

THE ARTERY BLOOD SUPPLY VARIANT OF THE UPPER LIMB

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Abstract

Variations of arterial patterns in the upper limb have represented the most common subject of vascular anatomy. Different types of artery branching pattern of the upper limb are very important for orthopedists in angiographic and microvascular surgical practice.

The brachial artery (BA) is the most important vessel in the normal vascular anatomy of the upper limb. The classical pattern of the palmar hand region distribution shows the superficial palmar arch. Normally this arch is formed by the superficial branch of the ulnar artery and completed on the lateral side by one of these arteries: the superficial palmar branch of the radial artery, the princeps pollicis artery, the superficial palmar branch of the radial artery or the median artery.

After the routine dissection of the right upper limb of an adult male cadaver, we found a very rare variant of the superficial arch artery – a division in a higher level brachial artery. We found this division at 10.4 cm from the beginning of the brachial artery. This superficial brachial artery became a radial artery and was not involved in the formation of the palm arch. In the forearm region, the artery variant was present with the median artery and the ulnar artery, which form the superficial palm arch.

Keywords: brachial artery, superficial brachial artery, superficial palm arch, median artery

Introduction

Variations of the upper limb arterial system are very common. They are present in 10 to 55% of cases – Trotter [16], Konarik [8], reaching 23% of cases in the free part of the limb - Valsecchi [17]. The brachial artery begins at the distal border of the tendon of the teres major muscle and ends close to the elbow joint. Frequently the brachial artery divides more proximally into radial, ulnar and common interosseous arteries. Some of the common variations of the brachial artery are present in the superficial brachial artery of the arm. This artery moves together with the median nerve and continues as the radial artery twice as frequently, when compared to the ulnar artery; less frequently it continues as both arteries - Bergman et al. [2]. The brachial artery is used in routine procedures, such as blood pressure recordings and arteriography of different parts of the body. Variation in the proximal and

distal branching pattern of brachial artery is important for vascular surgeons. Radiologists also must be aware of these kinds of variations during their diagnostics.

The superficial palmar arch is formed predominantly by the ulnar artery, with a contribution from the superficial palmar branch of the radial artery. According to the classic description (Goss, Bouchet & Cuilleret [3], anastomosis among the ulnar and radiopalmar arteries form the superficial palmar arch. Adachi [1] thinks that the superficial palmar arch has an ulnar-predominant formation, which he calls the Ulnar-type (59% of cases). Coleman & Anson [4] developed a classification, in which the superficial palmar arch is formed in 78.46% of cases. The hand surgeon needs to know about the existence and healthy functioning of the palmar arch and the types of variations. This is very important before surgical procedures such as arterial repairs or a vascular graft. The main purpose of this case report is to describe the blood supply variations in the upper limb and to analyze the actual formation of the superficial palmar arch in the palm region.

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Case Report

The case was described after a routine dissection during the anatomy class with students from the Department of Anatomy, histology and pathology at the Medical faculty of the University of Sofia. The 75 years old male cadaver was fixed with the formaldehyde method. At the left upper limb were observed and documented vascular variations of the brachial artery and composition of the superficial artery arc. The dissection was performed layer by layer. It became possible to trace the brachial artery after the removal of subcutaneous adipose tissue and venous branches. In the proximal part of the brachial artery we found a higher branch. This division was approximately at 10.4 cm from the beginning of brachial artery (Figure 1). This superficial brachial artery became radial and was not involved in the formation of the palm arch. The superficial brachial artery pathway was closer to the median nerve in the first several

centimeters, but after that it strayed on the lateral position and passed through the lateral sulcus of the cubital region. In this region, the brachial artery together with the ulnar and median nerve passes along the medial sulcus. The brachial artery on the forearm gives the beginning of median, common interosseous and ulnar branches approximately 4 cm after the cubital region (Figure 2). The pathway of the median artery is accompanied by the median nerve and on the distal forearm part composes the superficial artery arch. This structure is an anastomosis between the median and ulnar artery (Figure 3). The radial artery was not involved in forming the superficial palmar arch. The left upper limb did not show variation in the artery blood supply. The brachial artery persisted in the brachial region without the superficial branch and on the proximal forearm was divided by the common interosseous, ulnar and radial artery. The superficial palmar arch was the connection between the ulnar and the radial artery in this case.



Figure 1. Higher division of the brachial artery.

BA – brachial artery

SBA – superficial brachial artery

MN – median nerve



Figure 2. Variant of blood supply of the arm and forearm regions.

- BA – brachial artery
- SBA – superficial brachial artery
- MN – median nerve
- UA – ulnar artery
- MA – median artery
- RA – radial artery

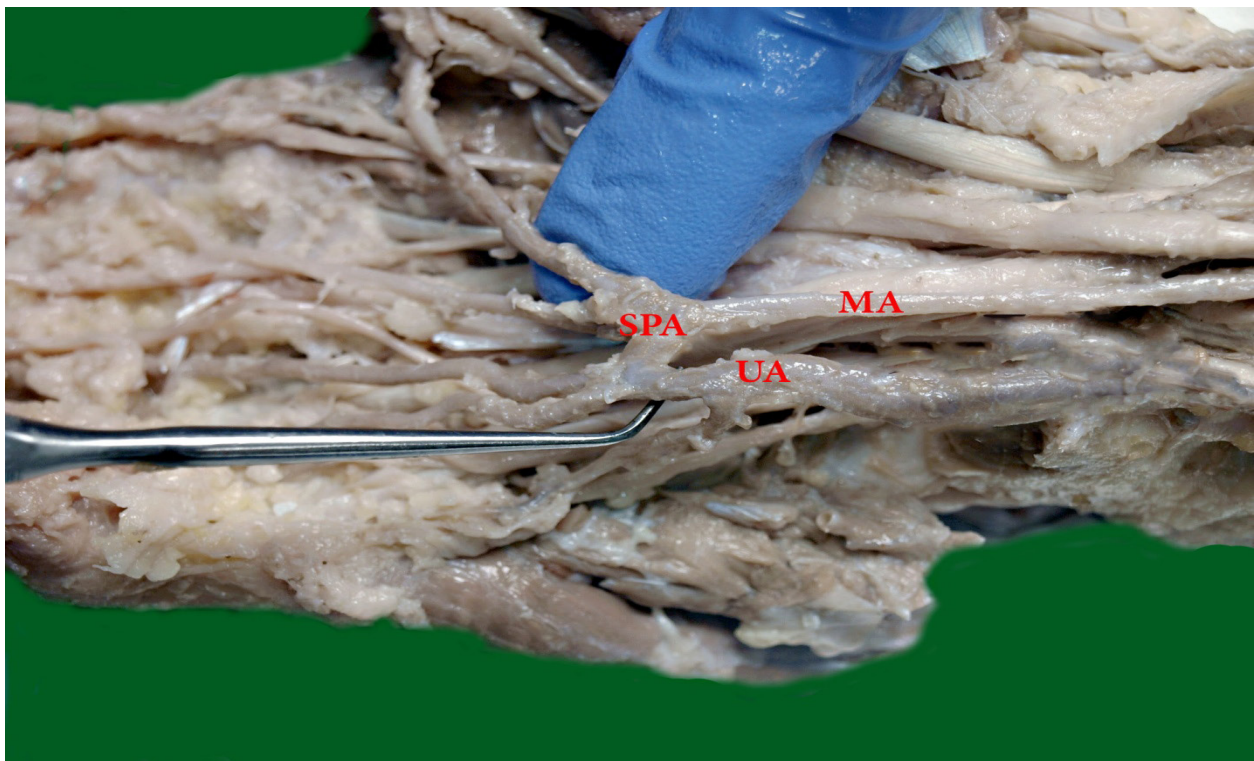


Figure 3. A rare variant of the superficial palmar arch.

- MA – median artery
- UA – ulnar artery
- SPA – superficial palmar arch

Discussion

At the time of embryo development, the deep artery system of the upper limbs originates from the primitive axial artery and superficial brachial artery (Muller [10], Senior [14], Rodriguez-Baeza A, et al. [13]). The axillary, brachial and interosseous arteries are the main branches of the primitive axial artery. The brachial and axillary arteries merge with the help of the superficial brachial artery in the proximal region of the arm. Distally, the superficial brachial artery anastomoses with the brachial artery by medial branch of the superficial brachial artery. The derivatives of the forearm artery are median (colligate with the deep branch of the radial artery, the branch of the primitive axial artery) and the ulnar artery, which anastomoses with the terminal trunk of the primitive axial artery (ulnar system). According to Singer [15], because of these anastomoses, there is an increase in the local blood flow and involution of the proximal segment of the superficial brachial artery. In this case it is possible for the ulnar artery to arise directly from the primitive axial artery. This is one of the common morphological and genetic alterations found in the variations of the upper limb blood supply. Changes in the origin or involution of these segments are the cause of morphogenetic alterations found in the anatomy of the arteries of the upper limbs. The position of the high bifurcation of the brachial artery relative to the biepicondylar line of the elbow and the pathway of median nerve are observed very well. Most significant research of detailed arterial variations of the upper limb are articles by Adachi [1], Bouchet & Cuilleret [3] Coleman & Anson [4]; according to these authors summative of more than a thousand cases, 18.5% are anatomical variations, 77% being cases with high origin of radial artery, while the ulnar artery was a persisting 12.2% of the variations. Docimo et al. [6] described a case of arterial malformation in an old female cadaver, whereby the radial artery was formed in the axillary artery with a superficial path in an anterior region of the arm, converging deeply at the brachial artery in the cubital fossa. According to Pelin et al. [12] the high origin of the radial artery is 14.27% in dissections of cadavers and 9.75% in an angiographic study. In some cases, there is a trifurcation of the brachial artery. Malci-Gürbuz et al. [11] described one case of triple branches of brachial artery on the 4.9 cm, which began at the brachial artery and formed the radial, ulnar and superior collateral ulnar arteries. Another interesting case described the trifurcation of the brachial artery occurring in the proximal third of the forearm and composing the radial, ulnar and common interosseous branches, which passed into the pronator teres muscle [1,4]. The presence of the superficial brachial artery originating in the axillary artery was observed in 12.2 % of 304 Korean cadavers.

The superficial palmar arch (SPA) is the main vascular structure of the palm region and is localized beneath the same name aponeurosis. Coleman SS, Anson

BJ [4] found a 37% chance occurrence of a complete arch, formed entirely by the ulnar artery. They observed more than 650 specimens, while exploring the SPA, and found out that the ulnar artery joined a large vessel from the deep palmar arch at the base of the thenar region. The median artery (MA) of the antebrachial forearm region is the most important vessel at the time of embryo development. It maintains the superficial palmar arch (SPA), while the radial and ulnar arteries are developing. When the main arteries of this region are fully developed (radial and ulnar arteries), the median artery disappears. In very rare cases, this artery persists in adult individuals. After that the MA may form the SPA (Claassen H, Schmitt O, Wree A [5]). Due to its close proximity to the median, the median artery nerve can be involved in several clinical disorders such as carpal tunnel syndrome, anterior interosseous nerve syndrome and pronator syndrome. In view of the described variations, we believe that the knowledge of this unusual blood supply is extremely important, especially for the clinical or surgical practice.

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