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Bovine Arch Variation Detected During Cerebral Digital Subtraction Angiography in Nepalese Population: A Retrospective Study

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Background: Anatomical variation of aortic arch play's significant role in diagnosing and planning further therapeutic intervention of cerebrovascular diseases. Objectives: Aim of this study was to review the neck vessels arising from the aorta and to determine the prevalence of aortic arch variation in digital subtraction angiography. **Materials and methods:**after ethical clearance from institutional review board, study was conducted retrospectively in 129 patients who underwent digital subtraction angiography for various reasons from December 2020 to December 2021. Age ranged between 21-87 years old. 88 were males and 41 were females. Mean age was 57.89.**Results:**bovine arch variations were found in 2.3% in our study population. Classic branching pattern was demonstrated in 97 % of studied cases. **Conclusion:** Determining bovine arch variation though rarely detected, is essential for diagnostic and therapeutic intervention of cerebrovascular conditions for uncomplicated navigation of catheters and guide wires.

Key words: Angiography, Bovine Arch, Cerebrovascular Diseases, DSA

Aortic arch is located in left side of the thoracic cage. It gives of three great vessels, brachiocephalic trunk (BCT), left common carotid artery (CCA), and left subclavian artery (SCA). BCT arises in the right side and left CCA originated in the middle of BCT and left CCA. BCT branches off right SCA and right CCA to irrigate right side of the head and neck. Above mention pattern is the classical one and usually found in 6.5-94.3% of the general population.[1] Aortic arch variations are commonly demonstrated in the origin site of the main branches, which are significant for diagnostic and therapeutic neuro intervention of cerebrovascular diseases.

Methods and Materials:

Study was conducted retrospectively in 129 patients who underwent digital subtraction angiography for various reasons from December 2020 to December 2021. Ethical clearance was obtained from the institutional review board of B and C hospital. Angiographic and clinical data were obtained from neurosurgical data base of the B and C hospital. Angiographic data were reviewed and analyzed in interventional centre of B and C hospital. 4-vessel DSA (digital subtraction angiography) was mandatorily performed in all cases under AXIUM Artis C arm unit (Siemens medical system, Germany). Anatomical configuration of aorta and its branches were

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studied in preliminary aortogram before selective supra-aortic angiography. SPSS version 20 (IBM, USA) was used for statistical analysis. Anatomical variant of aortic arch were identified and expressed in terms of prevalence of each variant. Age varied between 21-87 years old. 88 were male and 41 were female patients. Mean age was 57.89.

Results:

Aortic arch variations were found in 2.3% in our study population. Classic aortic branching pattern was demonstrated in 97.7% of studied cases.

Discussion:

Embryologically, aorta develops during the 3rd week of the gestation.[2] Subsequently six pairs of aortic arches develop between ventral and dorsal aorta. These arteries get fused to form bilateral dorsal aorta. During 3rd week of gestation, these dorsal aortas fuse caudally into a single descending aorta. First second and fifth arches then regress. The third arch forms the carotid arteries. Fourth arch on the right-side forms BCT and right SCA and left SCA on the left side. This embryological configuration turns into the fully developed classical aortic arch.

During fetal development some segments of aortic arch persist. Persistency of one or two segments gives rise to anomaly or variation in aortic arch after birth. There are several literatures published concerning arising point of the left common carotid artery from brachiocephalic trunk.[3] Two variation of bovine pattern has been mentioned. The most common branching variation is the occurrence of a common trunk from which both brachiocephalic trunk and left CCA arise. Type A described as presence of long bovine trunk with 4-6 cm length left CCA arising from the BCT. Type B described as presence of short bovine trunk with common origin point of BCT AND left LCA. This type of variation has been found in 11% of Caucasian white people and 25% of African American black population.[4] In this study, only 3 cases (2.3%) of bovine arch variation had been detected in DSA (**Figure 1**).

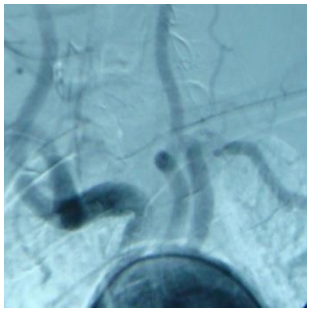

Figure 1: Aortogram picture showing normal of arising patterns of BCT, right subclavian left CCA and left subclavian artery

Most of the cases had classical pattern of aortic arch (97.7%) (**Figure 2**)

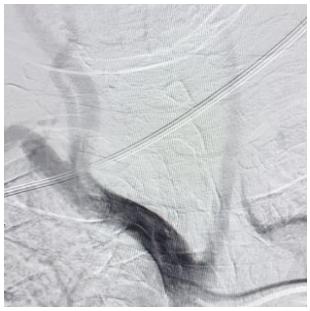

Figure 2: "Type B" bovine arch variation demonstrating both BCT and left CCA were arising from same root.

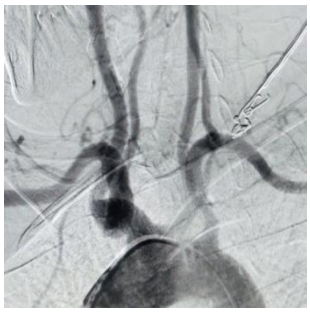

Figure 3: Aortogram in 46-year-old lady demonstrating "Type B" bovine arch variation

Bovine aortic variation is most common among other types of aortic arch variations reporting as 8-25% in the literature.[5] Bovine aortic arch variant is an aberrant origin of the left CCA with branching configuration. Left common carotid artery also originates from the BCT representing bovine or cattle horn. However, some authors conflict it as a misnomer.[6] Bovine variations are found to be associated with in-nominate transection in blunt

chest trauma.[7] Thoracic endovascular repair of aneurysm needs meticulous imaging of aortic arch configuration. This may complicate or contraindicate conventional stenting procedure. Unrecognized or misread aortic variants may lead to thromboembolic complication in brain and spinal cord. Presence of bovine arch is common reason for technical failure during catheter and guide wire navigation.[8] It is more vulnerable during carotid stenting procedure. Proper aortography before proceeding in for selective neck vessel angiography is obligatory to avoid vascular injury.

Wide range of tools and technology is required for successful completion of neuro intervention challenge. Availability of specific catheters does not always help for hooking up catheter and guide wire in vascular variations. It is a major challenge to accomplish even the most basic procedure in endovascular therapy.[9] Although proper equipment helps to intervene however proper anatomical variation has to be well known for accurate and timely intervention with much less radiation exposure. Thus, reduces thromboembolic complications as well. Besides risk of thromboembolic complications, vascular tear, vasospasm, pseudo-aneurysm formation, inadvertent rupture of cerebrovascular pathology may occur without anatomical knowledge of vascular variations. [9]

Suitable catheters have not yet been easily available in developing countries like ours. Each type of diagnostic cerebral angiography catheters has its specific task role. These are especially made to hook up in aortic arch variations for a-traumatic navigation for selective angiography.

Conclusion:

Aortic arch variation though rarely detected, one should have good knowledge about vascular variation for diagnostic and therapeutic intervention of cerebrovascular conditions for uncomplicated navigation of catheters and guide wires.

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