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## **Thyroid ima artery (the artery of Neubauer) — how much do we know?**

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## CASE REPORT

Kacper Bąk et al., Thyroid ima artery

### **Thyroid ima artery (the artery of Neubauer) — how much do we know?**

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## **ABSTRACT**

Blood supply of the thyroid gland was the subject of numerous original studies, case reports and meta-analyses. The number of surgical procedures carried out on the thyroid gland significantly increases during last few decades. The cadaveric report discusses the case of a thyroidea ima artery (TIA) which originated from the brachiocephalic artery before its terminal subdivision, giving off numerous branches to the infrahyoid muscles, trachea and thyroid gland. Based on the current literature we discuss the prevalence of TIA, its embryology, and possible clinical aspects of this variation, with special attention paid to the postoperative complications.

**Keywords: thyroid ima artery, artery of Neubauer, thyroid ima vein, thyroid gland, anatomical variation**

## **INTRODUCTION**

The thyroid gland is one of the best perfused organs in the body. The flow of blood through it is 5 mL/g/min. The organ is mainly supplied by two paired thyroid arteries: the superior thyroid artery (STA), a branch of the external carotid, and the inferior thyroid artery (ITA), a branch of the thyrocervical trunk. Out of these two the major vessel is supposed to be the ITA. It is estimated that over 70% of blood to the thyroid gland is delivered by this artery. Most textbooks mention also the thyroid ima artery (TIA) named artery of Neubauer (after the name of professor Johann Ernst Neubauer, who firstly described it in 1772) [21].

Following the literature it is postulated that the prevalence of TIA ranges between 1.5–12.2% and its variability associates also with its different origin. It has been deeply studied in the fundamental meta-analysis by Yurasakpong et al. [18] based on 36 articles (including 4335 patients). They calculated prevalence of TIA as 3.8% and studied also variation of its origin. According to them the most frequent origin of TIA is from the brachiocephalic trunk (BCT) (74%), the right common carotid artery (9.6%), the arch of aorta (7.7%), the right internal thoracic artery (4.8%), the left common carotid, and the left internal thoracic arteries (1.9% each) [14]. Very rarely TIA may originate from the subclavian, pericardiophrenic, or vertebral arteries [4, 14]. Decreasing number of open surgery procedures replaced by using laparoscopic techniques requires new look on this artery to avoid postprocedural complication, mostly severe internal bleeding.

The thyroid gland develops between the fourth and 7<sup>th</sup> gestational week. This period is characterized by the formation of the gland from the endoderm of the stomodeum floor but also its descend and simultaneous development of the branches of the aortic arch. At that time the vessels supplying the thyroid gland also develop. Vascularization of the gland exists in the form of dense rich vascular (arterial/venous) network which in the last week of thyroid development gives rise to pairs of STA and ITA while the rest of the vessels regress. However it happens sometimes that TIA which is present throughout the developmental period does not atrophy and persists as additional artery supplying the lower part of the gland [13].

In the current case [16] we describe the presence of TIA which arose from the brachiocephalic trunk and supplied the isthmus and the right lobe of the thyroid gland, gave off several branches to the trachea and neighboring fragments of the infrahyoid muscles.

## **CASE RAPORT**

During routine anatomical dissection of 67-year-old female cadaver we observed thyroidea ima artery. It arose form the left aspect of the BCT and after short course it gave off its first branch which supplied the infero-medial surface of the right lobe of thyroid gland. Next the artery gave off large anterior branch to infrahyoid muscles (mostly sternohyoid and sternothyroid) while the main trunk coursed almost the midsagittal plane to divide finally into two terminal branches: the anterior to supply the isthmus and the posterior to supply the anterior aspect of the trachea (Fig. 1).

To improve visibility of the artery it was painted with red acrylic emulsion (McBinney and Smith, Forks Township, PA, USA).

The artery has been gently dissected and the photographic documentation was made. All possible measurements were carried out by the help of digital caliper (Lux-tools, Poland). They were repeated by two independent researchers.

TIA originated from antero-medial surface of BCT. The distance between the origin of the BCT from the aortic arch and the of the TIA was 23.29 mm. Next the artery ran upwards and obliquely under the right thyroidea ima vein. The caliber of TIA in this fragment was 2.18 mm.

After the course of around 22.43 mm TIA gave off its first branch which migrated laterally to the right. The branch ran posterior to the branches of the right thyroidea ima vein, and next arched running upwards and slightly anterior together with the aforementioned vein. After a short distance the branch entered the infero-anterior part of the right lobe of the gland and supplied it.

Next TIA ran further upwards within midsagittal plane and gave off second branch to supply the sternohyoid and the sternothyroid muscles.

After giving off the second branch the TIA changed its course and ran obliquely upwards and backwards. It divided into two subdivisions which together reached the thyroid isthmus and the anterior aspect of the traches, supplying them.

## **DISCUSSION**

The thyroid ima artery belongs to one of the easiest recognizable anatomical variations that exist in the human body. Its presence significantly increases the risk of surgical approaches in the lower neck and superior mediastinum [15]. Rate of its occurrence varies between different studies from 4–10% depending on the population. It is significantly more frequent in the fetuses [12, 18]. Its higher prevalence in fetuses — 14.8% compared to adults may be result of “unstable” relation between blood vessels formation and thyroid development [12, 13].

In our case we present the most frequent origin of TIA (from the BCT) with its detailed course and branching pattern. Its route agrees with reports of Fujimoto et al. [3]. It is similar to observations of Totlis et al. [14] both according to the course and supply. Natsis et al. [9] observed higher prevalence of TIA combined with brachiocephalico-carotid trunk or associated with right aberrant subclavian artery. These findings confirm observations made by Robinson et al. [13] who postulated higher prevalence of TIA in case of disruption between angiogenesis and formation of the thyroid gland.

The inherence of such a big and variable vessel in the root of the neck may significantly endanger performing surgical operations in this field. Lack of proper recognition before percutaneous dilational tracheostomy, thyroidectomy or partial resection of the thyroid gland may increase risk of complications i.e. mediastinal bleeding or postoperative ischemia [8, 10]. The risk is increased specially in case of primary mediastinal goiter [17, 18]. The presence of the TIA may cause may increase the risk of intraoperative hemorrhage but can be potentially reason for distant complications i.e. erosion of the wall of TIA as a result of inflammation caused by tracheostomic tube [7]. Similar risk is associated with abnormal position of the carotid arteries and the aortic arch [11], specially accompanied by dissecting aortic aneurysm [5].

Endovascular embolization of the thyroid arteries is a safe and effective procedure in diminishing the blood perfusion of the thyroid gland in Graves-Basedov disease [1]. Besides in case of emergencies surgeons should be aware of the fact that blunt thoracic trauma causing damage to the TIA may cause massive mediastinal hematoma. In such case selective embolization of the TIA may be a sufficient treatment. [17].

## **CONCLUSIONS**

Our case presents the most frequent form of quite rarely observed anatomical variation — thyroid ima artery which is a developmental remnant after formation of the vascular network of the thyroid gland and may bring significant risk during surgical approaches of lower neck/ upper chest when injured.

## **ARTICLE INFORMATION AND DECLARATIONS**

### **Ethics statement**

Not applicable for this study.

### **Author contributions**

KB and KF — dissection of the cadaver, measurements, description of the case. A. Patra, ML, J. Walocha — literature review, linguistic correction. J. Walocha, J. Wajda, A. Pasternak — content-related supervision, linguistic correction. KB, A. Pasternak, J. Walocha — writing the manuscript.

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### **Conflict of interest**

None of the authors declared conflict of interest.

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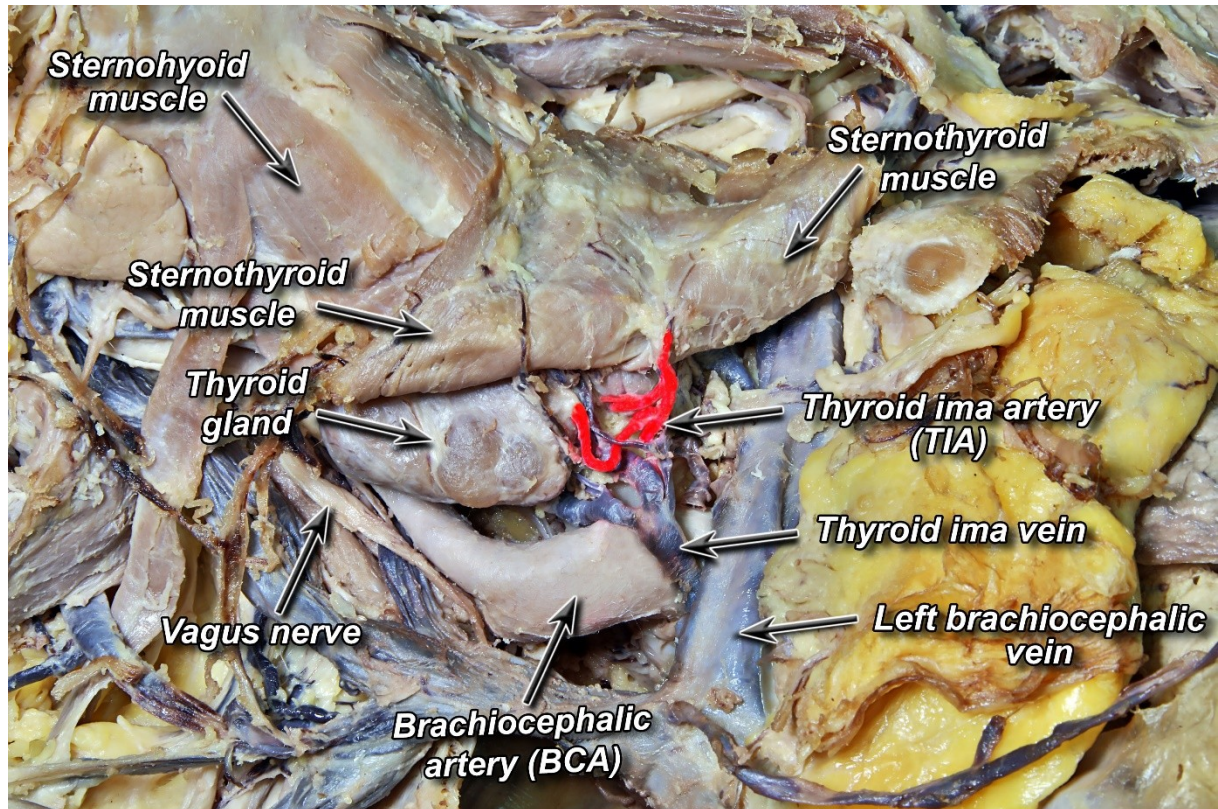


Figure 1