

## AN ANATOMICAL INSIGHT INTO HIGH DIVISION OF BRACHIAL ARTERY: A STUDY IN 40 CADAVERS

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### ABSTRACT

**Objectives:** To document the variations in the termination of brachial artery with its high up division into radial and ulnar arteries in the arm and to establish embryological and clinico-anatomical correlations of such variation.

**Material and Methods:** The findings were noted after thorough and meticulous dissection of the upper limbs of both sides (axilla, arm, cubital fossa and forearm) of 40 cadavers in the Department of Anatomy, Bhaskar medical college, India. Photographic documentation of the variation was also made.

**Results:** Variations were reported in 4 cadavers. An unusually short segment of brachial artery was noted in two cadavers. This short segment brachial artery bifurcated more proximally just 2cm below the lower border of teres major into radial and ulnar arteries. Of these two, in one cadaver radial artery was thin, laterally placed and superficial throughout its course. Ulnar artery was medial and accompanied the median nerve. In the other cadaver, radial artery was medial initially and then wound round the median nerve to run lateral to it. It was medial to the ulnar artery throughout the arm and crossed it to course laterally in the cubital fossa. Ulnar artery was thin compared to radial artery. In other two cadavers the brachial artery divided into radial and ulnar arteries in the lower 1/3 of the arm. Further course and distribution of these two arteries was normal.

**Conclusion:** The variation can be explained in the light of embryological development. In addition, knowledge of such variation is important for carrying out surgical procedures in the arm.

**KEY WORDS:** Brachial Artery, High Division, Bifurcation, Ulnar Artery, Radial Artery, Cubital Fossa.

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### INTRODUCTION

The brachial artery, a continuation of the axillary artery, begins at the inferior border of the tendon of teres major and ends about a centimeter below the elbow joint (at the level of neck of radius) by dividing into radial and ulnar arteries. At first it is medial to the humerus, but gradually spirals anterior to it until it lies midway between the humeral epicondyles. Its pulsation can be felt throughout.

Variants are described like occasionally the artery divides more proximally into two trunks which reunite. Frequently it divides more proximally than usual into radial, ulnar and common interosseous arteries. Most often radial branches arise proximally, leaving a common trunk for the ulnar and common interosseous arteries. Sometimes ulnar artery arises proximally from the brachial artery and the rest of the artery continues as a common

trunk for radial and common interosseous arteries. [1].

Such variations can be explained on the basis of embryonic development. According to Feinberg, ectodermal-mesenchymal interactions and extracellular matrix components within the developing limb bud are controlling the initial patterning of blood vessels [2].

There is a view that some inductive factors from the limb mesenchyme cause the changes in the blood vessel pattern [3].

Anson and Maddock (1952) divided the course of the brachial artery in three equal parts i.e., proximal 1/3, middle 1/3, and distal 1/3 [4]. High up division of the brachial artery can also be explained on the basis of observations made by Arey in 1957 where he highlighted that, there may be persistence of vessels which normally obliterate and disappearance or failure of development of vessels which normally persist [5]. This reversal of vascular development is largely due to altered local hemodynamic environment [6].

Brachial artery is used in routine procedures like blood pressure recordings and arteriography of different parts of the body. Variation in the branching pattern of brachial artery is noteworthy for vascular surgeons particularly in cases involving traumatic injuries. Radiologists also must be aware of these kinds of variations during various imaging studies. Distal part of brachial artery is chosen for pulsed Doppler sonographic measurements [7].

The objective of our study is to discuss the anatomy, embryological reasons for these kind of variations and clinical significance along with review of literature.

## MATERIALS AND METHODS

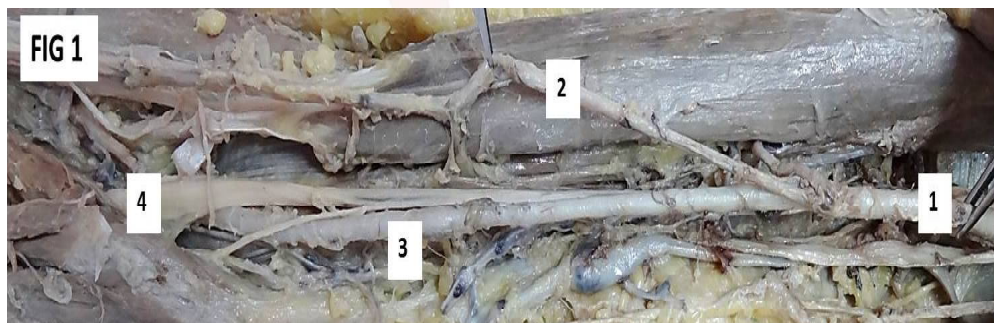
This study was carried out on 80 upper limbs of 40 formalin fixed cadavers during routine gross anatomy dissections for the undergraduate students over a period of five years (2010-2015) in the department of anatomy, Bhaskar medical college, Hyderabad, India. A longitudinal incision was made on the anterior aspect of both arms extending from the acromion process to the point 2.5 cm below the elbow joint. The incision was extended horizontally from both ends of the initial longitudinal incision. The skin was reflected carefully along with the subcutaneous fascia. The brachial artery was traced proximally to see the continuity with the axillary artery at the level of lower border of teres major. Distally in the cubital fossa, the bicipital aponeurosis was divided and brachial artery was traced up to its bifurcation.

## OBSERVATIONS

Among the 40 cadavers variations were found in four cadavers.

**Cadaver I:** High division was found in right arm. The brachial artery divided into radial and ulnar arteries 2cm below the lower border of teres major. Radial artery was thin, laterally placed and superficial throughout its course. Ulnar artery was medial and accompanied the median nerve. (Fig 1)

**Fig. 1:** High division of brachial artery into radial and ulnar arteries in the upper 1/3 of the arm in right arm. (1- Brachial artery, 2- Radial artery, 3- Ulnar artery, 4- Median nerve)

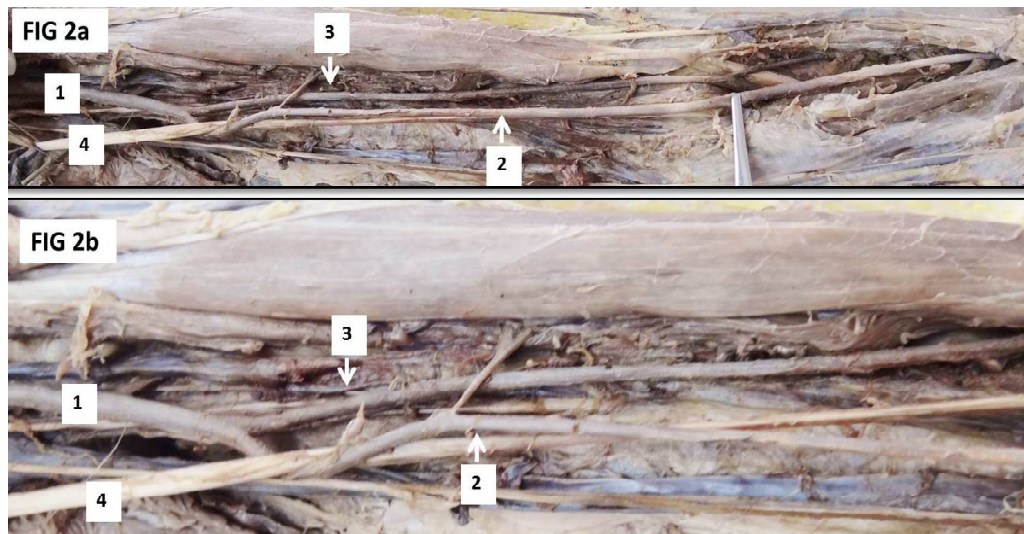


**Cadaver II:** High bifurcation was found in left arm. The brachial artery divided into radial and ulnar arteries 2cm below the lower border of teres major. Radial artery was medial initially and then wound round the median nerve to run

lateral to the median nerve. It was medial to the ulnar artery in the arm and then crossed it to course laterally in the cubital fossa. Ulnar artery was thin compared to radial artery. (Fig 2a & 2b)

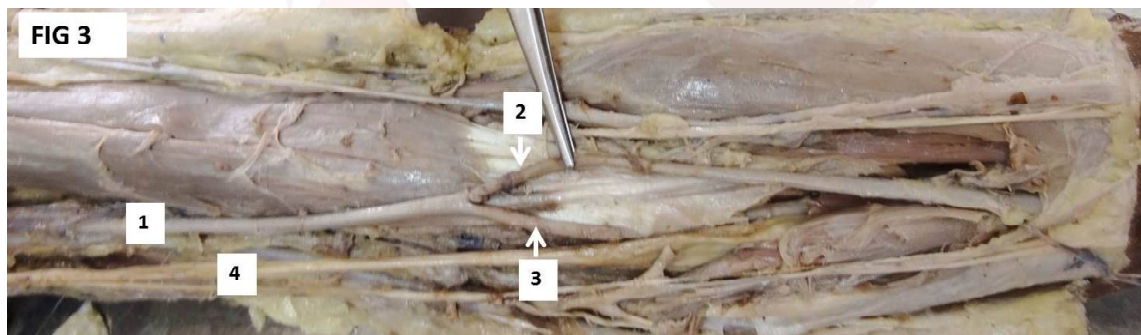


**Fig. 2:** High bifurcation of brachial artery in left arm. The brachial artery divided into radial and ulnar arteries 2cm below the lower border of teres major. Radial artery was medial initially and then wound round the median nerve to run lateral to the median nerve. It was medial to the ulnar nerve in the arm and then crossed lateral to the ulnar artery in the cubital fossa. Ulnar artery was thin compared to radial artery. (1- Brachial artery, 2- Radial artery, 3- Ulnar artery, 4- Median nerve)



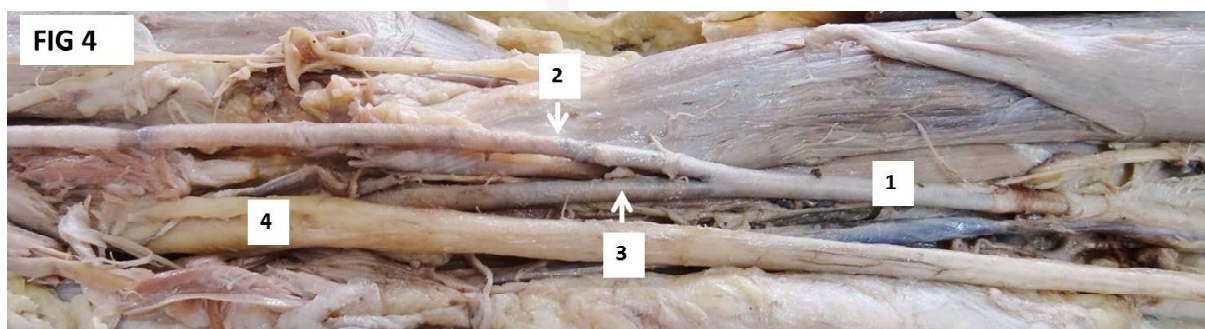
**Cadaver III:** High division was found in left arm. Brachial artery bifurcated into radial and ulnar arteries in the lower 1/3 of the arm over the tendon of biceps brachii. Radial artery was lateral and ulnar artery was medial. (Fig 3)

**Fig. 3:** High division of brachial artery into radial and ulnar in left arm in the lower 1/3 of the arm over the tendon of biceps brachii. Radial artery was lateral and ulnar artery was medial. (1- Brachial artery, 2- Radial artery, 3- Ulnar artery, 4- Median nerve)



**Cadaver IV:** High bifurcation was found in right arm. Brachial artery divided into radial and ulnar arteries in the lower 1/3 of the arm just above the formation of biceps brachii tendon. Radial and ulnar arteries placed lateral and medial respectively. (Fig 4)

**Fig. 4:** High bifurcation of brachial artery divided into radial and ulnar arteries in the lower 1/3 of the in right arm just above the formation of biceps brachii tendon. Radial and ulnar arteries placed lateral and medial respectively. (1- Brachial artery, 2- Radial artery, 3- Ulnar artery, 4- Median nerve)



The course of the radial and ulnar arteries was normal in the 3<sup>rd</sup> and 4<sup>th</sup> cases.

## DISCUSSION

Arterial variations in the upper limb were noted for the first time by Von Haller in 1813 [8,9]. It is not uncommon to find variation in the branching pattern of arteries of upper limb [10].

The anomalies of various blood vessels of upper extremity can be explained on the basis of embryological development of vascular plexus of limb buds. The early limb bud receives blood via intersegmental arteries, which contribute to a primitive capillary plexus. At the tip of the limb bud, there is a terminal plexus that is constantly renewed in a distal direction as the limb grows. Later one main vessel supplies the limb and the terminal plexus; it is termed the axis artery [6,11].

The brachial artery is the proximal part of the axis artery while the distal portion, beyond the cubital fossa is the interosseous artery. The radial and ulnar arteries arise relatively late in development as new vessels branching from brachial and interosseous arteries respectively [12].

Arey and Jurjus mentioned six explanations for the variations in the blood vessels of upper limb [5,12].

1. The choice of unusual paths in the primitive vascular plexus.
2. The persistence of vessels which are normally obliterated.
3. The disappearance of vessels which are normally retained.
4. An incomplete development.
5. The fusion and absorption of parts which are normally distinct.
6. A combination of factors leading to an atypical pattern normally encountered.

Singer [13] staging of development:

Stage 1: The lateral branch of seventh intersegmental artery, i.e., subclavian artery extends to the wrist and terminates by forming capillary plexus; its distal portion forms the anterior interosseous artery.

Stage 2: Median artery arises from the anterior interosseous artery grows along the median nerve to communicate with palmar capillary plexus. By this time the anterior interosseous

artery undergoes regression.

Stage 3: The ulnar artery arises from brachial artery and unites distally with the existing median artery to form superficial palmar arch.

Stage 4: The superficial brachial artery develops in axillary region from the axial trunk and traverses the medial surface of the arm, runs diagonally from the ulnar to the radial side of the forearm to the posterior surface of the wrist to divide over the carpus into digital branches.

Stage 5: Three changes occur simultaneously, the median artery regresses to a small slender vessel, familiar in adult life as the *arteria nervi mediana*.

Shewale et al reported a case of termination of brachial artery at its commencement below the lower border of the teres major [14].

Chandrika Teli et al reported a case of high division of brachial artery into radial and ulnar arteries, about 1.5cm distal to the lower border of the teres major muscle in the upper third of the arm [15]. Our study reports two such cases. But in our study, in both cases, brachial artery divided 2cm below the lower border of teres major. There is a case reporting division of the brachial artery in the upper third of the arm into radial and ulnar arteries about 4cm distal to the lower border of teres major muscle [16]. Sharad kumar et al reported a case of high division of brachial artery in the middle of the arm with radial artery giving rise to the common interosseous artery in the cubital fossa which terminated into anterior and posterior interosseous arteries [17].

Jacomo et al reported a case of high division of brachial artery in the proximal portion of the middle of the arm into radial and ulnar arteries of which ulnar artery gave rise to common interosseous artery [18].

Namani satyanarayana et al reported a case of high division of brachial artery at the level of insertion of coracobrachialis muscle in the middle of right arm [19].

Our study showed 2 cases where brachial artery divided below the coracobrachialis. Rossi Junior et al reported a case of high division of brachial artery in their study on 56 cadavers. The division of brachial artery observed by them is situated 20cm above the cubital fossa and 8.5cm



below the axilla in the right arm and 21.5cm above the cubital fossa and 7cm below the axilla in the left arm [20].

## CONCLUSION

Variations in the arterial pattern of the arm and forearm are not uncommon. These variations have an embryological basis and need to be taken into consideration while analyzing arteriograms and planning surgeries in the upper extremity. The study of basic anatomy is important for understanding circulation of blood to improve the operative outcome. Orthopaedic surgeries around the elbow, accidental crush injuries leading to haemorrhage need special mention. Superficial radial artery can be mistaken for a vein and accidental injection of certain drugs into this artery leads to disastrous gangrene [21]. Present study helps to flash little more light on the variations of brachial artery termination.

**Conflicts of Interests: None**

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