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VARIANT ARTERIAL PATTERN IN THE FOREARM WITH ITS EMBRYOLOGICAL BASIS

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ABSTRACT: During routine dissection for the first MBBS students, we observed that the radial artery was absent in the right upper limb of a 70 years old, donated embalmed male cadaver in the Department of Anatomy, K.J.Somaiya Medical College, Sion. In the lower part of the arm, brachial artery divided into ulnar and common Interosseous artery. Anterior interosseous artery was large in size. Deep to pronator quadratus, it turned laterally and reached the dorsum of the hand, where its lateral branch supplied the thumb and index finger and its medial branch dipped into the palm at the second inter-metacarpal space. Superficial palmar arch was absent. Digital arteries from the medial and lateral branches of ulnar artery supplied the fingers. Embryological basis is presented.
Key words: Brachial artery, Anterior interosseous artery, Common Interosseous artery, Radial artery, ulnar artery

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INTRODUCTION

The main artery of the arm, the brachial artery divides at the level of the neck of the radius into radial and ulnar arteries. Ulnar artery, which shows a slight medial convexity, travels along the medial side of the forearm. It then crosses the flexor retinaculum and ends in the palm as the superficial palmar arch. One third of the superficial palmar arches are formed by the ulnar artery alone, another one third are completed by the superficial palmar branch of the radial, and another third either by the arteria radialis indicis or a branch of arteria princeps pollicis or by the median artery. Radial artery appears as a direct continuation of the brachial artery. It descends along the lateral side of the forearm travelling superficially between Flexor Carpi Radialis tendon and the Brachioradialis tendon in the distal one-third of the forearm. Here it is covered only be the superficial fascia and skin and lies against the lower part of the anterior surface of the radius where it is palpated as the radial pulse. It then curves round the carpus beneath the tendons of abductor pollicis longus and extensor pollicis brevis, travels through the anatomical snuff-box, and reaches between the heads of the first dorsal interosseous muscle. It then enters the palm and forms the deep palmar arch with the deep branch of the ulnar artery.

The common interosseous artery, which is a branch of the ulnar artery given out just distal to the radial tuberosity, divides into the anterior and posterior interosseous arteries at the proximal border of the interosseous membrane. Anterior interosseous artery descends on the anterior aspect of the interosseous membrane with anterior interosseous nerve. Proximal to pronator quadratus, it pierces the interosseus membrane and reaches the back of the forearm. Posterior interosseous artery passes backward between the oblique cord and the upper border of the interosseous membrane and reaches the back of the forearm. It descends on the posterior aspect of the interosseous membrane and in the lower part it anastomoses with the anterior interosseous branch [1].

Case Report

During routine dissection for the first MBBS students, we observed that the radial artery was absent in the right upper limb of a 70 years old, donated embalmed male cadaver in the Department of Anatomy, K.J.Somaiya Medical College, Sion. In the lower part of the arm, brachial artery divided into ulnar and common Interosseous artery which further divided into anterior and posterior interosseus arteries.

Anterior interosseous artery was large in size. Deep to pronator quadratus, it turned laterally, crossing the anatomical snuff box and reached the dorsum of the hand, where its lateral branch supplied the thumb and index finger and its medial branch dipped into the palm at the second inter-metacarpal space. The Deep Palmar Arch was formed by this medial branch. It was completed by a branch of the ulnar artery and Superficial palmar arch was absent. The posterior interosseus artery passed to the back of the forearm above the interroseus membrane.

Fig.1: Photographic representation of Brachial Artery terminating into Ulnar & Common Interosseous Arteries.

The ulnar artery crossed superficial to pronator Teres. In the lower part of the forearm, it divided into a superficial and deep branch. The superficial branch ran medially superficial to flexor retinaculum and terminated by giving digital branches to the medial two and a half fingers. It also gave a branch which and completed the deep palmar arch The deep branch ran laterally deep to the flexor retinaculum and terminated by giving digital branches to the lateral two and a half fingers. The ulnar artery, common interosseous artery and the anterior interosseous artery supplied the muscles of the front of the forearm.

DISCUSSION

Variations in the arterial pattern of the upper limb are common and have been reported earlier by a number of authors. Also accessory branches arise from brachial artery are common like brachial artery dividing into radial, ulnar, and common interosseous arteries or radial artery arising proximally, with a common trunk for ulnar and common interosseous; or ulnar artery arising proximally, with a common trunk for radial and common interosseous forming the other division; at times, the common interosseous may also arise proximally.. However, case reports on congenital absence of unilateral or bilateral radial artery are rare. Absence of radial artery was first reported in1894 by Charles where he observed a unilateral absence of radial artery which was replaced by anterior interosseous artery [2]. Kadanoff and Balkansky (1966) observed left upper limb arterial system showing anterior interosseous artery as the chief blood supply to the forearm and hand with absent radial artery and the lateral terminal branch forming the deep palmar arch [3]. In 2002, Suganthy reported a case where the brachial artery divided into the ulnar artery and large interosseous artery, whereas the radial artery was not observed [4]. In 2006, Yalcin [12] also reported a case of absence of the left radial artery with a lateral inferior superficial brachial artery and large anterior interosseous artery on the left. On the right, a trifurcation of the brachial artery into the radial, ulnar and one muscular artery at the proximal one-third of the humerus was observed [5]. In the present case, anterior interosseous was the dominant perfusing artery, while the ulnar arteries were very small in size. Both anterior interosseous artery and ulnar artery supplied blood to the forearm and hand. The superficial palmar arch was absent. The anterior interosseous artery, after reaching the dorsum of the hand crossed the anatomical snuffbox, to enter into the palm in the second intermetacarpal space and form a somewhat deep palmar arch.

Embryological Basis

In early stages of development, a single axis artery supplies the upper limb. The seventh cervical intersegmental artery forms the axis artery of the upper limb and persists in the adult to form the axillary, brachial, and interosseous arteries. At a later stage, the median artery takes over the place of the main artery of the forearm while the axis artery remains as the small anterior interosseous artery. Still later, two new arteries i.e. ulnar and radial take over from the median as the main vessels of the forearm and the median artery persists only as a small vessel running along the median nerve [6]. The arterial pattern observed in this case is primitive as the anterior interosseous artery is the dominant supply of the forearm. The anterior interosseous remains as a dominant artery, not replaced by a median artery and while the ulnar artery developed, most of radial artery regressed. The developing terminal part of the anterior interosseous artery had joined a vessel somewhat corresponding to the course of the distal part of radial artery and replaced the radial artery, from the dorsum of the hand to the palm. When the median artery persists as a major vessel to the hand, the ulnar artery and radial artery are always present, but when the anterior interosseous artery persists as a major vessel, only the ulnar artery is present in the hand [7].

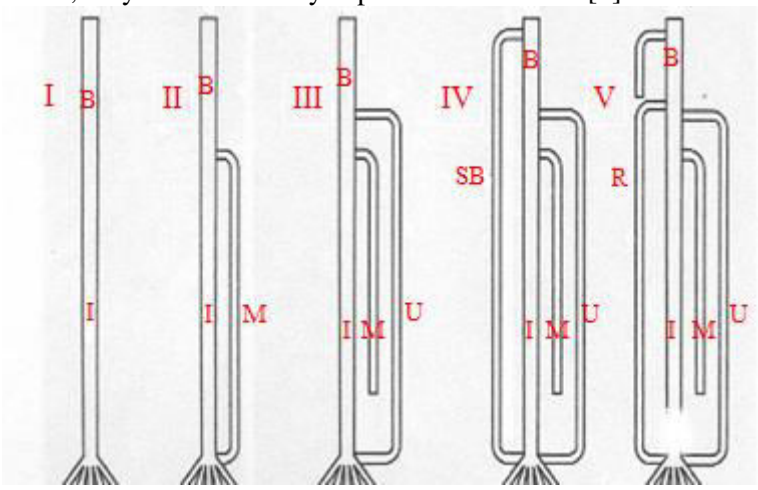

Fig: 2 - Normal Development of Radial Artery

Clinical Significance

The radial artery is used for access in coronary angiography as well as for coronary artery bypass surgery. There could be misinterpretation of incomplete angiographic pictures and problems in brachial artery catheterization. The clinical significance of potential vascular problems must be noted in such cases [8]. There would be an absence of radial pulse at the normal site but a strong pulse over the dorsal aspect of the wrist joint, due to the large anterior interosseous artery in the dorsum of the hand. Such arteries may also present a hazard to venupuncture, as do anomalous arteries in the cubital fossa. Carpal tunnel syndrome may occur due to compression of the deep branch of ulnar artery within carpal tunnel [9]. The superficial location of the ulnar artery in the present case, can lead to intraarterial injections or ligature instead of the vein in the cubital fossa. The case reported here may be of significance to angiologists, radiologists as well as physicians, surgeons, especially traumatologists and vascular surgeons, considering the frequency of procedures in this region. To avoid complications, examinations such as color Doppler imaging of arteries or even an arterial angiography, may be performed before cardiac catheterization or coronary artery bypass surgery [10].

CONCLUSION

Cases of congenital absence of unilateral or bilateral radial artery are rare. When present there could be misinterpretation of incomplete angiographic pictures and problems in brachial artery catheterization. Hence it is significant for angiologists, radiologists, traumatologists and vascular surgeons to be aware of the variation.

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Conflict of Interest

The authors declare that they have no conflict of interest.

Statement of Human and Animal Rights

All procedures performed in human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

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