

Anatomical variations in the site of origin of the arterial supply of the thyroid gland: A narrative review

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Abstract

Background: The thyroid gland is supplied by the superior and inferior thyroid arteries and sometimes by the thyroidea ima artery. Variations in the site of origin of the arterial supply of the thyroid gland are prevalent and very regularly described.

Aim: The goal of this narrative review is to examine the currently available information regarding variances in the thyroid gland arterial supply and its origin.

Methods: In the present study, we investigated 24 publications from previous studies concerning the origin site of arterial supply to the thyroid gland in dissected cadavers, surgical entrances, and angiographic investigations.

Results: The obtained data proved commonly evident that the superior thyroid artery is primarily derived from the external carotid artery and may be a branch of the common carotid artery. In contrast, the inferior thyroid artery is a branch of the thyrocervical trunk and may be a branch of the subclavian, vertebral, and common carotid arteries, or may be absent. If the thyroidea ima artery is present, it mainly originates from the aortic arch, and it may also branch off the internal thoracic, subclavian, and common carotid arteries.

Conclusion: Understanding these variations is critical for surgeons to secure lower limit bleeding or muscular paralysis period to achieve anterior neck operations, especially for thyroidectomy.

Keywords: Origin site variations of arterial supply of thyroid gland, superior thyroid artery, inferior thyroid artery, thyroidea ima artery

Introduction

The thyroid gland produces hormones into its surrounding capillaries and then into the blood stream, which are important for body growth, development, and metabolic rate [1]. The rich arterial supply is connected via various branches of the three distinct arteries: the superior thyroid artery, inferior thyroid artery, and sometimes the thyroidea ima artery. First, the superior thyroid artery originates from the same side of the external carotid artery (ECA) and runs downward to the upper gland as numerous branches. The inferior thyroid artery originates from the same side of the thyrocervical trunk and ascends to provide arterial supply to the lower gland. If present, the thyroidea ima artery may originate as one artery from the brachiocephalic artery or arch of the aorta and ascend to the middle gland (Fig 1) [2]. Aberrant in the origin site of each arterial supply of the thyroid gland are very prevalent and have been repeatedly reported. Human embalmed cadavers, arterial angiography, and accidental detection during neck surgery are the main sources for detecting variations in the origin sites of thyroid arteries, as reported in previous studies [3-6].

An earlier understanding of the variations in the origin of the thyroid arteries is important and may help surgeons in general make the right decision before surgical intervention. Investigation of the origin sites of these arteries by a radiologist helps in planning before thyroidectomy or other neck surgical entrances to avoid complications to structures that are adjacent to these arteries, especially injuries to the recurrent and external laryngeal nerves [7-10].

Most studies conducted on variations in the origin of thyroid arteries are simple case reports and a few original articles; hence, the information is scattered. The overall purpose of this narrative review is to collect the data and provide a valuable, solid, and critical summary about the variations of

the thyroid arteries concerning their origin and clinical significance, and also to form an idea review without having to read all published works in the field such that this review data can be applied by surgeons in general and radiologists to decrease accidental complications that may lead to death in patients who undergo thyroidectomy or other anterior neck procedures.

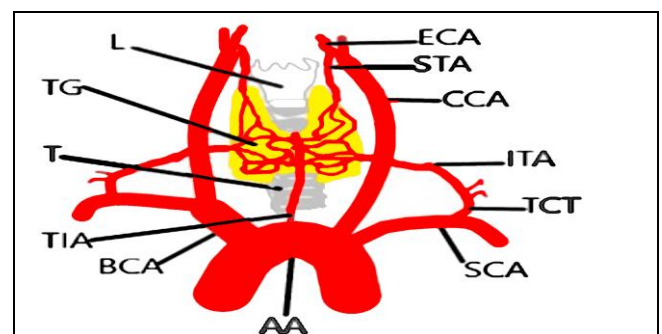


Fig 1: Original illustration by 3D painter showing normal arterial supply of thyroid gland. **ECA**= external carotid artery; **STA**= superior thyroid artery; **CCA**= common carotid artery; **ITA**= inferior thyroid artery; **TCT**= thyrocervical trunk; **SCA**= subclavian artery; **AA**= arch of aorta; **BCA**= brachiocephalic artery; **TIA**= thyroidea ima artery; **T**= trachea; **TG**= thyroid gland; **L**= larynx.

Materials and methods

This study was conducted in the Department of Anatomy, Medical College, Najran University, KSA, between February and March 2024. Narrative reviews were managed using indexed databases, including Midline and PubMed (National Library of Medicine), Google Scholar, Cochrane Library, SciELO (Scientific Electronic Library Online),

LILACS (Latin American and Caribbean Health Science Literature), Science Direct, Sematic Scholar, Embase, and Scopus, to obtain relevant articles describing the variations in the origin sites of the thyroid arteries and their associated clinical factors. The English terms used in the search strategy were "variation in the origin thyroid arteries", "abnormal pattern of the origin site of the superior and inferior thyroid arteries and thyroid ima artery", "developmental or embryological consideration in variations in the origin sites of thyroid arteries", and clinical significance and importance of arterial supply of the thyroid gland. Articles that were duplicated and those that contained other factors (pathological disease) regarding variations in thyroid arteries were excluded. Data on variations in the sites of origin of the thyroid arteries and their clinical impact were collected and analyzed.

Results

A total of 24 articles were included in this study concerning the variation in the origin site of the thyroid arteries and the

samples used, including cadaveric, patient accidental surgical case reports, and arterial angiography [11-34].

The superior thyroid artery may originate as a single branch from the external carotid artery, common carotid artery bifurcation, common carotid artery, and, in rare cases, from the internal carotid artery. The superior thyroid artery originates as a common trunk with the lingual artery (thyrolingual trunk), lingual artery, and facial artery (thyrolingofacial trunk) from the external carotid artery, common carotid bifurcation, and common carotid arteries. The variations in the site of origin of the superior thyroid artery are summarized in Fig 2 and Table 1.

The inferior thyroid artery may originate from the thyrocervical, common carotid, subclavian, vertebral, and thyrovertebral trunks. Variations in the origin sites of the inferior thyroid artery are shown in Fig 3 and Table 2.

The thyroidea ima artery is commonly absent, and if it is found, it may originate from the arch of the aorta, brachiocephalic, common carotid, and subclavian arteries. In rare cases, it originates in the internal thoracic artery (Fig 4 and Table 3).

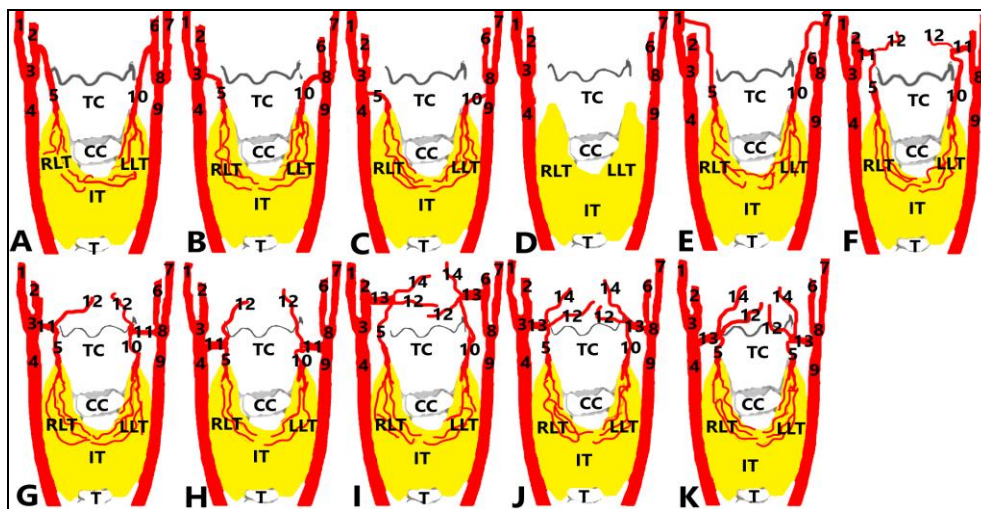


Fig 2: A-K images are the original illustration by 3D painter showing the variations of the origin sites of the superior thyroid artery: 1, right internal carotid artery; 2, right external carotid artery; 3, right common carotid artery bifurcation; 4, right common carotid artery; 5, right superior thyroid artery; 6, left external carotid artery; 7, left internal carotid artery; 8, left common carotid artery bifurcation; 9, left common carotid artery; 10, left superior thyroid artery; 11, thyrolingual trunk; 12, lingual artery; 13, thyrolingofacial artery; 14, facial artery; AA, arch of aorta; T, trachea; IT, isthmus of thyroid gland; RLT, right lobe of thyroid gland; LLT, left lobe of thyroid gland; CC, cricoid cartilage; TC, thyroid cartilage.

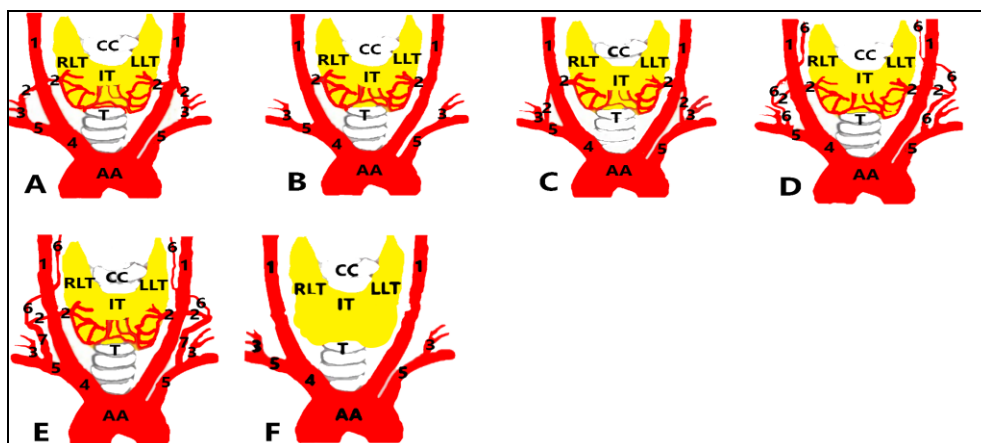


Fig 3: A-F images are the original illustration by 3D painter showing the variations in origin site of the inferior thyroid artery: 1, common carotid artery; 2, inferior thyroid artery; 3, Thyrocervical trunk; 4, brachiocephalic artery; 5, subclavian artery; 7, Thyrovertebral trunk artery; AA, arch of aorta; T, trachea; IT, isthmus of thyroid gland; RLT, right lobe of thyroid gland; LLT, left lobe of thyroid gland; CC, cricoid cartilage.

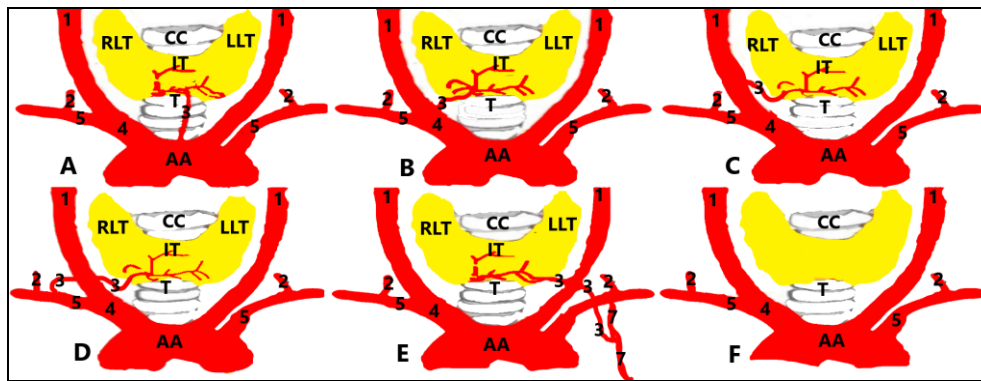


Fig 4: A-F images are the original illustration by 3D painter showing the variations in origin site of the thyroidea ima artery: 1, common carotid artery; 2, vertebral artery; 3, thyroidea ima artery; 4, brachiocephalic artery; 5, subclavian artery; 7, left internal thoracic artery; AA, arch of aorta; T, trachea; IT, isthmus of thyroid gland, RLT, right lobe of thyroid gland; LLT, left lobe of thyroid gland; CC, cricoid cartilage.

Table 1: Variations in the origin site of the superior thyroid artery

| Origin site | Reference |
|-------------------------|------------------------------|
| External carotid artery | [11, 12, 13, 14, 15, 18, 23] |
| Carotid bifurcation | [12, 13, 15, 18] |
| Common carotid artery | [12, 13, 14, 15, 18, 20] |
| Internal carotid artery | [21, 23] |
| Absent | 18 |

Table 2: Variations in the origin site of the inferior thyroid artery

| Origin site | Reference |
|-----------------------|------------------|
| Thyrocervical trunk | [12, 27, 31, 32] |
| Common carotid artery | [17, 29] |
| Subclavian artery | [12, 27, 28] |
| Vertebral artery | [12, 26] |
| Thyrovebral trunk | [30] |
| Absent | [24, 25] |

Table 3: Variations in the origin site of the thyroidea ima artery

| Origin site | Reference |
|--------------------------|------------------|
| Arch of aorta | [22, 26, 31, 33] |
| Brachiocephalic artery | [12, 16] |
| common carotid artery | [16, 19] |
| Subclavian artery | [24] |
| Internal thoracic artery | [20] |
| Absent | [34] |

Discussion

In normal anatomy, the superior thyroid artery is considered a branch of the external carotid artery. Studies examining variations in the origin site of the superior thyroid artery from the carotid arteries have shown that the superior thyroid artery can also originate from the common carotid artery or bifurcation of the common carotid artery [35]. According to a previous investigation, the inferior thyroid artery can originate from the subclavian, vertebral, or common carotid arteries [32]. However, it is typically considered to be a branch of the thyrocervical trunk. While the brachiocephalic trunk is thought to be the origin of the thyroidea ima artery, there are instances where the aortic arch serves as a direct source [31].

For radiologists and surgeons performing head and neck surgery, understanding the anatomy of the vascular supply to the thyroid gland is clinically essential to reduce the risk of these problems. When performing numerous anterior neck procedures, including those on the thyroid and parathyroid, larynx and trachea surgical entries, carotid

artery operations, and radiological inspections, extreme care must be taken [36]. The superior thyroid artery must be ligated during thyroidectomy in cases where it is accidentally served, as this may result in difficulty in control bleeding [37]. The external laryngeal nerve branch may be injured during laryngeal surgery, and if the superior laryngeal nerve is mistakenly injured while working on the superior thyroid artery, hoarseness, difficulty swallowing or breathing, or loss of voice are the expected clinical symptoms [37]. The recurrent laryngeal nerve, which is important for breathing and movement of the vocal cords, and the inferior thyroid artery have varying relationships with each other. Therefore, for the preservation of the recurrent laryngeal, it is crucial to be able to see the actual link between its origin and branching and the origin site of the inferior thyroid artery. The recurrent laryngeal nerve may run superficially, deeply, or through the space between the branches of the inferior thyroid artery. Consequently, understanding the anatomy of its site of origin requires extra care [38]. If the thyroidea ima artery is present, iatrogenic injury from procedures related to emergency care or surgery may result in both short- and long-term consequences if the artery variant origin site is not known [19].

Conclusion

Our findings revealed that anatomical differences in the origin site of the arterial supply to the thyroid gland were found accidentally during surgery. Since the surgeon can readily locate these arteries when performing common surgeries on the anterior and particularly the visceral compartment of the neck, a thorough understanding of the variations in the anatomical origin site of these arteries is necessary to prevent complications and iatrogenic injuries.

Author contribution

The author design and implementation of the research, analysis of the result, and writing of the manuscript

Conflict of interest declaration

The author declares that there is no involvement in any organization or entity with any financial interests in this manuscript.

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