

Original article:

Origin of left vertebral artery from aortic arch and thyroidea ima artery from brachiocephalic trunk

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ABSTRACT

Vertebral artery usually arises from the first part of subclavian artery and supplies mainly brain and part of the spinal cord. Knowledge of abnormal origin of vertebral artery from aortic arch can increase blood pressure, which can lead to atherosclerosis resulting in cerebrovascular accidents. Knowledge of rarely seen thyroidea ima artery is very important for surgeons especially during thyroidectomy and tracheostomy because this abnormal artery can cause bleeding during and after the surgery as well. During routine academic dissection we have observed the origin of left vertebral artery directly from the aortic arch between left common carotid and left subclavian arteries and thyroidea ima artery was arising from brachiocephalic trunk and was supplying the thyroid gland. Knowledge of these variations is very important for general surgeons, head & neck surgeons and radiologists.

Key words: vertebral artery, thyroidea ima artery, aortic arch

INTRODUCTION

The aortic arch continues from ascending aorta and continues as descending thoracic aorta. The brachiocephalic trunk, left common carotid artery and left subclavian artery are the three usual branches arise from the convex aspect of the arch. These branches may branch from the beginning of the arch or the upper part of the ascending aorta with varying distances between them. The point of origin of brachiocephalic trunk lies to the right of midvertebral line and that of left common carotid artery and left subclavian artery to the left of midvertebral line. Primary branches may be reduced to one but more commonly two. The left common carotid artery may arise from the brachiocephalic trunk. More rarely, the left common carotid and subclavian arteries may arise from brachiocephalic

trunk, or right common carotid and right subclavian arteries can arise separately. Left vertebral artery may arise between the left common carotid and the left subclavian arteries. Very rarely both external & internal carotid arteries can arise from aortic arch separately so that common carotids may be absent on one side or both the sides. Variations in the branching pattern of the aortic arch range from differences in the distance between origins of different branches to number of branches [1, 2].

The anomalies of branches arising from the aortic arches are due to variation in the extent of the fusion process & absorption of some of the aortic arches into the aortic sac. Increase or decrease in the number of branches arising from the arch depends on such process [3]. Even though these kinds of variations are most often asymptomatic,

they are very important to consider during surgeries, instrumentation procedures, and knowledge of these variations are very important for the vascular surgeons, general surgeons, head and neck surgeons & radiologists.

MATERIALS AND METHODS

During routine academic dissection for the 1st year undergraduate students of 2013-14 batch, of the thoracic region, in the dissection hall, department of Anatomy of our college, we have found the unusual origin of left vertebral artery from the arch of aorta and thyroidea ima artery arising from the brachiocephalic trunk in one cadaver. As we dissect 10 cadavers per academic year, branches of arch aorta were examined in other 9 cadavers also, which were appeared normal.

OBSERVATIONS

The thyroidea ima artery was arising from the Brachiocephalic trunk 1 cm below the bifurcation and 5 cm above the origin of brachiocephalic trunk. The variant artery was running upwards obliquely from the right side of the midline towards the thyroid gland, and it divided into two branches. One branch was supplying the base of left lobe and other was supplying the isthmus and base of right lobe of the thyroid gland. The usual inferior thyroid arteries were arising normally from their respective Thyro-cervical trunks on either side.

The vertebral artery on left side was arising from the arch of aorta between the origin of left common carotid artery and left subclavian artery. The artery was normal in its course to reach intracranium. The right side vertebral artery was normal in its origin and course. Rest of the branches of arch of aorta were Brachiocephalic trunk, left common carotid artery and left subclavian arteries arising normally.

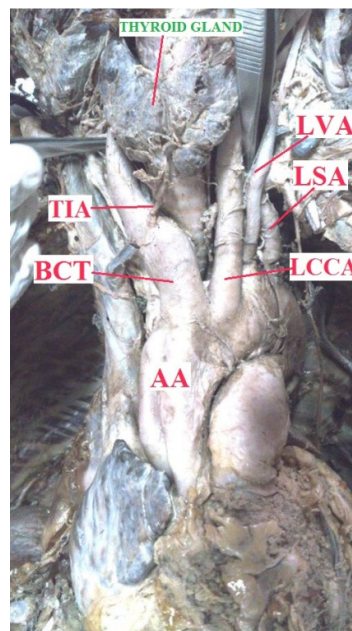


Figure 1: Showing the Left Vertebral Artery (LVA) arising from the Arch of Aorta (AA). The Thyroidea Ima Artery (TIA) is arising from the Brachiocephalic Trunk (BCT). Left Subclavian artery (LSA) & Left Common Carotid Artery (LCCA) are arising from the Arch Of Aorta as usual.

DISCUSSION

The vertebral arteries usually arise from the posterosuperior aspect of first part of the subclavian artery [1, 4]. Left vertebral artery may arise between the left common carotid and the left subclavian arteries [1]. Adachi et al have classified the branching pattern of aortic arch into three patterns in which the origin of left vertebral artery from arch of aorta proximal to the left subclavian artery named as pattern C in which four arteries arises from the arch of aorta & and occurred in 9% of specimens[5]. Similarly Rekha P et al, & Sanjeev Kumar et al have classified the variation as type I in their study, occurred in 4.5% and 10% of specimens respectively[6, 7]. Paraskevas G et al & Sumit Tulshidas Patil have classified this kind of variation as type III and occurred in 4.5% & 8% of

specimens respectively[8, 9]. There is no uniform classification followed.

Table 1: Incidence of the four aortic arch branches found in other studies is as follows

Study	Percentage of incidence
Matula et al [4]	3.0
Nelson and Sparks et al[10]	4.1
Adachi [5]	5.43
Anson [11]	2.5
Bergmen [12]	5%
Nayak [3]	1.6
Susan standing [1]	2.5

Williams and Edmonds reported finding variations in arch vessels after dissecting 407 human cadavers: 191 American whites and 216 blacks. According to their report, the similar variation they found in 2.6% of whites & 2.0% in blacks[13].

EMBRYOLOGICAL BASIS

The vertebral artery takes a vertical posterior course to enter into the foramen transversarium of sixth cervical vertebra. The segment of the artery from its origin at subclavian artery to its respective transverse foramen is called the first part, pretransverse or prevertebral segment[4].The first part of left vertebral artery develops from proximal part of dorsal branch of seventh cervical segmental artery proximal to post costalanastomosis. The second part is derived from longitudinal communications of the post costal anastomosis. If the left sixth dorsal intersegmental artery persists as first part of the vertebral artery [14]or if there is increased absorption of embryonic tissue of left subclavian artery between origins from the aortic arch to the origin of vertebral artery resulting in direct origin of the left vertebral artery from aortic arch[10].

The prevertebral segment of LVA of aortic origin is frequently affected by atherosclerosis

[15].Abnormal origin of vertebral artery may also favour cerebral disorder because of alterations in cerebral hemodynamic [16].Sumit Tulshidas Patil et al,have studied the death history and death certificates of the cadavers used in their study and have found the relation of branching pattern of aortic arch with cerebro-vascular disease. They have found more incidence of cerebrovascular disease in variant branching pattern (23%) compared to normal branching pattern (12%). Direct origin of left vertebral artery from arch of aorta increases blood flow in left vertebral artery. This direct (straight line) flow of blood from aorta to brain or imbalance of flow of blood on left and right side at circle of Willis may be the cause of increased incidence of cerebro-vascular diseases in cadavers with variant branching pattern [9].

Knowledge of variable branches arising from the aortic arch is of great importance in patients who have to undergo four vessel angiography, aortic instrumentation, or supra aortic thoracic, head and neck surgery.

The thyroid gland sometimes supplied by an arteria thyroidea ima artery which arises from the brachiocephalic trunk or arch of aorta. The thyroidea ima artery is a small and inconstant artery; it ascends on the trachea to the thyroid isthmus, where it terminates[1].It may also supply the neck viscera and thymus[17, 18]. It arises from the aortic arch, brachiocephalic trunk, common carotid, subclavian, internal thoracic, pericardiacophrenic, thyrocervical trunk, inferior thyroid, or transverse scapular artery. It usually but not always arises from the right side[1, 18, 19]. In our case the thyroidea ima artery has originated from the brachiocephalic trunk.

Table 2: Incidence of thyroidea ima artery was arising from the brachiocephalic trunk in other studies.

Study	Percentage of incidence
Bergmenet al [12]	4-10%
Adachi et al [5]	0.4% (1/271)
Ziolkowski M et al [20]	1.5% - 12.2%
Chummy S. Sinnatamby et al[17]	3%
Keith L. Moore et al [18]	10%
Courtney M. Townsend et al[21]	5%

EMBRYOLOGICAL BASIS

The embryological basis of the development of a thyroidea ima still remains largely unknown. A recent report by VasovicLet al. Claims that the thyroidea ima artery probably represents an example of the arterial self-differentiation and induced differentiation of the arteries of the aortic

arch [22]. However, we agree with the theory proposed by Robinson et al that, the thyroidea ima artery is the principal embryonic blood source to the third and fourth pharyngeal pouches. As a result, anomalous or late morphogenesis of the third and fourth pharyngeal pouches may favour the persistence of a thyroidea ima artery to adulthood [23].

The knowledge of the course of the thyroid ima artery is important mainly for surgeons, for the proper performance of surgeries in the neck like thyroidectomy and tracheostomy mainly. Atypical branching of vessels can cause intra-operative bleeding and/or postoperative hematoma by damaging of the thyroid ima artery or missing the ligation of the thyroid ima artery may lead to bleeding after operations. We being anatomists are very happy to add the information of our finding for the existing subject in various textbooks so that it will be helpful the surgeons and interventional radiologists.

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