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Anatomy

A STUDY OF ANATOMICAL VARIATIONS OF THE ORIGIN OF SUPERIOR THYROID ARTERY AND ITS RELATIONSHIP WITH THE EXTERNAL BRANCH OF SUPERIOR LARYNGEAL NERVE.

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ABSTRACT

AIMS: To examine the variations of the origin of superior thyroid artery and its relationship with the external branch of the superior laryngeal nerve.

MATERIALS AND METHODS: 43 embalmed cadavers were studied in this descriptive study. The anterior triangle of the neck region was dissected bilaterally. The presence or absence of STA and its origin, branching pattern, relationship with the external branch of the superior laryngeal nerve, level of origin in relation to the lamina of the thyroid cartilage and level of carotid bifurcation were observed and recorded.

OBSERVATION AND RESULTS: The superior thyroid artery arises from the external carotid artery in 44.2%, common carotid bifurcation in 27.9% and common carotid artery in 26.7% of cadavers.

KEYWORDS : Superior Thyroid Artery.

INTRODUCTION:

The main arterial supply of the thyroid gland, the upper part of the larynx, muscles and overlying skin of the neck region is the superior thyroid artery (STA) [1–3]. It is branched from the anterior surface of the external carotid artery (ECA) as a first branch, just below the level of greater cornu of the hyoid bone [1, 3–6]. It descends along the lateral border of thyrohyoid muscle anterolateral to the external branch of superior laryngeal nerve (EBSLN) to reach superior pole of the thyroid gland[3, 7]. The artery has the following named branches: infrahyoid, superior laryngeal, sternocleidomastoid and cricothyroid [1, 3, 8].

The STA is involved and has many roles in head and neck surgical procedures [9]. The variations in the origin and distribution pattern of STA are great importance for head and neck surgeons because of its vital relationship to the EBSLN[8, 10, 11]. The EBSLN, which supplies the cricothyroid muscle, runs parallel to STA and later crossing the artery from lateral to medial either above or below the upper pole of the thyroid gland[4, 7]. This muscle tensions the vocal folds to produce high-frequency sound during phonation, protect the airways against aspiration during swallowing, and optimize breathing[11, 12]. The EBSLN comes into play at frequencies above 150 Hz, thus it is particularly involved in producing the high tones. This can be predominantly significant for individuals using their voice professionally[13]. Because of its intimate relationship with STA, EBSLN is at risk when the artery is being ligated [8, 11, 14]. Clinical symptoms may present as weakness, tightness, and increased effort to speak, increased throat clearing, and vocal fatigue [15, 16]. Even for non-professionals, the perception of an abnormal voice impairs the quality of life and decreases the general health in many ways and affected patients may be unable to shout for help[15]. The incidence of EBSLN injury in patients undergoing thyroidectomy is reported to be up to 58%[13, 15, 18]. One of the earlies reported case goes back to 1935 when the famous opera singer Amelita Galli- Curci suffered from damage to the EBSLN after thyroid surgery. This nerve has since become known as the "nerve of Galli-Curci[16, 17].

The origin of STA and its relation with the EBSLN varies from population to population [4]. So this study provides the anatomical variations of the origin of STA in central India

MATERIALS AND METHODS:

A descriptive cross-sectional institutional based observational study was conducted on 43 embalmed human cadavers. The data were collected from january to December 2017 in the department of anatomy in a tertiary medical college in central India. If the following structures of the neck region are intact and were not destructed by the students, the cadaver was incorporated in the study: CCA, internal carotid artery(ICA), ECA, STA, facial artery, lingual artery, the vagus nerve, superior laryngeal artery, EBSLN and lobes of the thyroid gland. Cadavers that were macerated by the students and those that were difficult to dissect were excluded from the study.

A sliding caliper was used to make two measurements on each side of the dissected area, as follows:

1. Distance from upper pole of the thyroid gland to the level where EBSLN turn medially from STA by cm
2. The distance between the origin of the STA and the CCA bifurcation by cm

During the measurement of the distance between those structures, the part of the structures were fixed in position by pins. The data were entered into epi info 7 version 7.2.1.0 and transferred to SPSS 20 and frequency was calculated for each variable category. The origin of STA was analyzed using a Chi-square test with regard to sex and sides of the cadavers, branching pattern of STA and carotid bifurcation level in relation to the lamina of the thyroid cartilage.

RESULTS:

A total of 43 cadavers were included in the study. About 86% (37/43) of the study population were male and 14% (6/43) were female cadavers. The age of the study population was unknown. The STA arises from the ECA in 51.2% and 37.2% of the cases in the right and left sides respectively(Table 1)

The STA was branched independently from the carotid tree in 94.2% (81/86), commonly branched with the thyrolingual and linguofacial trunk in 2/86(2.3%) for each (Table 2).

The STA was observed closely related to EBSLN on both sides (Table 3). The mean distance from the upper pole of the thyroid gland to the level where EBSLN turn medially from STA was found to be 1.04cm with the mode of 1.00cm, median 1.0cm, standard deviation 0.5cm, minimum 0.3 and maximum of 3.0cm.

DISCUSSION:

In most of the previous studies, the STA arises primarily from ECA, which ranges from 60–80.4% [2]. The common carotid bifurcation was a primary origin of STA in a study done in Spain by Vazquez et al, which accounts 49%. In this study, STA arises from ECA in 23% of cases[18].

In the current study, the distance between the origin of the STA from the CCA and the CCA bifurcation was 0.2cm to 3.5cm and the distance between the origins of STA from ECA to the carotid bifurcation was 0.1cm to 3cm. According to Vazquez et al for the STA arise from CCA the distance from the origin to the carotid bifurcation was between 0.1 and 2.1 cm and for the arteries which arise from ECA it was 0.1 to 1.5 cm[18].

The EBSLN crossed the STA more than 1 cm or at a 1cm distance from the upper pole of the thyroid gland(Type 1) in 75%, 72.73%, and 60% of cases according to Magoma et al, Joshi et al, and Estrela et al respectively[2, 4, 11]. In the present study, the EBSLN cross the STA at

1 cm or more than 1cm from the upper pole of the thyroid gland in 57.0% of cases.

The EBSLN crossed the STA less than 1cm above the upper pole of the thyroid gland(Type 2a) in 25%, 27.27%, 17% and 40.7% based on the studies of Magoma, Joshi, Estrela and the present study respectively[2, 4, 11].

The EBSLN cross STA below the upper pole of the thyroid gland(Type 2b) in 20% according to Estrela[11]. In this study, 2.3% of nerve crosses the STA below the upper pole of the thyroid gland.

Although it is not assessed by this study, the relation of the EBSLN to the inferior constrictor muscle is also vital in the identification of the EBSLN. Based on Freidman classification there are three categories: Type 1 in which the EBSLN runs its whole course superficially or laterally to the inferior constrictor muscle, Type 2 in which the EBSLN penetrates the muscle in its lower portion and Type 3 in which the nerve dives under the superiormost fibers of the muscle[16].

CONCLUSION:

The knowledge of these variations is critical for physicians and could help to avoid serious complications during thyroid surgeries, tracheostomy, radiological examination, laryngeal surgeries and microvascular surgeries.

1. Table showing origin of superior thyroid artery among the cadavers:

Site of origin of superior thyroid artery	Right side (n=43) %	Left side (n=43)%	Total (n=86) %
External carotid artery	22 (51.2%)	16 (37.2%)	38 (44.2%)
Common carotid artery	8 (18.6%)	15 (34.9%)	23 (26.7%)
Common carotid artery bifurcation	12 (27.9%)	12 (27.9%)	24(27.9%)
Other (lingual artery)	1 (2.3%)	-	1 (1.2%)

2. Branching pattern of superior thyroid artery from the carotid tree.

Branching pattern	Side of the body		Total
	Right	Left	
Independently branched	90.7%	97.7%	94.2%
Branched from linguofacial trunk	2.3%	2.3%	2.3%
Branched from thyrolingual trunk	4.7%	-	2.3%

3. Relation of external branch of the superior laryngeal nerve to the superior thyroid artery according to Cernea's classification.

	Left sides	Right sides	Total
TYPE 1	25 (58.1%)	24 (55.8%)	49 (57%)
TYPE 2a	17 (39.5%)	18 (41.9%)	35 (40.7%)
TYPE 2b	1 (2.3%)	1 (2.3%)	1.0

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