



An anatomical study of variations in termination of brachial artery, with its embryological basis and clinical significance

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ABSTRACT

The brachial artery is the main artery of the arm. It begins as the continuation of 3rd part of axillary artery, at the level of inferior border of teres major muscle. It ends at the level of the neck of radius by dividing into radial and ulnar arteries. In the present study we found higher division of brachial artery at mid arm level into its terminal branches with superficial course of radial artery. The present study was done on 51 cadavers from our dept. of Anatomy. The upper limbs of the cadaver were dissected and observed for any variations in the branching pattern of brachial artery. In the present study, a total number of 51 cadaver's, 102 upper limbs were studied. In one male cadaver we found bilateral higher division of brachial artery, trifurcation on left side and bifurcation on right side brachial artery, with superficial course of radial artery. The knowledge of variation in origin and course of brachial artery is useful for orthopaedicians, physicians, radiologist, vascular and plastic surgeons.

Key words: brachial artery, higher trifurcation & bifurcation, superficial radial artery

INTRODUCTION

The brachial artery provides the main arterial supply to the arm. It begins as a continuation of axillary artery at the lower border of teres major muscle. At the level of the neck of radius it divides into its terminal branches, radial and ulnar arteries. In the proximal arm, the brachial artery lies on the medial side. In the distal arm, it moves laterally to assume a position midway between the lateral epicondyle and the medial epicondyle of the humerus. Median nerve crosses in front of the artery from lateral to medial side, at the middle of the arm. In the cubital fossa it is crossed by bicipital aponeurosis, where it lies immediately medial to the tendon of biceps brachii muscle. The brachial artery gives origin to arteria profunda brachii, nutrient artery, superior ulnar collateral artery, inferior ulnar collateral artery and muscular branches. There are wide variations in the termination and branching pattern of artery between the two halves of the same person. An accurate knowledge of the origin, course and branching pattern of these arteries of upper limb and its common variations has got clinical importance, especially in the field of orthopaedic, plastic and vascular surgeries, nephrologist, radiologist and also for diagnostic and therapeutic approaches^[1].

MATERIALS AND METHODS

The present study was done on 102 upper limbs of 51 embalmed cadavers. The cadavers were dissected carefully. We traced the brachial arteries proximally to the level of lower border of teres major where it continues with the axillary artery. Distally we traced towards the forearm for its further course of terminal arteries to observe any variations. The measurement of the brachial artery and its level of termination was taken at two levels. One from the lower border of teres major and other from the intercondylar line of humerus. Normal and abnormal terminations of the brachial artery were recorded and photographed.

RESULTS

In the present study, out of 102 upper limbs dissected, only one male cadaver of 65yrs, showed variation in the termination of brachial artery. We found higher division of terminal branches, at mid arm level. Though many articles reported variations in the division of brachial artery at various level, mid arm variations are relatively of rare occurrence.

The most interesting findings in this study was the higher division of brachial artery at mid arm level with trifurcation on left side upper limb and bifurcation on right side upper limb of the same cadaver. Such a variation was extremely rare.

On an average, the length of brachial artery was 26.29cm and its terminal branches 2.99cm distal to intercondylar line. Among the 102 upper limbs studied, a few limbs showed mild deviation from the normal bifurcation level. It ranged from 1.5 to 2cm just below the neck of the radius. And in a few limbs, the level of bifurcation was above the neck of radius ranged from 1 to 2cm. In 2 upper limbs, trifurcation and bifurcation occurs 13.5cm from the intercondylar line and 10.5cm from the lower border of teres major muscle.

DISCUSSION

Vascular anomalies involving the arteries of upper limb are common. Many anomalies involving the termination of brachial artery have been reported, but the termination of brachial artery at the mid arm level, with trifurcation on left side and bifurcation on right side upper limb of the same cadaver is extremely rare occurrence. Proximal to the terminal division of brachial artery, it gave origin to profunda brachii artery and branches to flanking muscles as it normally does.



Fig : 1 Bifurcation of brachial artery on right upper limb

(MN – median nerve, BA – brachial artery, RA – radial artery, UA – ulnar artery, SUCA – superior ulnar collateral artery)

On the right side upper limb, the brachial artery bifurcates at mid arm level into radial and ulnar arteries.

On the left side upper limb, the brachial artery trifurcates at mid arm level into radial, ulnar and superior ulnar collateral artery. In the arm, radial artery was seen lateral to the median nerve. In the forearm it had more superficial course accompanied by the tendon of the brachioradialis in its lateral side in lower part and flexor carpi radialis muscle on its medial side. So that the radial and ulnar arteries having a normal course in the forearm except the fact that the radial artery run superficial in the forearm.

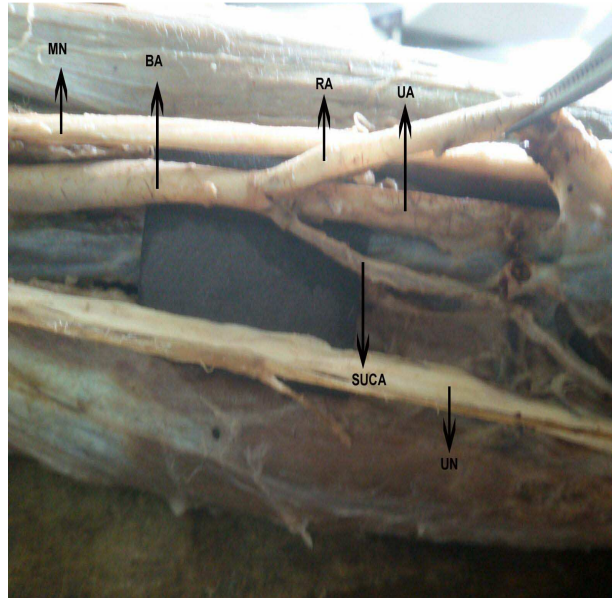


Fig:2 Trifurcation of brachial artery on left upper limb

(MN – median nerve, BA – brachial artery, RA – radial artery, UA – ulnar artery, SUCA – superior ulnar collateral artery, UN – ulnar nerve)

In the normal case the superior ulnar collateral arises a little distal to the middle of the arm. In this case it arises along with radial and ulnar arteries at mid arm level. Then it pierces the medial intermuscular septum along with the ulnar nerve to appear in the posterior compartment. But on the right side, it arise from the brachial artery just above its bifurcation at mid arm level. That also shows a slight variation in its origin.

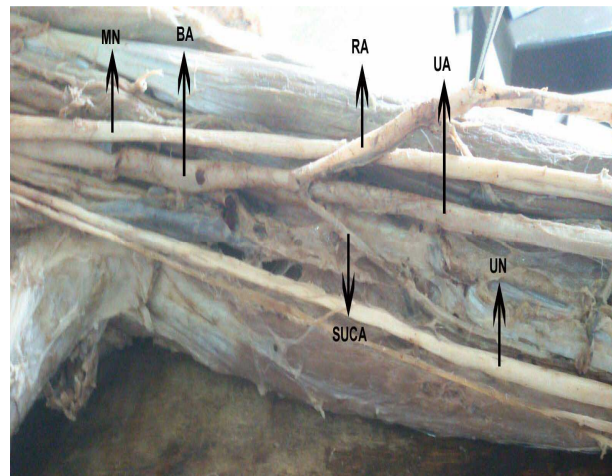


Fig:2 Trifurcation of brachial artery at mid arm level on left upper limb

(MN – median nerve, BA – brachial artery, RA – radial artery, UA – ulnar artery, SUCA – superior ulnar collateral artery, UN – ulnar nerve)

Embryological explanation

This type variation can be explained on the basis of embryogenic development. Limbs are supplied by axis artery that is derived from intersegmental arteries. The axis artery of the upper limb is derived from seventh cervical intersegmental or subclavian artery. This artery grows distally along the ventral axial line and terminates in a palmar capillary plexus in hand. Axillary artery, brachial artery, anterior interosseous artery and deep palmar arch develop from the main trunk of axis artery.

Radial and ulnar arteries develop later as sprouts of the axis artery close to bend of the elbow. Initially the radial artery arises more proximally than the ulnar artery. Later it establishes a new connection with the main trunk at or near the level of origin of the ulnar artery. Usually the upper portion of the original stem disappears. So that the radial and ulnar arteries arise at the same level^[11]. In the present study, both the radial and ulnar arteries arose more proximally from the brachial artery leading to its termination into radial and ulnar arteries a more proximal level near the middle of the arm. Persistence of upper portion of radial artery arising from the brachial artery proximal to the origin of ulnar artery and the failure of establishing new connection of the radial artery with brachial artery at the level of origin of the ulnar artery result in this type of variation^[3,4]. Various vascular variations of the upper limb results from the persistence or elimination of parts of these arteries.

In the upper part of the forearm, the superficial course of radial artery can be explained on the basis of haemodynamic mechanism between deep and superficial arteries of the forearm. Usually superficial terminal branches of radial artery undergo developmental arrest because of deep haemodynamic predominance and deep part persists as normal radial artery. But in this case deep part undergone regression and the superficial part persisted⁽⁵⁾.

The incidence of trifurcation and bifurcation of brachial artery in the same cadaver is a rare variation. Arey mentioned the following explanation for the variations in the blood vessels of the upper limb. I). Choice of unusual paths in the primitive vascular plexuses II). Persistence of vessels normally obliterated III). Disappearance of vessels normally retained IV. Incomplete development V). Fusion and absorption of the parts usually distinct^[6].

Clinical importance

The study was carried out to determine the correct position of the termination of brachial artery and its possible variations. Thorough knowledge about this type of variations is important during vascular and reconstructive surgery. Variation of the brachial artery may cause difficulties while measuring the blood pressure. Being superficial, the radial artery may be mistaken as a vein and the accidental injection of some drugs may cause reflex vascular occlusion, resulting in disastrous gangrene of hand⁽⁷⁾. The superficial course of radial artery can easily be injured by trauma.

Variations in the course and branching pattern of the brachial artery is of great importance in cardiac catheterization for angioplasty and arterial grafting. Arterial thrombosis, producing ischemia after radial cannulation, may be related to high risk of tissue gangrene or amputation⁽⁸⁾. Angiographic images and doppler ultrasound imaging is of considerable importance during invasive and non invasive investigative procedures due this kind of variations. So the surgeons should be aware of arterial variations in the region before embarking on the procedure..

CONCLUSION

The present study revealed higher termination with trifurcation & bifurcation of brachial artery on same cadaver. This study must be quite interesting for the clinicians to be aware of the possible variations in the branching pattern of the arteries in order to avoid complications in surgical and diagnostic procedures.

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