

*Case Report*

# An Unusual Origin of Brachiocephalic and Left Common Carotid Arteries as a Common Trunk from the Arch of Aorta: A Case Report

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## ABSTRACT

The variations in branching pattern of arch of aorta are likely to occur as a result of the altered development of certain branchial arch arteries during the embryonic period. The incidence of origin of left common carotid artery and brachiocephalic artery from a single trunk is estimated as 7.2-21%. This kind of variations in branching pattern may present with non-specific symptoms such as dyspnoea, dysphagia, intermittent claudication. This case highlights about Brachiocephalic and left common carotid artery arose from a common trunk on the arch of the aorta in a male cadaver. The knowledge of such variations is important for interventional radiologist and surgeons to perform safe and effective thoracic surgeries.

**Keywords:** Arch of aorta, Brachiocephalic, Left common carotid artery, Common trunk.

## INTRODUCTION

Aorta is the largest artery in the body, which distributes blood to the entire body through its branches. It begins from the left ventricle of heart at the aortic orifice with an approximate diameter of 3cm. For convenience of description, it is divided into ascending aorta, the arch of aorta and the descending aorta. The arch of aorta is a continuation of ascending aorta, begins at the level of upper border of second right sternocostal joint. It has three classical branches arise from the convex aspect of arch and supply blood to the head, neck and to the upper limbs. The variations in the aortic arch branching pattern are well known as they may arise from the beginning of the arch or the upper part of ascending aorta. The distance between these origins varies, the most frequent being approximation of the left common carotid

artery to the brachiocephalic trunk. Primary branches from the aortic arch may be reduced to one but more commonly two. [1,2] The variations in these branches are likely to occur as a result of the altered development of certain branchial arch arteries during the embryonic period. [3] The origin of left common carotid artery and brachiocephalic artery from a single trunk having a prevalence of 7.2-21%. [4]

This anomaly assumes some importance in the adult as well as in children, as a cause of variation in position of artery and improper blood flow to brain. Sometimes may be associated with a higher incidence of cerebrovascular disorders. [5]

## CASE REPORT

The present report describes variation in branching pattern of the aortic arch identified in a 70-year-old male

cadaver during routine dissection of undergraduate students in the Department of Anatomy, Sri Dharmasthala Manjunatheshwara College of Ayurveda and Hospital, Hassan. The Cadaver belongs to South India, Karnataka region procured through voluntary body donation programme. During routine dissection of thoracic cavity, in particular the pericardium and the heart it was noted that there was an unusual origin of brachiocephalic and left common carotid artery as a single trunk from the arch of aorta on right side of midline. The diameter of common trunk was

about 2.2 cm and length was 1.7 cm. The left subclavian artery was seen as a separate branch arising slightly left to this trunk and had normal course. The position of ascending aorta, arch of aorta and descending aorta were normal and no other variants noted.

The following photographs show two branch pattern of aortic arch (AA). Common trunk (CT) is arising from the AA & dividing into brachiocephalic trunk (BCT) and left common carotid artery (LCCA). Left subclavian artery (LSA) is arising next to CT.



Figure: a) Anterior view b) Posterior view c) Common trunk

## DISCUSSION

Aorta is the largest artery in the body, which arises from the left ventricle of heart at the aortic orifice with an approximate diameter of 3cm. It is the major artery which receives oxygenated blood from left ventricle and distributes blood to the entire body through its branches. For convenience of description, it divided into ascending aorta, arch of aorta and the descending aorta. The arch of aorta is the continuation of ascending aorta at the level of upper border of 2nd right sternocostal joint, lies in superior mediastinum. It arches superiorly, posteriorly and to the left and then inferiorly makes curved arch. This arch ascends anterior to the right pulmonary artery and bifurcation of trachea, reaching its apex at the left side of the trachea and oesophagus. The arch descends posterior to

left lung root beside the T4 vertebra. It ends by becoming thoracic aorta posterior to 2nd left sternocostal joint. The usual branches from the arch of aorta are the brachiocephalic trunk, left common carotid artery and left subclavian artery.

The brachiocephalic trunk is the first and largest branch of the arch of the aorta, arises posterior to manubrium, where it anterior to trachea and posterior to brachiocephalic vein. This trunk ascends superolaterally to reach the right side of the trachea and the right sternoclavicular joint, then divides into right common carotid and right subclavian arteries. The left common carotid artery arises from the arch, slightly to the left of the brachiocephalic artery, and as it ascends it is nearer to the posterior surface of manubrium sterni and passes posterolateral to the left margin of trachea.

Then it enters into neck by passing deep to the left sternoclavicular joint at the level of T2 vertebra, at the level of C4 vertebrae it bifurcates into left internal carotid and left external carotid arteries. The left subclavian artery arises from the aortic arch behind the left common carotid artery. It runs upwards along the left side of the trachea and the oesophagus, then enters the root of the neck at the level of left sternoclavicular joint and continues further as axillary artery at the level of outer border of 1st rib. [6,7]

### Developmental anatomy of arch of aorta and its branches

The variations in the aortic arch branching pattern are result from the deletion of chromosome 22q11 during development of certain pharyngeal arch arteries in embryological growth. [8] The Pharyngeal arches are formed by a series of mesodermal thickening in the wall of the cranial most part of the foregut during 4th to 6th weeks of development; each arch receives its own artery. These arteries, aortic arches are arising from the most distal part of the truncus arteriosus of aortic sac. The six pairs of aortic arches are a series of vessels that connect on each side of the aortic sac with the corresponding dorsal aorta. At a later developmental stage, the aortic arches are both reduced in number and extensively transformed, and finally an asymmetric blood distributing system is formed. The first and second aortic arches largely disappear by the time third to sixth arches develop. The left limb of the aortic sac normally forms the part of the arch of aorta that intervenes between the origin of the brachiocephalic trunk and the left common carotid artery. Brachiocephalic artery is derived from the right horn of the aortic sac and left Subclavian artery is from left 7th cervical intersegmental artery. [9] The branching pattern observed in this case results from slower growth of the ventral aortic roots between arches III-IV, allowing fusion between the brachiocephalic and left common carotid branches. [10]

The variations in the aortic arch branching pattern were well known as they may arise from the beginning of the arch or the upper part of ascending aorta. [11] The reported variations in the aortic arch branching pattern includes left common carotid artery originating from the brachiocephalic trunk; right common carotid artery and right subclavian artery originating individually from the aortic arch. Additionally, left common carotid artery and left subclavian artery may have a common origin in the form of the left brachiocephalic trunk from the aortic arch. [12] The classical branching pattern of arch of aorta was reported from studies as to occur in 74%-89.4% cases in radiological investigations and 63.5% to 77.3% in cadaveric studies. The prevalence of present case (the left common carotid artery arising from BCT) is estimated from previous studies ranges between 7.2% to 21.1%. [13] The incidence of present case branching pattern was reported in various studies are summarized table no 1. Edwards J E [14] and Kieffer E reported 10% of incidence in both autopsy studies and large surgical series of innominate artery disease study. [15] Anson and MC Vay reported 27% in 1000 cadaveric specimens, [16] Soubhagya R et.al found 4.8% in 62 cadavers, [17] Ogeng'o J A et.al reported 25.7% in 113 cadavers, [18] Rekha and Senthikumar S reported 2.72% in 110 cadavers, [19] Junagade B and Mukherjee A reported 8.58% in 35 cadavers [20] and Zhang Y et.al was found 13.2% of incidence among 38 specimens. [21]

Table :01. The incidence of left common carotid artery arising from BCT in various studies.

S.No.	Author	Percentage
1	Edwards JE & Kieffer E	10%
2	Anson & MC Vay	27%
3	Soubhagya R et.al	4.8%
4	Ogeng'o J A et.al	25.7%
5	Rekha&Senthikumar S	2.72%
6	Junagade B & Mukherjee A	8.58%
7	Zhang Y et.al	13.2%

These reports suggest that the left common carotid artery arising from Brachiocephalic trunk is common variation and may be frequent in large populations.

## CLASSIFICATION OF AORTIC ARCH BRANCHES

As per the survey study conducted by G. Vucurevic et al. in a group of 1265 patients, has reported about the classification of branching pattern based on their incidence. They found about 74.72% of patients have normal vascular pattern (type I) and remaining 25.28% are with variations in the branching pattern of the aortic arch and classified into type II to VIII and a few subtypes. The Type II (2.84%) pattern comprised a common origin of the left common carotid and subclavian arteries. Type III (15.56%) was related to an origin

of the left subclavian artery from the brachiocephalic trunk. Type IV (0.55%) included the aortic origin of both common carotid and subclavian arteries, with the right subclavian artery having a retro-oesophageal course. Type V (0.24%) included the same 4 supra-aortic branches, which, however, arose from a double or a right-sided aortic arch. Type VI (3.63%) comprised the aortic origin of the left vertebral artery, type VII (0.24%) the same origin of the right vertebral artery, and type VIII (2.22%) the aortic origin of the thyroidea ima artery. This classification summarized in table no.02. [22]

**Table No:2. Classification of arch of aorta branching pattern with the incidence.**

Type	Branching pattern of arch of aorta	Percentage (%)
I.	Normal branching pattern of the aortic arch	74.72
II.	A common origin of the left common carotid and subclavian arteries	2.84
III.	A common origin of BCT and LCCA	
	a)LCCA & BCT shared same site origin	6.79
	b)LCCA originate from typical BCT	6.64
	c)LCCA arose from a shorter BCT	2.13
IV.	Aortic origin of both carotid arteries (the RCCA and LCCA) and the subclavian arteries (RSCA and LSCA).	0.55
V.	4-vessel pattern (RCCA, LCCA, RSCA and LSCA)	0.08
	a) Double aortic arch- RCCA and RSCA arose on the right side, and the LCCA and LSCA on the left side.	
	b) Right-sided arch-LSCA and RSCA as the most distal aortic branches	0.08
	c) Right arch - LSCA and RSCA were the most proximal branches	0.08
	c) LVA as the most distal branch	0.08
VI.	a) a typical vessel arrangement (the BCT, LCCA, LSCA) with the LVA origin between the LCCA and LSCA	2.92
	b) 5-vessel pattern: the RSCA, RCCA, LCCA, LVA, and LSCA.	0.63
	c)LVA as the most distal branch	0.08
VII.	Aortic origin of the right vertebral artery (RVA)	0.24
VIII.	Aortic origin of the thyroidea ima artery (ThIA).	2.22

The present reporting case belongs to type III and subtype b, which has LCCA originate from typical BCT from a single trunk. This kind of variation in branching pattern of the aortic arch may cause dyspnea, dysphagia, intermittent claudication and may be misinterpreted in radiological examinations. Sometimes complications may develop during neck and thoracic surgeries. [23]

## CONCLUSION

The present observational study highlights about types and incidence of Brachiocephalic and left common carotid artery arising from a single trunk of aortic arch. The rare variations in the anatomical

branching pattern of arch of aorta and its branches are very important for angiography, aortic instrumentation and in thoracic surgeries. This type of cadaveric case reports gives better three dimensional understanding of these vessels. The knowledge of such variations is useful to the cardiologists, cardiothoracic surgeons and radiologists in various diagnostic and therapeutic procedures.

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