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Physiology and Anatomy

Elixir Physio. & Anatomy 97 (2016) 42246-42252

ISSN: 2229-712X

"The True Silent Killers" - Bovine and Truncus Bicaroticus Aortic Arches its Embryological Basis and Surgical Implications

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ARTICLE INFO

Article history:
Received: 18 July 2016;
Received in revised form:
19 August 2016;
Accepted: 19 August 2016;

Keywords
Bovine Aortic arch,
Truncus bicaroticus,
The true silent killers,
Thoracic Aortic Aneurysm

ABSTRACT

Normally, the adult archetype aortic arch branching variations was due to the deviation in the growth pattern of the aortic or branchial arch arteries and their associated "migration" and "merging" of their branches. Recently, it is well identified that the suspicion exists with the "bovine arch" and "Truncus bicaroticus" trunk Aortic arches, leads to sudden severe neurological complications due to the wide range of atheromatous plaques and congenital aneurysms, cause medical emergencies. Radiology reports are advised to overlook for the Bovine and Truncus bicaroticus Aortic arches, as the true silent killers for the precautionary efforts to rule out the TAA.

Introduction

Normally, the human Aortic arch branching into three great vessels, the brachiocephalic trunk (BCT) or innominate artery, the left common carotid artery (LCCA) and the left subclavian artery (LSA) are directly originating from the arch of the aorta. The adult archetype of the Aortic arch and its branches are formed, due to the different growth patterns of the aortic or branchial arch arteries and their associated "migration" and "merging" of their branches [1]. The most common variant in the Aortic arch branching pattern, due to the left common carotid artery (LCCA) has a common origin with the brachiocephalic trunk (BCT) or innominate artery. This unusual pattern origin of the LCCA from the Aortic arch, present with an orientation like the left common carotid artery (LCCA) origin was migrated to the right and merges with the originated trunk of the brachiocephalic trunk (BCT) or innominate artery. This uncommon branching pattern of Aortic arch most often termed a "Bovine Aortic arch" [2, 3, 4]. The similar variance, also known as 'Truncus bicaroticus", in this the left common carotid artery (LCCA) arises from the brachiocephalic trunk (BCT) or innominate artery at an average distance of one centimeter (1cm) to two and a half centimeters (2.5cms) from the Aortic arch, but not sharing the true common origin. Sometimes, the Truncus bicaroticus can be difficult to distinguish from the Bovine Aortic arch, if the left common carotid artery (LCCA) arises less than one centimeter (1cm) of the origin from the brachiocephalic trunk (BCT) or innominate artery [5].

Although, the Bovine and Truncus bicaroticus Aortic arches are usually viewed as normal, asymptomatic and clinically insignificant variants. In some cases of head and neck surgeries, it can be a risk factor for injury and cause complications [7]. Currently, the clinicians claimed the Bovine and Truncus bicaroticus Aortic arches are common in patients with Thoracic Aortic Aneurysm (TAA) [2, 4, 7]. Generally, the patients with TAA due to the Bovine and Truncus bicaroticus Aortic arches are clinically normal and arches are significantly more common in patients with TAA than in the general population [8], these Aortic arch variants are claimed as "The True Silent Killers". Till today the Bovine and Truncus bicaroticus Aortic arches are commonly regarded as a normal variant so, very little direct data are available. Recently, it was well identified, the suspicion exists with the Bovine and Truncus bicaroticus Aortic arches may predispose to the Thoracic Aortic Aneurysm (TAA) [8]. Radiology reports often overlook even for the normal individuals for Bovine and Truncus bicaroticus Aortic arches, as a precautionary effort for TAA. Aortic arch with Bovine and Truncus bicaroticus variants patients are grown faster than the general TAAs. Bovine and Truncus bicaroticus Aortic arches patients are more tend to dissect, especially in the descending aorta [8]. The present study observations argue strongly about the Bovine and Truncus bicaroticus Aortic arches should not be considered a normal variant of aortic arch anatomy [7].

The present study aimed to through insight knowledge about these common variants of the aortic arch called the Bovine and Truncus bicaroticus. It helps to understand their association with the aortic diseases, like TAA development and its complications [8].

Incidence

The Bovine Aortic arch was apparent in ~13% (range 8-25%) of the world populations [3]. The similar variance of the Aortic arch, the Truncus bicaroticus, exist incidence in ~9% (range 5-10%) of the total populations [6].

Observations

On the dissected human heart specimens with the Aortic arch branches, we observed the three different patterns of variance in the Aortic arch branches. The pattern one and two shows the left common carotid artery (LCCA) has a common origin with the brachiocephalic trunk (BCT) or innominate artery. Instead of arising from the Aortic arch as a direct branch, the left common carotid artery (LCCA) origin was migrated to the right and merges with the originated trunk of brachiocephalic trunk (BCT) or innominate artery. This unusual pattern of Aortic arch was referred as a Bovine Aortic arch (Fig-1A & 1B).

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The aforementioned two patterns also demonstrate the variants in the origin of the left vertebral artery (LVA). In pattern one, the variant Aortic arch origin of the left vertebral artery (LVA) arises between the left common carotid (LCCA) and left subclavian arteries (LSA) (Fig-1A). On the pattern two, the left vertebral artery (LVA) was observed after the origin of the left subclavian artery (LSA) from the arch of the aorta (Fig-1B).

The third variant Aortic arch pattern exhibits the left common carotid artery (LCCA) arises from the brachiocephalic trunk (BCT) or innominate artery but, not sharing a true common origin, this related variance also known as Truncus bicaroticus (Fig-1C). This pattern also explains the variant Aortic arch origin of the left vertebral artery (LVA) in this the left vertebral artery (LVA) arises between the left common carotid (LCCA) and left subclavian arteries (LSA) similar to the pattern one (Fig-1C).

In all the three patterns, the Aortic arch exhibits the variant aortic arch origin of the left vertebral arteries. But, in the pattern one and three, reveals the common trunk for the left subclavian and the left vertebral arteries. This common trunk pattern also referred as a “common vertebro-subclavian trunk (CVST)” (Fig-1A & 1C).

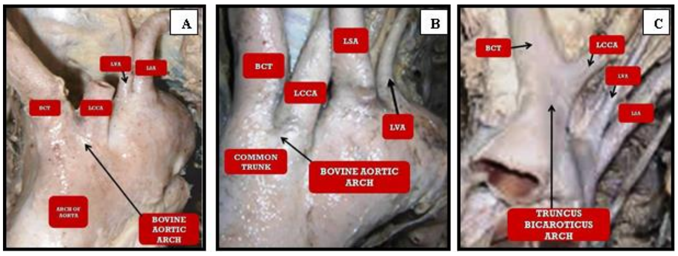

Fig-1. The Variants Aortic arch branching patterns A. Pattern-1: Bovine Aortic arch with variant Aortic arch origin of left vertebral artery between the left common carotid (LCCA) and left subclavian arteries, B. Pattern-2: Bovine Aortic arch with variant Aortic arch origin of left vertebral artery after the origin of the left subclavian artery (LSA) from the arch of the aorta and, C. Pattern-3: Truncus Bicaroticus Aortic arch with variant Aortic arch origin of left vertebral artery between the left common carotid (LCCA) and left subclavian arteries. The red stars indicate the “vertebro-subclavian trunk (VST)”. (BCT-Brachiocephalic Trunk and LBV-Left Brachiocephalic vein)

After its origin, the right and left common carotid arteries and the first part of the vertebral artery are followed their normal course and distributions. On the other hand, the right common carotid artery originated from the brachiocephalic trunk (BCT) or innominate artery and the right vertebral artery branched out normally from the first part of the right subclavian artery.

Ontogenesis for the normal Aortic Arch and its branching patterns

During development, in the primitive heart tube, the Truncus arteriosus (aortic sac) receives six sets (right and left) of Aortic or branchial arterial arch [9]. These arterial arches undergo selective apoptosis, and the residual branch vessels constitute the formation of Aortic arch and its great vessels. Any deviations in this normal process will result in the anatomical variations.

The first and second sets (right and left) arterial arches (I and II) are usually gets regressed. The third pair (right and left) arterial arches (III), forms the proximal part of the common carotid arteries bilaterally. The proximal part of the right fourth arterial arch (IV) persists as the right subclavian artery up to the origin of the internal thoracic (mammary) artery, whereas the distal part of the right fourth arterial arch gets regressed. The distal part of the left fourth arterial arch (IV) regresses and its proximal part formed a small segment of the adult Aortic arch between the origin of the left common carotid artery and the left subclavian arteries. The right and left, fifth arterial arch (V) either regresses or incompletely formed. The proximal part of the right and left sixth arterial arch (VI) forms the pulmonary arteries. The distal part of the right side sixth arch (VI), becomes ductus arteriosus, whereas in the left side distal part will regress completely [10].

The right horn of the Aortic sac forms the brachiocephalic trunk (BCT) or innominate artery and the left horn of the Aortic sac, normally forms the part of the Aortic arch intervenes between the origins of the brachiocephalic trunk (BCT) or innominate artery and the left common carotid (LCCA) arteries.

Normally, the anterior part of the Truncus arteriosus receives the third (III) and fourth (IV) sets (right and left) of arterial arches; eventually, it opens into the right and left horns of the Aortic sac. The posterior part of the Truncus arteriosus receives the sixth (VI) sets (right and left) of arterial arches, and forms the right and left pulmonary arteries. The formation of the spiral or Conotruncal septum divides the Truncus arteriosus into the anterior ascending aorta and the posterior pulmonary trunk. The anterior part of the Truncus arteriosus continuous above as the Aortic sac, where it connects with the third (III) and fourth (IV) sets (right and left) of Aortic or branchial arch arteries. Ultimately, the aortic sac and its horns receive, all the derivatives of third (III) and fourth (IV) sets (right and left) of Aortic or branchial arches (Fig-2 & 3).

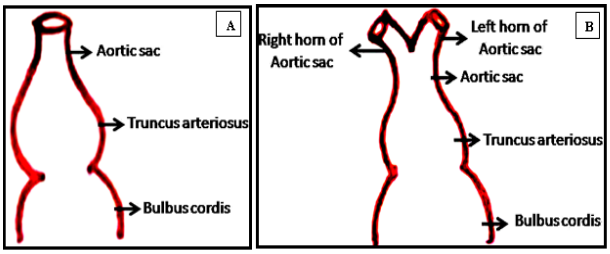

Fig 2. The development of Aortic sacs A. schematics showing the proximal part of the developing heart tube and B. During the later period, the Aortic sac shows its terminal branches called Right and Left horns.

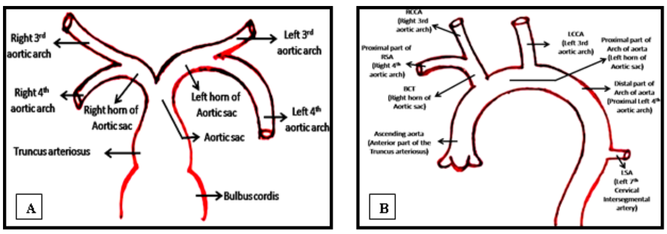

Fig 3. The derivatives of aortic arch arteries A. schematics showing the Truncus arteriosus receives the third (III) and fourth (IV) sets (right and left) of Aortic arch arteries, ultimately it opens into the right and left horns of the Aortic sac and B. Derivatives of the Aortic sac horns and third (III) and fourth (IV) sets (right and left) of Aortic arch arteries.(BCT-Brachiocephalic trunk, RSA- Right subclavian artery, RCCA- Right Common carotid artery, LCCA- Left Common carotid artery and LSA-Right subclavian artery).

Embryological basis for the Bovine Aortic Arch

In the one and two patterns, the left common carotid artery (LCCA) has a common origin with the brachiocephalic trunk (BCT) or innominate artery (Fig-1A & 1B). Instead of arising from the Aortic arch as a direct branch, the left common carotid artery (LCCA) origin was migrated to the right and merges with the originated trunk of the brachiocephalic trunk (BCT) or innominate artery. This pattern of Aortic arch was referred as a Bovine Aortic arch. In this pattern, the aortic sac fails to branch off into the right and left horns, it consequences the left common carotid artery (LCCA) artery connects directly into the aortic sac. The pattern forms as, a common trunk origin of the right and left common carotid arteries, and it was termed as a Bovine Aortic arch (Fig – 4).

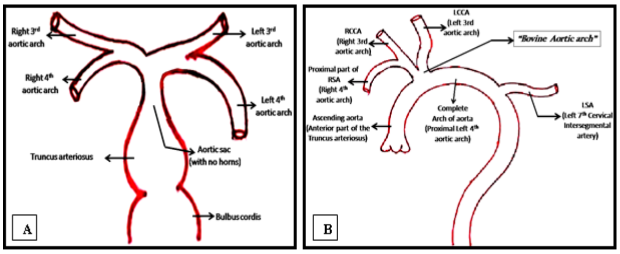

Fig 4. The variant development of Aortic sacs A. schematics showing the Aortic sac horns, results in crowding of the third (III) and fourth (IV) sets (right and left) of Aortic arch arteries at its terminal end and B. due to the aortic sac fails to bifurcate into right and left horns, it consequences into the "Bovine aortic arch", the left common carotid artery (LCCA) origin was migrated to the right and merges with the originated trunk of the brachiocephalic trunk (BCT) or innominate artery.

The patterns one and two, the aortic arch also demonstrates the variance in the aortic arch origin of the left vertebral artery (LVA). In pattern one, the left vertebral artery (LVA) origin directly from the aortic arch between the left common carotid (LCCA) and left subclavian arteries (LSA) (Fig-1A), exhibits the presentation of "Common Vertebro-Subclavian trunk-CVST" [11,12]. In pattern two, the left vertebral artery (LVA) was observed after the origin of the left subclavian artery (LSA) from the arch of the aorta (Fig-1B) displays the presentation of "Common Subclavian-Vertebral trunk-CSVT" [11,12].

Ontogenesis for the normal Vertebral Artery development

During the early development, small intersegmental branches arise from the dorsal aorta, extends from the cranial (cervical) to the caudal (sacral) region, to vascularize the somites of the developing embryo. In the cervical region, these intersegmental arteries are named as C1 to C7. The vertebral artery normally developed from the cervical intersegmental arteries. The dorsal branches (distal part) from the cervical intersegmental arteries from C1 to C7 are fused to form the postcostal longitudinal anastomosis.

Normally, the first part of vertebral artery developed from the seventh cervical intersegmental artery and its (proximal part) dorsal branch (proximal to postcostal anastomosis). The sixth cervical intersegmental artery and its dorsal division are usually disappeared. The second part is derived from postcostal longitudinal anastomosis between the C6 to C1 (Fig – 5, 6 &7).

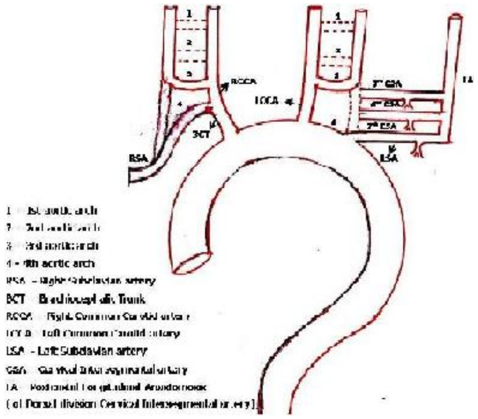

Fig 5. Ontogenesis of normal development Aortic arch and its branches.

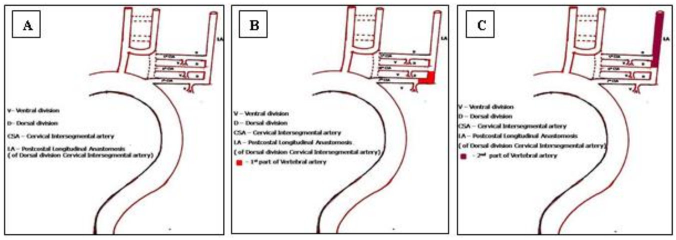

Fig 6. The schematic representation shows the Ontogenesis: A. connections from the 5th to 7th cervical intersegmental arteries with the Dorsal aorta, B. development of the 1st part of left vertebral artery from the dorsal branch of the 7th cervical intersegmental artery alone, and C. the 2nd part of left vertebral artery developed from the postcostal Longitudinal Anastomosis (LA) formed by the fusion of (distal segment of dorsal branches from) 6th and above cervical intersegmental arteries.

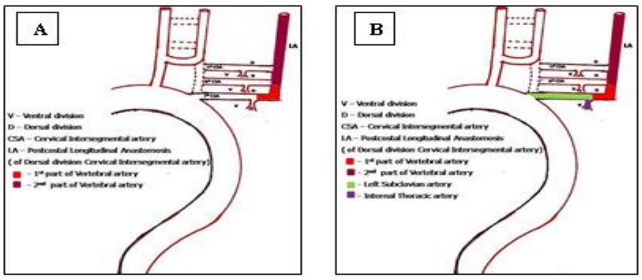

Fig 7. The schematic representation shows the Ontogenesis: A. normal source of development of left vertebral artery (LVA). B. normal source of development of left subclavian artery (LSA) from the 7th cervical intersegmental artery and its branch called internal thoracic or internal mammary artery from the ventral branch of the 7th cervical intersegmental artery.

Embryological basis for the variant Aortic Arch origin of LVA

In pattern one, where the vertebral artery arises from aortic arch between the left common carotid and left subclavian arteries. In this pattern, the left sixth intersegmental artery and its dorsal branch may fail to disappear. The blood from aortic arch directly flows to the persisting sixth cervical intersegmental artery forming the aortic arch origin of the left vertebral artery. This preferential blood flows through the persisting left sixth intersegmental channel, results in diminishes the normal flow through the seventh cervical intersegmental artery (to its dorsal branch), which ultimately disappear.

The first part of the left vertebral artery derived from the sixth intersegmental artery and also from the small proximal portion of its dorsal branch. The ventral branch of the sixth intersegmental artery was disappeared completely. The second part of the left vertebral artery developed from the postcostal Longitudinal Anastomosis (LA) formed by the fusion of (distal segment of dorsal branches from) sixth and above cervical intersegmental arteries. It gives the pattern of the left vertebral artery arises from aortic arch between the between the LCCA and LSA (Fig- 8and 9).

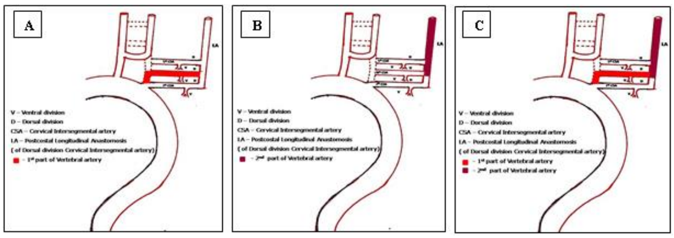

Fig 8. The schematic representation shows the Embryological basis: A. Pattern:1 - variants origin of the 1st part of left vertebral artery from the left sixth intersegmental artery and its dorsal branch, B. Normal development of the 2nd part of left vertebral artery developed from the postcostal Longitudinal Anastomosis (LA) formed by the fusion of (distal segment of dorsal branches from) the 6th and above cervical intersegmental arteries, and C. Pattern:1 - the variants Aortic arch origin of left vertebral artery from the left sixth intersegmental artery.

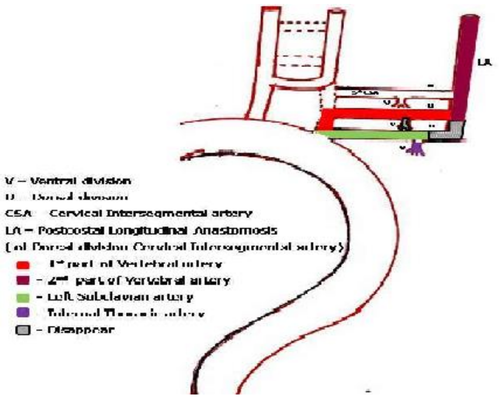

Fig 9. Pattern: 1 - The variants Aortic arch origin of the left vertebral artery (LVA) between the LCCA and LSA (green shaded). The normal source of development of left subclavian artery (LSA) from the 7th cervical intersegmental artery and its branch called internal thoracic or internal mammary artery from the ventral branch of the 7th cervical intersegmental artery.

In pattern two, the vertebral artery arises from aortic arch beyond the level of origin of the left subclavian artery (LSA) from the arch of the aorta. In this pattern, the dorsal branch of the left sixth intersegmental artery was disappeared. Whereas, the proximal part of the left sixth intersegmental artery with its ventral branch are persisted. The proximal part of left sixth intersegmental artery continuous as a left subclavian artery and, its ventral branch remains as an internal thoracic (mammary) branch (Fig-7 and 8).

The first part of the left vertebral artery derived exclusively from the seventh intersegmental artery and also from the small proximal portion of its dorsal branch. The ventral branch of the seventh intersegmental artery was disappeared completely. The second part of left vertebral artery developed from the postcostal Longitudinal Anastomosis (LA) formed by the fusion of (distal segment of dorsal branches from) seventh and above cervical intersegmental arteries. It gives the pattern of the left vertebral artery arises from aortic arch beyond the level of origin of the left subclavian artery (LSA) from the arch of the aorta (Fig-10and 11).

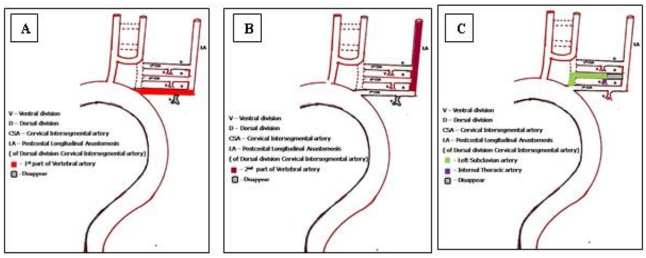

Fig 10. The schematic representation shows the Embryological basis of: A.Pattern:2 - variants origin of 1st part of left vertebral artery from the left seventh intersegmental artery and its dorsal branch, B. the unusual development of the 2nd part of left vertebral artery developed from the postcostal Longitudinal Anastomosis (LA) formed by the fusion of (distal segment of dorsal branches from) 7th and above cervical intersegmental arteries, and C. the variants origin of left subclavian artery(green shaded) from the left sixth intersegmental artery.

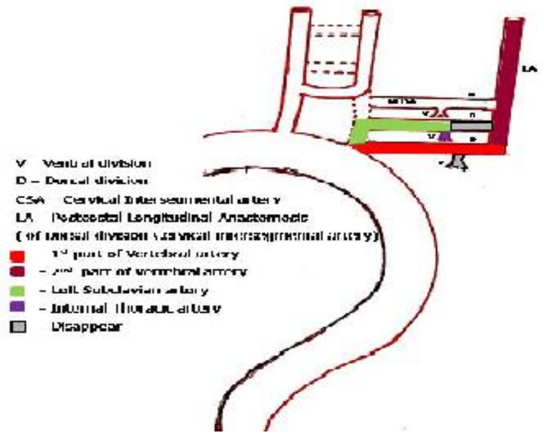

Fig 11. Pattern: 2 - The variants Aortic arch origin of the left vertebral artery (LVA), LVA originated directly from the aortic arch after the left subclavian artery (green shaded)(LSA). The variants origin of left subclavian artery (green shaded) from the left sixth intersegmental artery.

Embryological Basis for the Truncus Bicaroticus Aortic Arch

The pattern three, the variant Aortic arch exhibits, the left common carotid artery (LCCA) arises from the brachiocephalic trunk (BCT) or innominate artery but, not sharing a true common origin, called Truncus bicaroticus (Fig-1C). This pattern of Aortic arch, also explains the variant Aortic arch origin of the left vertebral artery (LVA). In this, the left vertebral artery (LVA) arises directly from the Aortic arch between the left common carotid (LCCA) and left subclavian arteries (LSA) (Fig-1C). It also explains the common trunk origin with the left subclavian artery, referred as a “common vertebro-subclavian trunk (CVST)”.

Normally, the proximal part of the third aortic arch gets absorbed into the left horn of the aortic sac. As an alternative, if it absorbed into the right horn of the aortic sac, it shows the branching pattern variations like the left common carotid artery (LCCA) arises from the brachiocephalic trunk (BCT) or innominate artery but, not sharing a true common origin, called Truncus bicaroticus. The LCCA arises from the brachiocephalic trunk (BCT) or innominate artery at an average distance from one centimeter (1cm) to two and a half centimeters (2.5cms) from the Aortic arch, which gives the pattern called Truncus bicaroticus (Fig-12).

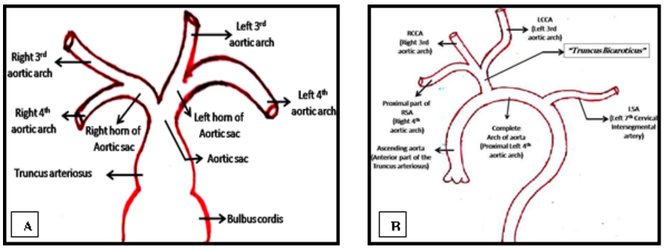

Fig 12. The variant development of third Aortic arch artery A. schematics showing the unusual extension and absorption of the left third (III) Aortic arch artery into the right horn of the Aortic sac and, B. due to the unusual extension and absorption of the left third (III) Aortic arch artery into the right horn of the Aortic sac, it consequences into the "Truncus bicaroticus", the left common carotid artery (LCCA) arises from the brachiocephalic trunk (BCT) or innominate artery but, not sharing a true common origin.

The pattern three, also demonstrates the variance in the aortic arch origin of the left vertebral artery (LVA). In this, the left vertebral artery (LVA) arises directly from the Aortic arch between the left common carotid (LCCA) and left subclavian arteries (LSA) (Fig-1C). The embryological basis for this variance is already explained in the pattern one above.

Discussion

Normally, the human Aortic arch branching into three great vessels, the adult archetype of the Aortic arch and its branches are formed, due to the different growth patterns of the aortic or branchial arch arteries and their associated "migration" and "merging" of their branches [1]. The most common variant in the Aortic arch branching pattern, due to the left common carotid artery (LCCA) has a common origin with the brachiocephalic trunk (BCT) or innominate artery. This unusual pattern origin of the LCCA from the Aortic arch, present with an orientation like the left common carotid artery (LCCA) origin was migrated to the right and merges with the originated trunk of the brachiocephalic trunk (BCT) or innominate artery. This anomalous branching pattern of Aortic arch most often termed a "Bovine Aortic arch" [2, 3, 4]. The similar anomalies, also known as 'Truncus bicaroticus", in this the left common carotid artery (LCCA) arises from the brachiocephalic trunk (BCT) or innominate artery at an average distance from one centimeter (1cm) to two and a half centimeters (2.5cms) from the Aortic arch, but not sharing a true common origin. Sometimes the Truncus bicaroticus can be difficult to distinguish from the Bovine Aortic arch if, the left common carotid artery (LCCA) arises less than one centimeter (1cm) of the origin of the brachiocephalic trunk (BCT) or innominate artery [5].

In Bovine aortic arch, the left common carotid artery (LCCA) has a common origin with the brachiocephalic trunk (BCT) or innominate artery. Instead of arising from the Aortic arch as a direct branch, the left common carotid artery (LCCA) origin was migrated to the right and merges with the originated trunk of the brachiocephalic trunk (BCT) or innominate artery. This pattern of Aortic arch was referred as a Bovine Aortic arch. In this pattern, the aortic sac fails to branch off into the right and left horns, it consequences the left common carotid artery (LCCA) artery connects directly into the aortic sac. The pattern forms as, a common trunk origin of the right and left common carotid arteries, and it was termed as a Bovine Aortic arch (Fig – 4).

Normally, the proximal part of the third aortic arch gets absorbed into the left horn of the aortic sac. As an alternative, if it absorbed into the right horn of the aortic sac, it shows the branching pattern variations like the left common carotid artery (LCCA) arises from the brachiocephalic trunk (BCT) or innominate artery but, not sharing a true common origin, called Truncus bicaroticus. The LCCA arises from the brachiocephalic trunk (BCT) or innominate artery at an average distance from one centimeter (1cm) to two and a half centimeters (2.5cms) from the Aortic arch, which gives the pattern called Truncus bicaroticus (Fig-12).

Currently, the clinicians claimed, the Bovine and Truncus bicaroticus Aortic arches are common in patients with Thoracic Aortic Aneurysm (TAA) [2, 4, 7]. Now it is believed, the variations or anomalies in the aortic arch arteries will lead to the increased pressure in the blood across the aorta, which in turn increases the stress in the descending thoracic aorta, leading in the development of Thoracic Aortic Aneurysm (TAA). The present study aimed to through the insight ontogenesis knowledge about these common variants of the aortic arch called the Bovine and Truncus bicaroticus. This study will be very much helpful to understand the basic correlations about these common variants of the aortic arches associated with the aortic arch related diseases, like TAA development and its complications [8].

In this current observation the patterns one and two aortic arches are also demonstrates the variance in the origin of the left vertebral artery (LVA). In pattern one, the left vertebral artery (LVA) origin directly from the aortic arch between the left common carotid (LCCA) and left subclavian arteries (LSA) (Fig-1A), exhibits the presentation of "Common Vertebro-Subclavian trunk-CVST" [11]. In pattern two, the left vertebral artery (LVA) was observed after the origin of the left subclavian artery (LSA) from the arch of the aorta (Fig-1B) displays the presentation of "Common Subclavian-Vertebral trunk-CSVT" [11].

The normal diameter of LVA was identified as 3-5mm, in LSA was in 10 -12mm. The vertebral artery diameter was significantly more on the left side than the opposite [13, 14, 15]. The average diameter of this common vertebro-subclavian trunk (CVST) was reported as ~ 20mm. The large diameter CVST receives the high-pressure blood from the ascending and arch of the aorta, results in the increased blood pressure in the LVA and LSA. The increased in the pressure of the common vertebro-subclavian trunk causes dilatations of LVA and LSA vessels up to the one and a half to two times that of a normal diameter, so called as ectasia, if the dilatations occur more than the twice of the normal diameter, results in an aneurysm [16]. These aneurysms (LVA and LSA aneurysms) should be repaired to avoid possible limb and life-threatening tribulations. The pressure increases in the common vertebro-subclavian trunk resulting from asymmetric vertebral blood flow might influence the disturbances in the cerebral arterial system, cause infarcts in the areas before or after the vertebrobasilar junction, cause various neurological medical emergencies.

An atherosclerotic lesion was the most common (60%) cause, for an aneurysm. The arterial bifurcations are the most common site for the atheromatous plaque formations. Atheromatous plaques are developed in the crucial regions with intricate blood flow patterns with fluctuation lateral pressure on the blood vessels as in the regions such as bifurcations, bends and junctions [17, 18, 19]. The patients with the common vertebro-subclavian trunk may be asymptomatic unless it involved with the atherosclerotic lesions [20]. Angiographic studies show the extracranial atheromatous plaques with the atherosclerotic lesions are very common in the first few centimeters of the CVST, often extension into the origins of LVA and LSA. The atherosclerotic lesion in the LVA causes transient hypoperfusion leads to ischemic attacks. According to the previous observations, only 20% of strokes are due to the hemorrhagic origin. Although the hemorrhagic strokes are less common than ischemic strokes, it causes more severe lesions than the ischemic type. The ischemia is often resulting from the high blood pressure or lateral wall pressure on the blood vessels which are before now damaged by the atherosclerotic lesions.

The ischemic strokes are the more common (80%) type of all strokes. Normally, the left vertebral artery (LVA) is often larger than the right vertebral artery (RVA) [21], and the dominant vertebral artery was most frequent on the left side (69.2%). The curvature of the basilar artery (BA) was directly opposite side of the dominant vertebral artery. The aforementioned two reasons results in the basilar artery (BA) curvature were mainly directed to the right side. The most frequent morphological change in the Basilar artery (BA) was a C-shaped bend, followed by S-shaped, J-shaped, and no bend or straight.

Conclusion

A true bovine aortic arch bears no resemblance with any of the aforementioned common human aortic arch variations. In bovines, a single great vessel arises from the aortic arch [22], called the brachiocephalic trunk. It gives derivations for the innominate artery, the left common carotid artery, and the left subclavian artery. Further, the innominate artery branches into the right common carotid artery and the right subclavian artery. The incidence of this pattern occurs approximately in 70% of the individuals. It is generally accepted that the "true bovine aortic arch" was a normal aortic arch configuration. In view of the fact that, the "bovine arch" and "Truncus bicaroticus" Aortic arches is a misnomer, the "the common trunk variants aortic arch" can be used to describe these anatomical variants.

Conventionally, the clinicians regarded as, the congenital variant aortic arches like the "bovine arch" and "Truncus bicaroticus" the clinically worthless findings unless it causes the vascular insufficiencies [23, 24]. Now it is believed, the variations or anomalies in the aortic arch arteries will lead to the increased pressure in the blood across the vessel, which in turn increases the stress in the LVA, LSA and descending thoracic aorta, ultimately it develops the Vertebral, Subclavian, and Thoracic Aortic Aneurysms. On the other hand, the recent studies confirmed that the "bovine arch" and "Truncus bicaroticus" and the variant origin of the vertebral arteries cause the vascular insufficiencies and become the major risk factors for the neurological symptoms, need the emergency critical care attention [25, 26, 27, 28].

Recently, it is well identified that the suspicion exists with the "bovine arch" and "Truncus bicaroticus" trunk Aortic arches, leads to sudden severe neurological complications due to the wide range of atheromatous plaques and congenital aneurysms, may cause medical emergencies and critical care attentions.

In this study, we elaborated the embryological basis behind the common human aortic arch variations with the combinations of unusual left aortic arch origin of left vertebral arteries. These variations in the aortic arch arterial patterns and their absolute ontogenesis, until then not documented.

The present study aimed to through the insight knowledge about the ontogenesis of these common variants aortic arches, called "the Bovine and the Truncus bicaroticus". Radiology reports are advised to overlook for the Bovine and Truncus bicaroticus Aortic arches, as the true silent killers for the precautionary efforts to rule out the TAA. In this sense, the objective of this study recommends the radiologists, to consistently report for the anatomy of Bovine and Truncus bicaroticus Aortic arches, during the thoracic scans, for the purposes of serial follow-up to monitor to analyze the development and its complications of TAA, and this is the "relative literature state of the art" of this study. The present case may provide useful information in the different fields of Anesthesia, Head & neck and thoracic surgeries, Emergency and Critical care units.

References

1. Osborn AG. The Aortic arch and great vessels. In: Diagnostic Cerebral Angiography. 2nd ed. Philadelphia, Pa: Lippincott Williams & Wilkins; 1999:3–29

2. Shaw JA, Gravereaux EC, Eisenhauer AC. Carotid stenting in the Bovine arch. Catheter Cardiovasc Interv 2003; 60:566–69

3. Lippert H, Pabst R. Aortic arch. In: Arterial Variations in Man: Classification and Frequency. Munich, Germany: JF Bergmann-Verlag; 1985:3–10

4. Deutsch L. Anatomy and angiographic diagnosis of extracranial and intracranial vascular disease. In: Rutherford RB, ed. Vascular Surgery. Philadelphia, Pa: Elsevier Saunders; 2005:1916–57

5. Layton KF, Kallmes DF, Cloft HJ, Lindell EP, Cox VS. Bovine Aortic arch variant in humans: clarification of a common misnomer. AJNR Am J Neuroradiol 2006; 27:1541-1542.

6. De Garis CF, Black IB, Riemenschneider EA. Patterns of the Aortic arch in American white and Negro stocks, with comparative notes on certain other mammals. J Anat 1933; 67:599–618

7. Becker C, Csatari Z, Pfeiffer J. Truncus bicaroticus: an underestimated anatomic variation. Laryngoscope. 2014; 124 (5): 1141-2.

8. Hornick M1, Moomiaie R, Mojibian H, Ziganshin B, Almuwaqqat Z, Lee ES, Rizzo JA, Tranquilli M, Elefteriades JA. 'Bovine' aortic arch - a marker for thoracic aortic disease. Cardiology. 2012; 123(2):116-24.

9. Williams PL. Gray's Anatomy. New York: Churchill Livingstone; 1995:312–15

10. Bogousslavsky J; Van Melle G, Regli F. The Lausanne Stroke Registry: analysis of 1,000 consecutive patients with first stroke. Stroke 1998;19:1083–92

11. Ganesh Elumalai, Sushma Chodisetty, Pavan Kumar D.2016. Ganesh Elumalai et al Classification of Type - I and Type - II "Branching Patterns of the Left Arch Aorta". Imperial Journal of Interdisciplinary Research. 2(9): 161-181.

12. Ganesh E, Sushma C. The deer horn aortic arches" embryological basis and surgical implications. Anatomy Journal of Africa. 5: 746 – 759.

13. Jeng JS, Yip PK. Evaluation of vertebral artery hypoplasia and asymmetry by colorcoded duplex ultrasonography. Ultrasound Med Biol 2004;30:605–9.

14. Perren F, Poglia D, Landis T, et al. Vertebral artery hypoplasia: A predisposing factor for posterior circulation stroke? Neurology 2007;68:65–7.
15. Min JH, Lee YS. Transcranial doppler ultrasonographic evaluation of vertebral artery hypoplasia and aplasia. J Neurol Sci 2007;260:183–7.
16. Befeler B, Aranda MJ, Embi A, Mullin FL, El-Sherif N, Lazzara R. Coronary artery aneurysms: study of the etiology, clinical course and effect on left ventricular function and prognosis. Am J Med 1977;62:597–607.
17. Daoud AS, Pankin D, Tulgan H, Florentin RA. Aneurysms of the coronary artery. Report of ten cases and review of literature. Am J Cardiol 1963;11:228–37.
18. Stajduhar KC, Laird JR, Rogan KM, Wortham DC. Coronary arterial ectasia: increased prevalence in patients with abdominal aortic aneurysm as compared to occlusive atherosclerotic peripheral vascular disease. Am Heart J 1993;125: 86–92.
19. Peker O, Ozisik K, Islamoglu F, Posacioglu H, Demircan M.Multiple coronary artery aneurysms combined with abdominal aortic aneurysm. Jpn Heart J 2001;42:135–41.
20. Phan T, Huston J 3rd, Bernstein MA, Riederer SJ, Brown RD Jr. Contrastenhanced magnetic resonance angiography of the cervical vessels: experience with 422 patients. Stroke. 2001;32(10):2282-6.
21. Jeng JS, Yip PK. Evaluation of vertebral artery hypoplasia and asymmetry by colorcoded duplex ultrasonography. Ultrasound Med Biol 2004;30:605–9.
22. Habel RE, Budras KD. Thoracic cavity. In: Bovine Anatomy: An Illustrated Text. Hanover, Germany: Schlu¨tersche GmbH & Co; 2003:62–65
23. Cloud GC, Markus HS. Diagnosis and management of vertebral artery stenosis. QJM 2003; 96:27–54.
24. Trattnig S, Hubsch P, Schuster H, et al. Color-coded doppler imaging of normal vertebral arteries. Stroke 1990; 21:1222–5.
25. Perren F, Poglia D, Landis T, et al. Vertebral artery hypoplasia: A predisposing factor for posterior circulation stroke? Neurology 2007;68:65–7.
26. Chuang YM, Huang YC, Hu HH, et al. Toward a further elucidation: Role of vertebral artery hypoplasia in acute ischemic stroke. Eur Neurol 2006;55:193–7.
27. Park JH, Kim JM, Roh JK. Hypoplastic vertebral artery: Frequency and associations with ischaemic stroke territory. J Neurol Neurosurg Psychiatry 2007;78:954–8.
28. Perren F, Poglia D, Landis T, et al. Vertebral artery hypoplasia: A predisposing factor for posterior circulation stroke? Neurology 2007;68:65–7.
29. Min JH, Lee YS. Transcranial doppler ultrasonographic evaluation of vertebral artery hypoplasia and aplasia. J Neurol Sci 2007;260:183–7.
30. Befeler B, Aranda MJ, Embi A, Mullin FL, El-Sherif N, Lazzara R. Coronary artery aneurysms: study of the etiology, clinical course and effect on left ventricular function and prognosis. Am J Med 1977;62:597–607.
31. Daoud AS, Pankin D, Tulgan H, Florentin RA. Aneurysms of the coronary artery. Report of ten cases and review of literature. Am J Cardiol 1963;11:228–37.
32. Stajduhar KC, Laird JR, Rogan KM, Wortham DC. Coronary arterial ectasia: increased prevalence in patients with abdominal aortic aneurysm as compared to occlusive atherosclerotic peripheral vascular disease. Am Heart J 1993;125: 86–92.
33. Peker O, Ozisik K, Islamoglu F, Posacioglu H, Demircan M.Multiple coronary artery aneurysms combined with abdominal aortic aneurysm. Jpn Heart J 2001;42:135–41.
34. Phan T, Huston J 3rd, Bernstein MA, Riederer SJ, Brown RD Jr. Contrastenhanced magnetic resonance angiography of the cervical vessels: experience with 422 patients. Stroke. 2001;32(10):2282-6.
35. Jeng JS, Yip PK. Evaluation of vertebral artery hypoplasia and asymmetry by colorcoded duplex ultrasonography. Ultrasound Med Biol 2004;30:605–9.
36. Habel RE, Budras KD. Thoracic cavity. In: Bovine Anatomy: An Illustrated Text. Hanover, Germany: Schlu¨tersche GmbH & Co; 2003:62–65
37. Cloud GC, Markus HS. Diagnosis and management of vertebral artery stenosis. QJM 2003; 96:27–54.
38. Trattnig S, Hubsch P, Schuster H, et al. Color-coded doppler imaging of normal vertebral arteries. Stroke 1990; 21:1222–5.
39. Perren F, Poglia D, Landis T, et al. Vertebral artery hypoplasia: A predisposing factor for posterior circulation stroke? Neurology 2007;68:65–7.
40. Chuang YM, Huang YC, Hu HH, et al. Toward a further elucidation: Role of vertebral artery hypoplasia in acute ischemic stroke. Eur Neurol 2006;55:193–7.
41. Park JH, Kim JM, Roh JK. Hypoplastic vertebral artery: Frequency and associations with ischaemic stroke territory. J Neurol Neurosurg Psychiatry 2007;78:954–8.
42. Caplan LR. Arterial occlusions: Does size matter? J Neurol Neurosurg Psychiatry 2007;78:916.