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Case Report

A case report of high origin superficial ulnar artery, its embryological background and clinical significance

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Abstract

Variations in the arterial pattern of the upper limb have been observed frequently either in cadaver dissection or in clinical practice. In these variations radial or ulnar arteries commonly are involved. No properly documentation of these variations can lead to damage during surgical procedures. This report presents a case of unilateral superficial ulnar artery (SUA), its embryological explanation and clinical significance.

During routine anatomy dissection of a Caucasian male cadaver about 65 years of age, a unilateral case of SUA was observed. The variant artery arose from the lower third of the brachial artery, passed subcutaneously in the forearm. In the hand, the SUA coursed over the flexor retinaculum and anastomosed with the superficial palmar branch of the radial artery to create the superficial palmar arch. No muscular or other arterial variations were observed in this cadaver.

Our finding demonstrated a rare variation in arterial pattern of upper extremity that has clinical importance. The embryological explanation of this variation may arise as a result of modifications to usual pattern of capillary vessels maintenance and regression. Furthermore, the clinical importance of this variation was discussed.

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Key words [brachial artery] [anatomical variation] [ulnar artery] [upper limb]

Introduction

The brachial artery is the major artery of the arm. It is continuation of the axillary artery that begins at the level of inferior border of teres major tendon and terminates about 1 cm distal to the elbow joint, at the level of the neck of the radius bone [1]. In the end route, it sinks deeply into the triangular intermuscular cubital fossa and occupies its medial portion [1]. In this region it lies deep to the skin, superficial and deep antebrachial fascia and divides into radial and ulnar arteries [1]. Two venae comitantes usually accompany the artery in its course [1]. Variations in the number and/or course of the arteries of the upper limb are abundant and diverse in the adult human body [2–4]. Most of these variations occur in either the radial or the ulnar artery, while brachial artery variations are less common [3]. These variations have been observed and reported frequently, either in routine dissection of cadavers or in clinical practice [1, 5]. Some anatomy textbooks referred to some of these variations [5]. These variations in number and/or course have clinical and surgical significance [5, 6, 7]. The prevalence of right side variations relative to the left upper limb have been reported 2:1 by Lanz & Wachsmuth [8], while in another research it has been 1.2:1 [5]. Bilateral variations have been noticed in 35% of cases in a study that arterial variations of arm and forearm have been studied in 23 subjects [5]. An important variation of upper limb is superficial ulnar artery (SUA) with high origin that lies superficially in the forearm [9]. The frequency of this variation has been reported from 0.17% to 2% [9].

Because the upper limb is a frequent site of injury and various surgical and invasive procedures are performed on it, hence, it will be of utmost importance to be aware of arterial variations in this region [3]. Therefore, in this report we presented a case of unilateral high origin superficial ulnar artery with embryological explanation and its clinical significance.

Case Report

During routine anatomical dissection of the right upper limb of an about 65-year-old Caucasian male cadaver in Anatomy Department of Birjand University of Medical Sciences during 2011, a unilateral case of SUA was observed that arose high origin, from brachial artery in lower third of the arm (Figure1). The artery coursed superficially and subcutaneously over the cubital fossa and lied in front of the flexor tendons (Figure1). The terminal portion of this artery followed usual pattern in course and branches. It passed over the flexor retinaculum and entered the palm beneath palmar aponeurosis. Then

anastomosed with the superficial palmar branch of the radial artery, to form the superficial palmar arch in this region. The common interosseus and ulnar recurrent branches originated from the radial artery, instead of the ulnar artery, in the cubital fossa (Figure2). The course and other branches of radial artery showed no variation. The usual ulnar artery was absent and no muscular or other arterial variations were observed in the cadaver.

Discussion

Variations of brachial artery and its tributaries are very abundant and diverse in adult human bodies [3]. For example, brachial artery may be absent in some bodies [10]. Presence of lateral inferior superficial brachial artery with large interosseus branch has been observed and reported by Yalcin et al. [11]. In that case the radial artery has been absent,

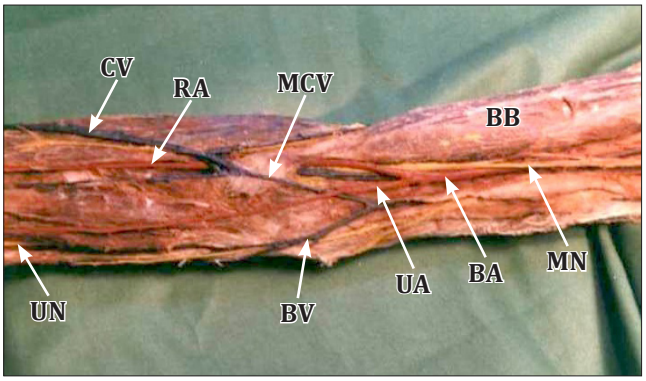

Figure 1. Dissection of the anterior region of the right arm and forearm showing a high bifurcation of brachial artery in the lower third of arm and subcutaneous course of superficial ulnar artery. *(**CV**: cephalic vein; **RA**: radial artery; **MCV**: median cubital vein; **UN**: ulnar nerve; **BV**: basilic vein; **UA**: ulnar artery; **BA**: brachial artery; **MN:** median nerve; **BB**: biceps brachii)*

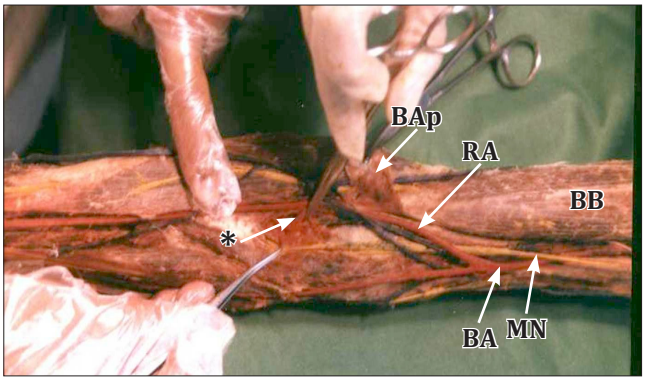

Figure 2. Dissection of the anterior region of the right arm and forearm showing the origin of common interosseus and ulnar recurrent branches from radial artery, instead of ulnar artery. *(**BAp**: bicipital aponeurosis; **RA**: radial artery; **BA**: brachial artery; **MN:** median nerve; **BB**: biceps brachii; **asterisk**: common interosseus and ulnar recurrent branches)*

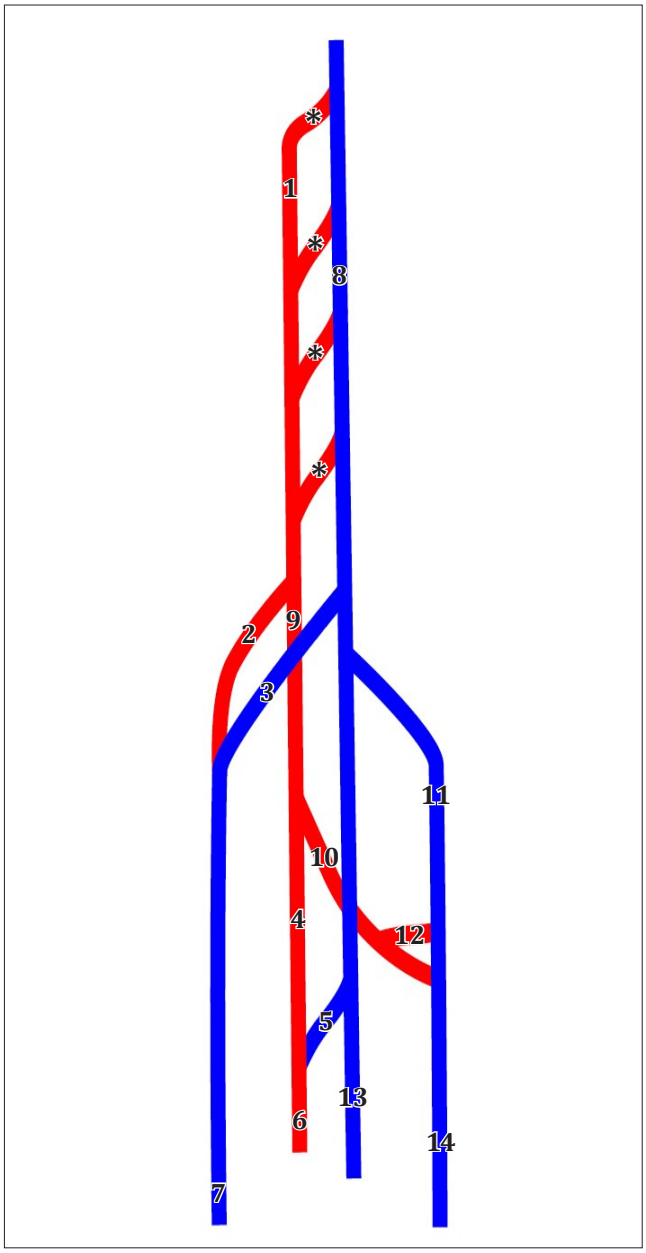

Figure 3. Schematic diagram showing arterial segment that is present during development of the brachio-antebrachial arterial system. Diagram summarizes all segments during normal development. The deep arterial system (blue lines) remains in the definitive arterial pattern whereas only distal segments (red lines) of the superficial arterial system persist as a part of the radial and ulnar arteries. *(**asterisks**: trunks of deep origin of the superficial brachial artery; **1**: superficial brachial artery; **2**: lateral branch of the superficial brachial artery; **3**: trunk of deep origin of the radial artery; **4**: median branch of the superficial antebrachial artery; **5**: trunk of deep origin of the median artery; **6**: median artery; **7**: radial artery; **8**: primitive axial artery; **9**: median branch of the superficial brachial artery (superficial antebrachial artery); **10**: ulnar branch of the superficial antebrachial artery; **11**: trunk of deep origin of the ulnar artery; **12**: ulnar communicans arterial branch at the cubital fossa; **13**: common interosseus artery; **14**: ulnar artery)*

and anterior interosseus branch originated from brachial artery about 1.2 cm lower than the neck of radius [11]. Such a variant artery may be in danger during vascular injection or surgical procedures in cubital fossa and the lower end of the arm [11]. Connection of the axillary or brachial artery to one of the forearm arteries by an anastomotic artery has also been reported by Uzun et al [12]. This connection may disturb the interpretation of angiograms [12]. A loop may be present in the brachial artery, which can yield difficulties in coronary angiography via transradial approach [13]. One of the most important variations in arterial pattern in upper limb is presence of an unusual origin and course of the ulnar artery, which is undoubtedly of interest to the clinicians as well as the anatomists [14]. Some studies reported unusual ulnar arteries that arose superficially at the arm and entered the forearm subcutaneously [15, 16]. Natsis et al. have also reported a high origin SUA that arose from axillary artery, at the level of the junction of the two median nerve roots [9], crossing the lateral root, and running lateral to it, in the two-third upper part of the arm. In the inferior third of the arm, SUA crossed over the median nerve and ran medially to it [9]. In another report a SUA has been observed in accompany with an aneurysm of deep palmar arch in the hand [16]. In the latter case SUA, like the previous one, arose from the third part of the axillary artery, at the junction of the two median nerve roots [16]. In similar to our reported case in a Nepali cadaver, the ulnar artery ran downward superficially on the flexor muscles and the radial artery gave off common interosseus branch [17].

Explanation for arterial variation in human upper limb has generally been based on the classical outlines of arterial development [1,18]. However, anatomical and embryological correlation in some publications shows that it may differ from the classical descriptions [18]. The embryological interpretation of this variation may arise as a result of modification to the normal pattern of capillary vessels maintenance and regression (maintenance of superficial branch and regression of deep branch in oppose of normal modification) [5, 9, 19].

It has been elucidated that formation of the arterial system in the upper limb takes place as a dual process [20]. First an initial capillary plexus appears from the dorsal aorta and enters the developing upper limb. Then, this capillary plexus begins a maturation process involving the enlargement and differentiation of selected parts. This remodeling process starts in the aorta and continues in a proximal to distal sequence [20]. The capillary plexus appears during stage 12, and develops parallel to development of the skeletal system synchronously [10]. Its differentiation starts at stage 13, and by the stage 18 reaches the forearms arteries and finally by stage 21 the whole arterial pattern is present in its definitive morphology in the upper limb [15].

According findings of Müller (1903), and Senior (1926), during stage 17, maturation of the capillary plexus reaches the brachial artery [21, 22]. In this stage the main arteries that appear in this plexus are as follows:

1. The primitive axial artery that makes later, the axillary, brachial and interosseus arteries (Figure 3) [5].

2. The superficial brachial artery that joins the axillary and brachial segments of primitive axial artery by means of several trunks of origin (Figure 3) [5, 21, 22]. The terminal branch of this artery take part in the development of the radial, ulnar and median arteries, joining with the trunk of deep origin of these arteries in the primitive axial artery [5]. Regression of the superficial arterial segments located proximal to this anastomosis give rise to the definitive arterial pattern, either the total or partial persistence of the superficial arterial segments, explains those cases of high origin of either radial or ulnar arteries [5].

Today, diagnostic coronarography and coronary bypass procedure carried out extensively worldwide and the femoral artery usually used to access for coronary angiography and intervention, but due to the significant risks, the radial artery increasingly substitute it and now widely used in cardiac catheterization [23–25]. The anatomical and size variation of this artery is not always suitable and ulnar artery occasionally used as an alternative in such cases [22]. Aptecar et al. compared the transulnar and transradial approaches for coronary angiography and angioplasty. They found that successful access was in 93.1% of patients in the ulnar group and 95.5% of patients in the radial group for angiography procedures [25]. Furthermore, in Jolly et al.'s study the success of angioplasty procedures were in 95.2% and 96.2% of procedures in ulnar and radial group respectively, and statistical analysis did not show significant difference [24]. They concluded that the transulnar approach is a safe and effective alternative for diagnostic and therapeutic coronary interventions [24]. In addition, they suggested that the transulnar approach has the potential to spare injury to the radial artery in anticipation of its use as a coronary bypass conduit [24]. The success of transulnar procedure has been reported 90.9% by Roberts et al. in a review article [23].

Conclusion

One of the rare variations of ulnar artery taking its origin from brachial artery in the arm, and its background is modification to the usual pattern of capillary vessels, maintenance and regression.

As the radial and the ulnar arteries widely used in cardiac catheterization, coronary angiography, arterial injections in the forearm, and also cardiac surgery and kidney transplantation, hence, being aware of their variations has clinical importance.

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