

Origin of thyroid arteries in a Kenyan population

Authors: Magoma G, BSc (Anat), H. Saidi BSc (Anat), MBChB, MMed (Surg), FCS (ECSA), FACS, Kaisha WO, MBChB, MMed (Surg). Department of Human Anatomy, University of Nairobi. Corresponding author: Magoma Georgina, P.O. Box 30197 00100, Nairobi

Abstract

Introduction: The thyroid gland receives blood supply predominantly from paired superior and inferior thyroid arteries. The superior thyroid artery originates from external carotid while the inferior thyroid artery is a branch of thyrocervical trunk. Unusual origins of superior thyroid artery include common carotid and cervical part of internal carotid arteries while those for the inferior thyroid artery are subclavian, common carotid or the vertebral arteries. These origins vary between populations. Knowledge of variant anatomy of these arteries is important in surgical procedures within the neck. This study describes variant origin of the thyroid arteries in a Kenyan population.

Materials and Methods: Fifty formalin fixed cadavers from the Department of Human Anatomy, University of Nairobi were available for the study. Skin incisions were made from the chin to the supra-sternal notch, along the clavicle to the acromion and then to the mastoid process. Skin flaps and platysma muscle were reflected for exposure of the anterior triangle of the neck. The sternocleidomastoid was cut close to its origins on the clavicle and reflected superiorly. The strap muscles were transected and reflected to expose the thyroid gland lying within the visceral fascia. The dissection field was cleaned by blunt and sharp dissection to expose the gland. The two thyroid arter-

ies were identified from either pole of the gland and traced to their respective origins

Data Analysis: Data was coded, tabulated and analysed using SPSS 16.0 for windows® (SPSS Inc., Chicago, Illinois) for percentages and frequencies of the observed variations in origin and nerve relations. Results were presented in tables and macrographs.

Results: Superior thyroid artery originated from external carotid and common carotid artery in 74.4% and 25.6 % of cases respectively. The right side displayed a higher frequency of origin from the common carotid artery. The inferior thyroid artery arose from thyrocervical trunk in 87.5% and from subclavian artery in 12.5% of cases. There was a higher incidence of the inferior thyroid artery originating from the subclavian on the left than the right side.

Conclusion: Over 25% of superior thyroid arteries and 11 % of inferior thyroid arteries show variant origins. The common carotid and subclavian arteries were the most frequent variant sites of origin for superior and inferior thyroid arteries respectively. Bilateral asymmetry was observed. Neck surgeons should be aware of these variations during ligation and selective embolisation of thyroid arteries to avoid complications during surgery

Introduction

The thyroid gland is a highly vascular organ receiving blood mainly from the paired superior (STA), inferior (ITA) thyroid arteries and occasionally thyroidea ima artery (1). The STA is classically described as a branch of the external carotid (EC) artery (2). On the other hand, ITA originates from the thyrocervical trunk (TC) of the subclavian (SC) artery (3).

Variant origins of STA may include the common carotid (CCA) artery either below or at the carotid bifurcation (4), thyrolingual trunk of the EC artery (5) and rarely as originating from cervical part of the internal carotid artery (6). On the other hand ITA may gain origin from the SC (7) CCA (8) and vertebral (VE) arteries (9).

These variations in origin display population differences (10). However, reports from African populations including the Kenya are scarce. This variant anatomy is important during clinical and surgical procedures performed on the neck such as selective arterial embolisa-

tion in tumors of the thyroid gland (11) invasive imaging approach for localisation of mediastinal parathyroid adenomas(10), interpretation of angiograms in the neck region (12) and carotid endarterectomy (6). The aim of the present study was therefore to describe the pattern of origin of the thyroid arteries among Kenyans.

Objective

To determine the pattern of origin of thyroid arteries and their nerve relations in a Kenyan population

Materials and Methods

Fifty formalin fixed cadavers obtained from the Department of Human Anatomy, University of Nairobi were available for the study. Dry cadaveric specimen that were difficult to dissect and those that were macerated by the students before data collection were excluded from the study. Skin incisions were made from the chin to the supra-sternal notch, along the clavicle to the acromion and from the medial end of the clavicle to the mastoid.

Skin flaps and platysma were reflected for exposure of the anterior triangle of the neck. The sternocleidomastoid were cut close to their origins on the clavicle and reflected superiorly. The strap muscles were transected and reflected to expose the thyroid gland lying within the visceral fascia. The dissection field was cleaned by blunt and sharp dissection to expose the gland. The thyroid arteries were identified and traced to their respective origins. STA was considered a branch of the CCA if it originated anywhere along its course before the bifurcation. Branches that arose from the EC directly or from a common trunk as the lingual artery were both considered as a branch from the EC. The ITA was considered a branch of the TC when it was associated with transverse cervical, suprascapular or superficial cervical arteries. Therefore an ITA separated from these canonical vessels was not considered a branch of the TC.

Macrographs of thyroid vessels that exhibited variations in origin were taken using a digital Kodak Easy Share V103® camera.

Data Analysis and Presentation

Data obtained was coded, tabulated and analysed using SPSS 16.0 for windows® (SPSS Inc., Chicago, Illinois) for percentages and frequencies of the observed variations in origin. Results are presented in tables and macrographs.

Results

Superior and inferior thyroid arteries were present in all the cases and approached the superior (STA) and inferior poles (ITA) of the thyroid gland. The STA divided into an anterior and posterior branch that anastomosed with branches of the ITA. Division of the ITA was variable but commonly it divided into a medial and lateral branch.

Pattern of Origin of Superior and Inferior Thyroid arteries

Eighty two STA (41 right and 41 left) were studied. On the right side, 30 (73.2%) arose from the external carotid while 11 (26.8%) originated from the common carotid arteries. On the left side, 31 (75.6%) were branches of external carotid while 10 (24.4%) had their origin from the common carotid artery. Cumulatively, 61 out of 82 (74.4%) superior thyroid arteries originated from external carotid artery. The remaining 21 (25.6%) were branches from the common carotid artery. (Figure 1A, B)

Seventy two inferior thyroid arteries (38 right and 34 left) were analysed in the current study. Out of 38 arteries dissected on the right side, 34 (89.5%) arose from the thyrocervical trunk while 4 (10.5%) originated from the subclavian artery. On the left side out of 34, 29 (85.3%) were branches of the thyrocervical while 5 (14.7%) had their origin from the subclavian artery. Cumulatively, of the 72 ITA, 63 (87.5%) were branches of the thyrocervical while the remaining 9 (12.5%) originated from the subclavian artery (Figure 2A, B)

Discussion

The STA and ITA were present in all the specimen studied. This is inconsistent with literature reports (Adachi 1928; Toni et. al, 2003; Toni et. al, 2005) that have shown these arteries to be absent in a few cases.

Superior thyroid artery

Superior thyroid artery is usually a branch of the EC artery (1,10). Observations of the current study, however, reveal that STA originated from EC in only 74.4% of cases. This is higher than 46.7% reported in German (13) and 58.4% in Japanese (14) studies (Table 2).

This difference is probably attributable to the sample size or methodology. For example, Adachi (14) reported from a sample size of 310 and Toni et. al, (10) used in vivo angiography while in the current study the sample size of 82 arteries and gross dissection were used. It is possible however that actual population differences in anatomical variations exist. Superior thyroid arteries originating from the CCA are liable to inadvertent injury during carotid endarterectomy and when carrying out selective arterial embolisation in the superior thyroid pedicle (11) Accordingly, in view of the high prevalence of the variant origin in the Kenyan population, due diligence should be exercised during thyroid surgery to prevent inadvertent damage to this artery.

The STA was more frequently a branch of the common carotid on the right side than on the left. This differs with what has been observed in other populations where the STA was more often a branch of CCA on the left side (table 3). Bilateral asymmetry even on the same individual should therefore be expected during surgery around the area of the superior thyroid pedicle.

Variations in origin of STA are as a result of asymmetries during development of the aortic arch and the thyroid bud (16) with the right STA likely to originate from the

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Legend

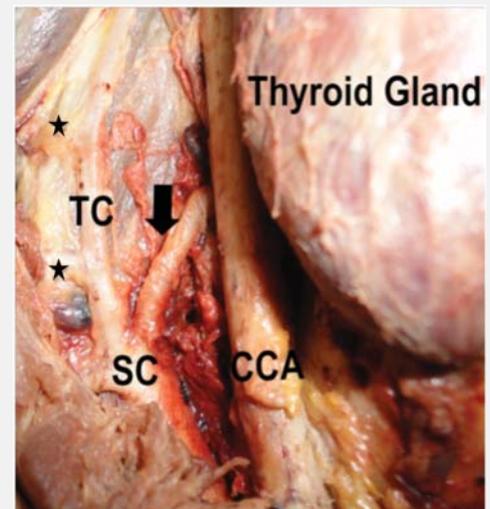
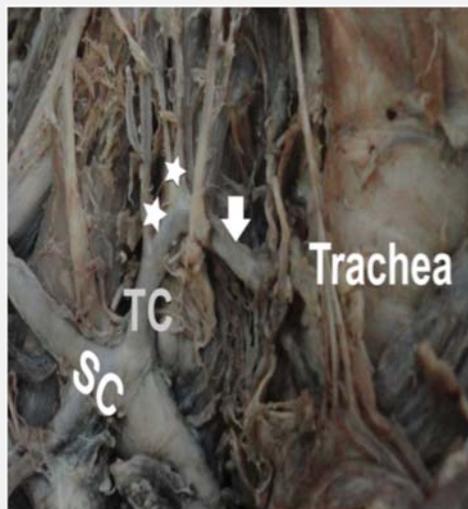
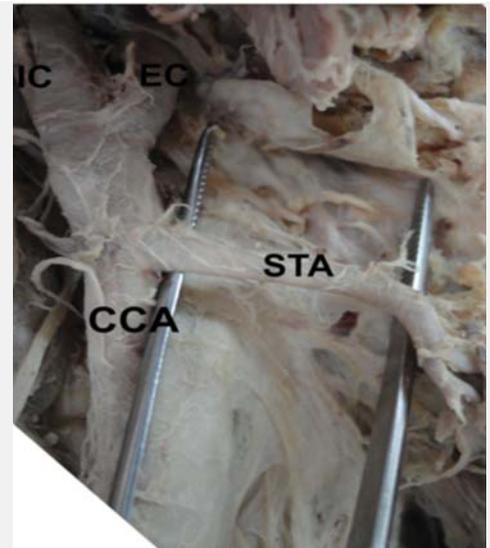
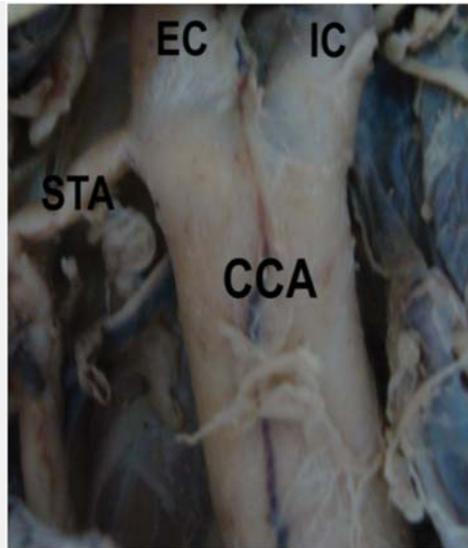
Macrographs of the lateral view of the neck showing:

1A: Origin of Superior Thyroid Artery (STA) from the left Common Carotid Artery (CCA) at the level of the bifurcation into Internal Carotid (IC) and External Carotid (EC)

1B: Origin of STA from the Right CCA below the bifurcation;

1C: Origin of Inferior Thyroid Artery (ITA) –shown by the arrow, from the right subclavian (SC), shows other branches of the TC

1D: Origin of ITA –shown by the arrow, from the right Thyrocervical trunk (TC), shows other branches of the TC



region of the future brachiocephalic trunk and the left STA from the left common carotid, a branch of the third aortic arch. In addition, different patterns of anatomic origins for STA have been found within vertebrates with the origin changing from CCA to EC moving from lower to higher species (10). The EC thus becomes the predominant source of STA among humans.

Inferior thyroid artery

The ITA is a branch of the TC (1). In the current study, however, it arose from the TC in only 87.5% of cases. This is within the range of 81.2% and 94.8% reported within literature (Table 4). Origin from the SC in this study accounted for 12.4%, a value higher than what has

been observed in other study populations except in the Polish study (17). Other population based studies have reported in isolated cases origins from VE and CCA (17, 18). These were not observed in this current study, similar a report from Toni et. al, 2003. (Table 4)

(10) reported that the ITA was more likely to originate from the SC artery in Caucasians, whereas in East Asian subjects, it arose more often from the TC. In the current study origin from the SC was higher than that reported in the Japanese. Differences in the incidence of origin from the VE and CCA could be attributed to a larger sample size increasing the likelihood of picking out these variations. These variant origins of the ITA are usu-

ally accompanied by other anomalies of the SC artery warranting care during dissection of the neck (19)

Analysis for the asymmetry in origin in the current study showed a higher incidence of the ITA originating from the SC on the left side (14.7% of the cases) as compared to the right (10.5% of the cases). This differs with studies done on other populations where this incidence was almost similar (20) – Caucasians) and higher on the right than the left side – Japanese) (Table 5).

Variation in origin of ITA may also have an embryological basis. During embryogenesis; multiple feeder arteries supply the gland. These arteries regress with time leaving the STA and the ITA. Failure to do so, however, leaves persistent vessels that supplement or replace these two vessels. This accounts for variant origin from the VE, CCA and SC (19).

Study Limitations

Specimen used in this study were cadaveric obtained from Department of Human Anatomy, University of Nairobi during routine gross dissection therefore specimen that were mutilated by students and cadavers that were macerated or dry and difficult to dissect were excluded from study.

Conclusion

Over 25% of STAs and 11 % of ITAs show variant origins. The EC for the STA and TC for the ITA are the most frequent sites of origin. Bilateral asymmetry was also observed in origin. In view of these variations, due care should be exercised by neck surgeons during ligation of thyroid arteries and arterial embolisation to avoid inadvertent complications. Pre operative thyroid artery angiography is recommended.

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Table 2 Pattern of origin of the STA in different populations

Author	Population	N	Common Carotid	External Carotid
Remmert et. al, 1998	Germans	30	53.3%	46.7%
Adachi, 1928	Japanese	310	41.6%	58.4%
Toni et. al, 2004	Italians	160	Nil	100%
Current Study 2010	Kenyans	82	25.6%	74.4%

Table 3 Asymmetry of Origin of the STA in different populations

Author	Population	Origin of STA	N	Right	Left
Adachi, 1928	Japanese	CCA	310	24.7%	58.3%
		EC		75.3%	41.7%
Daseler and Anson 1959	Polish	CCA	180	34.5%	
		EC		65.5%	54.8%
				45.2%	
Current Study, 2010	Kenyans	CCA	82	26.8%	
		EC		73.2%	24.4%
				75.6%	

Table 4 Pattern of origin of the ITA in different populations

Author	Population	N	TC	SC	VE	CCA
Daseler and Anson						
1959	Polish	775	81.2%	17.7%	0.6%	0.5%
Rohlich 1940	Polish	192	92.5%	7%	0.5%	Nil
Toni et. al, 2005	Italians	160	94.8%	5.2%	Nil	Nil
Adachi 1928	Japanese	292	94.5%	4.7%	0.7%	Nil
Current Study	Kenyans	72	87.5%	12.5%	Nil	Nil

Table 5 Asymmetry of Origin of the ITA in different populations

Author	Population	Origin of ITA	N	Right	Left
Toni et. al,(2005)	Italians	TC	160	94.9%	94.8%
		SC		5.1%	5.2%
		VE		Nil	Nil
Adachi (1928)	Japanese	TC	321	92.3%	96.9%
		SC		7%	2.3%
		VE		0.7%	0.8%
Rohlich (1940)	Polish	TC	192	92.8%	92%
		SC		7.2%	6.8%
		VE		Nil	1.1%
Current study (2010) Kenyans	Kenyans	TC	72	89.5%	85.3%
		SC		10.5%	14.7%
		VE		Nil	Nil

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