

Anatomical Variations of Ulnar Artery in Hand: Clinical Importance

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ABSTRACT

The ulnar artery shows different patterns in hand and provides major contribution in the formation of superficial palmar arch. We have dissected twenty four hand specimens to follow the course of the ulnar artery and its branches. Classical radio-ulnar arch was observed in all hand specimens except one female cadaveric specimen where four common palmar digital arteries were arising from the convexity of the SPA instead of three as seen in classical radio-ulnar arch. The first common palmar digital artery was dividing into arteria radialis indicis and arteria princeps pollicis. The arch was completed by superficial palmar branch of radial artery. One exclusive communication was reported between radial artery proper and arteria princeps pollicis. Knowledge about arterial variations will be useful for cardiovascular surgeons, radiologists and anatomists working in this area. Occlusion of the arteries may lead to ischemia characterised by claudication, rest pain and gangrene if untreated. Therefore, anatomy of the arteries and the possibility of developing collateral circulation is of utmost importance.

Keywords: Arteria princeps pollicis, claudication, collateral circulation, common palmar digital artery, superficial palmar arch

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INTRODUCTION

Arterial supply to the human hand mainly by radial and ulnar arteries in the form of superficial and deep palmar arches was first described by Haller in 1753. Geometrical variations of these arches were later observed by Tiedman in 1831.¹ The ulnar artery (UA) is the branch of the brachial artery. At the wrist it lies beneath the skin, fasciae and palmaris brevis and plays a major role in the formation of superficial palmar arch (SPA). It enters the palm accompanying the ulnar nerve and lies anterior to the flexor retinaculum and lateral to the pisiform bone. Thereafter this artery runs medial to the hook of hamate, curving laterally to form the SPA which is nourished mainly by the same artery. The arch is completed by any of the following arteries; superficial palmar branch of radial artery (RSP), arteria princeps pollicis (APP), arteria radialis indicis (ARI) or arteria mediana. Customarily, three common palmar arteries arise from the convexity of the arch.²

Three theories have been proposed in order to define the development of ulnar artery in humans. The first theory described the development of this artery due to remodelling of intricate primitive networks. According to the second theory, arteries of the superior extremity were the result of bud formation from axis artery and the final theory suggested the development of arterial pattern by the differentiation of the capillary vessels in the forearm.³ Adachi in 1928 classified the complete SPA in the following manner on the basis of arterial contribution: Ulnar type, Radio-ulnar type, Mediano-ulnar type. A similar study conducted by Al-Turk M suggested a new arterial pattern of SPA contributed by radial, median and ulnar arteries.⁴

Collateral circulation plays an important role in case of occlusion of UA in the hand. Occlusion of the artery may lead to ischemia characterised by claudication, rest pain and gangrene if untreated.⁵ Any change in the symmetry of the arch can be determined by Doppler ultrasonography, photoplethysmography and oximetric techniques.⁶ Therefore, knowledge about arterial variations will be useful for radiologists and cardiovascular surgeons working on this area.

The aim of the study was to establish the anatomical variations of the ulnar artery in the palm.

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MATERIALS AND METHODS

Twenty four hand specimens belonging to seven female and five male cadavers were dissected, for the dissection curriculum of undergraduate medical students in the Department of Anatomy, Kasturba Medical College, Manipal University, to trace the course of the ulnar artery and its branches in the palm. All cadavers were formalin fixed. Dissections were carried out following Cunningham's Manual of Practical Anatomy. Digital photographs were taken to demonstrate the palmar arterial arches.

RESULTS

We found the classical radio-ulnar arch in all hand specimens except one. Arterial pattern in the classical arch is the result of contribution from UA and any of following arteries; RSP, APP, ARI or arteria mediana. Only one female cadaveric specimen was found with unique pattern of right side UA forming SPA and its branches. We observed total five palmar digital arteries on her palmar aspect out of which four common palmar digital arteries arose from the convexity of the SPA instead of three as seen in classical radio-ulnar arch. These common palmar digital arteries passed to the corresponding first, second, third and fourth web space which fed the contiguous side of her fingers by dividing into proper digital arteries except the first one. The first common palmar digital artery divided into ARI and APP (Fig 1). The arteria radialis indicis ran along the radial side of her index finger and APP supplying the ulnar side of thumb. The arch was completed by RSP. One exclusive communication was reported between RA and APP (Fig 2). A fifth palmar digital artery arose from her SPA and running along the ulnar side of her little finger. We did not observe any aberrant path of deep palmar branch of UA.

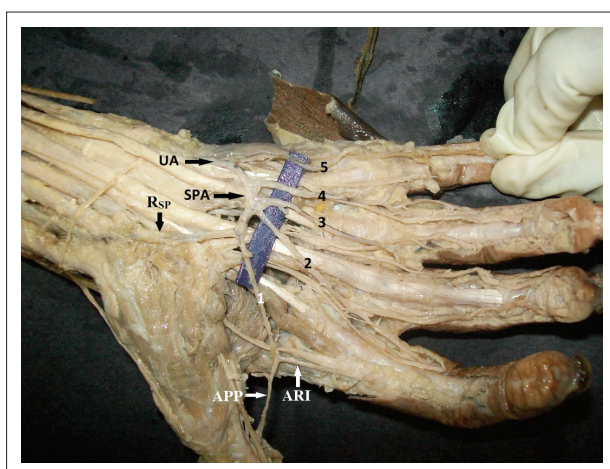


Fig 1. Palmar aspect of hand showing the five palmar digital arteries (1-5). Note the origin of arteria princeps pollicis (APP) and arteria radialis indicis (ARI) from first common palmar digital artery (1). (RSP- Radial artery; UA- Ulnar artery and SPA- Superficial palmar arch).

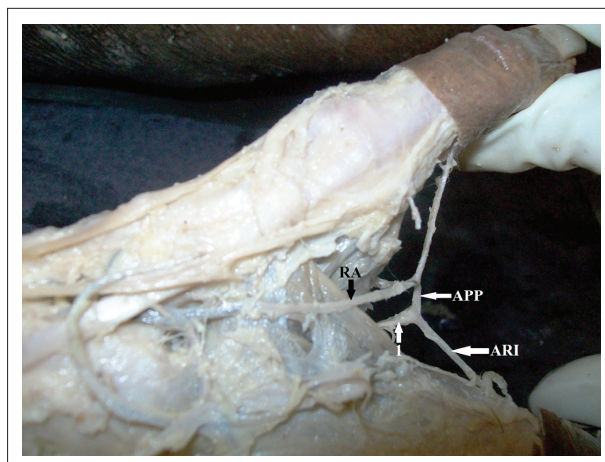
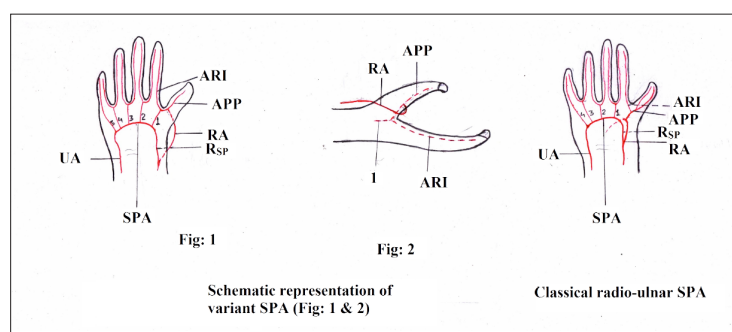


Fig 2. Dissection of dorsolateral aspect showing the communication and path of collateral circulation between arteria princeps pollicis (APP) and radial artery proper (RA). (ARI- arteria radialis indicis; 1- common palmar digital artery).



Diagrams- SPA

DISCUSSION

We examined 24 dissected hand specimens to locate the course of UA. This study was mainly focused **on UA** and its branches in the hand since it contributes to set up the SPA. The choice of artery was based upon its various modes of forming SPA. A study conducted on patients using Doppler ultrasonic flow meter suggested the classical radio-ulnar arch in 78% cases. Five different patterns of SPA and its branches have been defined.⁴ No similar results were found with our study. Mookambika et al reported a case of SPA contributed exclusively by superficial palmar branch of UA.⁷ The findings of Anitha et al were similar to the study of Mookambika et al, in which 20% of cases the ulnar artery contributed the SPA and the formation of complete SPA was recorded by both ulnar and median arteries in 60% cases.⁶

Present findings on the origin of APP and ARI from SPA were consistent with the Erbil et al.⁸ In contrast, McCormack et al did not notice the origin of these branches from SPA.⁹ Al-Turk et al opine that arteries to the thumb and index finger are referred to APP and ARI if they arise exclusively from the deep palmar arch.⁴ We observed the origin of these branches from the first common palmar digital artery.

A case reported by Jiji et al showed the communication of SPA with first dorsal metacarpal artery, branch of radial artery.¹⁰ We did not come across such findings in our study. We have observed a unique pattern of SPA and its branches constituted by UA. As described before, four common palmar arteries were noticed in one of the hand specimens examined. Our results showed the importance of these arteries. We observed the anastomosis of radial and ulnar arteries and concluded that the first common palmar artery can be utilized for coronary artery bypass grafting (CABG). This particular arterial branch can be harvested without affecting the collateral circulation in the hand since the radial artery takes over its function in this case (Fig 2). We recommend the Allen test, Doppler ultrasonography and arteriogram to follow the collateral circulation in the hand before grafting. Knowledge about this specific type of SPA is also important to perform safe hand surgeries.

Direction of blood flow in variant SPA

Collateral circulation in arteries can be determined using the Allen test, Doppler Ultrasonography and arteriogram in living persons. Since this study was performed on cadavers, the possible direction of blood flow in the present case might be:

Medial 4 digits received blood from the branches of 5 proper palmar digital arteries (Branches of UA). The radial side of the index finger got blood supply from ARI and thumb from APP. Collateral circulation was established by RA either with ARI or with APP.

CONCLUSION

Different patterns of arches provide information about various collateral circulations. We observed the

course of the UA in hands and came across an exceptional pattern of the artery. This specific arterial pattern can be implemented in CABG. Awareness about the course of the ulnar artery with its branches in the hand may be valuable for cardiovascular surgeons, radiologists as well as for anatomists.

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