

A complex variation in the superficial palmar arch

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In this article we describe a unique and complex variation in the arterial pattern of the left hand of a female cadaver. The following variations were found in this case: a) persistent median artery of the palmar type, terminating in the hand as the princeps pollicis and radialis indicis arteries; b) the ulnar artery giving only two common palmar digital arteries; c) the second digital palmar artery without division into two digital branches and instead supplying only the radial side of the ring finger; d) absence of the first common digital artery with the contiguous sides of the second web space supplied by the first palmar metacarpal artery from the deep palmar arch; e) early bifurcation of the median nerve proximal to the flexor retinaculum.

Key words: radial artery, ulnar artery, median artery, princeps pollicis artery, radialis

INTRODUCTION

The superficial palmar arch is the major blood supply to the hand [8]. The high incidence of anatomical variations in the arterial pattern of the hand has been the subject of many studies [3, 6, 10, 12, 14]. Various anomalous patterns in the superficial arch (SPA) of the hand have been reported. Among these variations are the superficial palmar branch of the radial artery passing deep to the flexor retinaculum to form the SPA [19], absence of the SPA [22] and incomplete development of the SPA [2]. In addition, variable patterns of SPA and deep palmar arches have been encountered [6, 10]. Moreover, variations have been noted in the diameter of the arteries contributing to the SPA [6, 20]. Knowledge of the frequency of anatomical variations of the arterial pattern of the hand is crucial for safe and successful hand surgery [12]. Several techniques are used to identify and locate any unusual vessel in the upper limb, including Doppler ultrasound, the modified Allen test, pulse oximetry and arterial angiography [7, 17, 26]. In this case report a complex neurovascular variation in one

hand discovered during a routine practical anatomy session is described and its clinical implications discussed.

MATERIAL AND METHODS

This work was carried out during routine dissection sessions for medical students in the Faculty of Medicine and Health Sciences at Sultan Qaboos University. The left upper limb of a female cadaver was dissected thoroughly for the blood vessels supplying the hand. The cadaver was formalin-fixed. Skin was carefully dissected to avoid overlooking any contribution of the superficial vessels to the SPA. All arteries and nerves distal to the elbow joint were identified and dissected. The same procedure was applied to the right upper limb.

RESULTS

The variations were found in the left upper limb, while the right one showed no variation in the arterial pattern. The median artery arose from the ulnar artery about 5 cm below the intercondylar

line and descended in the forearm under the flexor digitorum superficialis. In the hand it passed through the carpal tunnel lateral to the median nerve before it terminated as the princeps pollicis and radialis indicis arteries (Fig. 1). The superficial palmar branch of the radial artery terminated in the thenar muscles without any contribution to the SPA. On the other hand, the ulnar artery displayed its typical course in the forearm. It terminated by dividing into a palmar digital artery to the ulnar side of the fifth finger and common palmar digital arteries to the third and fourth web spaces (Fig. 1). The common palmar digital artery to the fourth web space divided into two digital branches to supply the sides of the fourth web space, while the common palmar digital artery to the third web space did not divide and supplied only the radial side of the fourth finger (Fig. 1).

The common digital artery to the second web space was missing and the contiguous sides of the space were supplied by the first palmar metacarpal artery from the deep palmar arch (Fig. 1). There was no connection between the median and ulnar arteries in the hand, resulting in an incomplete SPA. The radial artery coursed distally as usual and anatomised with the deep branch of the ulnar artery to complete the deep palmar arch. No arteries from the deep

palmar arch were seen to supply the thumb. Proximal to the flexor retinaculum the median nerve was divided into a smaller medial branch and a larger lateral branch. The medial branch supplied the contiguous surfaces of the third and the fourth fingers, while the lateral branch supplied the contiguous surfaces of the first and second fingers and the second and third fingers respectively (Fig. 1).

DISCUSSION

We found that the median artery contributes to the formation of an incomplete superficial palmar arch which terminates as the princeps pollicis and radialis indicis arteries.

Although the study of Coleman and Anson [3] showed that the median artery contributes to the formation of a complete palmar arch in 5% of cases and an incomplete superficial arch in almost 5% of cases, it did not show any termination of the median artery into the princeps pollicis and radialis indicis arteries. McCormack et al. [16], in their comprehensive study on the arterial pattern of 750 hands, did not find the origin of the princeps pollicis and radialis indicis arteries from the superficial palmar arch. Moreover, Erbil et al. [5] described five cases in which the superficial palmar arch provided the blood supply to the thumb and index fingers

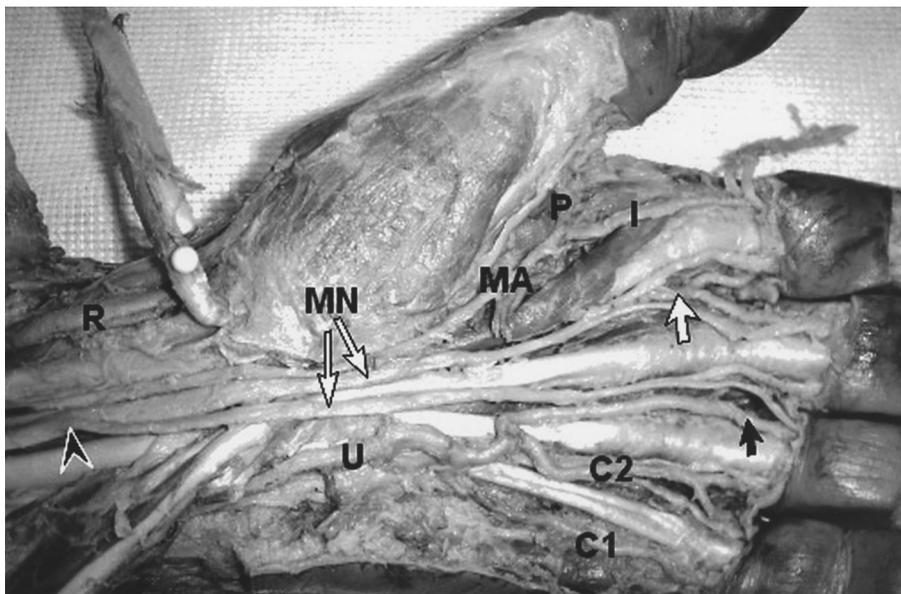


Figure 1. A photograph shows the left hand of a female cadaver. Note the early bifurcation of the median nerve (MN) at the arrow head and the median artery (MA) running lateral to the nerve in the carpal tunnel. The median artery divides into the princeps pollicis artery (P) and radialis indicis artery (I). The ulnar artery (U) divides into the carpal digital branch to the ulnar side of the little finger (C1), the common palmar digital artery supplying the sides of the fourth web space (C2) and a common palmar digital artery (black arrow), which supplies the radial side of the ring finger. Notice the absence of the common palmar digital artery to the second web space, which is supplied by the first palmar metacarpal artery (white arrow). The radial artery (R) does not contribute to the formation of the superficial palmar arch.

through the princeps pollicis and radialis indicis arteries. Neither of the above studies demonstrated that these arteries arise from the median artery. In another study the median artery terminated as a common palmar digital artery supplying the first web space between the thumb and the index fingers, but there was no indication that it was the sole blood supply to this region [23]. Moreover, another study demonstrated the persistent median artery but without any indication of its fate in the hand [9].

Although we reported the absence of the common palmar digital artery to the second web space, this space was supplied by the first common palmar metacarpal artery from the deep palmar arch. A previous study showed that the common palmar digital artery to the second web space did not arise from the superficial arch; instead it arose from a common trunk which supplies that third web space [21]. There was also a report of the absence of the first palmar metacarpal artery, in addition to the early bifurcation of the second palmar metacarpal artery [4].

There is a contradiction in the origin of the blood supply to the first web space of the hand. Karlsson and Niechajev [13], in their study of the blood supply of the hand, demonstrated the presence of the princeps pollicis artery in all 139 cases studied and it was the most constant branch of the palmar metacarpal arteries. In contrast, the princeps pollicis artery was only found in 56% of 50 cases studied [1]. In addition, the arteries to the thumb and index finger are not referred to as the princeps pollicis and radialis indicis arteries unless they originate from the deep palmar arch [1]. However, Ikeda et al. [11] described the artery arising from the superficial palmar arch to supply the first web space as the first common palmar digital artery.

Variation of the nerves in the upper limb is well documented. These variations may include piercing of the median and anterior interosseous nerves by the median artery [23], an ulnar nerve formed of two roots [24] and a median nerve coming from a single trunk as the ulnar and the musculocutaneous nerves [18]. Although, early bifurcation of the median nerve proximal to the flexor retinaculum is uncommon, identification of such variation is crucial before attempting local nerve block or radial artery harvesting for coronary artery bypass.

The variations in the present study may have resulted from the persistent median artery and arrested development of other arteries. In addition, the

palmar arterial network arrangements in foetal and adult human hands are similar [15]. This similarity indicates that the various configurations of the arterial pattern of the hand have been well established during early prenatal growth and maintained into the adulthood.

In considering radial artery harvesting for coronary artery bypass the least number of complications may be expected when the median artery is the main blood supply to the first web space. Identifying the median artery as one of the causes of carpal tunnel syndrome is crucial for proper management [9]. In addition, the identification of any variation in the arterial pattern of the hand using Doppler ultrasonography, photoplethysmography and oximetric techniques acquires great importance in various surgical interventions in the hand.

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