

## A STUDY ON VARIATIONS IN TERMINATION OF BRACHIAL ARTERY

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### ABSTRACT

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#### BACKGROUND

Variations in arterial system of upper limb is common. Branching pattern of brachial artery and their variations are very important in clinical practice. Surgical procedures in upper limb and cardiac intervention procedures require thorough knowledge of arterial system. It is also important for nephrologists to fix fistula in patients with chronic renal failure.

#### MATERIALS AND METHODS

This study is aimed at enumerating possible variations in termination of brachial artery. The study was done in 44 upper limbs. The length of brachial artery, branches particularly the terminal branches were examined and variations were recorded. There were 6 cases of higher bifurcation of brachial artery.

#### RESULTS

Out of 44 specimens studied, 38 showed normal division of brachial artery. Anomalous high division was noted in 6 cases.

#### CONCLUSION

Among six cases of high division of brachial artery, one was superficial brachial artery and rest were high origin of radial artery. Embryologic basis of variations are discussed in this study.

#### KEYWORDS

Brachial Artery, Radial Artery, Ulnar Artery, Variations, Superficial Brachial Artery.

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#### BACKGROUND

Brachial artery is the continuation of axillary artery. It commences from lower border of teres major and terminates at the level of neck of radius by dividing into radial artery and ulnar artery. During its course, it lies successively on long head of triceps, medial head of triceps and then on brachialis. As it enters the cubital fossa, it lies deep to bicipital aponeurosis. Median nerve crosses the artery superficially from lateral to medial side at the middle of arm. Brachial artery gives off profunda brachii artery, superior ulnar collateral, inferior ulnar collateral, nutrient artery and muscular branches. It terminates by dividing into ulnar and radial artery at level of neck of radius. The knowledge of arterial anatomy of upper limb and their variations in branching patterns are very much essential for vascular surgeons and orthopaedic surgeons in performing various surgical procedures and definitely for radiologists while doing investigative procedures. Coronary angioplasty through radial artery is a common procedure nowadays and

failure in procedure also reported due to anomalous branching pattern.<sup>1</sup>

#### Aims and Objectives

The variations in brachial artery have been documented by many previous researches. Superficial brachial artery is one of the commonest among them. This artery may arise at axilla or upper arm and crosses the median nerve superficially. McCormack, Cauldwell and Anson found that these superficial brachial arteries were unilateral and constitute about 18.53%.<sup>2</sup> The division of brachial artery can be determined with reference to line joining the epicondyles. The bifurcation of brachial artery above this line is terminated as high division.<sup>3</sup> The aim of this study is to enumerate the variations in the termination of brachial artery.

#### MATERIALS AND METHODS

44 upper limbs were taken for this study, 20 upper limbs were of right side and 24 upper limbs were left sided. The study was done along with the dissection of upper limb for undergraduate students. Later, the study was extended to the limb specimens stored in the department.

Length of the brachial artery was noted by taking the extent from lower border of teres major to its termination. The branches were examined for their course and branching pattern.

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**RESULTS**

The termination of brachial artery was noted by taking the interepicondylar line as the landmark. Length of brachial artery was measured by taking the proximal point at lower border of teres major and distal point at interepicondylar line. The termination below this point was also noted and recorded. Out of 44 specimens studied, 38 showed normal division of brachial artery. Anomalous high division was noted in 6 cases. Mean length of brachial artery was noted. It measured 21.62 cm.

**Case No. 1-** Brachial artery was 5 cm long. It was divided into superficial and deep branch below this level. Superficial branch continued as radial artery. Superficial radial artery gave origin to superior ulnar collateral artery. A communication between radial and ulnar artery was noted in cubital fossa and it was in the form of an arcade from which 2-3 small branches were originated (Figure 1).

**Case No. 2-** Brachial artery was 6 cm long. Division of the artery was noted below this level. Superficial branch was running superficially and ulnar collateral arteries was found to be originating from deep branch. There was a similar formation of an arterial arch as in case no. 1 (Figure 2).

**Case No. 3-** There was higher bifurcation of brachial artery 10 cm from its origin. Superficial branch continued as radial artery. Within the cubital fossa, ulnar artery gave origin to median artery, which was running along with median nerve (Figure 3).

**Case No. 4-** Brachial artery gave origin to one branch, which was running superficial to median nerve. Stem of brachial artery was deeply placed and it was divided into radial and ulnar artery within the cubital fossa. Radial artery made a connection with superficial branch soon after its formation.

**Case No. 5-** Brachial artery had a high division. Radial artery, which was superficial, made a connection with posterior interosseous artery in cubital fossa and this connecting branch gave origin to radial recurrent artery (Figure 4).

**Case No. 6-** There was bifurcation of brachial artery 5 cm from its origin and superficial branch continued as radial artery. Anterior interosseous artery originated directly from ulnar artery, which showed communication with radial artery in cubital fossa (Figure 5).

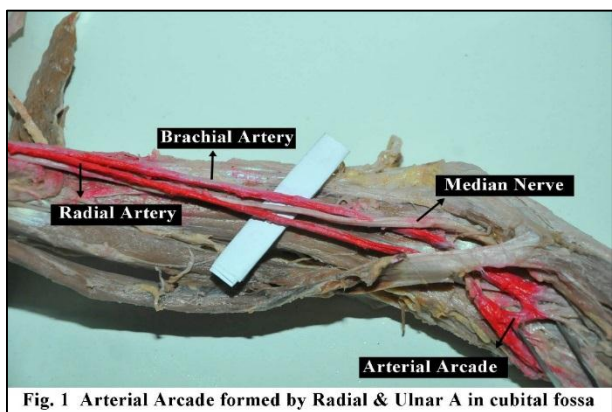


Fig. 1 Arterial Arcade formed by Radial & Ulnar A in cubital fossa

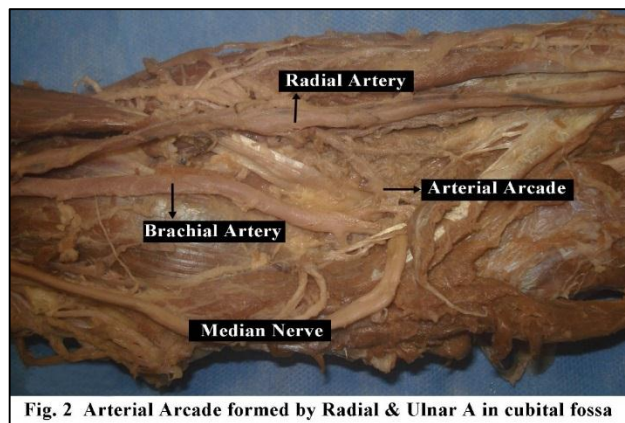


Fig. 2 Arterial Arcade formed by Radial & Ulnar A in cubital fossa



Fig. 3 Median Artery

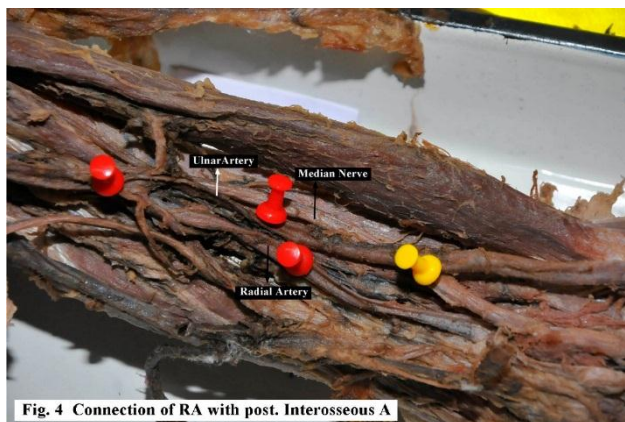


Fig. 4 Connection of RA with post. Interosseous A

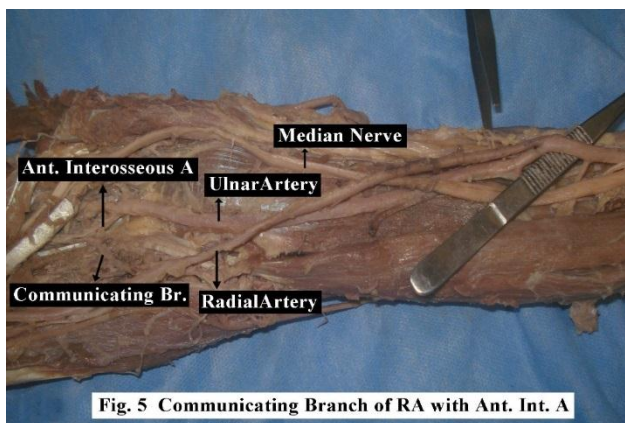
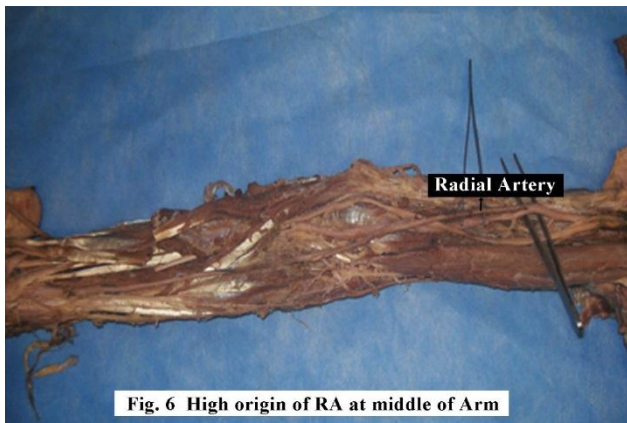


Fig. 5 Communicating Branch of RA with Ant. Int. A



## DISCUSSION

Variations in termination of brachial artery is common. The present study showed 6 cases of higher bifurcation of brachial artery (13.64%). In five cases, the radial artery coursed down superficial to median nerve as 'superficial radial artery' or 'high origin radial artery'. McCormack and his coresearchers reported that high origin radial artery to be the commonest variation of arteries of arm. They dissected 750 cadavers and variations noted by them are 18.53%.<sup>2</sup> A study by M. Rodriguez-Niedenfuhr, T Vasquez described variations of brachial artery. They observed 9.4% of incidence of superficial brachial artery. Another finding was brachioradial artery, which was actually radial artery originating above elbow. They found 20.3% of total incidence of brachioradial artery.<sup>4</sup>

In another study, incidence of brachioradial artery was 4%.<sup>5</sup>

Another study by Patnaik et al found out that 18% variations among branching pattern of brachial artery.<sup>6</sup> Superficial brachial artery was found crossing median nerve and replaces the main artery. Superficial brachial artery divides into radial and ulnar arteries (Adachi 1928, Patnaik 2002).<sup>6,7</sup>

Rodriguez, Breza et al 1995<sup>8</sup> suggest that superficial brachial artery is a constant embryonic vessel that plays important role in arterial development. They suggested that superficial brachial artery divides into 2 terminal branches - medial superficial antebrachial artery, which divides into ulnar and median artery and a lateral branch, which continues as definitive radial artery.

In the present study, we could observe one case of superficial brachial artery. The branch which was originated from brachial artery at a higher level superficial to median nerve continued into cubital fossa and connected to definitive radial artery. Higher bifurcation of brachial artery in mid arm with superficial course of radial artery was observed in previous studies (Harban Singh, Subash M Gujar, Uma Sivanal).<sup>9,10,11</sup>

Superficial brachial artery anastomoses with distal segment of brachial artery plays an increasing haemodynamic role and that leads to involution of proximal segment of superficial brachial artery. This may represent the origin of radial artery (Keen J A).<sup>12</sup>

Stage IV development of brachial artery by Singer described development of superficial brachial artery from

axial artery at middle of arm, which runs superficially. At the elbow, an anastomotic branch develops, which connects main trunk with superficial branch. Median artery arises as a branch of interosseous artery. This artery plays a major haemodynamic function in Singer stage III and IV. After that, it regresses in Singer stage V and remains as residual artery.<sup>13</sup> With Doppler ultrasound evaluation, Ozcan et al demonstrated the occurrence of median artery as 4.4% to 8.3%.<sup>14</sup>

In the present study, high origin radial artery established connection with main trunk in 2 cases and there was a case of anomalous connection with anterior interosseous artery. Mean arterial length was 21.62 cm in present study.

Lateral branch of 7<sup>th</sup> cervical intersegmental artery forms subclavian artery. It continues as axis artery of upper limb. Later, axillary and brachial artery develops as continuation of axis artery. Brachial artery passes to forearm and terminate as deep plexus in developing hand. Original axis artery persists as anterior interosseous artery and deep palmar arch. A branch from main trunk passes dorsally between radius and ulna as posterior interosseous artery. A second branch accompanies median nerve and ends in superficial capillary plexus. Radial and ulnar arteries are the last to develop. Initially, radial artery arises proximally than the ulnar artery. It crosses in front of median nerve and supplies biceps. Later radial artery establishes a new connection with brachial artery close to origin of ulnar artery and proximal connection regresses.<sup>15</sup>

If the proximal connection retains and second connection does not develop, it will lead to high origin of radial artery.

## CONCLUSION

There was a variation of 13.64% in termination of brachial artery. Among these variations, 5 of them were higher terminal division with radial artery running superficial to median nerve. Median artery was present in one case, which took origin from ulnar artery. Superficial brachial artery was present in one case, which made a connection with stem of brachial artery in cubital fossa. Superficially running radial artery can be explained on embryological basis. The superficial course may lead to complications in performing various surgical procedures or in making permanent fistula for dialysis in patients with chronic renal failure. As radial artery lies superficially, it may also complicate to withdraw blood for investigative procedures.

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