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Original Research Article

Incidence of Higher Origin of Radial Artery with Its Superficial Course: A Cadaveric Study

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Abstract: The knowledge about the radial artery variations are useful for surgeons while performing angiography, vascular re-constructive surgeries. The variations encountered during routine undergraduate dissection was recorded and reported in the study. The present study was carried in department of anatomy to know the incidence of higher origin of radial artery and its superficial course. Careful dissection was done on 32 cadavers (64 Upper limbs) 20 belong to males and 12 belong to females, the higher level of brachial artery bifurcation with superficial course of brachio-radial artery was found in 3 cadavers, unilaterally. Out of 3 cases, two male cadaver showed on its left upper extremity with higher bifurcation of brachial artery and superficial brachio-radial artery. The right upper extremity of female cadaver also evidenced with the same variation, in all the cases brachio-radial artery was supplied to flexor muscles of arm.
Keywords: Higher origin, Superficial radial artery, Variations, Anomalous

INTRODUCTION

The radial artery is smaller terminal branch of brachial artery, but appears a more direct continuation of the brachial artery. It origins about a centimetre distal to the flexion crease of the elbow and lies beneath the antebrachial fascia between the brachioradialis and the flexor carpi radialis muscles [1]. The radial artery descends along the lateral side of the forearm, accompanied by paired venae comitantes, in the proximal part of the forearm it is situated in a medial position close to the biceps brachii tendon, runs deep to the muscular belly of the brachioradialis, and the remainder of its course in the forearm is medial to the brachioradialis tendon [2]. In the distal part of the forearm it is palpable between flexor carpi radialis medially and the salient anterior border of the radius. It passes deep to the tendons of the abductor pollicis longus, the extensor pollicis longus and brevis across the anatomical snuffbox. The radial artery terminates in the hand by anastomosing with the deep branch of ulnar forming the deep palmar arch [1, 3]. The standard anatomical textbooks mentioned about the variations of radial artery, it may occasionally arise as continuation of superficial brachial artery, or as a high proximal division of brachial artery. Sometimes it may give rise to common interosseous artery.

The variations of the arterial system of the upper limb have been well documented by several authors and have a considerable significance towards the clinical and surgical point of view [4]. The high origin of the radial artery with its superficial course is the most frequent vascular variation found in the upper limb. The variability of arterial pattern is to failure in regression of a part of pathway taken by embryonic arterial trunks [5]. This explains high bifurcation of brachial artery with superficial course of radial artery in forearm.

Variations of the radial artery may be seen at origin or its course. While the variations in the origin are common, with an incidence of 15% McCormack *et al*., [6]; Tountas and Bergman, [7], variations in the course are rare, with an incidence of only 0.52% Rodríguez-Niedenführ *et al*., [8]. The subjects with anatomical variations of the radial artery have a substantial lower puncture and procedural success rate. Even though the variations of radial artery during its course are less common, it has been classified in to two classes by Manners Smith [9] according to its relation to the tendons forming the anatomical snuff box. The first class given name as superficial dorsal artery of the forearm as radial artery is single and it passes superficial to the tendons of the anatomical snuff box

[9]. In the second class, the radial artery divides into superficial and deep branches, also documented as partial duplication of the radial artery [6], or duplication of the radial artery.

Fair knowledge about the variations in the origin and course is compulsory as surgeons use in various clinical procedures like angiography, vascular and re-constructive surgeries. The anastomoses between radial and ulnar arteries in the palm play a significant role in diseases of the palm through collateral circulation [10]. Some of the authors have documented unusual vascular variations of upper limb like presence of vasa aberrentia, variations of radial artery in its course, median artery variations in the formation of superficial palmar arch.

MATERIALS AND METHODS

The anatomical study of vasculature of upper limb were studied on 32 randomly selected formalin fixed adult cadavers aged 48 ± 9 years. The cadavers were assigned to medical and dental students for dissection in department of anatomy, out of 32 cadavers (64 Upper limbs) 20 belong to males and 12 belong to females. The topography of the upper limb vasculature of all the cadavers were examined during dissection and those showing variations were recorded, photographed and described. None of those upper limbs had the presence of macroscopic lesions, signs of instability and deformity or any other major abnormalities.

RESULTS

The current study was carried on 64 upper limbs, 40 belongs to Males and 24 Females. Each limb was dissected carefully and typically. The mean age of cadavers was 48 ± 9 years. The mean age of male and female cadavers had no significant differences in terms of gender distribution.

Each dissected limb was thoroughly inspected for arterial variations. Out of 32 cadavers, 3 cadavers (9.3%) were showed unilateral high origin of radial artery with its superficial course.

The left upper limb brachial artery of two male cadavers aged 45 ± 2, bifurcated into brachio-radial and brachio-ulnar arteries in middle of arm around 6.5 cm above the line joining two epicondyles of humerus (Fig. 1). The brachio-radial artery was superficial, throughout its course from its origin. While passing through arm, the artery passing medial to lateral side crossing median nerve superficially and continued down on the lateral side of the cubital fossa. The superficial radial artery in arm gave only small branches to biceps and brachialis muscles. From cubital fossa radial artery running superficial to bicipital aponeurosis and to the muscles of the forearm but resting deep to the antebrachial fascia on its radial border. The radial artery in the lower part of forearm and after that it had the same course as commonly seen. The brachio-ulnar artery had a normal course, running on medial side of biceps brachii muscle till reaching cubital fossa, from here onwards it continued as ulnar artery and runs deep to bicipital aponeurosis.

Another case was a 50 years female cadaver showed higher bifurcation of right upper limb brachial artery in to brachio-radial and brachio-ulnar arteries (Fig. 2). The bifurcation of brachial artery into radial and ulnar was observed relatively at higher level i.e. 7.2 cm above the line joining humeral epicondyles. The course of the brachio-radial artery was same as described in the first two cases and the brachio-ulnar artery had its normal course. Throughout its course this superficial brachio-radial artery supplied the flexor compartment muscles of arm and forearm by giving numerous branches.

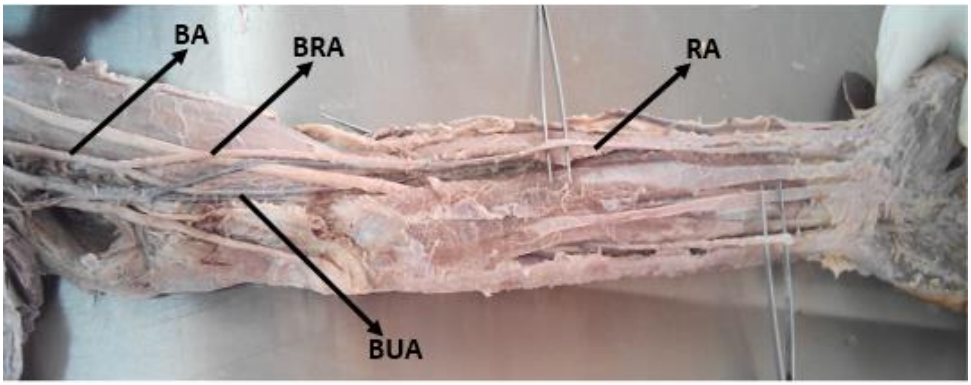

Fig-1: Photograph showing dissection of Left Upper limb with higher level bifurcation of Brachial artery and Superficial course ofBrachio-radial artery(BA: Brachial Artery, BRA: Brachio-Radial artery, BUA: Brachio-Ulnar artery, RA: Radial Artery)

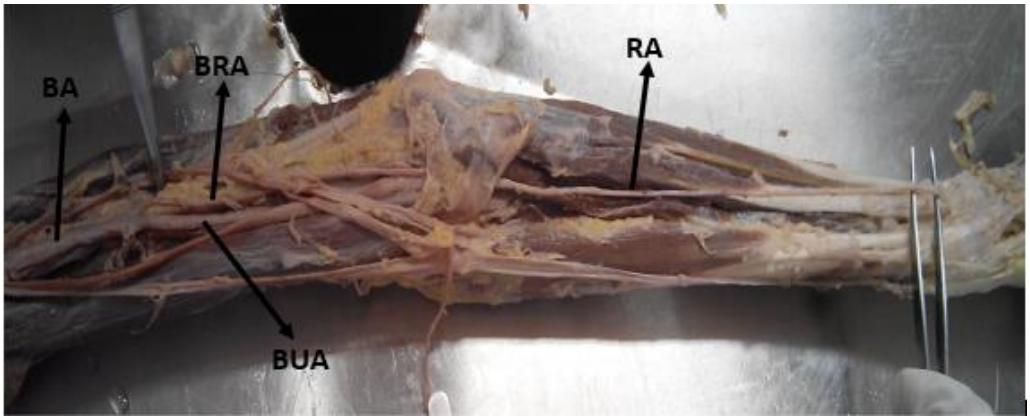

Fig-2: Photograph showing dissection of Right Upper limb with higher level bifurcation of Brachial artery and Superficial course of Brachio-radial artery(BA: Brachial Artery, BRA: Brachio-Radial artery, BUA: Brachio-Ulnar artery, RA: Radial Artery)

DISCUSSION

The major variations of blood vessels may be due to anomalies during the formation of blood vessels or may be persistence of vessels which are normally obliterated or disappearance of vessels which are normally retained and incomplete in development in respective part of the body [3, 11]. The arteries of upper limb bud develops from axial artery represents a branch of seventh cervical inter segmental artery [9]. It gives off a superficial brachial artery which runs anterior to cords of brachial plexus and divides into two terminal branches lateral and medial of which the medial branch named as superficial ante-brachial artery [12]. The lateral and medial terminal branches of axial artery anastomoses each other in later stage. As the development progress, the primitive axial artery attains haemodynamic predominance, stays as axillary and brachial artery, the superficial brachial artery and its pre-anastomotic segments disappears. The hemodynamic predominance contribute for development of definitive radial artery, usually it's an persistent artery of lateral branch of primitive axial artery with the post anastomotic segment of lateral terminal branch of superficial brachial artery [5, 9].

Vascular variations and anomalies of the arterial pattern of the upper extremity are fairly common but variations in the origin of major arteries of upper limb are not uncommon. Arterial variations of upper limb in relation to the higher level bifurcation of brachial artery and the superficial course of radial artery was documented by various authors. The high origin of radial artery from brachial artery are designate as brahio-radial artery, in most of the cases brachio-radial artery runs superficial in course with few braches supplies to flexor muscles of arm [6].

The major and minor variations of the arteries of the upper extremities have been detailed by Adachi [13], Schwyzer and De Garis [14]. Often, brachial artery divides more proximally than usual level of bifurcation, brachio-radial artery, and superficial radial artery from axillary artery. However, rarecases like complete absence of radial artery have been reported by Kadanoff and Blkansky [15], Suganthy J [16].

The higher origin of radial artery as brachio-radial artery with superficial throughout its course was reported by Clemente [12]. The superficial radial artery is most frequent variation reported 14.26% in cadaveric studies and 9.75% in angiographic studies [16, 17]. The radial artery with normal origin but superficial in its course at the wrist crosses superficially to the tendons that outline the anatomical snuff box was reported by Rodríguez-Niedenführ *et al* [8]. Nagalaxmi *et al* [18], presented a case of unilateral higher division of brachial artery at the level of middle of arm with superficial course of radial artery in upper part of forearm. In an another case higher division of brachial artery was encountered on left side though the course of radial and ulnar arteries from elbow downwards was normal reported by Harbans Singh [19], Yalcin *et al* [20].

CONCLUSION

The variations found in our study with higher origin and superficial course of radial artery may be significant in clinical cases especially to vascular and plastic surgeons. While performing reconstructive surgery of upper extremity, the radial artery may be ligated or cut, mistaking it for a vein. Variation of radial artery at its origin attains unmanageable and results of failure to radial approach in cases of coronary angiography. The superficial course of radial artery is always vulnerable for damage in accidents, superficial cuts and crush injuries. It's worthful to present the variations encountered in current study for diagnostic purposes like cardiac catheterization, arterial grafting and other angiographic procedures.

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