

Clinically Relevant Variations of the Inferior Thyroid Artery: An Anatomic Guide for Neck Surgeries

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ABSTRACT:

The Inferior thyroid artery (ITA) is the chief artery which supplies the posterior and inferior parts of the thyroid gland and parathyroid glands. The knowledge of variations in the origin of ITA and its close relationship with recurrent laryngeal nerve is important for surgical procedures in the neck region such as thyroidectomy, radical neck dissection, catheterization, reconstruction of aneurysm and interventional radiology. The surgical anatomy of ITA was studied in 114 formalin preserved cadavers between the age groups of 40 to 60 years over a period of 5 years i.e., 2008 to 2012. A detailed review of literature was done to enlighten the surgical, radiological and clinical importance.

KEY WORDS: Inferior thyroid artery, subclavian artery, thyroidectomy.

INTRODUCTION

Thyroid gland is highly vascular endocrine gland. Mayo and Tschuewsky estimate it as relatively 3-4 times as great as that of brain and is six times as vascular as kidney^(1,2)

The inferior Thyroid Artery (ITA) is the main source of blood supply to the thyroid gland. The ITA usually originates from the thyrocervical trunk of subclavian artery (SCA). It loops upwards anterior to the medial border of the scalenus anterior, turns medially just below the transverse process of sixth cervical vertebra, then descends on longus colli muscle to the lower border of the thyroid gland. It passes anterior to vertebral vessels and posterior to the carotid sheath and its contents. On the left side, near its origin, the artery is crossed anteriorly by the thoracic duct as the later curves inferolaterally to its termination⁽³⁾ on reaching the lower pole of the gland, the artery divides into ascending and descending glandular branches which supply the posterior and inferior parts of the thyroid gland. The ascending branches anastomose with the superior thyroid artery and supply the parathyroid glands. Close to the lower pole of the thyroid gland, the recurrent laryngeal nerve (RLN) presents a variable relation with the ITA. Sometimes it passes

in front or behind the loop of ITA, or between the divisions of the artery⁽⁴⁾. The branches of ITA are ascending cervical, inferior laryngeal, tracheal, oesophageal and pharyngeal. The ascending cervical is the largest and acts as a guide for localization of phrenic nerve.

MATERIALS AND METHODS

Collection of specimen: 114 embalmed, formalin preserved cadavers between the age group of 40 to 60 years were collected over a period of 2008 to 2012 in the department of anatomy, Chalmeda Anandrao Institute of Medical Sciences, Bommakal, karimnagar, Andhra Pradesh, India.

Dissection method was employed for this study. The infrahyoid group of muscles were identified and reflected. The sternocleido mastoid muscle and superior belly of omohyoid were displaced laterally. After reflecting the sternohyoid and the sternothyroid muscles, the thyroid gland was exposed. The fascia was removed from the lobes of the thyroid gland exposing the arteries and veins. The length of the main trunk of ITA was measured from the origin to lower pole of thyroid gland. The external diameter of the ITA was taken at its origin with the help of vernier caliper.



Fig.1: Showing excessive ramification of superior thyroid artery supplying the entire thyroid gland on left side. Inferior thyroid artery was absent on the same side.



Fig-2: Showing absence of inferior thyroid artery on left side. It was substituted by thyroidea ima artery arising from arch of aorta.

OBSERVATIONS:

TABLE 1 : Showing the site of origin of Inferior thyroid artery in cadaveric male & Female

	Right side(n=108)				Left side(n=102)			
	Thyrocervical trunk		Subclavian artery		Thyrocervical trunk		Subclavian artery	
	Number	%	Number	%	Number	%	Number	%
Male	54	84.04	10	15.6	54	90.0	6	10.0
Female	40	90.9	4	9.1	38	90.05	4	9.5
Total	94	87.0	14	13.0	92	90.2	10	9.8

TABLE 2 : Showing the Number of Inferior thyroid arteries in cadaveric male & Female

Name of Artery	Sex	Number of Cadavers	Side	Single		Double		Absent	
				No.	%	No.	%	No.	%
Inferior Thyroid Artery	Male	68	Right	64	94.1	-	-	4	5.9
			Left	62	91.2	2	2.9	4	5.9
	Female	46	Right	44	95.7	-	-	2	4.3
			Left	38	90.5	-	-	8	9.5

TABLE 3 : Showing External diameter and length of the main trunk of Inferior thyroid Artery in cadaveric male & Female

Side	Mean diameter at origin in mm	Mean Length of main trunk in mm
Right side n=108	5.1 ± 1.5 mm	36.0 ± 7.5mm
Left side n=102	5.3 ± 1.5 mm	40.5 ± 7.1 mm

RESULTS AND DISCUSSION

The following parameters were taken into consideration during dissection and the observations were noted on the basis of

- i) Site of origin of ITA in each cadaver
- ii) The number of inferior thyroid arteries in each cadaver
- iii) External diameter and length of main trunk of ITA in each cadaver

The ITA usually originates from the thyrocervical trunk. However it may originate from the SCA or from one of the branches of SCA i.e., vertebral artery, internal thoracic artery, dorsal scapular or even costocervical trunk. Occasionally, the ITA may also originate from Common carotid artery, Brachiocephalic trunk, aortic arch or as a common stem with the contralateral inferior thyroid artery⁽⁵⁾.

Daseler et al⁽⁶⁾ state that the ITA usually arises from the thyrocervical trunk but in about 15% of individuals, it arose from SCA or its branches. The same observation was also made by Tzinas et al⁽⁷⁾. A supernumerary ITA which arose from SCA close to the origin of internal mammary artery was reported. The supernumerary artery looped around the subclavian vein and passing superficially entered the right lobe of the thyroid gland⁽⁸⁾. In our present study, out of the 54 male cadavers and 40 female cadavers on right side (n=108), 84.04% in males and 90.9% in females, the ITA arose from thyrocervical trunk and in 15.6% of males and 9.1% of females, the ITA originated from SCA. On the left side, out of 54 males and 38 females (n=102), the ITA originated from thyrocervical trunk in 90% of males and 90.05% in females where as in 10% of males and 9.5% of females it arose from SCA (Table no.1).

ITA may be double or it may be absent.

Allan et al⁽⁹⁾ reported a case of double inferior thyroid artery on the same side where as one of the artery as usual arises from the thyrocervical trunk and the other from the SCA. The accessory thyroid artery may also arise from the thyrocervical trunk[10]. In the present study it is observed that in majority of cases, the ITA was single (94.1% on right side 91.2% on left side in males) and 95.7% on right side, 90.5% on left side in females. In 2.9% of males, the ITA was double and the accessory inferior thyroid artery arose from SCA (Table no.2).

Weiglein⁽¹¹⁾ described a rare variation in the thyroid gland vascularization. The right ITA was replaced by right internal thoracic artery, a branch of vertebral artery between the transverse processes of second and third cervical vertebrae. In foetus, there exists an anastomotic arterial chain ventral to the spinal column consisting of thyrocervical trunk and ascending cervical artery which itself is connected to vertebral artery and this may explain the variation.

Faller et al⁽¹²⁾ observed that in 60% of 100 sides that they investigated and reported, the incidence of absence has been given in the literature as from 0.20% to 5.9%. When an ITA is absent, its place is usually taken by a branch from superior thyroid artery of same side or the ITA of other side or its place is taken by thyroid ima artery. In the present study, the ITA is absent in 5.9% of males on both sides and 4.3% of females on right side and 9.5% on the left side (Table no.2). In most of these cases, in our study the ipsilateral superior thyroid artery or the thyroid ima supplied the gland (figure 1 & 2).

Lang et al⁽¹³⁾ examined 73 cadavers and reported a long thyrocervical trunk (average=4.9mm) with an outside diameter between 2.8 and 9.5 mm (average=5.5mm). Which is consistent with our study. The mean \pm sd length of the main trunk of ITA on the right side was 36.0 ± 7.5 mm and on the left side was 40.5 ± 7.1 mm. It was observed that the mean length of main trunk of ITA was higher on left side compared to the right side.

CLINICAL SIGNIFICANCE

Evidence has been advanced to the effect that although the superior thyroid artery is the primitive artery to the thyroid gland, the ITA is generally the larger and the more important one from the point of view of occlusion to reduce the vascularity of goiters and a route for exposure of truncal ligation of this vessel has been worked out on the cadaver and practiced first in dissecting room and later in toxic goiter⁽¹⁴⁾.

Recent advances in the use of interventional radiology made out of arterial embolization, a possible alternative for the

treatment of Grave's disease and other conditions requiring thyroid ablation. The vascular nature of the thyroid gland dictates the use of extra measures to ensure safety of embolizations by performing selective angiography before the procedure, to be certain of catheter placement⁽¹⁵⁾.

The frequency of retropharyngeal haematoma after stellate ganglion block is reported and it was observed that the ITA is the major source of retropharyngeal haematoma because of its vulnerable and variable anatomy. As the artery has a very tortuous, serpentine course, it may be injured by the needle and ultra sound guided stellate ganglion block may improve the safety of the procedure⁽¹⁶⁾.

It is a well known fact that most of the blood supply to the four parathyroid glands i.e., about 80-86% of superior parathyroids and 90-95% of inferior parathyroids comes from ITA. Hypocalcemia or hypoparathyroidism is among the well recognized complications of thyroid surgery and its incidence is a sensitive measure of the quality of thyroid surgery⁽¹⁷⁾.

Sub-total thyroidectomy is a good therapeutic option for patients with diffuse multinodular goiter. Intraoperative, post operative bleeding and recurrent laryngeal nerve injuries can be prevented by paying attention to anatomic details and careful haemostasis during surgery⁽¹⁸⁾.

CONCLUSION

From the above literature, it is evident that there is a possibility of a wide range of variations in the ITA. Variations observed in our study adds to the long list of known abnormalities and could help to avoid serious implications during radiological examination, anaesthetic procedures like stellate ganglion block, thyroid surgeries and micro vascular surgeries⁽¹⁹⁾.

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