DOI: 10.7860/JCDR/2015/14219.6253

Case Report

Anatomy Section

Two Common Trunks Arising From Arch of Aorta: Case Report and Literature Review of A Very Rare Variation

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ABSTRACT

Arch of aorta normally gives off three branches, the brachiocephalic trunk, left common carotid artery and left subclavian artery. Due to its complex development, variations in the branching pattern are not infrequent and since many such variants remain asymptomatic, they are detected incidentally at diagnostic imaging, autopsy and surgery. The classical branching pattern is reported to be present in 63.5%–89.4% cases and the most common variant observed is the presence of common trunk of brachiocephalic and left common carotid arteries. Direct aortic arch origin of left vertebral artery is the second most common pattern observed. We report here an extremely rare branching pattern of two common trunks arising from the arch, the first common trunk of brachiocephalic and left common carotid arteries and the second designated as vertebro-subclavian trunk, the common trunk of origin of left subclavian and left vertebral arteries. To the best of our knowledge this is the second such case to be reported.

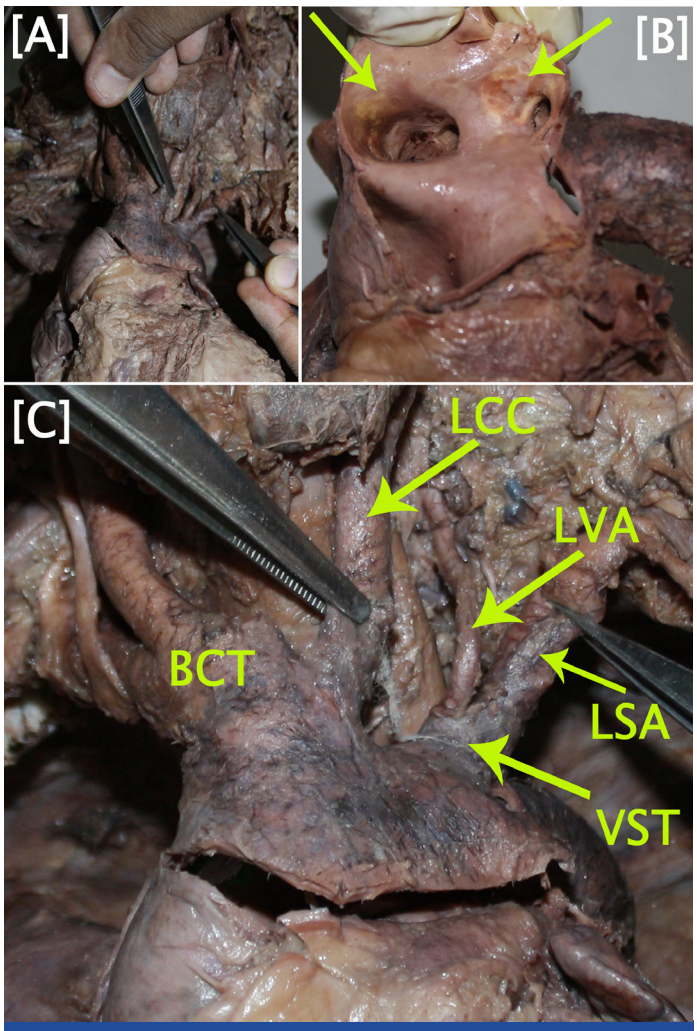
Keywords: Bovine aortic arch, Variant branching pattern, Vertebro-subclavian trunk

CASE REPORT

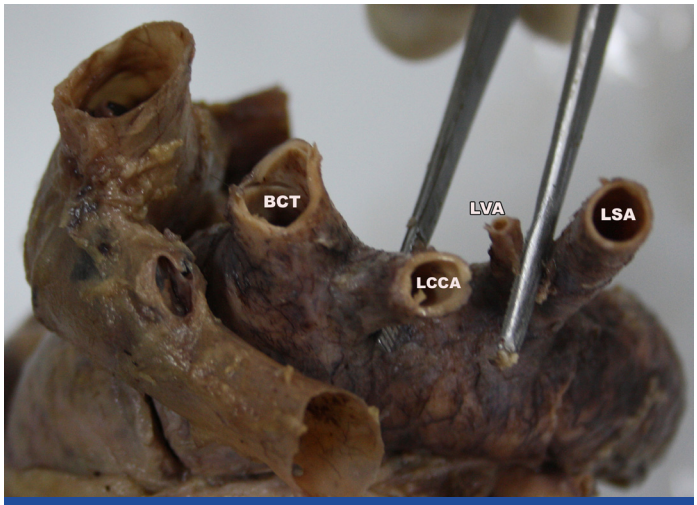
Advancements and application of several endovascular interventional and complex surgical procedures has revived interest in the study of variant branching pattern of arch of aorta. Knowledge of the variations of arch of aorta is of crucial importance before any interventional and surgical procedures in thorax and neck are undertaken. During routine anatomical dissection of thorax for undergraduate medical students when the heart was removed enblock along with the great vessels, a variation of branching pattern of arch of aorta was noted in a north Indian male cadaver aged 68 years. Only two branches arose from the arch; the first being a common trunk of origin of brachiocephalic trunk (BCT) and left common carotid artery (LCCA) and the second a vertebro-subclavian trunk giving rise to left vertebral artery (LVA) and left subclavian artery (LSA) [Table/Fig-1A-C,2]. To confirm the common origin, a window was made in the anterior wall of arch to expose the lumen and only two ostia were observed [Table/Fig-3]. The distance between the two ostia was 12.91 mm. The external diameter of the common trunk was 18.84 mm and the diameter of the ostium measured 17.35 mm. The common trunk was very short (length 6.0 mm) and gave rise to LCCA from its anteromedial aspect, which then passed anterior to trachea to reach the left side of neck. The brachiocephalic trunk divided normally into right subclavian and right common carotid arteries [Table/Fig-1A&C]. The common vertebro-subclavian trunk was also very short (length 5.1 mm; external diameter 10.08 mm; diameter of ostium 7.93 mm) and gave rise to LVA from its posteromedial aspect [Table/Fig-1C]. The LVA then ascended in the superior mediastinum posterior to LSA to reach the root of neck. Atheromatous plaques were observed in the lumen of aorta [Table/Fig-1B]. This is the first report of an extremely rare variant branching pattern of arch of aorta in a north Indian male and the second case to be reported in the world literature.

DISCUSSION

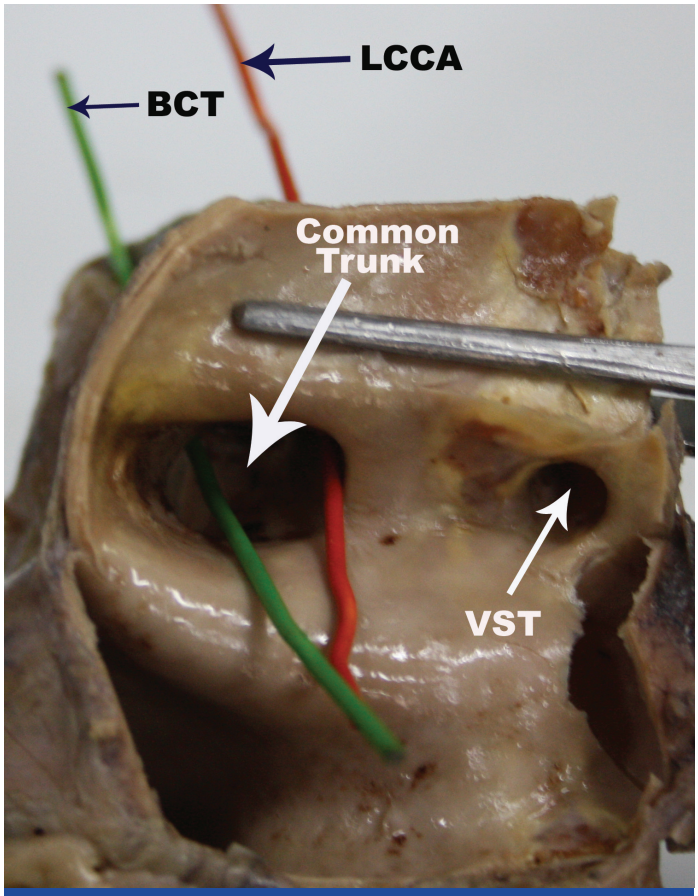
The classical branching pattern of arch of aorta giving origin to BCT, LCCA and LSA (Type I) was reported to occur in 74.0% - 89.4% cases in radiological investigations [1-3] and 63.5% to 77.3% in cadaveric studies [4-6]. The most common variant branch observed is the common trunk of BCT and LCCA (Type II) having a prevalence of 7.2% to 21.1% [7,8]. The second most common variant branch is the direct aortic arch origin of left vertebral artery (LVA) (Type



[Table/Fig-1A-C]: [A] Dissection of mediastinum and root of neck with heart in situ showing the origin of two common trunks from arch of aorta.
[B] Aortic lumen showing two atheromatous plaques (arrow) close to the ostia of the two common trunks.
[C] Showing the common trunk from arch of aorta dividing into brachiocephalic trunk (BCT) and left common carotid artery (LCCA) and BCT dividing into right common carotid and subclavian arteries. The vertebro-subclavian truk (VST) is dividing into left vertebral (LVA) and left subclavian arteries (LSA).



[Table/Fig-2]: Arch of aorta showing the origin of two common trunks, the first common trunk dividing into brachiocephalic trunk (BCT) and left common carotid artery (LCCA) and the second giving origin to left vertebral artery (LVA) and left subclavian artery (LSA)



[Table/Fig-3]: Lumen of arch of aorta showing only two ostia; the first, ostium of common trunk giving origin to brachiocephalic trunk (green probe, BCT) and left common carotid artery (red probe, LCCA) and a second ostium of vertebro-subclavian trunk (VST)

III) with a reported incidence of 2.8% to 5.8% [7,9,10]. We have reported here an extremely rare branching pattern of two common trunks arising from the arch, the first common trunk of origin of BCT and LCCA and the second common trunk of origin of LSA and LVA. Similar branching pattern of two common trunks was earlier reported in a Turkish female cadaver by Yazar et al., [11] and to the best of our knowledge the present case is the second case report of co-existence of vertebro- subclavian trunk with common trunk of brachiocephalic and left common carotid arteries. .

Common trunk of origin of LVA and LSA has been reported sporadically in cadaveric case reports without any other associated branching variation by Nelson and Sparks (2 out of 193 cadavers) [12], Alsaif and Ramadan (1 out of 36 cadavers) [13], Ogeng'o et al., (1 out of 113 cadavers) [5], Bayat et al., Ottone et al., (2 out of 51 cadavers) and Sateesha et al., who designated this common trunk as vertebro-subclavian trunk [14-16]. Rekha and Senthil kumar and Pillai et al., described in their cadaveric study that LVA originated from the arch of aorta at the upper angle of the junction of LSA but did not indicate whether the two arteries had separate ostia or shared a common ostium [17,18]. A common trunk of LVA and LSA was demonstrated in a patient by cardiac catheterization [19]. A three branched aortic arch with a common bicarotid trunk, common trunk of LVA and LSA and an aberrant retro esophageal right subclavian artery was also seen in a cadaver [20]. In a retrospective review of MDCT scans of 2287 patients, Uchino et al., found LVA having direct aortic arch origin proximal to LSA in 4.1 % cases and LVA having common origin with LSA in 0.3 % cases [9]. None of the other radiological studies involving a large number of patients have reported the presence of the vertebro-subclavian trunk suggesting that this common vertebro- subclavian trunk is an extremely rare variant [1-3, 7, 8].

The most common aortic arch branching variation observed is the occurrence of common trunk of origin of BCT and LCCA, erroneously referred to as "bovine arch", with an incidence of 7.2% to 21.1 % [7,8,21]. Celikyay et al., preferred the term "bovine type arch" to denote this variant [8]. Some authors distinguish two subtypes of this variant, one with a long bovine trunk (4 – 6 cm long) described as LCCA arising from BCT (Type-A) and one with a short bovine trunk described as the common origin of LCCA and BCT (Type-B) [6]. This common trunk gives rise to LCCA, right common carotid artery (RCCA) and right subclavian artery (RSA). In the present case the common trunk can be classified as, Type-B since it measured 6.0 mm in length. In a retrospective analysis of MDCT angiographic scans of 2352 patients Uchino et al., found a prevalence of 6.0 % for LCCA arising as a branch from BCT and 5.5% prevalence for common trunk of LCCA and BCT [21]. Berko et al., reported a long bovine trunk in 7.8 % and a short bovine trunk in 19.6 % of patients among 1000 cases examined by CT angiography [22]. Another CT angiographic study on 900 patients found LCCA arising from BCT in 8.88% cases and common trunk of LCCA and BCT in 5.11 % [23]. Presence of common trunk for BCT and LCCA in conjunction with direct aortic arch origin of LVA has been reported to occur in 1.2% - 1.9% cases [1,5,24] and in a cadaveric dissection [25]. Though coexistence of common trunk for BCT and LCCA with direct arch origin of LVA has been reported, presence of two common trunks as in the present case has been reported only once [11].

Embryologically arch of aorta and its branches are derivatives of six pairs of pharyngeal arch arteries which appear symmetrically connecting the right and left limbs of the aortic sac to the right and left dorsal aortae which fuse to form a single median descending aorta just caudal to fourth thoracic segment. Fifth pair of pharyngeal arch arteries disappears very early. Persistence of some and regression of other parts of these symmetrical pharyngeal arch arteries finally give rise to arch of aorta and its three branches. Normally during development the left third pharyngeal arch artery, connected to left horn of aortic sac, elongates to give rise to LCCA and the left horn of aortic sac itself will form the part of aortic arch between the origins of BCT and LCCA. The right horn of aortic sac itself will develop into BCT. The common trunk of origin of BCT and LCCA can develop due to the regression or slower growth rate of left horn of aortic sac such that the left third arch artery (LCCA) gets connected to the right horn of aortic sac (BCT). The aortic arch origin of LVA is explained by the persistence of 6th intersegmental artery and regression of dorsal branch of 7th intersegmental artery which normally develops into V1 segment of vertebral artery. Incorporation of proximal left 7th intersegmental artery into the developing arch of aorta could also result in LVA originating directly from the aortic arch [12]. It is suggested that persistence of 6th intersegmental artery and absorption of portion of left 4th arch artery into the developing LSA

could result in the origin of LVA from the root of LSA, the so called vertebro subclavian trunk. It is observed that patients with some types of aortic arch anomalies without any associated intracardiac defects were having deletion of chromosome 22q11.

Major cerebral ischemic complications can occur in occlusive disorders affecting the common BCT-LCCA trunk because this trunk gives rise to both common carotid arteries and the right vertebral artery. Trans femoral catheterization of LCCA will be difficult if the common trunk is longer. The LCCA arising from BCT crosses the trachea anteriorly to reach the left side of root of neck, a surgically important relation. Risk of neurological complications increases in patients with variation of the LCCA origin. Sound knowledge and pre-procedural awareness of such variations will help to avoid complications during neuroradiological interventions. Variation in the origin and anomalous proximal course of V1 segment of vertebral artery in superior mediastinum is dangerous during surgery of the mediastinum and lower neck region. Moreover, it is suggested that the V1 segment of the vertebral artery is more prone to atherosclerotic changes especially close to its origin. Variations of the LVA are thought to alter cerebral haemodynamics and can produce cerebral dysfunction. Pre procedural knowledge of such variations aid in successful accomplishment of catheterization of LVA and avoid complications during neuroradiological interventions and surgical procedures.

CONCLUSION

We have reported here what we believe to be the second case report of an extremely rare variation of aortic arch with two common trunks, the first common origin of BCT and LCCA (the so called bovine aortic arch) and the second common origin of LSA and LVA (Vertebro-subclavian trunk). Knowledge of the variations of arch of aorta is of crucial importance before any interventional and surgical procedures in thorax and neck are undertaken.

ACKNOWLEDGEMENT

Technical assistance rendered by Mr. Sushil Kumar and Mr. Tithender of Muzaffarnagar Medical College is acknowledged.

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FINANCIAL OR OTHER COMPETING INTERESTS: None.

Date of Submission: **Mar 30, 2015**
Date of Peer Review: **Jun 01, 2015**
Date of Acceptance: **Jun 05, 2015**
Date of Publishing: **Jul 01, 2015**