

HIGHER BIFURCATION OF BRACHIAL ARTERY WITH SUPERFICIAL COURSE OF RADIAL ARTERY IN FOREARM: A STUDY REPORT

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ABSTRACT

Background: Normally brachial artery divides into its terminal branches namely radial and ulnar arteries at the neck of the radius in the cubital fossa and these are the main arteries responsible for the irrigation of the forearm. In the present study we found higher division of brachial artery into radial and ulnar arteries with superficial course of radial artery unilaterally during routine dissection for MBBS student. Accurate information regarding these variations is important during vascular and re-constructive surgery and also in evaluation of angiographic images.

Aims & Objective: The altered anatomy of the blood vessels may make them more vulnerable to trauma and to haemorrhage but at the same time more accessible for cannulation. Our aim is to report the occurrence of the higher division of brachial artery with superficial course of radial artery in a sample of western Indian population.

Material and Methods: A prospective evaluation was conducted on cadavers at various Medical Colleges, in Gujarat. The upper limbs of cadavers were dissected and observed for any variation in the course of brachial artery and its terminal branches radial and ulnar arteries.

Results: A total of 96 arms of 48 subjects were studied. In three upper limbs we found higher division of brachial artery with superficial course of radial artery. The variant was present unilaterally in left upper limb of three males (6.25%, n = 48).

Conclusion: Anomalies in origin and course of principal arteries have practical importance for orthopaedicians, radiologists and vascular surgeons. Awareness of incidence of this variation is necessary to avoid complication during pre-operative procedure or surgeries in the upper limb.

KEY-WORDS: Brachial Artery; Superficial Radial Artery; Ulnar Artery; Higher Bifurcation

Introduction

The brachial artery is often used in medical procedures, as brachial pulse palpation, blood pressure monitoring, arterial puncture, arteriography and others. The brachial artery, a continuation of the axillary, begins at the distal (inferior) border of the tendon of teres major and ends about a centimeter distal to the elbow joint (at the level of the neck of the radius) by dividing into radial and ulnar arteries.

At first it is medial to the humerus, but gradually spirals anterior to it until it lies midway between the humeral epicondyles. Its pulsation can be felt throughout.^[1] The course of brachial artery divide in 3 equal parts i.e. proximal 1/3, middle 1/3 and distal 1/3.^[2] Variations in upper limb arteries are fairly common and have been reported by several

authors. Majority of these variations occur in radial artery followed by ulnar artery.^[3] Brachial artery variations are less common.^[4] Though some cases of anomalous divisions of brachial artery in cubital fossa have been described^[5] but mid-arm variations in brachial artery are relatively of rare occurrence.

Keen^[6] subdivides superficial brachial artery (found in 12.3% dissections) into 3 types: (a) Those superficial brachial arteries which continue in cubital fossa and bifurcate as usual into radial and ulnar arteries (3.6%); (b) Superficial brachial artery continues as radial artery and known as 'High origin of radial artery' (5.9%); (c) Superficial brachial artery continues as ulnar artery and known as 'High origin of ulnar artery' (2.8%).

Both radial and ulnar arteries run a superficial

course in forearm in such cases. Superficial brachial artery is so called because it runs superficial to median nerve whereas usually the brachial artery runs deep to the median nerve. According to Adachi^[7] arteries emit terminal and collateral branches. Terminal branches appear when the main artery divides (bifurcation or trifurcation) and no longer exists, for instance, as the brachial artery divides into the radial and ulnar arteries. Collateral branches occur when the main artery gives off other vessels but still continues ahead as the same vessel.^[8]

In present study, the brachial artery bifurcated into its terminal branches at higher level, mid of arm unilaterally into radial and ulnar arteries. The laterally placed artery was named as radial artery and medially placed as ulnar artery.

Knowledge of possible arterial anatomical variations in the upper limb is important because of their role in local vasculature and in plastic surgical and other invasive procedures. Being closer to the heart and of easy approach than other large arteries, the brachial artery is extensively used in medical practice.^[9]

A study^[10] stated that in approximately 30% of individuals there are two brachial arteries in an arm. The two arteries usually unite in cubital fossa and again divide into ulnar, radial arteries. If they don't unite, the identity of the vessels is determined by their relation to the median nerve and their fate in the forearm. The normal artery, representing the axial artery of the limb, takes the usual course of the normal brachial artery and is crossed superficially by the median nerve. The anomalous artery is more superficial position and named as superficial brachial, ulnar or radial depending on branching pattern. The bifurcation of the brachial artery far above the level of the elbow (cubital fossa) has been reported at every eighth or tenth individual. This high division is seen more at the upper third of the arm than at the medial and lower thirds.^[11]

Variation in the branching pattern of the brachial artery is of significance in cardiac catheterization for angioplasty, pedicle flaps, or arterial grafting. Any abnormal positions or divisions of the brachial artery should be identified before

surgery. But a full work up by CT angiography for every single patient presenting to the emergency department is neither feasible, nor cost-effective. Hence it is necessary to physicians to be aware of this possibility before initiating the procedure.

High bifurcation of the brachial artery presenting with acute ischemia secondary to an embolic event was reported. This anomaly was identified, and the ischemia was successfully resolved with embolectomy.^[4]

Materials and Methods

The present study was conducted on upper limbs of 48 embalmed cadavers. They were utilized for dissection for MBBS students at various medical colleges in Gujarat, west region of India. The brachial artery and its branches were exposed after dissection of both upper extremities (right and left) according to the Instruction by Cunningham's Manual of practical Anatomy to observe any variation.

Results

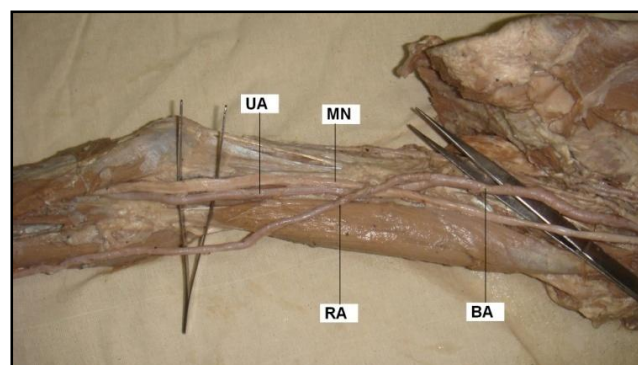


Figure-1: Higher Division of Brachial Artery into Radial & Ulnar Arteries (BA: Brachial Artery; RA: Radial Artery; UA: Ulnar Artery; MN-Median Nerve)

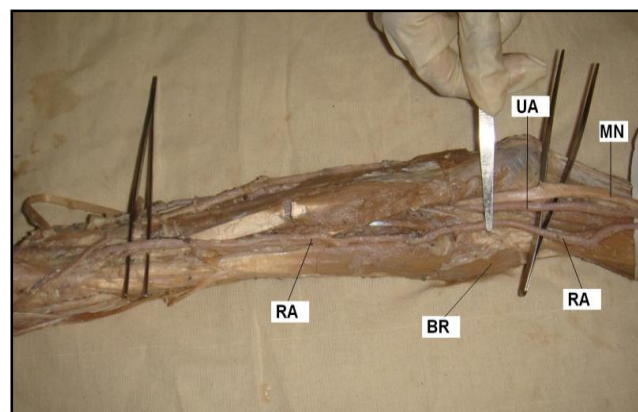


Figure-2: Superficial Course of Radial Artery (BA: Brachial Artery; RA: Radial Artery; UA: Ulnar Artery; MN: Median Nerve; BR: Brachioradialis)

Brachial arteries were traced proximally to the continuity with axillary artery at the level of lower border of teres major to its termination and further course of bifurcated arteries in forearm to observe any variation. In the present study, we found unilateral higher division of brachial artery into radial and ulnar arteries in mid-arm in three left limb of male cadavers (Figure-1). After bifurcation the median nerve crossed the ulnar artery superficially from lateral to the medial side. In the cubital fossa ulnar artery lies lateral to the median nerve, and had its normal course in forearm.

After division the radial artery crossed median nerve superficially from medial to lateral side and then descended laterally to it, remained superficial lying just deep to brachial and ante-brachial fascia up to lower part of forearm from there onwards it had its usual course(Figure-2).

Discussion

High division of brachial artery is the most common variation of brachial artery. The incidence of superficial radial artery is most frequent variation and is observed to be 14.26% in cadaveric studies and 9.75% in angiographic studies.^[12] Similar results were reported in 14.27% by Patnaik et al^[13], 15% by Anson^[2] and 3% by Miller^[14].

High origin of ulnar artery as superficial ulnar artery was found in 2.26% cases^[3] and was also observed by Adachi^[7] in 7%, by Muller^[15] in 2% and by Quains^[16] in 1.7%. In 2-3% Korean cadavers, a superficial brachial artery arising from axillary artery and continuing in the forearm as radial artery has been reported.^[17]

Brachial artery may bifurcate proximally and reunite to form a single trunk. It trifurcates proximally into ulnar, radial and common interosseus arteries. Sometimes slender vasa aberrantia connect the brachial artery to the axillary artery or to one of the forearm arteries usually the radial.^[1]

Our study of higher division of brachial artery into radial and ulnar arteries with superficial

course of radial artery was similar to case report has been published by Nagalaxmi.^[18]

The importance of documenting such cases are of high interest for physicians, plastic and vascular surgeons and radiologists.^[19] For these professionals, the precise knowledge of the arterial variation patterns is very important for repair surgeries in the shoulder region and reducing arm fractures.^[20]

Embryological Explanation

Different theories have explained the embryologic origins of the vascular variations in the upper limb. Rodriguez-Neidenfuhr stated that arterial system in the upper limb develops from a capillary network that originates from the dorsal aorta.^[21] In another accepted theory, Singer suggested the limb arteries arise from a main axial artery and branches arise through axial sprouting. It seems that the persistence or elimination of parts of these arteries is responsible for numerous vascular variations of the upper limb.^[22]

The superficial course of radial artery in upper part of forearm can be explained on the basis of haemodynamic mechanism between deep and superficial arteries in the forearm. Normally due to deep haemodynamic predominance, superficial terminal branches of radial artery undergo developmental arrest and deep part persists as normal radial artery. The superficial radial artery in right upper limb as seen in this case appears to be due to chance variations in haemodynamic factors which lead to regression of deeper vessels and persistence of one of the superficial terminal branches of radial artery.^[22,23]

Conclusion

The higher origin of radial artery with superficial course may be because of the variations in the stages of formation of brachial artery and its bifurcation into radial and ulnar arteries. In our study, the incidence was counted for 6.24%. Facing the evidences shown off in our study, must be quite interesting for the health professionals to be aware of an individual's anatomy before undergoing invasive procedures.

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