

## STUDY ON BRANCHING PATTERN OF ARCH OF AORTA IN SOUTH INDIAN POPULATION

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### ABSTRACT

**Background and aim:** Arch of aorta is the continuation of ascending aorta lies in the superior mediastinum. The present study aims at finding the branching pattern of arch of aorta and correlate it with the embryological and clinical significance.

**Materials and Methods:** 30 formalin-fixed cadavers procured from the department of anatomy, Karpaga Vinayaga Institute of Medical Sciences, Madhuranthagam were dissected to study the branching pattern of arch of aorta.

**Results:** Out of 30 cadavers 19 cadavers Normal branching pattern (Right brachiocephalic, Left common carotid and Left subclavian artery). 10 cadavers showed the left common carotid arising in common with the brachiocephalic trunk. Only one showed the left vertebral artery arising directly from the aorta, the origin lying between left carotid and left subclavian arteries.

**Conclusion:** Knowledge of normal anatomy and frequency in the variations in the branching pattern of the arch of aorta is of great importance in patients who have to undergo aortic instrumentation, four vessel angiography or supraaortic thoracic, head and neck surgery.

**KEY WORDS:** Arch of aorta, Brachiocephalic, Vertebral artery.

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### BACKGROUND

Aortic of aorta or aortic arch is the continuation of the ascending aorta in the superior mediastinum. Its origin is slightly to the right and is in level with the upper border of the second right sternocostal joint. The arch first ascends diagonally back and to the left over the anterior surface of the trachea, then back across its left side and finally descends to the left of the fourth thoracic vertebral body and continues as the descending thoracic aorta. It ends level with the sternal end of the second left costal cartilage [1]. The brachiocephalic trunk, left common carotid and left subclavian arteries are the three major branches that arise from the convex aspe-

ct of the arch. These branches may arise from the beginning of the arch or from the upper aspect of the ascending aorta. Variant branching pattern of the aortic arch includes the variation in the number of branches and difference in the distance between origins of different branches from the arch [2]. The distance between these origin of branches varies, the most frequent being approximation of the left common carotid artery to the brachiocephalic trunk [1]. Most of the anomalies of the arch of aorta and its branches are due to altered development of primitive aortic arches of the embryo during the early gestation period [3]. Variations in the branching pattern may result

in iatrogenic injuries of the variant branches and their compression by adjacent structures or problems in the catheterization procedures [4]. Less than 1% of the congenital cardiovascular defects shows the incidence of the congenital aortic arch abnormalities [3]. Anomalous origins and the distribution of the large aortic arch vessels could cause changes in the cerebral haemodynamics that could lead to cerebrovascular accidents [5]. Knowledge of normal anatomy and frequency in the variations in the branching pattern of the arch of aorta is of great importance in patients who have to undergo aortic instrumentation, four vessel angiography or supraaortic thoracic, head and neck surgery. The present study was undertaken to describe the branching pattern of the aortic arch in south indian subjects and correlate same with embryological and clinical significance.

**MATERIALS AND METHODS**

The present study was done in the 30 formalin-fixed cadavers that were used for the dissection training of undergraduate medical students of Karpaga Vinayaga Institute of Medical Sciences, Madhuranthagam. Only male cadavers were used for the study because of the non-availability of female cadavers.

Branching pattern of the arch was noted as follows:

Type A - Normal pattern (Right brachiocephalic, Left common carotid and Left subclavian artery).

Type B - The left common carotid arising in common with the brachiocephalic trunk.

Type C- Origin of left vertebral artery directly from the aorta, the origin lying between left carotid and left subclavian arteries.

**RESULTS**

In the present study, the normal branching pattern was observed in 19 cases. 10 cases showed type-B. In only one case the vertebral artery directly arose from the arch of aorta (Type C).

Type of presentation	Percentage
Type-A	63.33
Type-B	33.33
Type-C	3.33

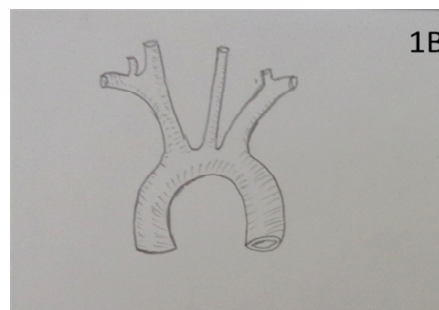
**Tab. 2:** Frequency of distribution of branching pattern of aortic arch among Indian Population.

Type of presentation	Normal	Common trunk	Lt vertebral artery from arch of aorta
Sunnitha et al[9]	74.28	14.2	11.4
Faizal et al[12]	84	-	16.6
Sumita Tulsidas Patel et al[13]	77.3	14.66	8
Rekha et al[14]	92.72	2.72	4.5
Present study	66.33	33.33	3.33

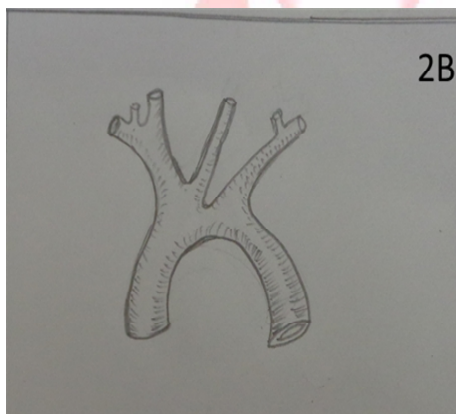
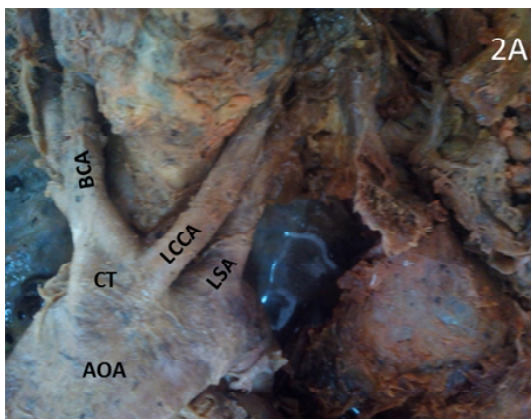
**Tab. 3:** Frequency of distribution of branching pattern of aortic arch among various Populations.

Type of presentation	Normal	Common trunk	Left vertebral artery from arch
Musca acar et al[15] (Turkish population)	74.46	14.91	2.13
Mange et al [16] Kenyan population)	67.3	25.7	-
Adachi et al[17] (Japanese population)	83.3	10.9	4.3
Present study(South Indian population)	63.33	33.33	3.33

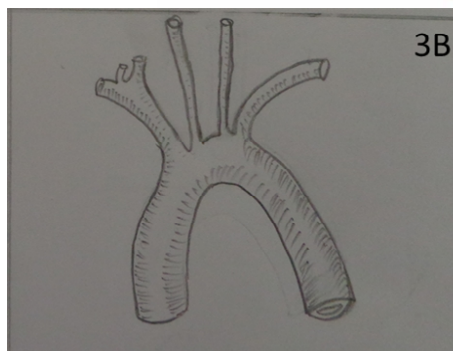
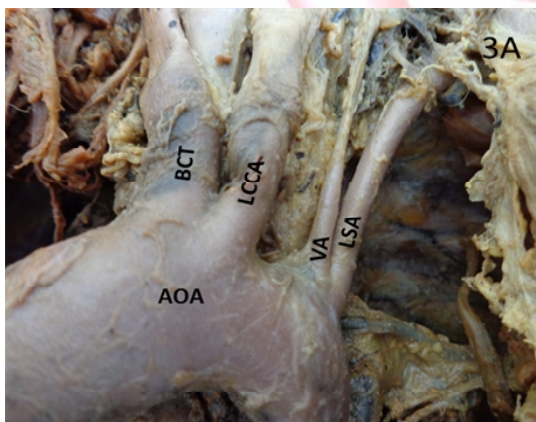
**Fig. 1A, 1B:** Type A- Normal Branching Pattern AOA- ARCH of Aorta, BCT-Brachiocephalic Trunk, LCCA-Left Common Carotid Artery, LSA-Left Subclavian Artery



**Fig. 2A, 2B:** Type B-LCA arising in common with BCT, AOA-Arch of Aorta, CT-Common Trunk, BCA-Brachiocephalic Trunk, LCCA-Left Common Carotid Artery, LSA-Left Subclavian Artery.



**Fig. 3A,3B:** Type C- VA arising from AOA, AOA-Arch of Aorta, BCT-Brachiocephalic Trunk, LCCA-Left Common Carotid Artery, VA-Vertebral Artery, LSA-Left Subclavian Artery.



## DISCUSSION

The great vessels of the thoracic region are well known for their variations. The arch of aorta is one of them, with well known variations [6]. These variations in origin and course of main vessels occurring either individually or in combination with other cardiovascular defects are mostly explainable on ontogenic basis, which serves as basis for a multitude of clinically relevant abnormalities [7]. The final relative disposition of the aortic arch and its branches is probably due to difference in growth rates in the various arteries and the associated "migration" and "merging" of the branches [8].

An analysis of variation in branches from 1000 aortic arches showed the usual pattern in 65%, a left common carotid shared the brachiocephalic trunk in 27% and the four large arteries branched separately in 2.5%. The remaining 5% showed a great variety of patterns, the most common (1.2%) being symmetric right and left brachiocephalic trunks [1].

The classic or normal pattern of branching is the origin of brachiocephalic artery, left common carotid artery and left subclavian artery as separate branches from arch of aorta. This "normal" form occurs in approximately 70% of patients. The incidence of this pattern is known to occurring in 48% of white and 84% of black individuals.[9] The present study shows it to be 63.33%.

The Common Origin of the brachiocephalic and left Common Carotid Arteries is called by a misnomer "bovine" arch. This pattern of aortic arch is more common in blacks with the occurrence of 25% and is seen in only 8% of whites. Overall 13% of patients show this pattern of branching [9]. The present study shows this a pattern in the frequency 20% which is of higher incidence of normal population.

The third most common pattern observed is the origin of the Left Common Carotid Artery from the right brachiocephalic trunk. This variant is similar to the common origin variety, except that the left common carotid artery originates from the brachiocephalic artery more distally, rather than as a commontrunk. The overall incidence in the general population of this pattern is 9% with the frequency of 10% in blacks and 5% of

whites [9]. It was found to be in the frequency of 13.33% in the present study which was higher than the general population.

In the present study, there was a direct origin of the left vertebral artery from the upper surface of the aortic arch in only one case and it was located between origins of the left common carotid and left subclavian arteries. Increased absorption of embryonic tissue of the left subclavian artery between the origin of the aortic arch and the vertebral artery may be the reason for such direct origin of the left vertebral artery from the aortic arch. If the detection of a vertebral artery in the normal position is not possible, the presence of such a variant must be taken into consideration [10]. Even though the branching patterns of the aortic arch are considered to be variants of some deviations from the commonest pattern of development, there were not any noticeable signs of anatomical pathology associated with those variations [11].

**Conflicts of Interests: None**

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