

STUDY OF PALMAR TYPE OF MEDIAN ARTERY AND ITS FATE

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ABSTRACT

Background: The median artery is a transitory vessel that represents the arterial axis of the forearm during early embryonic life. When present, it appears mainly as two types: antebrachial and palmar.

Context and purpose of the study: In the present study the objective was to investigate the occurrence and fate of palmar type of median artery. The study was conducted on 40 cadaveric upper extremities dissected in the department of Anatomy, Guru Gobind Singh Medical College, Faridkot, India.

Results: In the present study, persistent median artery (palmar type) was seen in 2.5% of the limbs dissected. It was originating from the posterior aspect of the ulnar artery approximately 3.2 cm distal to the elbow joint. It pierced the median nerve (traversing from its medial to its lateral aspect) in the proximal third of the forearm. The artery then travelled lateral to the median nerve in rest of the forearm. Subsequently, it accompanied the median nerve into the palm passing deep to the flexor retinaculum. Finally, the artery terminated by completing the superficial palmar arch. In addition to the above described variant blood vessel, we also observed high division of median nerve into its medial and lateral branches.

Clinical implications: When median artery is patent and reaches the hand, it forms the only arterial supply to the median nerve and damage to this artery could have serious effects. The aim of our study was to provide additional information about anomalous palmar type of median artery and its clinical implications.

KEY WORDS: Palmar type of median artery, Median nerve, Superficial palmar arch.

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INTRODUCTION

The median artery is a transitory vessel that represents the arterial axis of the forearm during early embryonic life. The artery normally

presents a short course (antebrachial type) and less commonly appears as a long slender vessel reaching the palm (palmar type) [1]. The incidence and pattern of this artery seem to be

dependant on race; hence, the ranges given for its occurrence are extensive [2, 3]. The antebrachial type is a short artery arising from the anterior interosseus and is said to occur at a higher incidence than the palmar type of median artery [1]. Importance of persistent median artery (Palmar type) lies in the fact that the one with large calibre may lead to early compression of median nerve in carpal tunnel in patients prone to it e.g. in myxoedema, rheumatoid arthritis etc. It has also been related to compressive pathology of the median nerve secondary to arterial calcification, thrombosis, arteriosclerosis, aneurysm and trauma [4]. There are very few studies reporting the incidence, origin and fate of the palmar type of median artery. So, this study was carried out to evaluate these properties of the palmar type of median artery in the routinely dissected cadavers. The underlying ontogeny and phylogeny have also been discussed in detail.

METHODS

The present study was done on 40 formalin fixed upper extremities belonging to 20 cadavers dissected in the Department of Anatomy, Guru Gobind Singh Medical College, Faridkot, Punjab, India. The dissection was performed as per the guidelines in the Cunningham's Manual of Practical Anatomy [5]. Flexor aspects of both the forearms of each cadaver were dissected and the presence of the palmar type of median artery was determined by naked eye inspection. The artery and its branches were traced, cleaned and photographed.

RESULTS

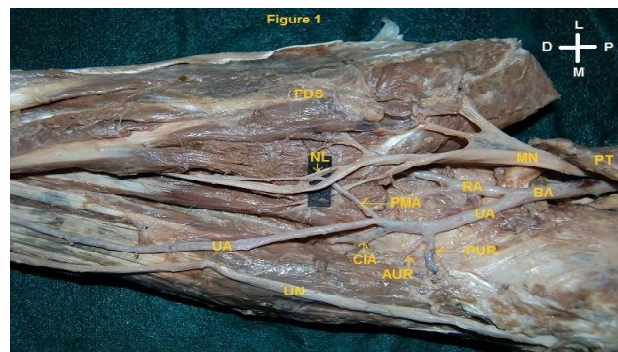
Careful dissection of 40 upper extremities revealed the presence of palmar type of median artery in 2.5% (right forearm of an adult female cadaver) cases. It was originating from the posterior aspect of the ulnar artery approximately 3.2 cm distal to the elbow joint; deep to the flexor digitorum superficialis (Figure 1). Median artery pierced the median nerve just distal to its emergence between the two heads of pronator teres (traversing from its medial to its lateral aspect) thereby splitting the nerve approximately into two halves. The separated nerve fibres reunited immediately below the site of penetration, thus forming a neural loop which

circumscribed the artery (Figure 1). The artery then travelled lateral to the median nerve in the distal two thirds of the forearm. Subsequently, it accompanied the median nerve into the palm passing deep to the flexor retinaculum. Finally the artery terminated by completing the radial part of the superficial palmar arch whose medial part was a continuation of the superficial branch of the ulnar artery. The complete mediano-ulnar arch so formed gave one proper palmar digital branch to the medial aspect of the little finger and four common palmar digital branches which supplied all the four interdigital clefts and the adjoining aspects of the corresponding fingers (Figure 2).

The course of radial artery was normal in the forearm. After giving a branch to the lateral aspect of the thumb i.e. the princeps pollicis artery, it entered the palm between the two heads of the first dorsal interosseous muscle and continued as its deep palmar branch. The superficial branch of the radial artery was absent (Figure 2).

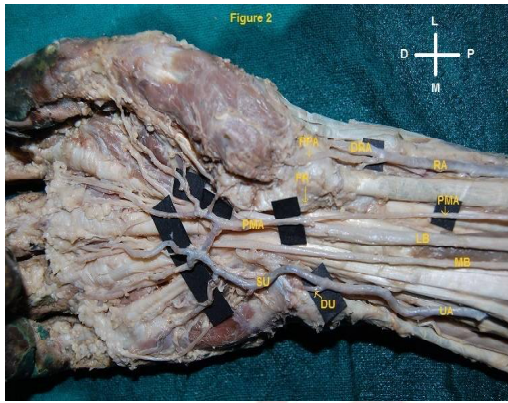
In addition to the above described variant blood vessel, we also observed high division of median nerve into its medial and lateral branches at the junction of the proximal and middle thirds of the forearm (Figure 3). Both the branches passed through the carpal tunnel to reach the palm. The distribution of the median nerve in the palm was otherwise normal.

Fig. 1: Showing origin of Persistent Median Artery and neural loop of Median nerve encircling the artery.



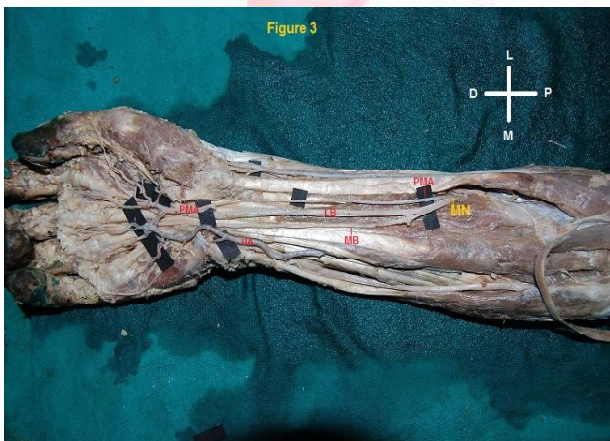
AUR-Anterior ulnar recurrent artery, BA-Brachial artery, CIA: Common interosseous artery, FDS-Flexor digitorum superficialis, MN-Median nerve, NL-Neural loop, PMA-Persistent median artery, PT- Pronator teres, PUR-Posterior ulnar recurrent artery, RA-Radial artery, UA-Ulnar artery, UN-Ulnar nerve.

Fig. 2: Showing formation of complete mediano- ulnar palmar arch and its branches.



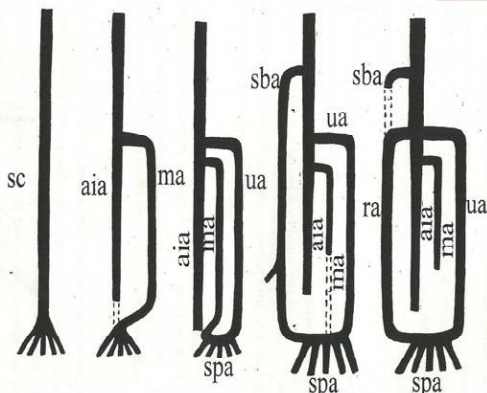
DRA-Deep branch of radial artery, DU-Deep branch of ulnar artery, FR-Cut end of flexor retinaculum, LB-Lateral branch of median nerve, MB-Medial branch of median nerve, PMA-Persistent median artery, PPA-Priniceps pollicis artery, RA-Radial artery, SU-Superficial branch of ulnar artery, UA-Ulnar artery.

Fig. 3: Showing high division of median nerve in the forearm.



LB-Lateral branch of median nerve, MB-Medial branch of median nerve, MN-Median nerve, PMA-Persistent median artery, UA-Ulnar artery.

Fig. 4: Stages of development of arteries of upper limb.



Sc-Subclavian artery, Ma-Median artery, Aia-Anterior interosseous artery, Ua-Ulnar artery, Ra-Radial artery, Sba-Superficial brachial artery, Spa-Superficial palmar arch.

Table 1: Showing incidence of Palmar type of Median Artery as reported earlier.

Sr. No.	Author	Incidence
1	Rodriguez- Niedenfuhr et al [1]	20%
2	D'Costa et al [9]	15.80%
3	Durgesh & Rao [10]	4%
4	Kumar & Kulkarni [11]	20%
5	Joshi et al [12]	4%
6	Raviprasanna & Dakshayani [13]	8%

DISCUSSION

In our study we observed palmar type of median artery in 2.5% of the dissected specimens. The difference in the incidences of the artery reported by the various authors (Table 1) can be attributed to the difference in the races they studied; which may be the result of the allelic variation of genes regulating this anatomical variation.

Coleman and Anson [14] performed a composite study on the arteries forming superficial palmar arch and classified the arch into following groups:

Group I: Complete arch (Found in 78.5% cases). It can be further divided into five types:

Type A: The classical radio ulnar arch is formed by superficial palmar branch of radial artery and the larger ulnar artery. It was found in 34.5% dissections.

Type B: This arch is formed entirely by ulnar artery. It was found in 37% dissections.

Type C: Mediano ulnar arch is composed of ulnar artery and an enlarged median artery. It was found in 3.8% dissections.

Type D: Radio-mediano-ulnar arch in which all the 3 vessels (i.e. radial, ulnar, median) entered into the formation of arch. It was found in only 1.2% dissections.

Type E: It consists of a well formed arch initiated by ulnar artery and completed by a large sized vessel derived from deep palmar arch which comes to superficial level at the base of the thenar eminence to join the ulnar artery. It was found in 2% dissections.

Group II: Incomplete arch: When the contributing arteries to the superficial arch do not anastomose or when the ulnar artery fails to reach the thumb and index finger, the arch is incomplete. Such type of arch was found in 21.5% cases. It can be further divided into four types:

Type A: Both superficial palmar branch of radial artery and ulnar artery take part in supplying palm and fingers but in doing so, they fail to anastomose. It was found in 3.2% dissections.

Type B: Only the ulnar artery forms superficial palmar arch. The arch is incomplete in the sense that the ulnar artery does not take part in the supply of thumb and index finger. It was found in 13.4% dissections.

Type C: Superficial vessels receive contributions from both median and ulnar arteries but without anastomosis. It was found in 3.8% dissections.

Type D: Radial, median and ulnar artery all give origin to superficial vessels but do not anastomose. It was found in 1.1% dissections.

The present study corresponds to Group I Type C of their classification. The complete superficial mediano-ulnar palmar arch in our study supplied the medial four and a half fingers while the lateral aspect of the thumb was supplied by a direct branch from radial artery. The superficial palmar branch of radial artery was absent which coincided with the studies conducted by Kumar & Kulkarni [11] and Tsuruo et al [15].

In addition to the above findings, median artery pierced the median nerve just distal to its emergence between the two heads of pronator teres which is in consonance with some of the earlier studies [9,16,17,18]. The median nerve exhibited higher division into its medial and lateral branches as reported earlier by Vollala et al [16] and Agarwal et al [19].

Ontogeny: The complex embryological development of the vascular system often results in a myriad of clinically relevant anomalies. Many of such anomalies noted in man represent either a retention or reappearance of primitive patterns and this is in consonance with the view that ontogeny repeats phylogeny [20]. Arey [21] is of the view that the anomalous blood vessels may be due to (i) the choice of unusual paths in the primitive vascular plexuses, (ii) the persistence of vessels normally obliterated (iii) the disappearance of vessels normally retained, (iv) incomplete development and (v) fusions and absorption of the parts usually distinct.

Keibel and Mall [22] opined that the earliest channels of an arterial source into the anterior

limb buds are doubtless capillaries which arise directly from the lateral aortic wall at many points and anastomose profusely in the early limb tissue. One of these which is always opposite the 7th cervical intersegmental region from where upper limb bud arises, attains haemodynamic preference, enlarges and persists as subclavian or axial artery of the upper limb bud. It now forms the sole supply to the capillary plexus in upper limb. Further development of the arteries of upper limb has been delineated by Singer [6] in 5 stages (See figure 4) as follows:

Stage I: Originally the subclavian artery extends to the wrist, where it terminates by dividing into terminal branches for the fingers. The distal portion of the artery becomes the interosseous artery of the adult.

Stage II: The median artery arises from interosseous artery and becomes larger while interosseous artery subsequently undergoes retrogression. During this process the median artery fuses with the lower portion of interosseous artery and ultimately forms the main channel for the digital branches; becoming the principle artery of the forearm.

Stage III: In embryo of 18 mm, the ulnar artery arises from brachial artery and unites distally with the median artery to form superficial palmar arch. Digital branches arise from this arch.

Stage IV: In embryo of 21 mm length, the superficial brachial artery develops in the axillary region and traverses the medial surface of the arm and runs diagonally from the ulnar to the radial side of the forearm to the posterior surface of the wrist. There it divides over the carpus into branches for the dorsum of the thumb and index finger.

Stage V: Finally three changes occur. When the embryo reaches the length of 23 mm, the median artery undergoes retrogression becoming a small slender structure, now known as arteria comes nervi mediani. The superficial brachial artery gives off a distal branch which anastomoses with the superficial palmar arch already present. At the elbow an anastomotic branch between brachial artery and superficial brachial artery becomes enlarged sufficiently to form with the distal portion of the latter, the

radial artery, as a major artery of the forearm; the proximal portion of the superficial brachial artery atrophies correspondingly [6].

Thus it is evident that in stage III of Singer [6], ulnar artery fuses with median artery to form superficial palmar arch. Later on in stage V median artery severs its connection with superficial palmar arch and retrogresses while radial artery takes haemodynamic preference and one of its branch fuses with ulnar artery to form superficial palmar arch.

In the present study, similar to Singer's stage III there was an anastomosis between ulnar and median arteries and thus a complete median ulnar superficial palmar arch was formed. Both median and ulnar artery continued to supply palmar digital arteries in their respective areas. Probably in present study, embryological development ceased at stage III, wherein the median artery failed to regress.

Phylogeny: As the median artery is reportedly conserved in domestic mammals, [23] and is the usual condition in lower tetrapods, [24] its persistence in the adult human represents a retention of the primitive arterial pattern. Also the growth of a blood vessel to a particular site is necessary for providing nutrition and oxygen to that part of the embryo. An artery penetrating a nerve is usually considered to be a phylogenetic or a developmental remnant, because this structural feature is common in lower primates, correlating with extreme muscular development and the requisite, extensive blood supply [25].

Clinical implications: The importance of the persistent median artery lies in the fact that it necessitates the ligation of radial and ulnar arteries above its origin or even ligation of brachial artery, in cases of wound of the palm [26]. Also a median artery with large calibre may lead to early compression of median nerve in carpal tunnel in patients prone to it eg. in myxoedema, rheumatoid arthritis etc. It has also been related to compressive pathology of the median nerve secondary to arterial calcification, thrombosis, arteriosclerosis, aneurysm and trauma [4].

An anomalous artery penetrating the median nerve in the arm can compress it and produce

symptoms of proximal median neuropathy similar to struther's ligament or a tight bicipital aponeurosis. The compressive force of the pulsating penetrating artery may produce ischemia, distributed unequally in the nerve. These nerves are usually weak at the site of arterial penetration and are more susceptible to pathological conditions [26]. This finding may be relevant to the pathologies that require a surgical intervention.

CONCLUSION

The persistence of the median artery is a common and important arterial variation in the upper limb. It is, therefore, mandatory to be aware of a persistent median artery, particularly the palmar type, during surgical approaches to the forearm and hand.

Conflicts of Interests: None

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