

Inferior Thyroid Artery - Course, Branching, and Relation to the Recurrent Laryngeal Nerve - A Cadaveric Study

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ABSTRACT

BACKGROUND

The inferior thyroid artery is an important artery arising from the thyrocervical trunk. It provides the main arterial supply to the parathyroids along with the lower half of the thyroid gland. It is also believed to be responsible for thyroid perfusion during the foetal development. The inferior thyroid artery is known for its anatomical variations. High variations in the inferior thyroid artery may result in unnecessary morbidity during the operative procedures involving those areas. So a proper knowledge of the variations and relations of the artery with the surrounding anatomical structures mainly recurrent laryngeal nerve, is a surgeon's best defence in preventing an iatrogenic injury to the artery and nerve. Injury to the recurrent laryngeal nerve paralyzes muscles of larynx thereby causing problems with phonation and respiration. We wanted to study the variations in the origin, course, and branches of the inferior thyroid artery particularly with the recurrent laryngeal nerve.

METHODS

This study was conducted in the Department of Anatomy, Kottayam Medical College by dissection of 50 embalmed cadavers following routine dissection methods. The specimens were obtained after ethical clearance. The inferior thyroid artery was carefully dissected out, its origin, course and relations with recurrent laryngeal nerve were documented and pictures taken.

RESULTS

On the right side of 46 (92 %) of the 50 specimens, the inferior thyroid artery was seen originating from thyrocervical artery and in the remaining 4 (8 %), directly from the subclavian artery. On the left side, the artery originated from thyrocervical trunk in 45 (90 %) specimens and from the main subclavian artery in 5 (10 %) specimens. On the right side, in 30 specimens (60 %), the nerve passed anterior to the artery, in 14 (28 %) the nerve passed behind the artery and in the remaining 6 (12 %) specimens, in-between the branches of the artery. The nerve passed behind the artery in 32 (64 %) specimens, in front of the artery in 16 (32 %) and in between the branches of the artery in 2 (4 %) specimens on the left side. In 49 specimens (98 %) the artery passed in front of the vertebral artery which is the normal course but in 1 specimen (2 %), the inferior thyroid artery passed behind vertebral artery this being a rare finding.

CONCLUSIONS

Inferior thyroid artery is one of the main culprits of massive bleeding during thyroidectomy. Its importance also increases due to the fact that it is the main artery supplying the parathyroids. The recurrent laryngeal nerve is frequently injured when there is an anomalous course of the inferior thyroid artery. It is a frequent site for thyrocervical trunk aneurysms too and its relation to the vertebral artery gains importance there. A good knowledge of the variations in its origin, course and branching is therefore very essential for the surgeon in preventing an iatrogenic injury.

KEYWORDS

Inferior Thyroid Artery, Subclavian Artery, Thyrocervical Trunk, Recurrent Laryngeal Nerve, Thyroid Gland, Parathyroid Glands

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BACKGROUND

The inferior thyroid artery which provides primary supply to the thyroid and parathyroid glands arises from the thyrocervical artery which in turn originates from the first part of the subclavian artery. It courses superiorly in front of the medial border of the scalenus anterior and turns medially at the level of transverse process of the sixth cervical vertebra.¹ Subsequently it turns inferiorly atop the longus colli muscle and enters the thyroid gland as three separate branches near the inferior pole.^{2,3} The inferior thyroid artery is believed to be responsible for thyroid perfusion during foetal development and has gained importance due to its use in the identification of recurrent laryngeal nerve.⁴ In its course, it lies between the vertebral artery behind and carotid sheath and its contents in front. The sympathetic trunk and the middle cervical sympathetic ganglion also lie in front of it. On reaching the thyroid base, it branches off into upper and lower thyroid branches supplying posterior and inferior surfaces of the gland.⁵ The superior branch in addition, supplies the parathyroids. The ascending cervical artery, a branch of the inferior thyroid artery supplies the cervical vertebrae and spinal cord, while the inferior laryngeal artery, another branch, supplies laryngeal muscles and mucous membrane of the larynx inferior to level of the vocal cords. Branches are also given to the infrahyoid muscles. Near the inferior pole of the thyroid gland, the recurrent laryngeal nerve shares an intimate relation with the inferior thyroid artery. It either crosses in front of the branches of the artery or passes behind them or may have some branches both in front and back of the nerve. The inferior thyroid artery thus has an extremely variable relationship with the recurrent laryngeal nerve which is clinically significant. Iatrogenic injuries to the nerves that supply the larynx represent a major complication of thyroid surgeries. While lying close to the gland, the right nerve is likely to be in front of, behind or in between the branches of the artery and the left nerve is posterior.⁶ On entering the gland, the artery usually passes behind the nerve.

METHODS

This descriptive study was conducted in 50 preserved cadavers in the Department of Anatomy, Kottayam Medical College. The specimens without any gross anomaly were included while cadavers with crush injuries or severe lacerations involving the head and neck, surgical scars over the neck region suggestive of previous surgeries like thyroidectomy and gross malformations like severe torticollis were excluded from the study. The study was carried out over a period of one year from February 2019 to February 2020. The specimens were dissected with the body in supine position and neck extended slightly. Skin is incised in the midline from the chin to sternum, and the flaps reflected laterally and below. The platysma is reflected superiorly. The sternocleidomastoid muscle is cleaned, exposed and

retracted. The deep fascia is also removed. The infrahyoid muscles are dissected out. The thyroid gland is identified. Fat and fascia are cleaned from the lobes to identify the vessels supplying the common carotid artery along with the internal jugular vein are exposed after dissecting the carotid sheath and fat surrounding it. Vagus nerve passes between them and is traced to find the origin of the recurrent laryngeal nerve. The thyrocervical trunk is traced and its origin from the subclavian artery and the branches given off from it are identified. Inferior thyroid artery is identified along the medial border of the scalenus anterior. Just below transverse process of C7, it courses medially in front of the vertebral artery to reach the middle of posterior aspect of the thyroid gland.

RESULTS

50 embalmed cadavers were dissected to find the origin, course and branching of the inferior thyroid artery along with its relation to recurrent laryngeal nerve. The results obtained were as follows.

Source of Origin	Right Side		Left Side	
	No	%	No	%
Thyrocervical Trunk	46	92	45	90
Subclavian Artery	4	8	5	10

Table 1. Source of Origin of Inferior Thyroid Artery

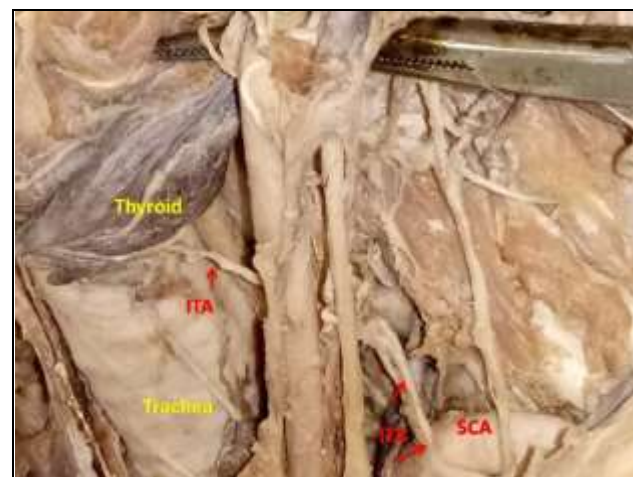


Figure 1. Inferior Thyroid Artery Arising Directly from the Main Trunk of Subclavian Artery on Left Side

Relation of recurrent laryngeal nerve with inferior thyroid artery	Right Side		Left Side	
	No	%	No	%
Recurrent laryngeal nerve passing in front of inferior thyroid artery	30	60	16	32
Recurrent laryngeal nerve passing behind inferior thyroid artery	14	28	32	64
Recurrent laryngeal nerve passing in between branches of inferior thyroid artery	6	12	2	4

Table 2. Relation between Recurrent Laryngeal Nerve and Inferior Thyroid Artery

The source of origin of the inferior thyroid artery was observed on both sides. On right side it was seen that in 46 specimens (92 %) the artery arose from the thyrocervical artery while in 4 specimens (8 %) the artery arose from the trunk of the subclavian artery. On the left side the artery was seen to arise from the thyrocervical artery in 45 specimens

(90 %) and directly from subclavian artery in 5 specimens (10 %) (Figure 1). No other source of origin could be identified.

In 30 out of 50 specimens (60 %) on the right side, nerve passed in front of artery while in 14 specimens (28 %), the nerve passed behind the artery. In 6 specimens (12 %), the nerve passed in between arterial branches. (Figure 2). However, on the left side, in 32 specimens (64 %), the nerve passed posterior to artery, in 16 specimens (32 %), it passed anterior to artery and in 2 specimens (4 %) in-between arterial branches. In 49 out of the 50 specimens, inferior thyroid artery was seen passing in front of the vertebral artery following its normal course. But one specimen showed a variation where the artery passed behind the vertebral artery (Figure 3). This was a rare finding.

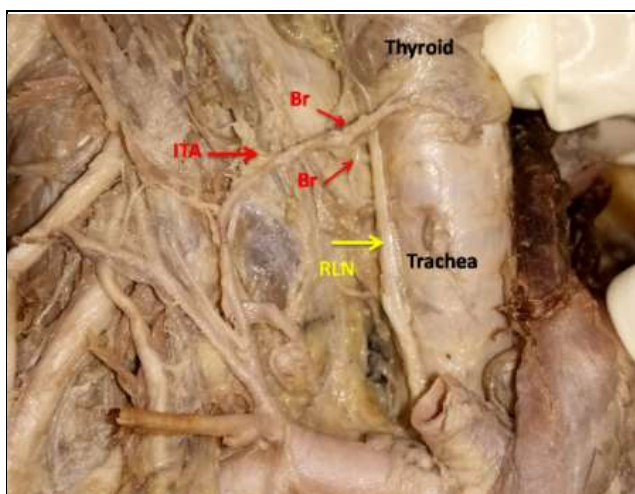


Figure 2. Recurrent Laryngeal Nerve Passing between Branches of Inferior Thyroid Artery

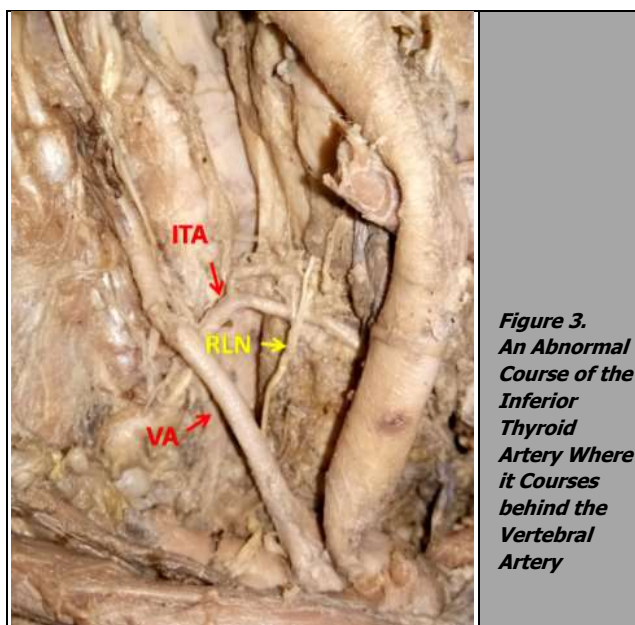


Figure 3. An Abnormal Course of the Inferior Thyroid Artery Where it Courses behind the Vertebral Artery

DISCUSSION

The inferior thyroid artery (arteria thyroidea inferior in Latin) is the biggest division of the thyrocervical trunk that provides vascular supply to many structures in the neck like thyroid

gland, the upper neck muscles, larynx, pharynx, trachea and oesophagus. It reaches the thyroid gland through its posterior surface and supplies it along with the superior and inferior parathyroid glands. The vessel is intimately and variably related to the ascending limb of the recurrent laryngeal nerve. Thyroid gland is a highly vascularised gland. Dissection, cutting and ligation of the thyroid vessels is an essential step of every thyroid surgery. Additionally, the recurrent laryngeal nerve crossing the inferior thyroid artery is often the most vulnerable location when doing a thyroid surgical procedure. Injury to the recurrent laryngeal nerve is one of the most frequent and important cause of morbidities in thyroidectomy.^{6,7} A case report by Jyothilakshmi, Manjunath and Balasubramanyam described an accessory inferior thyroid artery originating directly from the common subclavian artery and giving rise to the inferior thyroid artery along with the transverse cervical, ascending cervical, suprascapular and vertebral arteries.⁸ In the present study the most common source of origin of the inferior thyroid artery was the thyrocervical trunk (92 % on the right and 90 % on the left side) followed by subclavian artery (8 % on the right and 10 % on the left). No other source of origin could be observed.

Inferior thyroid artery is however a highly varying structure that can arise from other vessels like subclavian artery, vertebral artery or common carotid artery.⁹ Second most common point of origin is the subclavian artery (10 %). Pathologies compressing the subclavian artery can pose a risk of disrupting the thyroid vascular flow. Thoracic outlet syndrome can occur from the compression of brachial plexus with or without involving the subclavian vessels.¹⁰

Both the nerve and artery are prone to injuries during various surgical procedures. Ligament of Berry and the tracheoesophageal groove are useful in identifying the recurrent laryngeal nerve due to their consistency. Recurrent laryngeal nerve is most often found behind the inferior thyroid artery on the left and in front of the artery on the right. The nerve is also observed to ramify in the neck on an average one - third people and it is strongly recommended to identify the nerve during thyroidectomy. Ideally this occurs below or at the level of intersection with the artery. In the present study also, the nerve was found to ramify in the neck in 12 specimens (24 %). The ramification was mostly seen inferior to the level of intersection with the inferior thyroid artery. Proper identification of the nerve and artery can also reduce the risk of damaging the recurrent laryngeal nerve and parathyroid glands and improve voice, swallowing and parathyroid preservation.¹¹ Three types of relationships were commonly seen between the artery and nerve, artery passing in front of nerve, artery passing behind the nerve and nerve between the branches of the artery.¹² Patel JP et al conducted study in 50 cadavers. The right recurrent nerve passed behind the inferior thyroid artery and its branches in 76 % dissected nerves while in front of artery in 24 %. On left side, nerve passed behind the inferior thyroid artery and its branches in 90 % of dissected nerves and in front of the artery in 10 %.¹³ It was observed in the present study that on the right side, the nerve coursed in front of the artery in 60 % specimens, behind the artery in 28 % and in between branches of the artery in 12 %. On

left side nerve coursed behind the artery in 64 %, in front of artery in 32 % and in between branches of the artery in 4 %.

Henry Hollishead W stated three chief relations existing between the recurrent laryngeal nerve and the inferior thyroid artery. On right side, in 47 – 50 % cases, the nerve is between the branches, 26 – 33 % in front of the branches and 18 – 25 % behind the branches. On the left side 50 – 55 % behind the branches, 33 % between the branches and 11 – 12 % in front of the branches.¹⁴

Another interesting observation was made in relation to the vertebral artery. In 49 specimens (98 %) the inferior thyroid artery coursed in front of the vertebral artery on both sides which is its normal course. But in one specimen (2 %) the inferior thyroid artery was seen passing behind the vertebral artery on both the sides which is a rare finding. Any pathology involving the vertebral artery at this level can cause a kinking of inferior thyroid artery leading to ischaemia of the thyroid and parathyroids. Such variations become important to vascular surgeons during inferior thyroid artery catheterization done to repair an aneurysm or rupture involving thyroid region.¹⁵

CONCLUSIONS

The present study showed many variations in origin and course of inferior thyroid artery and its relation with the recurrent laryngeal nerve. The present dictum for thyroid surgeons is to clamp and cut the inferior thyroid artery away from the thyroid gland. But the inherent danger involved in this step is deprivation of vascularity of the parathyroid glands. Hence, a better method would be to ligate the branches of inferior thyroid artery very close to the thyroid gland after sparing twigs supplying the parathyroids. In this era of microscopic and endoscopic dissections, this step may not pose any significant challenge if meticulously done. The vessel was observed arising directly from subclavian artery trunk too. This can put the artery at risk for compression or occlusion during cases of severe thoracic outlet obstruction. Another rare variation was observed where the inferior thyroid artery passed behind the vertebral artery. A good knowledge of such rare variations is vital to vascular surgeons during inferior thyroid artery catheterization.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.

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