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Variations in Branching Pattern of Brachial Artery in Upper Limb- A Cadaveric Study and Medical Emergency.

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Abstract:
The present study was conducted in the Post Graduate Department of Anatomy, Government Medical College , Srinagar to observe the variations in the branching pattern of brachial artery. The aim of this study was to make clinicians, nurses as well as paramedical staff academically wiser and practically more competent while dealing with these anomalous branches during surgery and other interventional procedures. 30 upper limbs were studied. 16 limbs were dissected for routine teaching during 2015-2017 and 14 wet anatomical specimens were taken and observations regarding the branching pattern of brachial artery were recorded simultaneously. It was observedin our study that brachial artery divided high up in one left upper limb i.e. it was superficial or high up division. This anomalous branching pattern of brachial artery though rare, is of great academic and clinical significance in general practice &orthopaedic surgery. These anomalies should be kept in mind and given due honour while operating and intervening in this region for emergency management of injuries, correction of congenital anomalies and while performing other general and specialized surgical procedures.
Keywords: *Brachial artery, Radial artery, Ulnar artery, high up division, gangrene.*

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I. Introduction

The blood to the upper limb is supplied by four main arteries: Axillary, brachial, radial and ulnar. The axillary artery is the continuation of subclavian artery which at the lower border of teres major continues as brachial artery. The brachial artery continues down the arm and just distal to the elbow joint, at the level of neck of radius, it terminates into radial and ulnar arteries. It is the main artery of the arm. It is related in the upper part of arm to medial cutaneous nerve of forearm, which lies anterior to it. Median nerve crosses it from lateral to medial side in the middle part, and in the lower part by bicipital aponeurosis. Posteriorly it lies on long head of triceps, medial head of triceps and brachialis. Medial relations of brachial artery are ulnar nerve and basilic vein in upper part and median nerve in lower part. Laterally it is related to coracobrachialis and biceps. An arterial anastomosis is formed around elbow between branches of brachial artery and those from upper ends of radial and ulnar arteries. The various branches of brachial artery are profunda brachii (largest and first branch), muscular branches to anterior compartment of arm, nutrient artery to humerus, superior and inferior ulnar collateral arteries, and terminal branches, radial and ulnar arteries[1].

Brachial artery is used for recording blood pressure, pulsed Doppler Sonographic measurements and arteriography. Hence, knowledge of variations in the course and branching pattern of this artery is important. The brachial artery divides proximally into two trunks which may reunite or divide more proximally than usual and either bifurcate normally or trifurcate into radial,ulnar and common interosseous arteries[2].Brachial artery is also palpated before taking a venous sample from median cubital vein. At times brachial artery is located superficially and one may inject drugs into superficial brachial artery instead of cubital vein leading to vascular spasm, gangrene and loss of limb. This is the reason why anaesthetists prefer dorsum of hand over cubital fossa for giving intravenous injections.

II. Aims and Objectives

To find out the incidence of variations in branching pattern of brachial artery and compare it with earlier studies.

III. Materials and Methods

The present study was carried out in the Post Graduate Department of Anatomy, Government Medical College Srinagar, Kashmir, India. 30 upper limbs were taken for this study. They were dissected strictly following instructions given in the Cunningham's manual of practical Anatomy [3]. The origin, course, relations of brachial artery and its mode of termination in the cubital fossa was studied macroscopically. Special attention was given to the level of division of brachial artery into its terminal branches radial and ulnar arteries.

Appropriate photographs were taken and labelled as shown in figure [1].

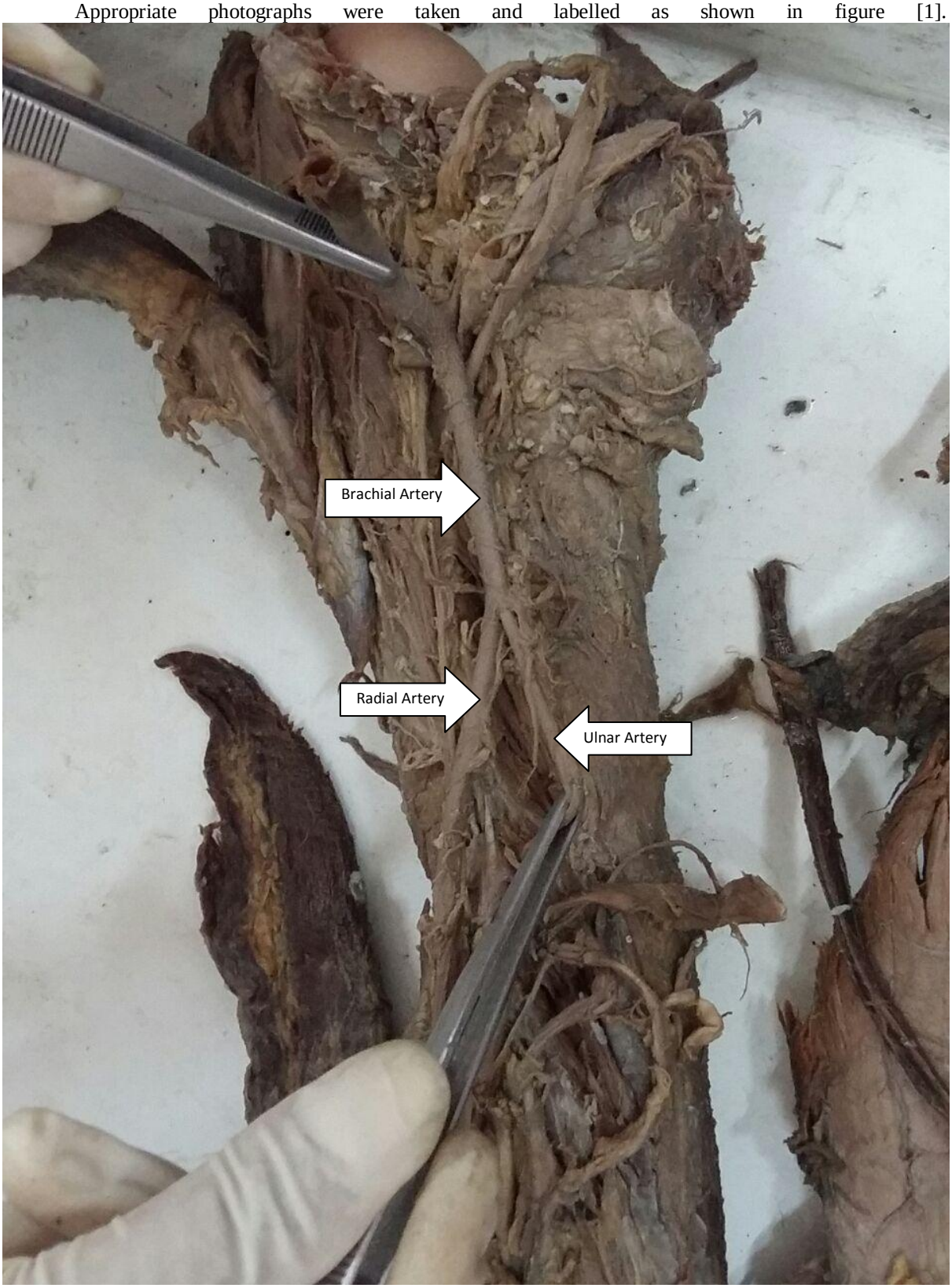

Fig:1

Fig:2

IV. Results

Out of 30 upper limbs taken for the study, high up brachial artery was found in one left upper limb specimen which was dividing into radial and ulnar arteries after a short course in the upper third of left arm, at the level of insertion of coracobrachialis. Radial and ulnar arteries were both of same calibre. Further distribution of these two arteries was normal. No other variation was found. In our study we did not find

symmetrical high up brachial artery in any of the cadavers. Out of 30 limbs, we found variation in brachial artery branching in one limb. This incidence of 3.33% is low as compared to earlier studies [4,5,6] that reported an incidence of 4.6-15.5%. This variation may be either due to small sample size of our study or racial differences. Keeping in view the great clinical implications of high brachial artery, it must be given due recognition and respect in academics and also during interventional procedures in this region.

V. Discussion

There are reports available in the literature related to the variable origin, course and the branching pattern of brachial artery in upper limb.It was first noted by Von Haller in 1813.The division of brachial artery can be determined with reference to line joining the epicondyles. The bifurcation of brachial artery above this line is designated as high division[7]. A comprehensive understanding of the possible arrangements of the arterial pattern of the upper limb is of great clinical importance [8,9,10]. The variation can be explained in the light of embryological development[11,12]. Classical theories of upper limb development assume that gradual sprouting of arterial trunks takes place from a primitive axial artery [13]. New models assume that upper limb arteries are formed as a result of isolation of main arterial trunks within the primitive capillary plexus and dominant vascular channels differentiate as a result of capillary remodelling[12,14]. According to Feinberg, ectodermal-mesenchymal interactions and extracellular matrix components within the developing limb bud are controlling the initial patterning of blood vessels.Further, there is a view that some inductive factors from the limb mesenchyme cause the changes in the blood vessel pattern [15].Arey in 1957 highlighted that, there may be persistence of vessels which normally obliterate and disappearance or failure of development of vessels which normally persist [16]. This reversal of the normal process of vascular development is largely due to altered local hemodynamic environment [8,14].Besides, many other regulators like genes, molecular signals and hemodynamic forces, may play an important role in the formation of definitive arterial pattern.The prevelance of high origin of brachial artery according to different authors varies from 4.67% to 15.6% [3, 4, 5, 6].

In 2011,Junior et al studied brachial artery variations in fifty six cadavers and observed a case of high division of brachial artery in upper one-third in both arms[17]. Satyanarayana et al reported a short segment brachial artery with high up division at level of coracobrachialis in the middle upper limb[18] similar to our study. Chandrika teli et al reported a case in which brachial artery divided into radial and ulnar arteries in upper one-third of arm just distal to teres major[19].Kumar and Rathnakar[20] reported a case of high division of brachial artery into medial and lateral branches, 9.5 cm distal to the lower border of teres major muscle. It was also observed that the two branches are crossing over near the lower part of the front of arm, and the lateral branch continued into the cubital fossa and trifurcated at the proximal border of pronator teres muscle.Gupta et al [21]noted a short segment brachial artery bifurcating into radial and ulnar artery in the middle of the left arm. There are only a few references in the literature on sex and laterality about accessory brachial artery. Rodríguez-Niedenführ et al [11] reported that the incidence of superficial brachial artery was more frequent in males and on the right side.Our study has reported the divisionin a male in the left upper limb.

Major anatomical variations of upper limb arteries often coexist with the variations of radial recurrent arteries[6]. According to Compendium of Human Anatomic Variation,major variations are present in about 25% of the subjects. The variations in the form of high proximal division into terminal branches occur in the radial artery (15%), ulnar artery (2%) and common interosseous artery. This high division may occur at any point in the normal course of the vessel, but it is more common in the middle third[22].Campta highlighted diagnostic, interventional and surgical significance of such a variation. Diagnostically this type of variation may disturb the evaluation of angiographic images[23]. High division of brachial artery presenting with acute ischemia secondary to embolism was reported. The anomaly was identified and ischemia successfully resolved with embolectomy[24,25].

VI. Summary and Conclusion

The short segment brachial artery and its variant termination in the form of high up bifurcation as noted in the present study are fairly common. The case can be explained in the light of embryological development. In addition, knowledge of such variation is important in the field of orthopedic, vascular and plastic surgeries. Knowledge of such variation is extremely important, especially for the limb surgeons (for carrying out surgeries in arm, creating arteriovenous fistulas for dialysis), flap surgeries, coronary artery bypass by the radial artery, fasciotomy to treat acute compartment syndrome, and limb amputations, routine blood pressure measurements, radiographic imaging and interventionists.Cardiac ventriculography is done using brachial artery when femoral artery is inaccessible.Such variation can cause confusion while performing arteriovenous (AV) fistula involving the radial artery and the cephalic vein to treat chronic renal failure.With the use of advanced techniques in microvascular reconstructive surgeries, it is important to have a thorough knowledge of vascular variations. The purpose of this study is to highlight the need for the awareness of the potential existence of such anatomical variations and how it can be preoperatively detected by non-invasive color Doppler imaging and MR

angiography, which would help the surgeons and clinicians to plan out surgery and therapeutic interventions, and prevent diagnostic errors and iatrogenic trauma.

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