

Variations in the Terminal Branches of Brachial Artery- A Cadaveric Cross-sectional Study

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ABSTRACT

Introduction: Brachial Artery (BA) begins as a continuation of axillary artery at the distal border of teres major, it appears in the cubital fossa, where it ends at the level of the neck of radius by dividing into radial and ulnar arteries. Common Interosseous Artery (CIA) is the largest branch of Ulnar Artery (UA) and arises in the cubital fossa. The terminal branches of BA at elbow are clinically important since they are responsible for the arterial supply to the forearm and hand. These arteries may get damaged during fractures of the elbow.

Aim: To know the variations in the terminal branches of the BA at elbow.

Materials and Methods: The present cross-sectional cadaveric study was done on 40 upper limbs from embalmed adult human cadavers in the Department of Anatomy, Kamineni Institute of Medical Sciences, Narketpally, Telangana, India, from August 2017 to August 2019. Dissection of BA in arm and cubital fossa was carried

out according to Cunningham's manual of practical anatomy. The distance of division of BA into radial and UA and distance of origin of CIA from Inter Epicondylar Line (IEL) of humerus were noted.

Results: In present study, 20 right-side specimens and 20 left-side specimens were obtained. Among 20 cadavers used, 16 were male cadavers and four were female cadavers. The mean distance (D1) of normal division of BA into the Radial Artery (RA) and UA at elbow was 2.8 cm Below the imaginary line joining the medial and lateral epicondyles of the humerus (IEL). The mean distance (D2) of normal origin of CIA was 6.8 cm below the imaginary line joining the medial and lateral epicondyles of the humerus (IEL). CIA arising from the UA was present in 37 specimens (92.5%) and in the rest three specimens Anterior Interosseous Artery (AIA) and Posterior Interosseous Artery (PIA) arose directly from the UA.

Conclusion: The present study has found variations in site of division of terminal branches of the BA at elbow in three specimens.

Keywords: Common interosseous artery, Cubital fossa, Elbow, Radial artery

INTRODUCTION

Cubital fossa is a triangular fossa at the front of the elbow. The base of the fossa is a line drawn between the two epicondyles of the humerus, the medial border is formed by pronator teres muscle and lateral border is formed by the brachioradialis muscle. The floor is formed by the brachialis and supinator muscles. The median nerve, BA, and tendon of biceps enter the cubital fossa. Here, the BA divides into radial and ulnar arteries. The RA leaves the fossa at the apex, the UA passes deep to pronator teres [1]. In cubital fossa the bicipital aponeurosis covers and protects the median nerve and BA, and it separates them from the median cubital vein [2].

The BA normally divides into the radial and ulnar arteries at the level of the neck of the radius in the cubital fossa. The smaller RA passes inferolaterally between brachioradialis and flexor carpi radialis to reach the anterior surface of the distal end of the radius between the tendons of these muscles. Here, the artery can be felt readily (radial pulse) against the bone. The UA passes inferomedially deep to the median nerve and the muscles arising from the medial epicondyle of the humerus and the coronoid process of the ulna. It descends vertically with ulnar nerve to pierce the deep fascia just proximal to the flexor retinaculum, between the tendons of flexor carpi ulnaris and flexor digitorum superficialis. The CIA is the principal branch of the UA in the forearm. It passes to the upper border of the interosseous membrane. Here, it divides into anterior and posterior interosseous arteries. The Posterior Interosseous Artery (PIA) passes above the interosseous membrane to the back of the forearm. The Anterior Interosseous Artery (AIA) descends on the front of the interosseous membrane and pierces the interosseous membrane at the upper border of pronator quadratus to enter the back of the forearm [1]. The cubital fossa contains the following structures, enumerated from the medial to the lateral side: the median nerve, the bifurcation of the BA into the ulnar and radial arteries, the tendon of the biceps muscle, and the radial nerve and its deep branch [3].

Sometimes the BA divides at a more proximal level than usual. In other cases, the UA passes superficial to the flexor muscles within the superficial fascia [2]. These variations must be kept in mind when performing venesections (incisions into a vein) at the elbow. If an aberrant artery is mistaken for a vein and certain drugs are injected into it, the result can be disastrous resulting in partial or total loss of the hand [2].

The arteries of the upper limb can be damaged by penetrating wounds or may require ligation in amputation operations. A clinician must know where the arteries of the upper limb can be palpated or compressed in an emergency [3]. There are only few studies have done to determine the distance of origin of radial and UA from a fixed line [4-6]. The authors did not found studies, which evaluated the distance of origin of CIA from IEL. The results of the present study may be useful in various surgical procedures in the cubital fossa at elbow for surgeons, orthopaedicians, vascular surgeons, physicians and clinicians.

Hence, present study was conducted to note the variations in the terminal branches of the BA at elbow. Present study is the part of a larger project and part of the study is already published [7].

MATERIALS AND METHODS

The present cross-sectional cadaveric study was conducted in the Department of Anatomy, Kamineni Institute of Medical Sciences, Narketpally, Telangana, India, over a period of two years from August 2017 to August 2019.

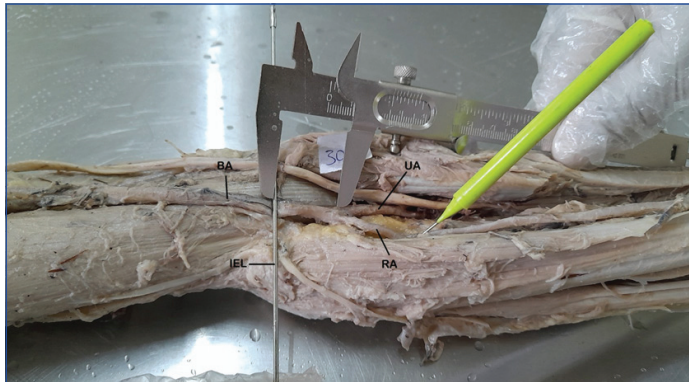
Inclusion criteria: Upper limbs specimen from embalmed adult human cadavers of both sexes, in good condition without external cut marks were included.

Exclusion criteria: All damaged specimens were excluded.

Sample size calculation: A total of 40 upper limb specimens fixed in 10% formalin solution were procured from the Department of Anatomy.

Study Procedure

Dissection of BA in arm and cubital fossa was carried out according to Cunningham's manual of practical anatomy [1]. According to Cunningham's manual of practical anatomy [1], skin was incised from the cubital fossa. BA was identified and cleaned. The Radial Artery (RA), Ulnar Artery (UA), CIA, AIA, PIA were identified and cleaned. The distance of division of BA into radial and UA from IEL of humerus (D1) was noted [Table/Fig-1]. The distance of origin of CIA from IEL of humerus (D2) was noted [Table/Fig-2]. A vernier caliper was used to take the measurements from an imaginary transverse line at elbow, joining the medial and lateral epicondyles of the humerus (IEL). Photograph was taken for the specimen by digital camera (Samsung A10S).



[Table/Fig-1]: Measurement of distance of normal division of Brachial Artery (BA) into Radial (RA) and Ulnar Artery (UA) from Inter Epicondylar Line (IEL) of humerus (IEL) using vernier caliper (D1).



[Table/Fig-2]: Measurement of distance of origin of Common Interosseous Artery (CIA) from Inter Epicondylar Line (IEL) of humerus using vernier caliper (D2).

STATISTICAL ANALYSIS

The mean, median, mode, standard deviation was calculated using calculator.net software.

RESULTS

In present study, 20 right-side specimens and 20 left-side specimens were obtained. Among 20 cadavers used, 16 were male cadavers and four were female cadavers. CIA arising from the UA was present in 37(92.5%) specimens. CIA was absent in 3 (7.5%) specimens and in such cases AIA and PIA arose directly from the UA [Table/Fig-3].

The mean distance (D1) of normal division of BA into the RA and UA at elbow was 2.8 ± 0.6 cm Below the imaginary line joining the medial and lateral epicondyles of the humerus (IEL) of the humerus. The median value was 3 cm. The mode value was 2 cm. The range value was 2 cm with minimum value of 2 cm and maximum value of 4 cm. The mean distance (D2) of normal origin of CIA was 6.8 ± 1 cm below the imaginary line joining the medial and lateral epicondyles of the humerus (IEL). The median value was 6.8 cm. The mode value was 6 cm. The range value was 3.2 cm with minimum value of 5 cm and maximum value of 8.2 cm [Table/Fig-4,5].



[Table/Fig-3]: Terminal branches of brachial artery at elbow. Brachial Artery (BA), Radial Artery (RA), Ulnar Artery (UA), Anterior Interosseous Artery (AIA), Posterior Interosseous Artery (PIA). Common Interosseous Artery (CIA) was absent. Anterior Interosseous Artery (AIA) and Posterior Interosseous Artery (PIA) were arising directly from Ulnar Artery (UA).

Distance (cm)	Mean (cm)	Median	Mode	Minimum	Maximum
Distance of normal division of BA into RA and UA from IEL (D1)	2.8 ± 0.6	2 cm	3 cm	2 cm	4 cm
Distance of origin of CIA from IEL (D2)	6.8 ± 1	6.8 cm	6 cm	5 cm	8.2 cm

[Table/Fig-4]: D1-Distance of normal division of Brachial Artery (BA) into Radial Artery (RA) and Ulnar Artery (UA) and D2-Distance of origin of Common Interosseous Artery (CIA) from Inter Epicondylar Line (IEL) of humerus.



[Table/Fig-5]: D1- Distance of normal division of Brachial Artery (BA) into Radial (RA) and Ulnar Artery (UA) from Inter Epicondylar Line (IEL) of humerus (IEL). D2- Distance of origin of Common Interosseous Artery (CIA) from Inter Epicondylar Line (IEL) of humerus.

DISCUSSION

In present study, variations were found in 3 (7.5%) specimens and in such cases AIA and PIA arose directly from the UA. BA divides into radial and UA. Datta AK mentions, RA begins in the cubital fossa about 1 cm below the bend of elbow at the level of neck of radius and just medial to the tendon of biceps brachii [8].

In the present study, the mean distance of normal division of BA into the RA and UA at elbow was 2.8 cm below the IEL of humerus. The median value was 3 cm. The mode value was 2 cm. The range value was 2 cm with minimum value of 2 cm and maximum value of 4 cm. Kadel M mentions in his study on 53 upper limb specimens, the origin of RA was 34.5 ± 6.31 mm below the level of the intercondylar line of the humerus [9]. Nasr AY found in his study on 100 upper limb specimens, mean distance of the normal origin of the RA, as one of the two terminal branches of BA was 3.87 ± 0.95 cm in men and

3.65±0.85 cm in women below the intercondylar line [4]. Present study findings are comparable to the findings of Nasr AY and Kadel M [4,9]. In the present study, CIA arising from the UA was present in 37 specimens (92.5%). CIA was absent in three specimens (7.5%) and in such cases AIA and PIA arose directly from the UA. Talalwah WA et al., mentions in their study on 34 adult cadavers, the CIA present in 67.6%, whereas it is congenital absence in 32.4% [10]. Present study confirms such variation of the absence of CIA.

Sawant SP and Dope SA reported a variation in the termination of a BA in right upper limb of a 70-year-old male cadaver, where, trifurcation of BA into the radial, ulnar and CIA was observed [11]. Sargon M and Cellik HH reported that, the CIA, a branch of ulnar, originated at the level of the humeral intercondylar line from the BA, instead originating from distal part of cubital fossa [12]. Satheeshnaik K and Lokanadham S reported, an unusual origin of an arterial trunk from RA in the right upper limb giving rise to CIA [13]. Babae S and Baazm M reported the origin of CIA from RA [14]. Present study has no such findings. The authors observed AIA and PIA arose directly from the UA. The distance of origin of radial, ulnar and common interosseous arteries from IEL of humerus is useful during surgical procedures. These arteries may get damaged during fractures of the elbow.

Limitation(s)

The study was conducted in single Institution with small sample size.

CONCLUSION(S)

In present study, variation was found in 7.5% specimen. CIA was absent in 3 (7.5%) specimens and in such cases AIA and PIA arose directly from the UA. The present study provides valuable information of distance of normal division of BA into radial and ulnar arteries and distance of origin of CIA from the IEL of the humerus at elbow, which may be useful during surgical procedures at elbow region such as fracture fixation. Future studies with large sample size should be conducted in different population, to know the variations in different ethnic groups.

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