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Bilateral High Division of Brachial Artery: A Case Report and Clinical Significance in Ayurvedic and Modern Medical Practice

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ABSTRACT

The brachial artery is a major artery of arm and continuation of the axillary artery. It begins at the lower border of the teres major muscle and ends at the level of the neck of the radius in deeper part of cubital fossa by dividing into radial and ulnar arteries. The brachial artery variations were observed in its course, branching pattern and division. Higher division of brachial artery is one of the common variations ranging from 15% to 20% of population. The course, termination and precise knowledge of variations of Brachial Artery is an important aspect in the clinical practice of Physician, Vascular surgeons, and Radiologist.

Key words: Brachial artery, Radial artery, Ulnar artery, Median Nerve, Marma, Siravyadha, Bhavi Marma.

INTRODUCTION

The brachial artery is a major artery of arm and continuation of the axillary artery. It begins at the lower border of the teres major muscle and ends at the level of the neck of the radius in deeper part of cubital fossa by dividing into radial and ulnar arteries. The brachial artery is superficial throughout its course and covered by skin and superficial fascia. It lies medial to the humerus in upper part but gradually spirals anterior to it until it lies midway between the humeral epicondyles. Anteriorly it is related to medial cutaneous

nerve of fore arm in upper part, crossed by median nerve in middle part and crossed by bicipital aponeurosis in lower part. Posteriorly it is related to triceps muscle coracobrachialis muscle and brachialis muscle from above downward. Medially it is related to ulnar nerve and basalic vein in upper part and median nerve in lower part. Laterally it is related to coracobrachialis, biceps brachia muscle and median nerve. The brachial artery gives origin to profunda brachii, superior ulnar collateral and inferior ulnar collateral, nutrient, muscular, radial, and ulnar arteries.^[1]

The brachial artery variations were observed in its course, branching pattern and division but the variations of Brachial Artery division are common and have been documented by many researches. The division of Brachial Artery can be determined with reference to imaginary line joining the medial and lateral epicondyles of Humerus. The bifurcation of brachial artery above this line is terminated as high division of brachial artery.^[2] According to Anson 15% of individuals have high origin of radial artery and may arise as high as the axillary artery but most commonly it arises from the proximal one third of the arm.^[3] The

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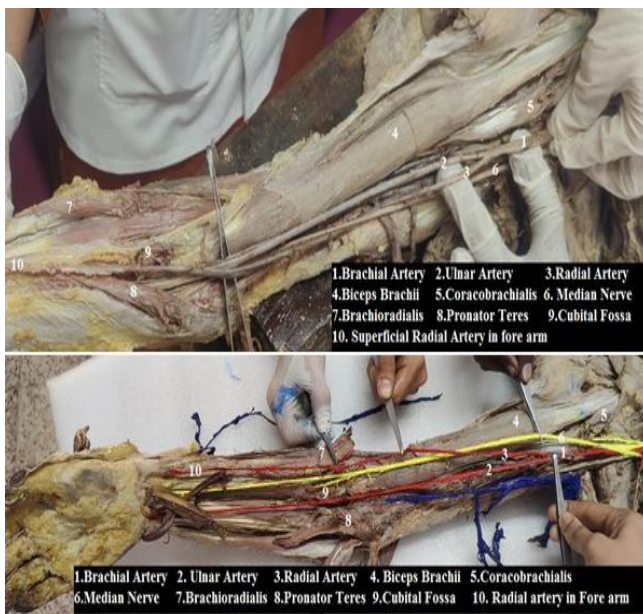
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course, termination and precise knowledge of variations of brachial artery is an important aspect in the clinical practice of Physician, Vascular surgeons, and Radiologist. Higher division of brachial artery is one of the common variations ranging from 15% to 20% of population. It divides more proximally in the arm into radial and ulnar artery (Proper Brachial Artery).

CASE REPORT

The present study was carried in a middle-aged formalin embalmed male cadaver during routine dissection of upper limb by Ayurvedic undergraduate students in the department of Rachana Shareera (Anatomy) at BLDE Association AVS Ayurveda Mahavidyalaya Hospital and Research Centre Vijayapur, Karnataka, India. The dissection of the upper limb was carried out as per Cunningham practical manual and observed that bilateral high bifurcation of brachial artery into radial artery and ulnar artery (proper brachial artery). The brachial artery and its variations were carefully traced and documented.



Observations in Right upper limb

The brachial artery bifurcated into medial and lateral branches 2cm distal to the lower border of teres major muscle. The medial branch is known as Radial artery and the lateral branch is known as ulnar artery or Proper brachial artery both arteries descend downwards parallel to each other.

The radial artery was originated from brachial artery 2cm below the lower border of teres major as medial superficial branch and descends downwards along with the median nerve in the arm. Approximately medial side of the middle of the arm radial artery is crossing posterior to the median nerve from lateral to medial side hence radial artery descends downwards lateral to the median nerve in the upper part of the arm and medial to the median nerve in lower part of the arm. In the cubital fossa radial artery cross anterior to the proper brachial artery and median nerve from medial to lateral side near to the base of cubital fossa then passes through apex of the cubital fossa after that descends downward superficially along with medial border of brachioradialis muscle and reached to wrist. Radial artery measures approximately 46 cms from its origin to the wrist. In the fore arm and hand the radial artery were found to be normal in course and branching pattern.

Proper brachial artery is thick in calibre and extends from lower border of the teres major to the neck of the radius their after continue as ulnar artery in the forearm. In the arm proper Brachial Artery descends downwards along with the medial border of biceps brachii muscle and lateral to the radial artery. In the cubital fossa proper Brachial Artery passes deep to the pronator teres muscle and continues as ulnar artery. Proper Brachial Artery gives following branches in the arm.

1. The profunda brachii artery was originated from proper brachial artery just 1 cm above the origin of radial artery and runs posteriolaterally in radial groove of humerus.
2. Superior Ulnar collateral artery was originated from proper brachial artery just 2.5 cms below the origin of radial artery.
3. Inferior Ulnar collateral artery was originated from proper brachial artery just 3.5 cms below the origin of radial artery.

Observations in Left Upper Limb

The brachial artery bifurcated into medial and lateral branches 4cm distal to the lower border of teres major

muscle. The medial branch is known as radial artery and the lateral branch is known as Proper Brachial Artery both arteries descend downwards parallel to each other.

The radial artery was originated from brachial artery 4 cm below the lower border of teres major as medial superficial branch and descends downwards along with the median nerve in the arm. The course of the radial artery is similar to the right upper limb. Radial artery measures approximately 42cms from its origin to the wrist. In the fore arm and hand the radial artery were found to be normal in course and branching pattern.

Left Proper brachial artery and its branching pattern is almost similar to the right one with following slight difference.

1. The profound brachi artery was originated from proper brachial artery just half centimetre below the origin of radial artery and runs posteriolaterally in radial groove of humerus.
2. Superior Ulnar collateral artery and Inferior Ulnar collateral artery were originated from proper brachial artery similar to the right upper limb.

The major difference between right and left upper limb observations are tabulated below

Features	Right upper limb	Left upper limb
1. Bifurcation of brachial artery	2 cm distal to the lower border of Teres major muscle	4 cm distal to the lower border of Teres major muscle
2. Length of Radial artery	46 cms	42 cms
3. Origin of the Profounda brachii	1 cm above the origin of radial artery	½ cm below the origin of radial artery

DISCUSSION

The upper limb, arterial variations was first time documented by von Haller in 1813.^[5] The brachial artery is the main artery of the arm and extends from lower border of teres major muscle to neck of the radius. It lies in the medial side of the arm, medial to

the biceps brachii muscle and anterior to the medial head of the triceps. Anatomical variations of the artery occur in almost 20% of the cases.^[4] According to Compendium of Human Anatomic Variation, the brachial artery variations were observed in 25% of the subjects.^[6] The brachial artery presents many types of variation among them high origin of radial and ulnar artery from brachial artery is the highest percentage ranging from 3% to 15 %, as reported by different authors.^[7,8]

Chandrika Teli *et al.* mentioned about a case in which the brachial artery divided into radial and ulnar arteries, about 1.5 cm distal to the lower border of teres major muscle, in the upper third of arm. They also noted that median nerve crossed radial artery from lateral to medial side as it travelled to cubital fossa, whereas the course of the arteries was same in the forearm.^[9] In our present case report, we observed that the brachial artery is divided in to radial and proper brachial arteries (ulnar artery) about 2 cm and 4 cm below the teres major muscle in right and left upper limb respectively.

Madhyastha *et al.* also reported that division of the brachial artery in the upper third of the arm into radial and ulnar arteries, about 4 cm distal to the lower border of teres major muscle,^[10] which is similar to our left brachial artery division.

Puspalata M also reported a case of bilateral high division of brachial artery into radial and ulnar artery. The radial artery passes downwards and laterally and ulnar artery passes downwards and medially in arm and passes deep to the ulnar head of pronator teres muscle in cubital fossa.^[11]

The radial artery graft is considered the second option after the left internal mammary artery graft in coronary artery bypass grafting, because the diameter of the Radial Artery is approximately equal to that of coronary artery but when Radial Artery arising at a high level in the arm sometimes have smaller diameter which cannot be used for coronary artery grafting. The coronary artery bypass graft (CABG) surgery is the treatment of choice for multivessel coronary artery disease.^[12] The radial artery graft is easy to harvest and

can be bypassed to reach the major coronary arteries and also multiple studies have shown better patency rate and survival with radial artery graft as compared to saphenous vein graft. Carpentier and his colleagues in 1973 first introduced the radial artery graft^[13] but within a few years, it was banned because of the high rate of occlusion. Acar and colleagues reintroduced it in 1992 after discovering patent radial graft on an angiogram. With modification in surgical technique and utilization of antispasmodic agents, the radial artery graft patency rate is more than 90% at both one year and five years.^[14]

Wen-yuan Li and his colleagues conducted study to establish the relationship between blood pressure measured on the brachial artery and blood pressure assessed on the radial artery in the right arm. The brachial artery blood pressure was significantly lower than the radial artery blood pressure. The difference between the two values varied from 13 to 18 mmHg in systolic Blood Pressure, diastolic Blood Pressure and mean blood pressure respectively.^[15] In our case report we found that radial artery lies superficial to the ulnar artery (Proper Brachial Artery) in the cubital fossa hence in such cases while recording the BP we are doing auscultation of radial artery that suggest for misdiagnosis of Blood Pressure.

Acharya Sushruta known as father of Indian surgery explained that two *Avedhyasira* and *Bahvi Marma* in relation to surgical anatomy of arm. *Avedhya Sira* means the vessel should not puncher or cut during surgical or parasurgical procedures. *Acharya Sushruta* explained two *Avedya Sira* in arm and named as *Bahvi Sira*.^[16] The brachial artery and profunda brachii are two major vessels present in arm (*Bhahu*) are known as *Bahvi Siras*. The *Bahwi Marma* is one finger breadth vital vascular predominant structure present in the mid of the arm, injury to this *Marma* leads to heavy bleeding and atrophy of upper limb hence this vital area should be protected during the surgical procedure.^[17] High origin of Radial Artery in the arm is usually lies superficially hence it is more prone to injuries leading to heavy bleeding. The knowledge of brachial artery or *Bahvi Sira* variations are important to Ayurvedic Surgeon's for the *Marma Chikitsa* and

Siravyadha Chikitsa (venesection). The *Marma Chikitsa* is specialised Keraliya Ayurvedic treatment modality through which they are treating neurovascular diseases and *Siravyadha* is specialised Parasurgical procedure through which blood is drained from vessels by using needles or *Jalouka* (leech).

CONCLUSION

The variations are the law of nature and the knowledge of arterial variations is necessary for the clinical practitioners. The brachial artery and its variations are having great interest to anatomists, surgeons, interventionists and radiologists, due to wide clinical and radiological implications. The rate of incidence of High division of Brachial Artery knowledge is important to anatomist for better dissection and documentation. The knowledge of high division of Brachial Artery documentation is highly significant for surgeon during coronary artery bypass graft by using the radial artery, for orthopaedic surgeon while handling Humerus fractures, for physicians while Blood Pressure examination, for Radiologist during diagnosis and for Ayurvedic surgeon while doing *Marma Chikitsa* and *Siravyadha Chikitsa* (Venesection).

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