



## ANATOMICAL STUDY OF VARIATIONS IN THE ORIGIN OF SUPERIOR THYROID ARTERY

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**ABSTRACT** **BACKGROUND:** The superior thyroid artery (STA) is the dominant arterial supply of the thyroid gland, larynx and the neck. Knowledge of these variations is crucial for decreasing morbidity during the surgeries. The present study was undertaken to evaluate the frequency of usual anatomical variations in the origin of STA in human cadavers. **METHOD:** The origin of STA was studied by dissecting hundred human carotid specimens obtained from the formalin embalmed cadavers who were allotted to the undergraduate students for dissection in the Department of Anatomy. **RESULTS:** STA arose commonly from external carotid artery (ECA) in 71 cases (71%), arising directly from common carotid artery (CCA) in 24 (24%) cases whereas only in 5 specimens (5%) it was arising at the level of bifurcation of CCA. On the right side STA was originated from ECA in 31 (43.7%) and on left side it was 40 (56.3%). STA was originated at bifurcation level in 5 (100%) cases on right side and on left side no case was observed (0%). On right side STA was originated from CCA in 14 (58.3%) cases and on left side in 10 (41.6%) cases. **CONCLUSION:** The wide range of variations of the STA on its origin, course, branching patterns and relationship with adjacent structures is a common phenomenon. Thus, the deep knowledge concerning the origin and branching pattern of STA is essential in enhancing precision and decreasing morbidity related to the surgical and interventional radiological head and neck procedures.

**KEYWORDS :** Superior thyroid artery, Thyroid gland, Origin, Cadaver, Carotid artery, Bifurcation

### INTRODUCTION

The superior thyroid artery is the first branch of external carotid artery that supplies the thyroid gland, cricothyroid and infrahyoid muscles, a part of the sternocleidomastoid muscle and upper larynx. STA is found in the carotid triangle of the neck, and stems from anterior surface of the ECA, inferior to the greater horn/cornu of the hyoid bone. The artery then courses inferiorly along the lateral border of thyrohyoid muscle and reaches the apex of thyroid lobe [1]. Occasionally it may arise directly from CCA and supply infrahyoid muscles. It accompanies the external laryngeal nerve, an important landmark during surgical procedures in the neck [2]. Neck vasculature, in general, and STA, in particular, is prone to several variations. These variations assume importance in surgical procedures in the neck region, such as radical neck dissection, cricothyroidotomy, diagnostic and therapeutic catheterization, plastic surgery, to name a few [1].

However, identification of arterial variation related to the thyroid gland is of immense importance in formulating planned surgical approaches to the thyroid gland in alerting the surgeons to avert inadvertent injuries to the vital anatomical structures in this area. Additionally, a detailed knowledge of these explicit arterial variations is extremely helpful while carrying out procedures like carotid angiographies, neck dissections and thyroid resections [3]. Several autopsy studies have provided an insight into the anatomic variations of STA [1]. The implications of arterial variations of thyroid gland may be important for academic and clinical purposes. Hence the study aimed to evaluate the frequency of usual anatomical variations in the origin of the STA in human cadavers and compared them with the results obtained in earlier studies.

### MATERIALS AND METHODS

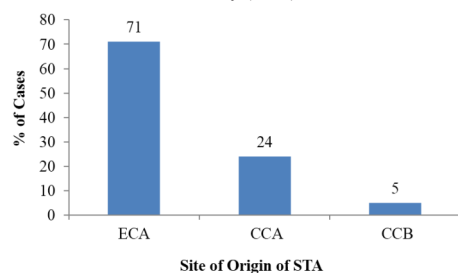
The origin of the STA was studied in hundred human carotid specimens, irrespective of sex and age. The specimens were obtained from the formalin embalmed cadavers allotted to the undergraduate students for dissection in the Department of Anatomy. The hemisectioned head and neck specimens which were allotted to students of previous year were also included. Cadavers having injury to ECA and nonallogenic tortuosities, dilatations, aneurysms or atheromatous/occlusive disease specimens were excluded.

An incision was made from the chin to the sternum in the midline and a second incision along the base of the mandible from chin to the tip of mastoid process. The skin was reflected inferolaterally. The superficial fascia containing platysma with nerves and the deep fascia were reflected. The anterior margin of sternocleidomastoid was pushed

laterally; the carotid sheath and its contents were exposed. The anterior layer of carotid sheath was incised exposing the common carotid artery and its bifurcation into internal and external carotid arteries. The levels of bifurcation of CCA, with respect to upper border of lamina of thyroid cartilage were noted. Expose the external carotid artery and its branches. The superior thyroid artery was the lowest branch in the triangle. When variations in the origin of the STA were identified, they were explored further, numbered and photographed. The results reported in earlier studies were reviewed and compared with the results of the present study.

### Observations and Results

The results showed that the STA originates from the ECA, common carotid bifurcation (CCB) and CCA, with different frequencies as depicted in figure 1. The highest incidence observed was origin of the STA from the external carotid artery (71%).

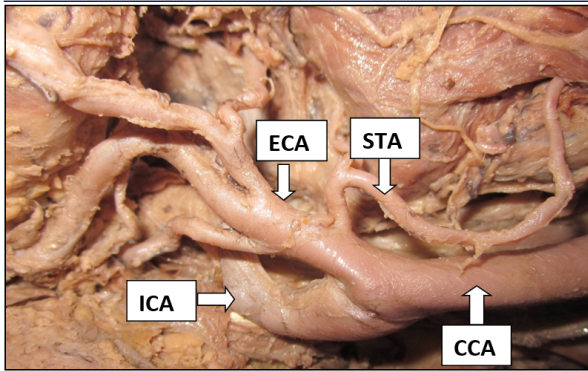


**Figure 1: Site of the origin of the superior thyroid artery**

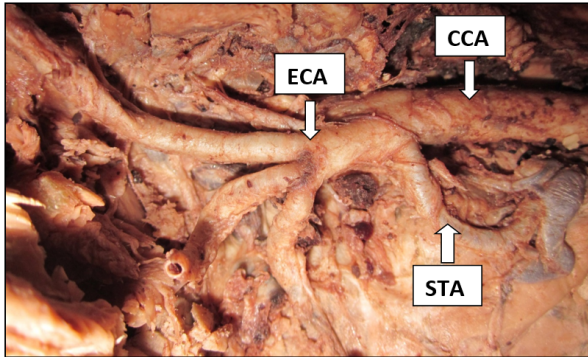
On right side the superior thyroid artery was originated from ECA in 31 (43.7%) and on left side it was 40 (56.3%). The superior thyroid artery was originated at bifurcation level in 5 (100%) cases on right side and on left side no case was observed (0%). On right side the superior thyroid artery was originated from CCA in 14 (58.3%) cases and on left side in 10 (41.6%) cases. The origin of STA from ECA was statistically significant on left side compare to right as shown in table 1.

**Table 1: Site of Origin of STA on Right and Left side among study groups**

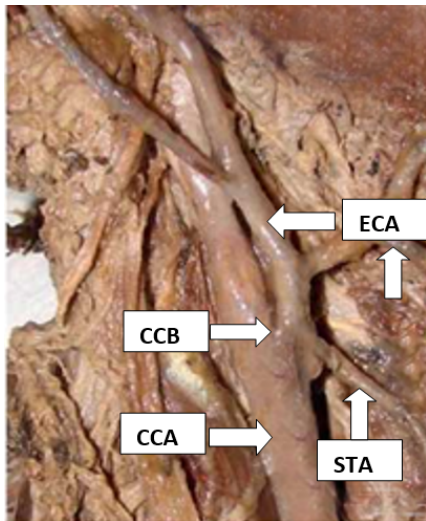
Side	Site of Origin			P value
	ECA	CCB	CCA	
Right	31 (43.7%)	5 (100%)	14 (58.3%)	0.021
Left	40 (56.3%)	0 (0.0%)	10 (41.6%)	Significant



**Figure 2: Origin of superior thyroid artery from external carotid artery**



**Figure 3: Origin of superior thyroid artery from common carotid artery**



**Figure 4: Superior thyroid artery from bifurcation point of CCA**

**DISCUSSION**

Thyroid gland has been studied extensively ever since it was discovered and is the subject of curiosity to anatomists, physiologist, pathologist, physician, surgeon and obstetrician as well. Thyroid arteries are of much importance in providing blood supply to the gland. In case of thyroidectomy ligation of all the thyroid arteries is highly essential to ensure proper homeostasis. Moreover the intimate relationship of superior laryngeal nerve with superior thyroid artery and recurrent laryngeal nerve with inferior thyroid artery should be kept in mind while ligating the thyroid vessels [4].

Moreover, considering the surgical importance of STA including its origin and branching pattern, several studies have been performed to explore this issue. Available data have been obtained from autopsy studies [5-7]. In the standard anatomical, surgical and radiological textbooks, the STA is considered to have a relatively constant origin from the anterior surface of ECA [8, 9]; but many studies have reported wide variations in the origins of the STA [10-12]. STA commonly

arises from the ECA just above the carotid bifurcation. It may also arise from the CCA or from the bifurcation of CCA. Various studies [5, 10, and 13] of the origin of the STA found that it arose from the ECA, CCB, or CCA. Less frequently the STA arises from subclavian artery (SCA) or as a common trunk with the lingual and facial branches of ECA. Rarely the superior thyroid artery may absent [14]. Studies have also reported the origin of STA from the ICA and subclavian artery (SCA) [10, 14]. In most of the previous studies, STA arises primarily from ECA, which ranges from 60-80.4% [10, 11, and 14] and incidence of origin of the STA from the CCA ranges from 5-45% cases [15]. Similarly, in present study, STA arise from ECA in 71% cases, from carotid bifurcation in 5% cases and from CCA in 24% cases. These findings are coincide with the findings of Nakamasa study in which in 70% cases STA arose from ECA and in 30% cases it arose from CCA [16]. The reported frequency of usual anatomical variations in the origin of STA in human cadavers were compared with those observed in the current study and tabulated (Table 2).

Dessie [17] conducted a study with 86 specimens and reported that the STA originated from the ECA in 44.2% of cases, from the CCA in 27.9% of cases, and from the CCB in 26.7%. Rafiah et al [18] studied 60 CCA in sagittal section of head and neck of 30 human adult cadavers and observed that the STA arose from the ECA in 80% of cases, in 18.3% of cases it originated from the CCA, and in 1.7% it arose from a thyrolingofacial trunk. Mata et al [19] studied 36 hemi-heads of adult human cadavers and observed that the STA was originated from ECA in 51.2% cases, from the CCA bifurcation in 45.3% cases, and from the CCA in 3.5% cases.

The present study found that STA originates most commonly from ECA (71%); of which, on right side it was 31(43.7%) and on left side it was 40(56.3%). This result is supported by several cadaveric studies [20] including Indian studies by Sanjeev et al [7] and Anitha et al [21]. We found CCA as the second most common site of origin of STA in 24 (24%) of cases out of which on right side it was 14(58.3%) and on left side in 10(41.6%) cases. Whereas STA originated from bifurcation of CCA in 5(5%) cases which were on right side only. These findings of site of origin of STA on right and left side are correlated with the earlier studies as shown in table 3. Rimi et al [22] observed that STA most commonly originated from ECA (male- 76.5% both right and left, female-91.3% right, 73.9% left), followed by bifurcation of common carotid artery (male-right14.7%, left 20.6%, female- left 13%, right 0%) and from common carotid artery (male -8.8% right, 2.9%left, female- 8.7% right, 13% left) at the level or above the level of upper border of thyroid cartilage. Gupta et al [1] performed twenty-five angiographic studies of 15 patients and identified the origins of the STA. In their study, the STAs on the right side of the body arose from the ECA, CCB, and CCA and, in one case, from the internal carotid artery (ICA), at proportions of 71.5%, 21.5%, 7%, and 7% respectively. On the left side 72.5% of STA arose from the ECA, 18.5% from the CCB, and 9% from the ICA.

From the above discussion, it is evident that there is possibility of a wide range of variations in the superior thyroid artery. Thus the knowledge of these variations could help to avoid serious implications during radiological examination, thyroid surgeries, tracheostomy, surgeries of larynx and microvascular surgeries.

**Table 2: Shows comparison of site of origin of STA in various studies**

Comparison with various studies	Site of origin of STA		
	ECA	CCB	CCA
Banna et al [6]	68%	22%	10%
Joshi et al [10]	66.67%	31.81%	1.51%
Shivaleela et al [13]	76.19%	21.43%	2.38%
Sreedharan et al [23]	88.33%	8.33%	3.33%
Present study	71%	5%	24%

**Table 3: Comparison of site of origin of STA on right and left side in various studies**

Comparison with various studies	Site of origin of STA					
	ECA		CCB		CCA	
	Right	Left	Right	Left	Right	Left
Gupta et al [1]	71.5%	72.5%	21.5%	18.5%	7%	9%
Joshi et al [10]	60.61%	72.73%	36.36%	27.27%	3.03%	0%
Shivaleela et al [13]	78.57%	73.80%	19.04%	23.80%	2.38%	2.38%

Sreedharan et al [23]	90%	86.6%	10%	6.66%	0%	6.66%
Present study	43.7%	56.3%	5%	0%	58.3%	41.6%

## CONCLUSION

Origin of STA is predictable which arising from ECA in more than 70% cases, likewise in present study STA arises from ECA in 71% of cases. Awareness of this could be important during invasive surgeries of neck. The wide range of variations of the STA on its origin, course, branching patterns and relationship with adjacent structures is a common phenomenon. Thus, the deep knowledge concerning the origin and branching pattern of STA is essential in enhancing precision and decreasing morbidity related to the surgical and interventional radiological head and neck procedures. Also, it is important to rule out anomalous origin of STA and verify its relationship to the external laryngeal nerve prior to ligation of the artery in thyroid surgeries, in order to prevent iatrogenic injuries.

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