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The prevalence of thyroid ima artery and its clinical significance

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ABSTRACT

Background: The thyroid ima artery (TIA) is an anatomical anomaly that commonly functions as an accessory blood supply for the isthmus and inferior aspect of the thyroid. Limited research has been performed to investigate the relative prevalence and clinical implications of the TIA in present literature.
Methods: Dissections were conducted on cadavers in the anatomy laboratory at Touro College of Osteopathic Medicine, New York (Harlem Campus), with 94 subjects examined using standard methods to identify thyroid vasculature and to determine the presence of a thyroid ima artery. Known origins of the thyroid ima artery were also examined for possible branching.
Results: Of the 94 cadavers, only one was found to have a thyroid ima artery present, suggesting a prevalence of 1.06 percent.
Conclusions: The thyroid ima artery is significant in its influence in head and neck procedures as well as emergent airway creation. With its relative rarity, its presence is worthy of consideration as a possible hematological source for hemorrhage.

Keywords: Thyroid ima artery, Thyroid, Thyroidectomy, Tracheostomy, Hemorrhage

INTRODUCTION

The thyroid ima artery (TIA) is a vascular variation that can be found ascending the anterior trachea and traversing the superior mediastinum and neck to reach the thyroid.[1,2] First defined in 1772, the TIA has been sporadically described in literature under alternative names such as the accessory thyroid artery, thyroid artery of Neubauer, and lowest thyroid artery.[2,3] Ranging from 1-15%, the prevalence of TIA in the general population has been difficult to determine due to its rarity, inconsistent nomenclature, and unpredictable presentation.[4-6]

While the TIA, if present, is identifiable on radiological studies, iatrogenic TIA damage associated with emergent or surgical procedures can have acute and long-term complications.[7,8] With its course and relation to the thyroid, the TIA is an important consideration for various medical specialties, such as emergency medicine, endocrinology, otolaryngology, and radiology.[7,9,10] The aim of this study was to examine the prevalence of the TIA and review the literature on its clinical impact and implications.

METHODS

Dissections were performed on 94 cadavers over the course of three years (August 2016-May2019) at Touro College of Osteopathic Medicine, New York (Harlem Campus) as part of the gross anatomy laboratory. Age range of the cadavers was 47 to 97 years old, with a gender distribution of 33 males and 61 females. The majority of the cadavers were of Caucasian descent (92), with the remaining two being of South Asian descent.

No associated gross pathological changes or surgical scars were present.

Standard dissection methods of exposing the mediastinum and neck were performed, with the heart and lungs removed at the cardiac base and pulmonary hilum respectively to facilitate visualization. Surrounding connective tissue was taken down in sequential planes to reveal the neurovascular connections between the mediastinum and thyroid. Special attention was paid toward preserving vascular findings around the aortic arch and identifying any anomalies. Arterial branching of the brachiocephalic trunk, left common carotid artery, and left subclavian artery were compared to known anatomical relations and traced to their end organs when course was uncertain. Upon identification of a TIA or other vascular variation, other surrounding tissue was removed from the dissection plane and stained using latex dyes.

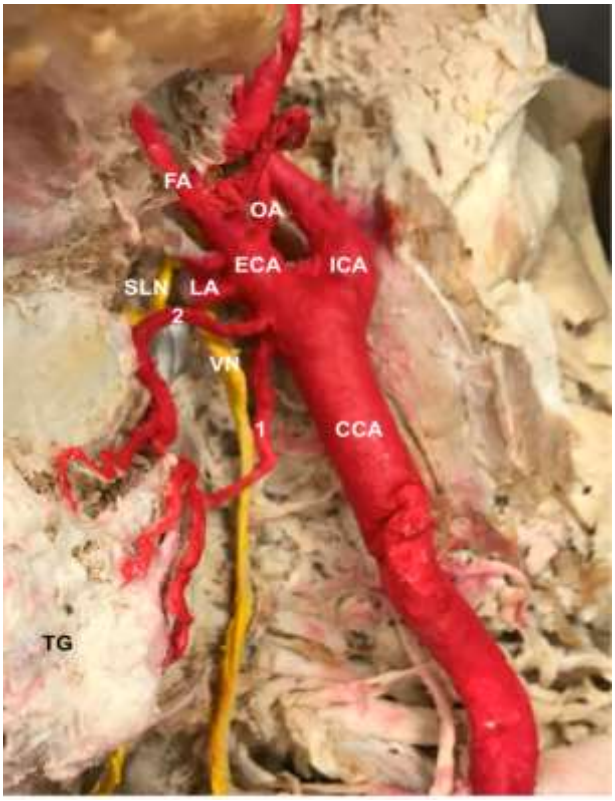

Figure 1: Left lateral view of the cadaver showing the thyroid ima artery (1) coming from the common carotid artery (CCA). Other structures seen include: external carotid artery (ECA), facial artery (FA), internal carotid artery (ICA), lingual artery (LA), occipital artery (OA), superior laryngeal nerve (SLN), superior thyroid artery (2), thyroid gland (TG), and vagus nerve (VN).

RESULTS

Of the 94 cadavers, only one was found to have a TIA present, thus a prevalence of 1.06 percent (Table 1). In the cadaver of interest, the left common carotid artery bifurcated above the upper border of the thyroid cartilage, with two branches arising 6 and 8 millimeters below the bifurcation (Figure 1). On the left lateral view, the first branch, which was identified as the TIA, entered at the apex of the thyroid and continued along the lateral aspect of the gland to supply the left inferior portion of the thyroid. The second branch, the left superior thyroid artery, also entered at the apex of the thyroid and split into three subdivisions to supply the anterior aspect of the gland. The left inferior thyroid artery was absent.

Table 1: TIA distribution in this study.

Gender	TIA absent (%)	TIA present (%)
Male (n=33)	33 (100)	0 (0)
Female (n=61)	60 (98.36)	1 (1.67)
Total	93 (98.94)	1 (1.06)

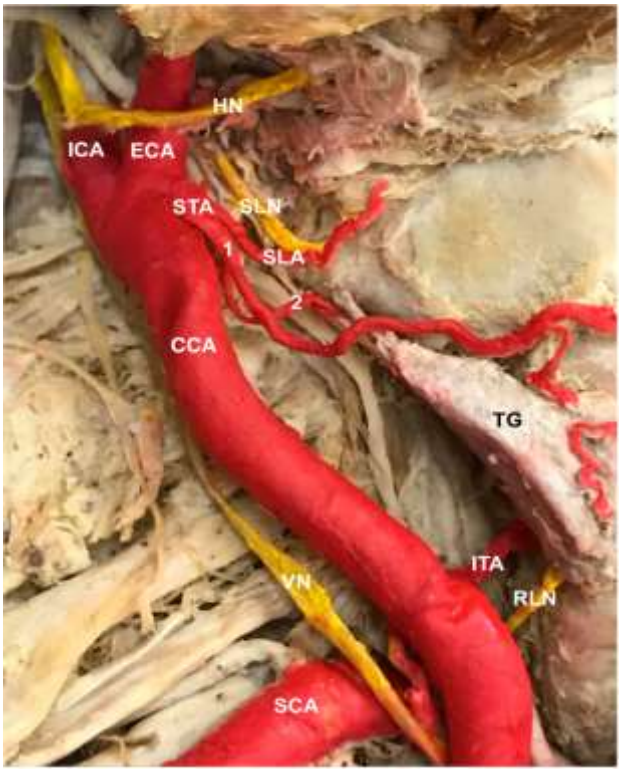

Figure 2: Right lateral view of a cadaver without a thyroid ima artery. Structures identified include the common carotid artery (CCA), external carotid artery (ECA), hypoglossal nerve (HN), inferior thyroid artery (ITA), internal carotid artery (ICA), main STA branch (1), glandular branch (2), recurrent laryngeal nerve (RLN), subclavian artery (SCA), superior laryngeal artery (SLA), superior laryngeal nerve (SLN), superior thyroid artery (STA), thyroid gland (TG), and vagus nerve (VN).

From the right lateral view, the right common carotid artery bifurcated above the superior border of the thyroid cartilage (Figure 2). The right superior thyroid artery

arose 4 millimeters below the bifurcation and subsequently branched into the superior laryngeal artery and two smaller glandular branches that coursed along the lateral aspect of the gland to supply the majority of the right. Arising from the right subclavian artery, the right inferior thyroid artery arose to supply the right inferior portion of the gland.

Figure 3: Artistic rendition of common locations from which the thyroid ima artery can originate. The most commonly reported location is from the brachiocephalic trunk (B); however, numerous cases can be found on the aortic arch (A), subclavian arteries (C), common carotid arteries (D), and external/internal carotid arteries (E). Image created by YaQun Zhou.

DISCUSSION

Commonly found and described as a direct arterial branch of the brachiocephalic trunk, the TIA can originate from other large arteries, such as the aortic arch, common carotid arteries, and subclavian arteries, or from smaller vessels, such as the pericardiophrenic artery and thyrocervical trunk (Figure 3).[11-14] With varied mediastinal origins, lengths, and termination points, the embryological origin of the TIA has been hypothesized to be related to the descent of the thyroid and variable arterial differentiation during the fetal period.[15,16] The TIA is clinically quiescent as the primary function, when present, is to act as an additional supply to the inferior thyroid and isthmus. With hypoplastic or absent inferior thyroid arteries, the TIA has also been shown to have a compensatory function in blood supply.[17,18] Reports have also identified a relation between the presence of the TIA in parathyroid adenomas and goiter.[19,20] Depending on arterial course and length, the TIA can also supply the trachea, parathyroid glands, and thymus as a single branch or as multiple branched anastomoses.[11,19,20]

The thyroid gland is typically supplied by the superior and inferior thyroid arteries which arise from the external carotid artery and thyrocervical trunk, respectively.[5] Identification and dissection of these vessels are critical in head and neck surgeries, such as hemi-/total thyroidectomies and parathyroidectomies, as these arteries are important landmarks for structures such as the recurrent laryngeal nerve.[21] Ligation of these arteries are standard procedures to decrease blood loss during surgery and to improve patient outcomes.[22] The presence of a TIA can complicate such surgeries as physicians may fail to recognize it due to its unpredictable location, morphology, and relative rarity, as well as variations in nomenclature.[4,23] With a large prevalence range of 1-15% reported in the general population, the percentage measured in this study was within this average. Advances in hemostatic surgical techniques and agents, however, have decreased the mortality and morbidity associated with operative hemorrhage and postoperative hematomas, thus mitigating such concerns.[24,25]

The TIA is considered a small arterial vessel, with an average diameter of 3 to 5 millimeters. Its origin is often a high-pressure large artery in which severe hemorrhage and blood loss can occur if prompt hemostasis is not achieved.[26] Due to its general relation to the trachea, the TIA can be damaged in emergency airway interventions such as cricoidectomies and tracheostomies.[10,27] In such situations, the emergent nature and potential complications in treatment delay may preclude radiological identification of the TIA.[10,26] In addition to frank hemorrhage, there may also be dissection of the artery in surgical settings, which can result in retraction into the superior mediastinum and creation of blood clots within the thoracic cavity that are difficult to access.[28,29] Prompt transfer for hemostasis and vascular repair has been shown to improve outcomes if the patient has been otherwise stabilized.[30]

CONCLUSION

The thyroid ima artery is a rare vascular variant that is present in 1-15% of the general population. The origin, course, and termination of the TIA is variable, which contributes to the difficulty in its identification. Emergency and surgical considerations of the TIA are critical in hemostasis and preventing hemorrhage into the mediastinal cavity. Limited research has been performed to investigate the relative prevalence and clinical implications of the TIA. Results of this study confirm reports in present literature on the prevalence of the

thyroid ima artery in 1-15% of the general population; this study provides support for the lower aspect of the given range. Greater standardization of TIA nomenclature and general research are additionally needed to highlight the significance of the TIA as it intersects numerous medical specialties.

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