GMR
The Original

A CADAVERIC STUDY ON MORPHOMETRY AND BRANCHING PATTERN OF ARCH OF AORTA IN EASTERN UTTAR PRADESH POPULATION

[1]Dr. Adarsh Ranjan, [2]Dr. Anushree Pandey, [3]Dr. Sandeep Pandey, [4]Shubham Kumar Gupta, [5]Dr. Anupriya Kumar

[1]Assistant Professor, Department of Anatomy (MVASMC, Ghazipur),
[2]Associate Professor, Department of Anatomy (MVASMC, Ghazipur),
[3]Senior Resident, Department of Anatomy (MVASMC, Ghazipur),
[4]Phd scholar, Department of Anatomy (UIMS, Prayagraj),
[5] Professor, Department of Anatomy (MVASMC, Ghazipur)

ABSTRACT

Background: The arch of the aorta is a major arterial segment supplying the head, neck, and upper limbs through its principal branches. Variations in its branching pattern and morphometry are of considerable clinical importance during cardiovascular, thoracic, and endovascular procedures, this study aims to observe branching pattern as well as the morphometry of the vessels.

Methods: This cadaveric observational study was conducted on 50 formalin-embalmed adult human hearts obtained from cadavers aged 30–70 years in the Department of Anatomy, MVASMC, Ghazipur. The branching pattern of the aortic arch was classified into three types: Type I (three branches), Type II (two branches), and Type III (four branches). External diameters of the arch of aorta and its branches were measured using digital Vernier callipers in both vertical and transverse planes. Data were analysed using Microsoft Excel, and descriptive statistics including mean, standard deviation, and range were calculated

Results: The classical Type I branching pattern was observed in 44 (88%) specimens, while Type II and Type III patterns were found in 4 (8%) and 2 (4%) specimens, respectively. The mean vertical and transverse diameters of the arch of aorta were 18.67±3.19 mm and 15.71±3.77 mm, respectively. The brachiocephalic trunk measured 10.68±0.89 mm (vertical) and 9.68±1.87 mm (transverse), the left common carotid artery 6.10±1.02 mm and 5.44±0.74 mm, and the left subclavian artery 7.32±1.29 mm and 6.77±1.33 mm, respectively.

Conclusions : The classical three-branch configuration was the predominant pattern in the Eastern Uttar Pradesh population. The morphometric data and observed anatomical variations provide valuable baseline information for anatomists, radiologists, and cardiovascular surgeons, facilitating safer diagnostic and surgical interventions involving the aortic arch

KEYWORDS: Arch of Aorta (AOA), Brachiocephalic trunk (BCT), Left Common Carotid (LCC), Left Subclavian (LSC), Left Vertebral (LV)

1. INTRODUCTION

The aorta is the principal arterial trunk arising from the left ventricle of the heart and is responsible for supplying oxygenated blood to various regions of the body. For descriptive and functional purposes, it is divided into the ascending aorta, the arch of the aorta, and the descending aorta, the latter continuing as thoracic and abdominal segments after crossing the diaphragm. The arch of the aorta serves as a crucial conduit between the heart and the major arteries supplying the head, neck, and upper limbs.. Normally, three branches arise from the convex superior aspect of the aortic arch: the brachiocephalic trunk(BCT), the left common carotid artery(LCCA), and the left subclavian artery(LCA).[1,2]In last few years Eastern Uttar Pradesh population has encountered with increased incidence of cardiovascular disease. To understand the complexity of heart is now become uttermost important that too of vascular variations emerging from the heart. As the aortic arch develops through a complex process, variations in its branching pattern are frequently observed. These variations may involve differences in the number of branches as well as variations in the distance between the points of origin of these branches.[3] The aortic arch is an important anatomical region for endovascular interventions [4,5]. Anomalous origins and altered branching patterns of the major vessels arising from the aortic arch can modify cerebral blood flow dynamics, which may predispose to adverse cerebrovascular outcomes.[6]

2. Aim & Objective

Aim

To study the morphometry and branching pattern of the arch of aorta in adult human cadavers from the Eastern Uttar Pradesh population and to identify anatomical variations of clinical and surgical significance.

Objective

1. To observe the branching pattern of arch of aorta
2. To Measure the external diameter of arch of aorta
3. To measure the external diameter of branches of arch of aorta

3. METHODS

A total of 50 hearts were studied in the department of Anatomy, MVASMC, Ghazipur. These specimen were dissected out from the formalin embalmed cadavers in the dissection hall, all these cadavers were in a range of 30-70 years of age. Theses were dissected from the body according to the standard method given in Cunningham's manual, after the extraction of specimen the branching pattern of the arch of aorta is being studied . The branching pattern, that has been observed is divided into three groups, Type 1 (classic with three branches), Type 2 (two branches), Type 3 (four branches). After that external diameters were being measured with the help of digital Vernier Callipers from one end to another end . This was done for the arch of aorta as well as for all the branches that were present on arch. As all the artery were not of symmetrically perfect spherical, so we took two diameter , one horizontal and one vertical. After measuring the diameters, data were saved in MS excel file and after that statistical analysis were done to calculate mean and standard deviation of each branch as well as for arch of aorta.

Fig 1:Diameter of Arch of aorta

Fig 2 :Diameter of Brachiocephalic trunk

Fig 3 :Diameter of Left Common Carotid

Fig 4 :Diameter of Left Subclavian

4. RESULTS

Above study had included 50 adult human cadavers to evaluate the morphometry and branching pattern of the arch of aorta.

Branching pattern of arch of aorta

This study had revealed that there is a larger of incidence of type 1 as it was observed in 44 cases while second largest was type 2 being observed in 4 Cases and least incident was type 3 that was only observed in 2 cases.

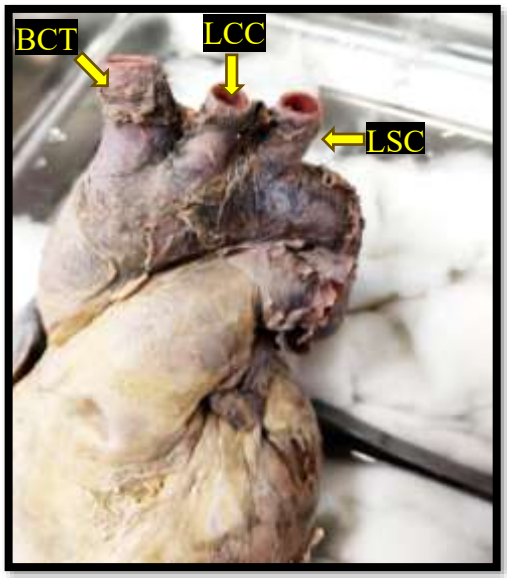

Fig 5: Type 1 Branching Pattern (three branches).

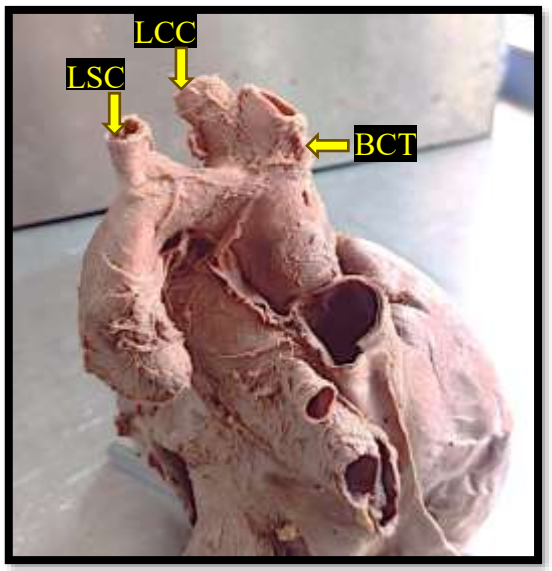

Fig 6: Type 2 Branching Pattern (two Branches)

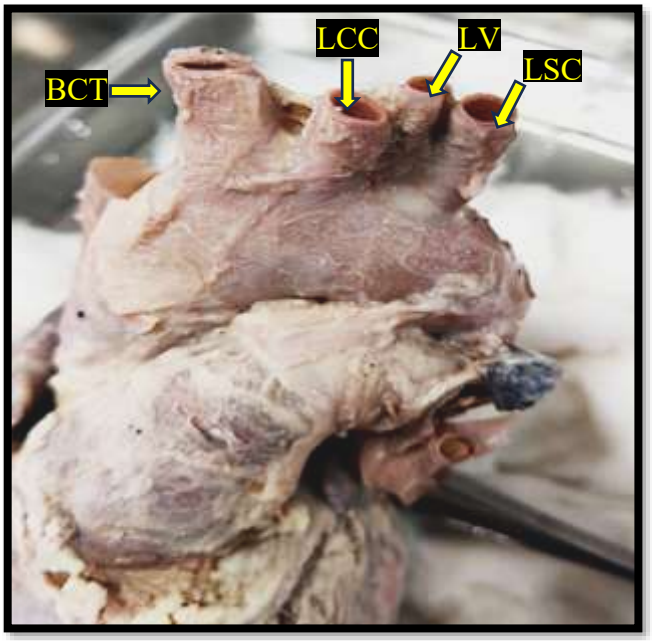

Fig 7: Type 3 Branching Pattern (four Branches)

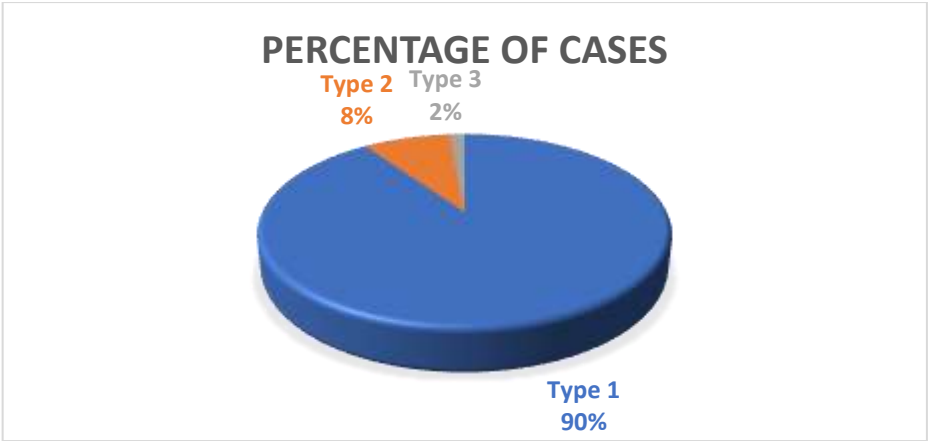

Fig 8: Distribution of Branching Pattern

Morphometry of the arch of aorta

The mean vertical diameter of the arch of aorta was **18.67 ± 3.19 mm**, while the mean transverse diameter measured **15.71 ± 3.77 mm**. The brachiocephalic trunk demonstrated a mean vertical diameter of **10.68 ± 0.89 mm** and a mean transverse diameter of **9.68 ± 1.87 mm**. The mean vertical and transverse diameters of the left common carotid artery were **6.10 ± 1.02 mm** and **5.44 ± 0.74 mm**, respectively. Measurements of the left subclavian artery were available in 46 specimens, with mean vertical and transverse diameters of **7.32 ± 1.29 mm** and **6.77 ± 1.33 mm**, respectively. A fourth branch was observed in only two specimens. Therefore, only descriptive statistics were calculated for this vessel, showing a mean vertical diameter of **1.85 ± 0.06 mm** and a mean transverse diameter of **2.88 ± 0.32 mm.**

VESSELS	RANGE	MEAN	STANDARD DEVIATION
A O A (Vertical)	13.08 –25.39 mm	18.67 mm	3.19mm
A O A (transverse)	10.44 – 25.07 mm	15.71 mm	3.77 mm
BCT (Vertical)	8.63 – 13.03 mm	10.68 mm	0.89 mm
BCT (Transverse)	6.52 – 13.47 mm	9.68 mm	1.87 mm
LCC (Vertical)	3.34 – 7.97 mm	6.10 mm	1.02 mm
LCC (Transverse)	4.10 – 7.83 mm	5.44 mm	0.74 mm
LSC (Vertical)	5.30 – 10.09 mm	7.32 mm	1.29 mm
LSC (Transverse)	4.57 – 9.37 mm	6.77 mm	1.33 mm
LV (Vertical)	1.80 – 1.89 mm	1.85 mm	0.06 mm
LV (Transverse)	2.65 – 3.10 mm	2.88 mm	0.32 mm

Table 1 : External diameters of Vessels

5. DISCUSSION

Our present study has shown two parameters , firstly talking about the incidence of branching pattern of arch of aorta had revealed that most of the cases were of type 1 i.e. 90% which is followed by type 2 (8%) and type 3 (2 %), this is accordance to a study by **Paraskevas et al**[8] where the type 1(65%) was most incident , followed by type 2 (27%) and type 3 (2.4-5.8%). Another study by **Patil ST et al**[9] on 58 cadavers has also revealed the same trend of type 1 (77.3 %) being most incident then type 2 (14.66%) and then type 3 (8%). A study by **Priyamvada et al**[10] shows some different incidence where most of the cases were type 1 i.e. 86.67% but the type 3(10%) was more than the type 2 (3.33%).

In our study for the morphometry we took two diameter of each vessels one vertical and one transverse , and the mean diameter of arch of aorta were 18.67 ± 3.19 mm for vertical and 15.71 ± 3.77 mm for transverse likewise for brachiocephalic trunk it was 10.68 ± 0.89 mm and 9.68 ± 1.87 mm. For Left common Carotid it was 6.10 ± 1.02 mm and 5.44 ± 0.74 mm and Left subclavian artery has 7.32 ± 1.29 mm and 6.77 ± 1.33 mm . This has also been observed in a study by **Shin et al**[11], where only one diameter were taken for each vessel and shows similarity with Brachiocephalic trunk(18.3 ± 7.0) but slightly differs for left common carotid(9.8 ± 1.9)and left subclavian(10.6 ± 2.4). same pattern has been observed for another study by **Chhabra & Saini**[12] BCT being a little less (9.43 ± 2.17), LCC (6.40 ± 1.22) and LSC (7.62 ± 1.76) and another study by **Junagade & Mukherjee**[13], has shown considerably same result according to our present study i.e. BCT (10.80 ± 2.10), LCC (6.55 ± 1.55) and LSC (8.38 ± 1.61) and final another study by **Sreedevi & Parimala**[14],also reveals same dimensions for all the vessels as BCT (11.22 ±2.29) , LCC (7.39 ±1.49) and LSC (8.38 ±2.15).

6. CONCLUSIONS

The present cadaveric study showed that the classical three-branch pattern is the most common branching configuration of the arch of aorta in the Eastern Uttar Pradesh population, although anatomical variations were observed in a proportion of specimens. The morphometric measurements obtained provide baseline anatomical data for this regional population. Awareness of these variations and morphometric characteristics is important for anatomists, radiologists, and cardiovascular surgeons, as they may influence diagnostic interpretation and surgical or endovascular procedures. Overall, the study enriches the existing anatomical literature by documenting both the morphometric characteristics and branching variations of the aortic arch in an Eastern Uttar Pradesh population.

REFERENCES

1. Moore KL, Dalley AF, Agur AMR. Clinlcally Oriented Anatomy. 6th ed. New Delhi, Wolters Kluwer Health-Lippincott Williams & Wilkins;2010:163.
2. Snell SR. Clinical Anatomy by Regions. 9th ed. NewDelhi, Wolters Kluwer Health-Lippincott Williams& Wilkins. 2012:96.
3. Williams PL, Bannister LH, Berry MM, Collins P, Dyson M, Dussek JE, et al., editors. *Gray's anatomy: the anatomical basis of medicine and surgery*. 38th ed. London: Churchill Livingstone; 1995.
4. Alsaif HA, Ramadan WS. An anatomical study of aortic arch variations. **J King Abdulaziz Univ Med Sci.** 2010;17:37–54.

5. Suzuki K, Kazui T, Bashar AHM, Yamashita K, Terada H, Washiyama N, et al. Total aortic arch replacement in patients with arch vessel anomalies. *Ann Thorac Surg.* 2006;81(6):2079–2083. doi:10.1016/j.athoracsur.2005.12.062
6. Bernardi L, Dettori P**.** Angiographic study of a rare anomalous origin of the vertebral artery. *Neuroradiology.* 1975;9(1):43–47. doi:10.1007/BF00330136
7. **Bernardi L, Dettori P.** Angiographic study of a rare anomalous origin of the vertebral artery. *Neuroradiology.* 1975;9(1):43–47. doi:10.1007/BF00330136
8. Paraskevas G, Agios P, Stavrakas M, Stoltidou A, Tzaveas A. Left common carotid artery arising from the brachiocephalic trunk: a case report.Cases J. 2008; 1:83.
9. Patil ST, Meshram MM, Kamdi NY, Kasote AP, Parchand MP. Study on branching pattern of aortic arch in Indian. Anat Cell Biol. 2012;45(3):203-206. doi:10.5115/acb.2012.45.3.203. PMID: 23094209.
10. Priyamvada, Kumari M, Suman K, Sinha BK. Cadaveric study on variations in the branching pattern of arch of aorta. Int J Pharm Clin Res. 2023;15(8):736-739.
11. Shin IY, Chung YG, Shin WH, Im SB, Hwang SC, Kim BT. A morphometric study on cadaveric aortic arch and its major branches in 25 Korean adults: the perspective of endovascular surgery. **J Korean Neurosurg Soc.** 2008;44(2):78-83. doi:10.3340/jkns.2008.44.2.78.
12. Chhabra K, Saini K. Morphometric study of arch of aorta and its branches. **Int J Anat Res.** 2015;3(2):1079-1083. doi:10.16965/ijar.2015.168.
13. Junagade B, Mukherjee A. The morphometric study of the normal and variant branching pattern of the aortic arch by cadaveric dissection. **Int J Med Res Rev.** 2015;3(5):461-469. doi:10.17511/ijmrr.2015.i5.090.
14. Sreedevi G, Parimala NBS. Morphometry of arch of aorta and its branches—A cadaveric cross-sectional study. **Int J Anat Radiol Surg.** 2023;12(6):AO18-AO20. doi:10.7860/IJARS/2023/63052.2949.