Various surgical risks have been reported lately like bleeding, infection, hypoparathyroidism, airway obstruction due to bleeding, hoarseness of voice. Thus, it is imperative that the anatomy of thyroid gland and the structures surrounding it be studied in detail.

Published literature shows that post-operative complications like voice disturbances and hemorrhages occurs temporarily in up to 80% of patients after they undergo thyroid surgery.[3] One of the major causes is the injury to the superior thyroid artery and external laryngeal nerve during the surgery.[4]

Based on our literature search, we see that there are limited research works conducted to study the anatomy of superior thyroid artery and external branch of superior laryngeal nerve in relation to thyroid gland.

It is very important to know about the variations of the superior thyroid artery and external laryngeal nerve in relation to the thyroid gland because it gives a clear idea to the surgeons doing thyroidectomy and to reduce the incidence of various complications after surgery. Moreover, it may not be an easy task to study variations in this anatomical relation in detail in a living patient during surgery. Thus, we studied the same in the well-preserved cadaveric specimens available in the department of anatomy in our institute.

Aims and Objective

Among the cadaveric specimen received in department of anatomy in a medical college in Tamil Nadu, India between July 2015 to August 2019.

To describe the variations of superior thyroid artery in relation to the Thyroid gland

To describe the variations of external branch of superior laryngeal nerve in relation to the thyroid gland.

MATERIALS AND METHODS

Study Design: Cross-sectional study

Study Population

Inclusion Criteria

Cadaveric specimens received from July 2015 to August 2019 and well-preserved in the department of anatomy, irrespective of age and gender.

Exclusion Criteria

Cadaveric specimens having distorted anatomy of the structures will be excluded.

Sample Size & Sampling Technique: All the available 50 cadaveric specimens were taken into the study and hence there is no sampling technique involved in the study.

Study Period: The study was conducted for 4 months (July-October) and the study was initiated only after obtaining clearance from ethical committee.

Methodology

Cadaver was placed in supine position with the neck hyper extended. A median longitudinal incision extending from mental protuberance to suprasternal notch was made. The incision was extended laterally from suprasternal notch along the clavicle to the acromion process bilaterally. Another incision from mental protuberance along the inferior border of the mandible towards the earlobe was made. Then the skin over the neck was reflected. Platysma was exposed. The fat deposits were cleared using clean cotton ball and scalpel.

Then the carotid triangle formed by sternocleidomastoid, superior belly of omohyoid and posterior part of digastric muscle was traced. Then the carotid sheath was pierced and its contents external carotid artery, internal jugular vein and the vagus nerve were traced. The 2 lateral lobes of the thyroid gland with its connecting isthmus were clearly defined. The course of the superior thyroid artery from its origin from the external carotid artery was traced. The external branch of superior laryngeal nerve from the vagus nerve was also traced till its termination near the apex of the lateral lobe of the Thyroid gland. After clear demarcation of both the artery and the nerve, the study was done.[13]

Statistical Analysis

Data was entered in MS Excel and analyzed using SPSS version 22.0. The variations in anatomical position of superior thyroid artery and external branch of superior laryngeal nerve were described in relation to the thyroid gland. Common positions of these structures in relation to thyroid gland was found out by expressing each position in proportion.

RESULTS

Out of 50 specimens dissected, the superior thyroid artery was found to take origin from external carotid artery in 41 specimens (82%), from the common carotid artery in 6

Specimens (12%)and from the bifurcation of common carotid artery in 3 specimens (6%). In all the specimens, the external branch of superior laryngeal nerve was passing medial to the superior thyroid artery to the apex of the lateral lobe of thyroid gland.

In figure 1, the superior thyroid artery was found to curve antero- inferiorly from the external carotid artery and disappears deep to the superior belly of omohyoid muscle and the external laryngeal nerve was found to accompany the artery medial to it. Close to the gland, the external laryngeal nerve deviated from its course and as it reached the apex of the lateral lobe of the thyroid gland, the nerve was found to pass away from the superior thyroid artery and supplly the cricothyroid muscle.

In figure 2, the superior thyroid artery was found to take origin from the bifurcation of the common carotid artery and was found to rest on the inferior constrictor muscle and disappear beneath the infra hyoid muscles to reach the apex of the lateral lobe of thyroid gland. During its course it was found to be accompanied by external branch of superior laryngeal nerve. At the level of the lamina of the thyroid cartilage the external branch of superior laryngeal nerve was found to get separated from the superior thyroid artery and reached the pyramidal lobe of the thyroid gland to supply the pyramidal lobe and the cricothyroid muscle.

In figure 3, the superior thyroid artery took origin from the common carotid artery and it was accompanied by external branch of superior laryngeal nerve on its medial side. On reaching the apex of the lateral lobe of the thyroid gland, the nerve was found to deviate from the artery to supply the cricothyroid muscle.

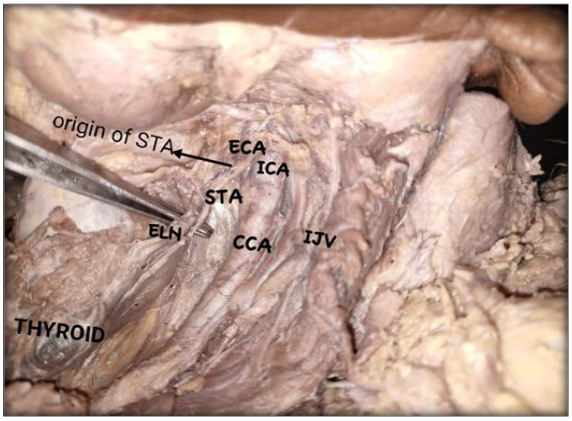

Figure 1: Origin of STA from ECA accompanied by external laryngeal nerve which runs medial to the STA

(STA- SUPERIOR THYROID ARTERY; ELN- EXTERNAL LARYNGEAL NERVE; CCA- COMMON CAROTID ARTERY; ECA- EXTERNAL CAROTID ARTERY; ICA- INTERNAL CAROTID ARTERY; IJV- INTERNAL JUGULAR VEIN; VN- VAGUS NERVE)

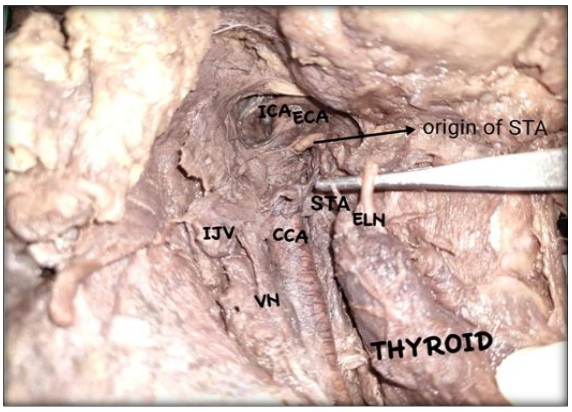

Figure 2: Origin of STA from CCA accompanied by external laryngeal nerve which runs medial to the STA

(STA- SUPERIOR THYROID ARTERY; ELN- EXTERNAL LARYNGEAL NERVE; CCA- COMMON CAROTID ARTERY; ECA- EXTERNAL CAROTID ARTERY; ICA- INTERNAL CAROTID ARTERY; IJV- INTERNAL JUGULAR VEIN; VN- VAGUS NERVE)

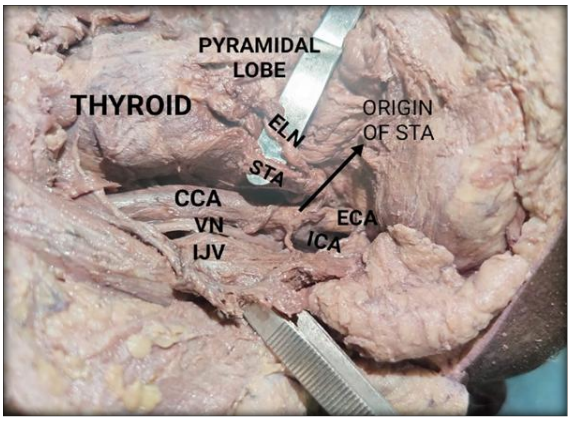

Figure 3: Origin of STA from bifurcation of CCA accompanied by external laryngeal nerve which runs medial to the STA

(STA- SUPERIOR THYROID ARTERY; ELN- EXTERNAL LARYNGEAL NERVE; CCA- COMMON CAROTID ARTERY; ECA- EXTERNAL CAROTID ARTERY; ICA- INTERNAL CAROTID ARTERY; IJV- INTERNAL JUGULAR VEIN; VN- VAGUS NERVE)

DISCUSSION

With increased rate of complications of thyroid surgery due to the damage to the superior thyroid artery and external laryngeal nerve, study of the variations of the superior thyroid artery and external laryngeal nerve in relation to the thyroid gland is very much necessary. This gives the surgeon a basic idea and helps to reduce post-operative complications following thyroid surgery.

Yalcin B et al has also studied the variations in the origin of superior thyroid artery and its relation to the external branch of superior laryngeal nerve with the apex of the lateral lobe of the thyroid gland. He has studied the variations in 81 cadaveric specimens and reported that most of the external branch of superior laryngeal nerve passed medial to the superior

thyroid artery, few has also passed lateral and few posterior to the superior thyroid artery in respect to its origin.[3] Dessie MA has dissected in 43 embalmed cadavers bilaterally and has reported that in most of the specimens the superior thyroid artery took origin from the external carotid artery, few from common carotid artery and very few from bifurcation of the common carotid artery.[4] Ranjith Sreedharan et al has studied in 60 human adults cadaveric hemi neck specimens. Out of 60

specimens, he has also reported that, in most of the superior thyroid artery was found to take origin from external carotid artery, few from bifurcation of common carotid artery and in one case he has noted that the external branch of superior laryngeal nerve did not cross the trunk of superior thyroid artery.[5] Vandana Mehta during her routine dissection in human male adult cadaveric specimen, has found that on right side the superior thyroid artery was missing and on the left side the superior thyroid artery took origin from the external carotid artery.[6] L K N'guessan et al dissected in 32 human cadaveric specimens and found that in most of the cases the external branch of superior laryngeal nerve was non- intermingled with superior thyroid artery and only in few cases it was intermingled with superior thyroid artery.[7] Pongpeera Taytawat et al has dissected 68 human cadaveric specimens of Thais. He has noted that in most of the cases, the external branch of superior laryngeal nerve was found to run superficial to the inferior constrictor muscle along its upper border which makes its more liable to get injured during thyroid surgeries.[8] Magoma et al has conducted the study in 20 human cadaveric specimens each on right and left side. In his study 25% of external laryngeal nerve was found to cross the superior thyroid artery within 1cm above the apex of the thyroid gland and 75% of the external laryngeal nerve crossed more than 1cm above the apex of the thyroid gland.9 Shivaleela et al has conducted the study in 42 cadaveric specimens. 76.19% of superior thyroid artery was found to take origin from external carotid artery, 21.43% from common carotid bifurcation and 2.38% from commom carotid artery.[10] Abhijeet et al has dissected in 33 donated cadavers and has reported that 66.67% of superior thyroid artery took origin from external carotid artery, 31.81% from common carotid bifurcation and 1.51% from common carotid artery.[11] Friedman et al has conducted a non randomized retrospective study in patients who underwent thyroidectomy operation in his 30 years of experience and has reported the variations in the relation of the external laryngeal nerve to inferior constrictor muscle. The External laryngeal nerve was found to run superficial to the inferior constrictor muscle or it was found to penetrate the lower border of the muscle, or divides under the superior most fibres of the muscle.[12]

In the present study, out of 50 human cadaveric specimens, the superior thyroid artery originated from the external carotid artery in 41 cadaveric specimens. In 6 human cadaveric specimens, the superior thyroid artery took origin from the common carotid artery and in 3 human cadaveric specimens, the superior thyroid artery took origin from the bifurcation of common carotid artery. In all the 50 human cadaveric specimens, the external branch of superior laryngeal nerve passed medial to the superior thyroid artery at the level of the greater cornu of hyoid bone and at the level of the oblique line of the thyroid cartilage, the nerve deviated from its course from the superior thyroid artery to innervate the cricothyroid muscle. Close to the apex of the thyroid gland the external branch of superior laryngeal nerve was found away from the superior thyroid artery.

The strength of the present study was that, the dissection was carried out in properly embalmed and well preserved human cadaveric specimens which gave us more time and opportunity to study the course of the superior thyroid artery and external branch of superior laryngeal nerve in relation to the apex of the lateral lobe of the thyroid gland in detail which is not possible if the study was carried out in live patients during surgery.

As the present study was done in preserved human cadaveric specimens, the exact anatomy of the study related structures was difficult to be traced along its entire course which is the limitation of the present study.

CONCLUSION

Number of studies have reported the variat in the origin of the superior thyroid artery and the external branch of superior laryngeal nerve with its relation to the apex of the lateral lobe of thyroid gland. In the present study also the variations of superior thyroid artery were noted and the relation in the course of the superior thyroid artery with the external branch of superior laryngeal nerve in relation to the apex of the lateral lobe of the thyroid gland was noted. This will be useful for the surgeons to anticipate the variations of the superior thyroid artery and external branch of superior laryngeal nerve in relation to the apex of the thyroid gland to avoid injury to the superior thyroid artery and external laryngeal nerve to reduce the post-operative complications and to improve the quality of life of the patients undergoing the thyroid surgery.

Conflicts of Interest: None.

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