ORIGINAL RESEARCH PAPER
Volume - 14 | Issue - 05 | May - 2025 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

ARTERIAL SUPPLY OF THYROID GLAND AND ITS RELATION TO THYROID CARTILAGE AND TRACHEA: A CADAVERIC STUDY OF NORTH EASTERN POPULATION.

Anatomy

Dr. Nibedita Talapatra* Post Graduate Resident, Department of Anatomy, Agartala Government Medical College, Agartala, Tripura. *Corresponding Author

Dr. Manirul Islam Associate Professor, Department of Anatomy, Agartala Government Medical College, Agartala, Tripura.

Dr. Hara Prasad Sarma Professor and Head, Department of Anatomy, Agartala Government Medical College, Agartala, Tripura.

ABSTRACT

Introduction: Thyroid is the butterfly shaped highly vascular endocrine gland. The origin, driving pattern and distribution patterns of arteries supplying the gland differ among individuals. Normal Superior thyroid artery arises from the External carotid artery, but it may also take origin from the Common carotid artery or bifurcation of Common carotid artery, as well as Inferior thyroid artery may have two sources of origin from thyrocervical trunk or Subclavian Artery. This study is aimed to investigate the origin, course, branching pattern of arteries supplying the thyroid gland in human cadavers and measure the relationship of Superior thyroid artery with thyroid cartilage and Inferior thyroid artery with trachea. **Methodology:** A cross sectional descriptive study of 50 adult embalmed cadavers from Tripura population was conducted. Each neck specimen was dissected by conventional method and data recorded by photographs, tables and charts. **Results:** STA originated from ECA (78%), Carotid Bifurcation (16%) & Common Carotid Artery (4%). 80% STA originated above the level of upper border of thyroid cartilage, followed by 16% below and 4% at the that level. Horizontal distance from STA to laryngeal prominence found 4.97 ± 0.49 cm (Right) & 4.96 ± 0.39cm (Left), and that from lower border of thyroid cartilage found 4.53 ± 0.50cm (Right) & 4.40 ± 0.53 cm (Left). ITA originated from Thyrocervical Trunk in 100% cases mostly at the level of 8th-10th Tracheal ring. Thyroid Ima was present in 2% cases. **Conclusion:** North east India has high prevalence of thyroid disorders and related surgeries are also high in number. Thorough knowledge of possible anatomical variations & position & relationship of supplying Arteries with the adjacent structures is crucial to minimize intra & post operative complications.

KEYWORDS

Thyroid Cartilage, Superior Thyroid artery, Inferior Thyroid artery, variations.

INTRODUCTION

The thyroid gland is a vital endocrine organ located in the anterior region of the lower neck, spanning from the fifth cervical vertebra (C5) to the first thoracic vertebra (T1). It consists of two lateral lobes connected by an isthmus, which crosses the midline in front of the second to fourth tracheal rings. Each lobe extends upward to the oblique line on the thyroid cartilage and downward to approximately the fourth or fifth tracheal ring. The gland is enveloped by the pre-tracheal layer of deep cervical fascia, ensuring its structural integrity and protection. The thyroid gland receives its blood supply primarily from two paired arteries: the superior thyroid artery (STA) and the inferior thyroid artery (ITA). The STA arises as the first branch of the external carotid artery (ECA), typically originating just below the greater cornu of the hyoid bone. It penetrates the thyroid fascia and bifurcates into anterior and posterior branches, with the anterior branch supplying the front surface of the gland and the posterior branch supplying its lateral and medial surfaces. Variations in STA's origin and branching patterns are clinically significant, especially for head and neck surgeons, due to its proximity to critical structures like the external branch of the superior laryngeal nerve (EBSLN). The ITA, originating from the thyrocervical trunk, approaches the base of the thyroid gland and divides into superior and inferior branches that supply its inferior and posterior surfaces. Studies indicate that ITA is generally larger than STA and can enlarge further in cases of goiter. It plays a crucial role in thyroid perfusion during fetal development and is often referenced in identifying recurrent laryngeal nerve (RLN) pathways. The thyroid Ima artery, although rare, may arise from various sources such as the brachiocephalic trunk or aortic arch, contributing to anatomical variability. Understanding these variations is essential for surgical procedures involving the thyroid gland, including radical neck dissections, cricothyroidotomies, and thyroidectomies. Thyroidectomy is one of the most prevalent surgeries performed on head and neck patients globally, with a reported mortality rate approaching 0% but complication rates under 3%. During this procedure, careful ligation of both STA and ITA is critical for achieving hemostasis while minimizing risks to surrounding nerves. The relationship between these arteries and adjacent anatomical structures often takes precedence over their origins in surgical considerations. The present study aims to explore common anatomical variations in STA and ITA origins while assessing their relationships with nearby structures such as thyroid cartilage and trachea, as well as documenting instances of TIMA in human cadavers. This research will contribute valuable insights for clinicians involved in surgical interventions related to thyroid pathology.

METHODS

Present study is a cross-sectional descriptive study of 50 adult embalmed cadavers (38 male, 12 female) from Tripura population was conducted during 2023-2024 after obtaining approval from institutional ethics committee. Age of cadavers ranged between 45 to 80 years of age. Mean age being 60 years. Each neck specimen was meticulously dissected by conventional method. STA was traced from its origin to the upper pole of the lateral lobe of the thyroid gland upwards. ITA supplying the lower pole of the gland was identified and its origin was traced backward. Course, number, branching pattern of arteries, distance of STA from Thyroid cartilage & level of tracheal ring at the origin of ITA was noted.

RESULTS

On dissection of both sides of neck of each embalmed cadaver we found in all the cadavers four vessels supplied the gland with an additional presence of Thyroid Ima artery in 2% case. Out of 50 cadavers of both genders, 100 nos of STA were observed. 39 (78%) no STA on each side was originated from external carotid artery (Figure: 1), 7 (14%) no STA on right side and 8 (16%) no STA on left side was originated from carotid bifurcation (Figure: 2), and STA origin from common carotid artery (Figure: 3) was found in 4 (8%) no cadavers on right side and 3 (6%) no cadavers on left side (Table: 1). STA had independent origin (100%) from its main artery in all cadavers, no common trunk of origin was noted. Among numerous branches of STA, we have noted the terminal branches entering the gland and found 90% case had double branch and only 12% had triple branch (Table:2). The point of origin of STA was noted in respect to upper border of thyroid cartilage. Out of 100 STA of both gender majority of the Arteries (80%) took origin above the level of upper border of thyroid cartilage followed by 16% STA originated from below the level of upper border of thyroid cartilage, and a very small no (4%) had origin at the level of the level of upper border of thyroid cartilage (Table:3). Distance of STA was measured from midline in respect to two bony prominences.

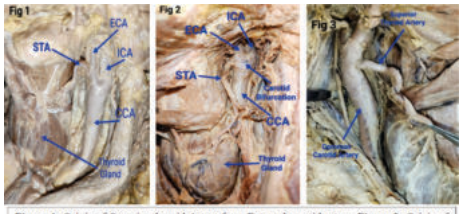

Figure 1: Origin of Superior thyroid Artery from External carotid artery. **Figure 2:** Origin of Superior thyroid Artery from Carotid bifurcation. **Figure 3:** Origin of Superior thyroid Artery from Common carotid artery.

One is at the level of laryngeal prominence of the thyroid cartilage and another at the level of lower border of thyroid cartilage. The mean distance of STA from the midline at the level of the Laryngeal prominence on right side was found 4.97±0.49 cm and on left side it was found 4.96±0.39 cm. At the level of the lower border of thyroid cartilage on right side STA was 4.53±0.50 cm distal to midline and on left side the distance was 4.40±0.53 cm (Table:4). Regarding ITA, all the cadavers had normal source of origin of ITA from thyrocervical trunk (100%). Also, course of the artery was found normal. The level of tracheal ring at point of origin of ITA is noted in this study. Out of 100 ITA under study 74% ITA was originated at the level of 9th-11th tracheal ring. 18% ITA showed origin at a higher level between 5th-8th tracheal ring. And very small no, 8% of ITA had lower level of origin at 12th-14th tracheal ring (Table:5). 94% ITA had double terminal branches and 6% had triple branches. In only 1 case (2%) thyroid Ima artery was found having origin from brachiocephalic trunk. In all cases STA and ITA was single in no on both sides of neck. No significant gender or age specific variation is noted (Figure:4, 5, 6).

Table 1: Origin of STA

Origin of STA	Right				Left				Overall (n=100)			
	M (n=38)	%	F(n=12)	%	M (n=38)	%	F (n=12)	%	Right	%	Left	%
Type I (from ECA)	28	73.6	11	91.7	29	76.3	10	83.3	39	78	39	78
Type II (from CB)	07	18.4	00	00	07	18.4	01	8.3	07	14	08	16
Type III (from CCA)	03	7.9	01	8.3	02	5.2	01	8.3	04	8	03	6
Others	00	00	00	00	00	00						

Table 2: Terminal Branching Pattern of STA and ITA

No of Terminal Branches	STA (n=100)				Total %	ITA (n=100)				Total %
	Male (n=76)	%	Female (n=24)	%		Male (n=76)	%	Female (n=24)	%	
Single	00	---	00	---	--	00	--	00	--	--
Double	66	86.8	24	100	90	74	97.3	20	83.33	94
Triple	10	13.1	00	---	10	02	2.6	04	1.6	6
Others	00	---	00	---		00	--	00	--	--

Table 3: Level of origin of STA in relation to Upper border of thyroid cartilage (UBTC)

Level of Origin	Right (n=50)				Left (n=50)				Overall (n=100)	
	M (n=38)	%	F (n=12)	%	M(n=38)	%	F (n=12)	%		
Above the level of UBTC	30	78.9	10	83.3	30	78.9	10	83.3	80	80 %
At the level of UBTC	02	5.3	00	00	02	5.3	00	00	4	4 %
Below the level of UBTC	06	15.8	02	16.7	06	15.8	02	16.7	16	16 %

Table 4: Horizontal distance of STA from Thyroid Cartilage.

Horizontal distance	Measure (average of all samples) in cm	
	Right (Mean±SD)	Left (Mean±SD)
From laryngeal prominence to STA	4.97 ± 0.49	4.96 ± 0.39
From lower border of thyroid cartilage to STA	4.53 ± 0.50	4.40 ± 0.53

Table 5: Relationship of ITA with Trachea.

Level of origin (Tracheal ring)	Right (n=50)				Left (n=50)				Overall (n=100)	%
	M (n=38)	%	F (n=12)	%	M (n=38)	%	F (n=12)	%		
5th–8th	06	15.8	03	25	06	15.8	03	25	18	18
9th–11th	29	76.3	08	66.7	29	76.3	08	66.7	74	74
12th–14th	03	7.9	01	8.3	03	7.9	01	8.3	8	8

Table 6: Comparison of Origin of STA with other studies.

Sl. No	Author	Sample size	Type	Place	STA			Other origin
					Type I	Type II	Type III	
1	Sreedharan R 2018	60	Cadaver	India	88.33%	8.33%	3.33%	
2	Shivaleela C 2016	42	Cadaver	India	76.19%	21.43%	2.38%	
3	Gupta P 2014	25	Angio graphic	India	72%	20%	12%	ICA 9%
4	Jaiswal P 2023	50	Cadaver	India	76%	16%	8%	
5	Saha A 2022	60	Cadaver	India	77.5%	11.67%	7.5%	
6	Rimi K R 2009	57	Cadaver	Bangladesh	78.94%	13.15%	7.89%	
7	Ozgur Z 2009	40	Cadaver	Turkey	25%	40%	35%	
8	Dessie MA 2018	43	Cadaver	Ethiopia	44.2%	27.9%	26.7%	LA 1.2%
9	Natsis K 2011	100	cadaver	Greek	39%	30%	31%	
10	Won SY 2016	30	Cadaver	Korea	20%	40%	40%	
11	Present study	50	Cadaver	India	78%	16%	6%	

Table 7: Comparison of level of origin of STA (%) with other studies.

Sl No	Author	Level of Origin in relation to UBTC*		
		At the Level	Below the level	Above the level
1	Rimi KR 2009	24.56%	57.02%	18.42%
2	Shivaleela C 2016	11.9 %	00	88.09%
3	Joshi A 2014	13.64%	00	86.36%
4	Sreedharan R 2018	1.66%	00	99.66%
5	Dessie MA 2018	51.2 %	44. 7 %	---
6	Jaiswal P 2023	86 %	00	14%
7	Present Study	4 %	16 %	80 %

Table 8: Comparison of Origin of ITA with other studies.

Sl. No.	Author	Sample size	Type	Place	ITA Origin		
					SA*	TCT**	Other
1	Esen K 2018	640	TC angio graphic	---	2.8% right 2% left	95% right 90.3% left	VA*** 0.6%
2	Rimi K R 2009	57	Cadaver	Bangladesh	9.80%	90.2%	--
3	Amanuel T 2019	16	Cadaver	Ethiopia	00	100%	--
4	Graves MJ 2018	36	Cadaver	Poland	10%	82.9%	CCA 4.3% VA 2.9%
5	Joshi A 2013	33	Cadaver	India	--	100%	--
6	Roshan S 2015	50	Cadaver	India	4% left	100% right 96% left	--
7	Peter S 2020	50	Cadaver	India	4% right 10% left	96% right 90% left	--
8	Bharadwaj Y	210	Angio graphic	India	3.3%	95.7%	VA 1%
9	Shama A 2018	30	Cadaver	India	---	100%	---
10	Present study	50	Cadaver	India	---	100%	---

*SA- Subclavian Artery, **TCT- Thyrocervical Trunk, ***VA- Vertebral artery.

Table 9: Comparison Tracheal level with origin of ITA.

Authors	Tracheal ring			
	4th – 5th	6th – 8th	9th – 10th	11th – 14th
Rimi K R 2009	00	27.7 %	51.4 %	20.9 %
Amanuel T 2019	--	21.87 %	68.75 %	9.37 %
Present Study	00	18 %	74 %	8 %

DISCUSSION

The variation in the blood supply of the thyroid has great importance in the diagnosis and treatment of cervical pathologies. These variations can be attributed to multiple factors, including genetic, dietary, developmental, and environmental influences, which contribute to the unrestricted nature of human diversity.[13] Won SY[2] classified origin of STA into 3 types.
Type I- STA origin from ECA.
Type II- STA origin from Carotid bifurcation.
Type III- STA origin from CCA.

Based on the classification of Won SY[2] we found Type I in 78% cases, Type II in 16% cases, and Type III in 6% cases, which is inconsistent with the finding of Won SY[2] who showed 20%, 40%, 40% incidence of Type I, Type II, and Type III origin respectively. Most of the Indian studies such as Sreedharan R et al[4], Shivaleela C et al[6], also many of foreign studies Such as Rimi KR et al[7], Amanuel T et al[19], Esen K et al[17] suggested STA origin from ECA to be the most common followed by CB and CCA origin. But studies done by Ozgur Z et al[14], Dessie MA et al[3] and Natsis K et al[15] does not agree with present study.

Gupta P et al[16] and Dessie MA et al[3] additionally mentioned about origin of STA from internal carotid and lingual artery respectively. Findings of various authors regarding origin of STA are compared in Table: 6. The upper border of thyroid cartilage is the most important landmark, as EBSLN is in close relation with STA at this level. So, its relation with STA will provide important guide for the thyroid surgeons, to prevent injury to EBSLN during manipulation of thyroid vessels. Previous studies reported origin of STA most commonly above the level of UBTC, similar trend is noted in present study. Dessie MA et al[3] did not found any STA above the level of UBTC, and majority STA at the level (51.2 %) followed by below the level (44.7%) of UBTC. Comparative studies in this regard are depicted in Table: 7. Most notable aspect of our study is the distance of STA in relation to thyroid cartilage. There is very limited literature available regarding this data. Won SY[2] noted horizontal distance from Hyoid bone to ECA measured as 4.9 +/- 0.5 mm, from laryngeal prominence to STA was 4.4 +/- 0.5 mm and from inferior border of Thyroid cartilage to STA distance was 3.1 +/- 0.6 mm.[2] In the contrary Ozgur Z et al[14] showed a higher distance of STA to laryngeal prominence as 7.3 ± 7.3cm on right and 7 ± 5.6cm on left side. Findings of these two studies are quite consistent with finding of present study (Table: 4).

From these findings we can see the STA near the inferior border of the thyroid cartilage, travels at a steep angle to the midline. This latter point may be particularly important in thyroidectomies.[14] The inferior thyroid artery is widely variable in terms of origin and size. With differences between the two sides (right and left), as well as differences related to gender, it can arise from other vessels like subclavian artery, vertebral artery or common carotid artery. In present study 100% of ITA had origin from thyrocervical trunk.

Our findings are compared with other authors in Table: 8. Rimi KR et al[7] found ITA arising most commonly from Thyrocervical Trunk, on right 87% and left 90.2%, followed by Subclavian artery, right 13% and left 9.80%. studies by Amanuel T et al[19], Joshi A et a[26] and Sharma A et al[10] shows 100% ITA origin from TCT, as like present study. Previous studies also suggest 2nd most common origin of ITA is Subclavian artery. Additionally, Esen K et al[17], Bharadwaj Y et al[25] and Graves MJ[9] noted origin of ITA from Vertebral artery and CCA. Bharadwaj N and Joshi A[18] reported bilateral absence (0.1%) of inferior thyroid artery and in one case unilateral absence of Rt. inferior thyroid artery.

We have analyzed origin point of ITA in respect to tracheal rings. Very few literatures are available regarding this relationship. In present study majority of ITA had origin at the level of 9th-10th tracheal ring (74%), which agrees with the findings of Amanuel T et al[19] (68.75%) and Rimi KR et al[7] (51.4%). Followed by ITA origin at the level of 6th-8th tracheal ring (18%) and least common at the level of 11th-12th ring (8%). Both Amanuel T et al[19] and Rimi KR et al[7] reported similar sequence of tracheal level but with higher percentage. Higher level of origin is seen in case of females (25%) in respect to males (15.8%). This relationship is important to note as the inferior thyroid artery sends multiple small tracheal branches to supply it. These branches are at risk of damage leading to hemorrhage during tracheostomy. Also, if this data is known before proceeding into surgery it may help to locate RLN precisely during surgery. Table: 9 summarizes the findings in this regard.

Procedures such as carotid endarterectomy, aneurysm repair, and endovascular procedures of the brain could impede thyroid blood supply in instances of either carotid artery (4.3%) or vertebral artery (2.9%) ITA origin.[20] Nowadays, inferior thyroid artery (ITAP) perforator flaps are also being tried as source vessel for cosmetic reconstructive procedures. [21] Variations of ITA should be borne in mind during catheterization for diagnostic or therapeutic purposes in the case of the aneurysm.[22] During a thyroidectomy, the recurrent laryngeal nerve need to be remoted to save it from being damaged while the ITA is ligated. Complication of such surgical procedure happens because of the unintended harm of this nerve. Thyroidea ima artery, though a rare anatomical variation can pose a risk for inadvertent injury and haemorrhage to a non suspecting surgeon.[12] Rimi KR et al[7] found presence of TIA in 10.52% cases, arising most commonly from Brachiocephalic trunk, followed by Arch of Aorta and right Common Carotid Artery. Chin J et al[23] and Sharma A et al[10] reported 1.06 % and 3.33% incidence of TIMA which originated from CCA. Esen K et al[17] also found similar incidence of TIMA (2.3%) as present study (2%). Sometimes, while thyroidea ima artery is present, the inferior thyroid artery is hypoplastic or absent.

CONCLUSION

The variation in the blood supply of the thyroid gland can be attributed to multiple factors, including genetic, dietary, developmental, and environmental influences, which contribute to the unrestricted nature of human diversity. [24] Procedures of the thyroid gland itself as well as seemingly unrelated structures could have detrimental impacts on thyroid vascular supply if variant anatomy is not considered.[9] North east India has high prevalence of thyroid disorders. Hence, a thorough review of a highly vascularized organ like thyroid is of immense value during surgical intervention and, thus, the knowledge of normal anatomy and its modification will guide the surgeons, and interventionists to plan the incision, prevent iatrogenic injury to vessels, preservation of laryngeal nerves and minimize life threatening complications during surgery.

REFERENCES

1. Standring S. Gray's Anatomy, 2020; 42nd Ed. The Anatomical Basis of Clinical Practice. Elsevier, Amsterdam.
2. Won, SY. Anatomical considerations of the superior thyroid artery: Its origins, variations, and position relative to the hyoid bone and thyroid cartilage, Anatomy & Cell Biology,2016; 49(2), p. 138–142. https://doi.org/10.5115/acb.2016.49.2.138
3. Dessie MA. Variations of the origin of superior thyroid artery and its relationship with the external branch of superior laryngeal nerve, PLOS One, 2018; 13(5). https://doi.org/10.1371/journal.pone.0197075.
4. Sreedharan R, Krishna L, and Shetty A. Origin of superior thyroid artery: Under the Surgeon's knife, Journal Vascular Brasileiro, 2018; 17(4), p. 290–295. https://doi.org/10.1590/1677-5449.004218.
5. Sharma N, Pandit R, Neupane B, Sah RP, Bhattarai L, Yadav PK, Right external carotid artery originated right superior thyroid artery in cadavers of a medical college in Western Nepal: A descriptive cross-sectional study. Journal of Nepal Medical Association, 2021; 59(241), p. 906–909. https://doi.org/10.31729/jnma.6419.
6. Shivaleela C, Anupama D and Subhash RLP. Study of anatomical variations in the origin of superior thyroid artery, International Journal of Anatomy and Research, 2016; 4(1), pp. 1765–1768. https://doi.org/10.16965/ijar.2015.327.
7. Rimi KR, Ara S, Hossain M, Shefyetullah K, Naushaba H, & Bose B. Postmortem study of thyroid arteries in Bangladeshi people, Bangladesh Journal of Anatomy, 2009; 7(1), pp. 26–33. https://doi.org/10.3329/bja.v7i1.3014.
8. Roshan S, Pandey N, Bhivate V, Kharate RP, Morphometric study of inferior thyroid artery in cadavers. Int J Anat Res 2015;3(4):1726-1731. DOI: 10.16965/ijar.2015.328.
9. Graves MJ, Henry BM, Sanna B, Pekala PA, Taterra D, Witczak K, Anatomical variations of the inferior thyroid artery: a cadaveric examination. przeglad Lekarski, 2018; 74(12). https://doi.org/http://www.researchgate.net/publication/322558969.
10. Sharma A, Kaur H, Chhabra U. Morphological variations in the arterial & nerve supply of thyroid gland – a cadaveric study, International Journal of Anatomy and Research, 2018; 6(1.3), pp. 5024–5029. https://doi.org/10.16965/ijar.2018.103.
11. Yohannan DG, Rajan R, Chandran AB, Krishnapillai R. An unusual origin and course of the thyroidea ima artery with absence of inferior thyroid artery bilaterally. Surg Radiol Anat. 2019; Feb;41(2):235-237. doi: 10.1007/s00276-018-2122-1 PMID:30361839.
12. Raj S, Mohiyuddin A, Merchant S, Jayaraju RM, Sasidharan B. Thyroidea Ima Artery: A Report of Two Cases. Int J Head Neck Surg 2014; 5(2):89-90.
13. Schulz A, Northridge ME. Implications for environmental health promotion: Social determinants of health. Health Educ Behav. 2004;31(4): p. 455-71.
14. Ozgur Z, Govsa F, Celik S, Ozgur T. Clinically relevant variations of the superior thyroid artery: an anatomic guide for surgical neck dissection. Surg Radiol Anat 2009;31:151-9.
15. Natsis K, Raikos A, Foundos I, Noussios G, Lazaridis N, Njau SN. Superior thyroid artery origin in Caucasian Greeks: A new classification proposal and review of the literature. Clin Anat. 2011 Sep; 24(6): p. 699-705. DOI: 10.1002/ca.21181. EPUB 2011 Mar 24. PMID: 21438023.
16. Gupta P, Bhalla AS, Thulkar S, Kumar A, Mohanti BK, Thakar A. et al. Variations in superior thyroid artery: A selective angiographic study. Indian J Radiol Imaging 2014;24: p. 66-71.
17. Esen K, Ozgur A, Balci Y, Tok S, Kara E., Variations in the origins of the thyroid arteries on CT angiography. Jpn. J. Radiol. 2018, 36, p. 96–102.
18. Bhardwaj N, Joshi A. Bilateral absence of inferior thyroid artery: A rare variation. region. Int J Med Sci Public Health 2019; 8(5): p. 401-403. DOI: 10.5455/ijmsph.2019.0305928032019.
19. Tsegay AT, Berhe T, Amdeslase F, Hayelom H. Variations on arterial supply of thyroid gland and its clinical significance in selected universities of north Ethiopia. Int J Anat Res 2019; 7(3.2): p. 6830-6834. DOI: 10.16965/ ijar.2019.237.
20. Ray B, Pugazhandhi B, D'Souza AS, Saran S, Fasil M, Srinivasa RS: Analysis of the arterial anatomical variations of thyroid gland: anatomic guide for surgical neck

dissection. Bratisl Lek Listy. 2012; 113: p. 669-672.
21. Mohammad Ali Azad, AKM Asaduzzaman, Mohammad Delwar Hossain, Mohsin FB, Safi A., Relationship between Inferior thyroid Artery and recurrent Laryngeal nerve- A Study of 200 cases. Bangladesh J Otorhinolaryngol. 2016;22(2): p.60-65.
22. Marrocco-Trischitta MM. Bilateral aneurysm of the inferior thyroid artery. Anat Rec 1943; 85:17-21.
23. Chin J, Zhou Y, Wan PJ, Lomiguen CM. The prevalence of thyroid ima artery and its clinical significance. Int J Otorhinolaryngol Head Neck Surg 2019 july;5: p. 845-9. DOI: http://dx.doi.org/10.18203/issn.2454-5929.ijohns20192704.
24. Schulz A, Northridge ME. Implications for environmental health promotion: Social determinants of health. Health Educ Behav. 2004;31(4): p. 455-71.
25. Bhardwaj Y, Singh B, Bhadoria P, Malhotra R, Tarafdar S, Bisht K. Computed tomography angiographic study of surgical anatomy of thyroid arteries: Clinical implications in neck dissection. World J Radiol 2023; 15(6): p. 182-190. DOI: https://dx.doi.org/ 10.4329/wjr.v15.i6.182.
26. Joshi A, Vaniya VH, Patel SG., Anatomical variation in the origin of inferior thyroid artery and relation with recurrent laryngeal nerve. Int J Res Med. 2014; 3(3); p. 137-141.
27. Jaiswal P, Pratihar P, Jain A, Asopa A., Variations in Origins of External, Internal Carotid Artery and Superior Thyroid Artery Branching Pattern: A Cadaveric Study. International Journal of Anatomy, Radiology and Surgery. 2023 Nov, 12(6): p.O35-O38. DOI: 10.7860/IJARS/2023/63845.2956.
28. Peter S, Sukumaran R., Inferior Thyroid Artery - Course, Branching, and Relation to the Recurrent Laryngeal Nerve - A Cadaveric Study. J Evid Based Med Healthc 2020; 7(40), p. 2290-2293. DOI: 10.18410/jebmh/2020/475.