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VARIATION IN AORTIC ARCH BRANCHES - A CADAVERIC CASE STUDY

Ayurveda

Dr. Swarup P. Kulkarni* Ph.D. (Registered Scholar), Associate Professor, Department of Rachana Sharir, Dr. N. A. Magadum Ayurvedic Medical college, Hospital and Research Centre, Ankali, Karnataka, India. *Corresponding Author

Dr. Rajendra V. Pakkannavar Professor and H.O.D., Department of Rachana Sharir, Dr. N. A. Magadum Ayurvedic Medical college, Hospital and Research Centre, Ankali, Karnataka, India.

ABSTRACT

Considering the human anatomy of the heart, particularly arteries of the heart, it consists of ascending aorta, arch of aorta, descending thoracic aorta, abdominal aorta along with the right and left coronary arteries which supplies the heart. Ascending aorta begins from left ventricle then it continues as arch of aorta. Arch of aorta generally gives three branches. On the right side, branch is called as brachiocephalic trunk which further divides into right common carotid artery and right subclavian artery. On the left side arch of aorta gives two branches as left common carotid artery and left subclavian artery. In this cadaveric case study, during the first year undergraduate course dissection, the arch of aorta was having four separate branches. On the right side, right common carotid artery, right subclavian artery. On the left side left common carotid artery and on slightly left posterior part there was left subclavian artery. This kind of variation in the branching pattern of arch of aorta is of importance for surgeons as well as clinicians in the treatment aspects.

KEYWORDS

Arch Of Aorta, Four Branches Of Arch Of Aorta, Cadaveric Case Study

INTRODUCTION

Arch Of The Aorta

The aortic arch continues the ascending aorta. Its origin, slightly to the right, is 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 left of the fourth thoracic vertebral body, continuing as the descending thoracic aorta. Its end is level with the sternal end of the second, left costal cartilage. Thus, the aortic arch lies wholly in the superior mediastinum. It curves around the peduncle of the left lung, and extends upwards to the mid-level of the manubrium of the sternum. Its diameter at the origin is the same as in the ascending aorta, about 28 mm, but it is reduced to 20 mm at the end, after the issue of its large collateral branches. At the border with the thoracic aorta, a small stricture (aortic isthmus), followed by a dilatation, can be recognized. In fetal life the isthmus lies between the origin of the left subclavian artery and the opening of the ductus arteriosus.

Relations

Anteriorly and to the left is the left Mediastinal pleura, deep to which it is crossed by four nerves: the left phrenic, left lower cervical vagal cardiac branch, left superior cervical sympathetic cardiac branch and left vagus, in anteroposterior order. As the left vagus crosses the arch its recurrent laryngeal branch hooks below the vessel left and behind (developmentally caudal to) the ligamentum arteriosum and then ascends on the arch's right. The left superior intercostal vein ascends obliquely forwards on the arch, superficial to the left vagus, deep to the left phrenic nerve. The left lung and pleura separate all these from the thoracic wall. Posterior to the right are the trachea and deep cardiac plexus, the left recurrent laryngeal nerve, oesophagus, thoracic duct and vertebral column. Above, the brachiocephalic, left common carotid and left subclavian arteries arise from its convexity, crossed anteriorly near their origins by the left brachiocephalic vein. Below are the pulmonary bifurcation, left principal bronchus, ligamentum arteriosum, superficial cardiac plexus and left recurrent laryngeal nerve. (Best viewed from the left, the concavity of the aortic arch is the upper curved limit through which structures gain access or exit through the hilum of the left lung.)

The fetal aortic lumen narrows between the origin of the left subclavian artery and the attachment of the ductus arteriosus, as the aortic isthmus; beyond the ductus arteriosus the vessel presents a fusiform aortic spindle, the junction of the two parts being marked inferiorly by an indentation; these features persist variably in adults.

Variations

The summit of the arch is usually about 2.5 cm below the superiorsternal border but may diverge from this. In the infant it is closer to the upper border of the sternum; the same is often the case in old age, because of the dilatation of the vessel. Sometimes the aorta curves over the right pulmonary hilum descending right of the vertebral column, a condition normal in birds; there is usually transposition of thoracic and abdominal viscera. Less often, after arching over the right hilum, it passes behind the oesophagus to its usual position; this is not accompanied by visceral transposition. The aorta may divide, as in some quadrupeds, into ascending and descending trunks, the former dividing into three branches to supply the head and upper limbs. Sometimes it divides near its origin, the two branches soon reuniting; the oesophagus and trachea usually pass through the interval between them; this is the normal condition in reptilia and is due to the persistence of a part of the right dorsal aorta which usually disappears.

Three branches spring from the vessel's convex aspect: the brachiocephalic trunk, left common carotid and left subclavian arteries .They may branch from the beginning of the arch or the upper part of the ascending aorta; the distance between these origins varies, the most frequent being approximation of the left common carotid artery to the brachiocephalic trunk (Wright 1969). Primary branches may be reduced to one, more commonly two, the left common carotid arising from the brachiocephalic trunk (7%), or (more rarely) the left common carotid and subclavian arteries arising from a left brachiocephalic or right common carotid and subclavian arising separately, in which case the latter more often branches from the left end of the arch and passes behind the oesophagus. The left vertebral artery may arise between the left common carotid and the subclavian. Very rarely, external and internal carotid arteries arise separately, the common carotid being absent on one or both sides; or both carotids and one or both vertebrals may be separate branches. When a 'right aorta' occurs, the arrangement of its three branches is reversed. The common carotids may have a single trunk, the subclavians separate and the right arising from the left end of the arch. Other arteries may branch from it, most commonly one or both bronchial arteries and the arteria thyroidea ima.

An analysis of variation in branches from 1000 aortic arches (Anson 1963) showed in 65% the usual pattern; in 27% a left common carotid shared the brachiocephalic trunk (contrast percentage quoted above); in 2.5% the four large arteries branched separately. The remaining 5% showed a great variety of patterns, the commonest (1.2%) being symmetrical right and left brachiocephalic trunks.[1,2&3]

Cadaveric Case Study

During routine dissection of first year undergraduate students at the dissection hall of Dr. N. A. Magadum Ayurvedic Medical college, Hospital and Research Centre, Ankali, Karnataka, India, a variation was found in the branching pattern of arch of aorta. This variation was found in the 60 year old female cadaver. The arch of aorta was having four separate branches. On the right side, right common carotid artery,

right subclavian artery. On the left side left common carotid artery and on slightly left posterior part there was left subclavian artery. The further course of right subclavian artery was normal as its continuation as axillary, brachial, radial, ulnar, superficial palmar arch and deep palmar arch. Right common carotid artery was also divided into right external carotid and right internal carotid arteries at the upper border of the thyroid cartilage at the level of the fourth cervical vertebra. The respective branches of external and internal carotid arteries were also as usual pattern. Left common carotid artery was also having its customary course, division and branching pattern. Left subclavian artery was present slightly on posterior aspect of arch of aorta on left side. Its course, branches and continuation was common.

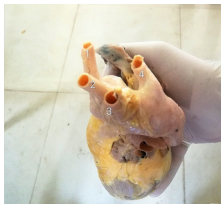

Photo 1 – Branching of Arch of aorta – 4 separate branches

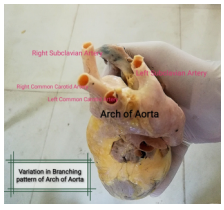

Photo 2 – Variations in branching pattern of arch of aorta

DISCUSSION

Information of branching pattern of aortic arch is imperative as it is one of the parts of largest artery of the human body. Arch of aorta is the continuation of the ascending aorta. It is situitated in the superior mediastinum behind the lower half of the manubrium sterni. The beginning and the end of the aorta are at the same level although it begins anteriorly and ends posteriorly. Arch of aorta generally gives three branches. On the right side, branch is called as brachiocephalic trunk which further divides into right common carotid artery and right subclavian artery. On the left side arch of aorta gives two branches as left common carotid artery and left subclavian artery. In this cadaveric case study, the arch of aorta was having four separate branches. On the right side, right common carotid artery, right subclavian artery. On the left side left common carotid artery and on slightly left posterior part there was left subclavian artery. So, there was a variation in branching pattern of arch of aorta specially in branching and dividation of brachiocephalic trunk. Scrutiny of variation in branches from 1000 aortic arches (Anson 1963) showed in 65% the usual pattern; in 27% a left common carotid shared the brachiocephalic trunk (contrast percentage quoted above); in 2.5% the four large arteries branched separately. The remaining 5% showed a great variety of patterns, the commonest (1.2%) being symmetrical right and left brachiocephalic trunks. So, as per the above study reference this type of separate four large arteries presence was noated in 2.5% cases.[2]

CONCLUSION

The arch of aorta is one of the major artery of the heart which supplies both the extremities, head neck and the brain through its three branches like brachiocephalic trunk which divides into right common carotid and right subclavian arteries, left common carotid and left subclavian artery. The observed variations in the arterial prototype of the arch of aorta specially in the brachiocephalic trunk amplify the possibility of injuries taking place specially during the surgical measures. So, this type of arterial difference should be always kept in mind before any surgical procedure. This awareness of four separate branches of arch of aorta arterial variation is also important for the clinical practitioners and cardiac surgeons particularly during operative procedures of the same. In this cadaveric case study the variations in the branching pattern of arch of aorta was noated particularly in the branches of brachiocephalic trunk and left subclavian artery was present slightly posteriorly on arch of aorta.

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