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Original Research Article

Study of Variations in the Course of Brachial Artery: A Cadaveric Study

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ABSTRACT

Background: Brachial artery begins as a continuation of axillary artery at the distal border of teres major, runs downward at first medial to the humerus and then inclines to lie in front of the bone until it appears in the cubital fossa, where it ends at the level of the neck of radius by dividing into radial and ulnar arteries.

Objectives: To know the variations in the course of brachial artery.

Methods: Dissection was done on 40 upper limbs from embalmed adult human cadavers in the Department of Anatomy, Kamineni Institute of Medical Sciences, Narketpally. Dissection of Brachial artery was carried out according to Cunningham's manual of practical anatomy.

Results: In all 40 specimens (100%), the brachial artery begins at the inferior border of the teres major muscle as the continuation of the axillary artery. In 37 specimens (92.5%), single brachial artery (BA) was present in the arm. It runs inferiorly on the medial side of the biceps brachii muscle to the cubital fossa. It divides into the radial artery (RA) and ulnar artery (UA) opposite the neck of radius at elbow. In 3 specimens (7.5%), doubling of the brachial artery in its course was observed. In these specimens, the brachial artery was divided into two divisions in the arm. Both divisions runs inferiorly on the medial side of the biceps brachii muscle to the cubital fossa. In these two divisions, one lies superficial to the median nerve and was called the superficial brachial artery (SBA) and other division continues as the brachial artery proper (BAP). In all these 3 specimens (7.5%), the superficial brachial artery (SBA) continued as the radial artery (RA) and brachial artery proper (BAP) continued as the ulnar artery (UA) in the cubital fossa.

Interpretation and Conclusion: The present study is important for Surgeons, Orthopedicians, Vascular surgeons, Clinicians and Anatomists as it provides the knowledge of variations in the course of brachial artery in the arm and cubital fossa.

KEY WORDS: Brachial artery, Superficial brachial artery, Cubital fossa. Radial artery

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INTRODUCTION

Brachial artery provides the main arterial supply to the arm. It begins at the lower border of the teres major muscle as a continuation of the axillary artery. It terminates opposite the neck of the radius by dividing into the radial and ulnar arteries. The brachial artery is superficial and is overlapped from the lateral side by the coracobrachialis and biceps. The median nerve crosses its middle part; and the bicipital aponeurosis crosses its lower part. The artery lies on the triceps, the coracobrachialis insertion and the brachialis. The tendon of the biceps lies lateral to the artery in the lower part of its course[1]. The cubital fossa is an important clinical area because it contains the biceps tendon, the brachial artery and its terminal branches (radial and ulnar arteries), the brachial veins and parts of the median and radial nerves[2]. Arterial blood pressure levels are routinely measured using a sphygmometer, consisting of an inflatable cuff and a mercury manometer. The cuff is placed around the arm and inflated with air until it compresses the brachial artery against the humerus and occludes it[2]. Pulsation of the brachial artery is felt or auscultated in front of the elbow; this helps as standard method of recording the blood pressure[3]. Compression of the brachial artery may be produced in almost its entire course to control hemorrhage. The best place to compress the brachial artery is near the middle of the arm, where it lies on the tendon of the coracobrachialis muscle medial to the humerus[2].

Occlusion or laceration of the brachial artery represents a surgical emergency because, within a few hours, the paralysis of muscles that results from the associated ischemia of the deep flexors of the forearm may be irreversible. Necrotic muscle is replaced by fibrous scar tissue that causes the involved muscles to become permanently shortened. This produces a flexion deformity called Volkmann's ischemic contracture. Extended and improper use of a tourniquet can also produce this injury, but it results more often from brachial artery tearing injury during a fracture of the elbow[2].

Hence, the study of the brachial artery was undertaken. The results of this study may be useful in various clinical procedures such as measurement of blood pressure, intravenous injections and various surgical procedures such as evaluating the brachial artery injuries and their management for Surgeons, Orthopedicians, Vascular surgeons and Clinicians.

MATERIALS AND METHODS

The specimens for this study were obtained from the embalmed adult human cadavers of both sexes from the Department of Anatomy, Kamineni Institute of Medical Sciences, Narketpally. 40 upper limb specimens fixed in 10% formalin solution were procured from the Department of Anatomy. Among 40 specimens, 20 belongs to right side and 20 belongs to left side. Among 20 cadavers used, 16 were male cadavers and 4 were female cadavers. Study conducted over a period of 2 years. Dissection of brachial artery in arm and cubital fossa was carried out according to Cunningham's manual of practical anatomy[4].

The specimens were dissected using scalpel and forceps. The upper limb in each supine cadaver was abducted and laterally rotated. Skin was incised from manubrium sterni to both xiphoid process of sternum as well as acromion process of scapula. Further, the skin was incised from xiphoid process extending upwards and laterally, along the floor of axilla, to the middle of the arm. Incision was further extended from middle of the arm up to apex of cubital fossa. The skin and superficial fascia were reflected from the deep fascia by blunt dissection. The deep fascia was then incised to expose muscles. The pectoralis major and minor muscles were reflected laterally to expose axilla. The axilla was dissected by removing loose connective tissue and fat. Axillary artery and vein and the large nerves surrounding them were exposed. Deep fascia was cut vertically on the anterior surface of the arm as far as elbow and was cut transversely at elbow level. Deep fascia was reflected to uncover biceps brachii. Neurovascular bundle of the arm was identified immediately deep to the deep fascia, medial to biceps. Brachial artery was identified as

continuation of the axillary artery at the lower border of teres major muscle and cleaned.

The course of brachial artery and any variations, if present noted. The site of division of brachial artery into radial and ulnar artery at elbow noted. Measurements were taken using vernier caliper from a imaginary transverse line at elbow joining the medial and lateral epicondyles of the humerus (inter epicondylar line). Photograph of each specimen was taken after dissection with digital camera.

RESULTS

In all 40 specimens (100%), the brachial artery begins at the inferior border of the teres major muscle as the continuation of the axillary artery.

In 37 specimens (92.5%), single brachial artery (BA) was present in the arm (**Figure 1**). It runs inferiorly on the medial side of the biceps brachii muscle to the cubital fossa. It divides into the radial artery (RA) and ulnar artery (UA) opposite the neck of radius at elbow.

Doubling of the brachial artery: In 3 specimens (7.5%), doubling of the brachial artery in its course was observed. In these specimens, the brachial artery was divided into two divisions in the arm. Both divisions runs inferiorly on the medial side of the biceps brachii muscle to the cubital fossa. In these two divisions, one lies superficial to the median nerve and was called the superficial brachial artery (SBA) and other division continues as the brachial artery proper (BAP). In first specimen (1R), the site of division of brachial artery into superficial brachial artery (SBA) and brachial artery proper (BAP) was 19 cms above the imaginary line joining the medial and lateral epicondyles of the humerus (inter epicondylar line) (**Figure 2**). In second specimen (6L), the site of division of brachial artery into superficial brachial artery (SBA) and brachial artery proper (BAP) was 16 cms above the inter epicondylar line of the humerus(**Figure 3**). In third specimen (7R), the site of division of brachial artery into superficial brachial artery (SBA) and brachial artery proper (BAP) was 6 cms above the inter epicondylar line of the humerus (**Figure 4**).

In 2 specimens (5%), (first specimen (1R) and third specimen (7R)), the doubling of the brachial artery was found on the right arm of the adult male cadavers. In 1 specimen (2.5%), (second specimen(6L)), the doubling of the brachial artery was found on the left arm of the adult male cadaver.

In all these 3 specimens (7.5%), the superficial brachial artery (SBA) was continued as the radial artery(RA) and brachial artery proper(BAP) was continued as the ulnar artery(UA) in the cubital fossa.

Fig. 1: Normal specimen (5L) : single brachial artery (BA) at arm. The brachial artery (BA) is dividing into the radial artery(RA) and ulnar artery(UA) in the cubital fossa.

Fig. 2: First specimen (1R) : doubling of brachial artery (BA) into superficial brachial artery (SBA) and brachial artery proper (BAP) at arm. The superficial brachial artery (SBA) continued as the radial artery(RA) and brachial artery proper(BAP) continued as the ulnar artery(UA) in the cubital fossa.

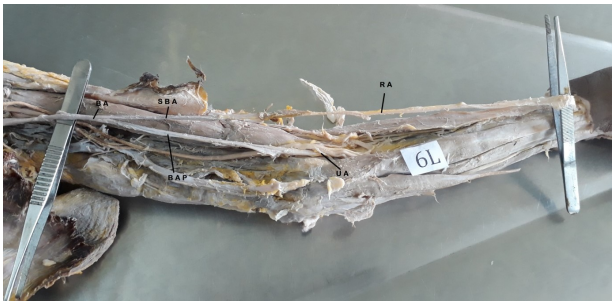

Fig. 3: Second specimen (6L) : doubling of brachial artery (BA) into superficial brachial artery (SBA) and brachial artery proper (BAP) at arm. The superficial brachial artery (SBA) continued as the radial artery(RA) and brachial artery proper(BAP) continued as the ulnar artery(UA) in the cubital fossa.

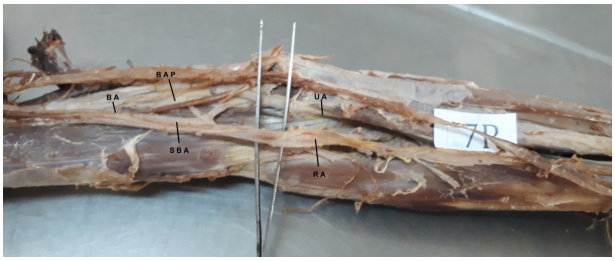

Fig. 4: Third specimen (7R) : doubling of brachial artery (BA) into superficial brachial artery (SBA) and brachial artery proper (BAP) at arm. The superficial brachial artery (SBA) continued as the radial artery(RA) and brachial artery proper(BAP) continued as the ulnar artery(UA) in the cubital fossa.

DISCUSSION

In the present study, out of 40 specimens, the brachial artery begins at the inferior border of the teres major muscle as the continuation of the axillary artery in all specimens(100%) and single brachial artery was observed in 37 specimens (92.5%). Present study has found doubling of brachial artery in the arm. Moore KL mentions, the brachial artery is doubled in 20% of cases during all or part of its course. In these people one of the arteries lies superficial to the median nerve and is called the Superficial Brachial artery[2]. Kaur A et al., mentions in their study on 40 upper limb specimens, higher bifurcation of brachial artery in 4 cases (10%)[5]. Fuss FK mentions in their study on 200 upper limb specimens, normal brachial artery was found in 83% specimens and superficial brachial artery was observed in 17% specimens[6]. Mc Cormark observed the superficial brachial artery in 8 out 750 limbs(1.07%)[7]. Quain found this variant in 1 out of 506 limbs(0.2%)[8] and muller found it in 1 among 100 specimens(1%)[9]. In the present study doubling of brachial artery was 7.5% of cases.

Clarke E reported , the presence of the superficial brachial artery originating from the second part of the axillary artery. It arose 23 cms above the inter epicondylar line of the humerus[10]. Gujar SM mentions in their studyon 30 cadavers that, in one specimen, the brachial artery was divided in middle 1/3rd of arm into radial and ulnar arteries and in another specimen, the radial artery arose from the 3rd part of the axillary artery[11]. Jadhav SD reported that, the brachial artery was dividing into radial and ulnar arteries after a short course in the upper 1/3rd of the right arm in a 60 year old male cadaver[12]. In the present study, we observed superficial brachial artery had originated from the brachial artery at arm. In the present study, the high division of brachial artery into superficial brachial artery and brachial artery proper was 19 cms, 16cms and 6cms above the inter epicondylar line of the humerus respectively in 3 specimens. The present study confirms the high division of brachial artery may occur at any place in the arm.

Clarke E reported that, the superficial brachial artery was divided into the radial and ulnar arteries in the cubital fossa[10]. Khullar M reported that, in a 50 year old female cadaver, on both sides, the 3rd part of the axillary artery divided into superficial brachial artery and deep brachial artery. The superficial brachial artery continued in the arm and ended in the cubital fossa dividing into radial and ulnar arteries. The deep brachial artery terminated by giving twigs to the muscles of arm[13]. Krstonosic B reported, a case of unilateral double brachial artery in a female cadaver. In that case, left axillary artery entered into arm branched into two brachial arteries – superficial brachial artery and brachial artery. In the cubital fossa ,both brachial arteries were connected with an anastomotic vessel. Superficial brachial artery continued as radial artery and brachial artery continued as ulnar artery[14]. In the present study, superficial brachial artery(SBA) continued as the radial artery (RA) and brachial artery proper (BAP) continued as the ulnar artery (UA) in all 3 specimens. The findings of present study is comparable with Krstonosic B.

A Clinician must know where the arteries of the upper limb can be palpated or compressed in an emergency. The brachial artery can be palpated in the arm as it lies on the brachialis and is overlapped from the lateral side by the biceps brachii[1]. The arteries of the upper limb can be damaged by penetrating wounds or may require ligation in amputation operations. In such cases present study provides valuable information regarding brachial artery variations.

CONCLUSION

In all 40 specimens (100%), the brachial artery begins at the inferior border of the teres major muscle as the continuation of the axillary artery. In 37 specimens (92.5%), single brachial artery (BA) was present in the arm. In 3 specimens (7.5%), doubling of the brachial artery in its course was observed. In these specimens, the brachial artery was divided into two divisions in the arm. Both divisions runs inferiorly on the medial side of the biceps brachii muscle to the cubital fossa. In these two divisions, one lies superficial to the median nerve and was called the superficial brachial artery (SBA) and other division continues as the brachial artery proper (BAP). In all these 3 specimens (7.5%), the superficial brachial artery(SBA) was continued as the radial artery(RA) and brachial artery proper(BAP) was continued as the ulnar artery(UA) in the cubital fossa.

The present study is important for Surgeons, Orthopedicians, Vascular surgeons, Clinicians and Anatomists as it provides the knowledge of variations in the course of brachial artery in the arm and cubital fossa.

Author Contributions

Raghavendra D R: Planning, data collection, data analysis, literature review , result analysis, review, corresponding with journal.

Smita minz: Data collection, data analysis, literature review, result analysis.

Sravanthi Repalle: Data collection, data analysis, literature review, result analysis.

Gangadhar chaganti: Literature Review

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Conflicts of Interests: None

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