

Prevalence of the Persistent Median Artery

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ABSTRACT

Introduction: Neurovascular variations in the upper limb are common and they are well documented. An accurate knowledge of the normal and the variant anatomy of the median nerve and the median artery are important for clinical procedures and for vascular surgeries. The persistent median artery is one such anomaly which was seen in 6.6% (4) of the 60 upper limbs which were dissected in the present study, it being bilateral in one cadaver.

Material and Methods: The present study was conducted on 60 upper limbs of 30 cadavers at the Government Medical College, Amritsar, India. The whole course of the median nerve and the persistent median artery was exposed.

Results: In all the 4 variant limbs, the persistent median artery originated from the anterior interosseous artery and terminated in the incomplete mediano- ulnar type of the superficial palmar arch. In three upper limbs, the persistent median artery simply accompanied the median nerve upto the palm. But in the left upper limb of the cadaver with the bilateral variation, the artery penetrated and divided the nerve into two halves which joined to form a neural loop around the artery. Thereafter, the nerve and the artery followed the same course upto the palm. Such a penetration of the median nerve by the persistent median artery is extremely rare. Further, its ontogeny and clinical implications have been discussed in detail.

Key Words: Persistent median artery, Median nerve penetration, Neurovascular variations

INTRODUCTION

The median artery is a transitory vessel that represents the arterial axis of the forearm during the early embryonic life. It normally regresses after the second embryonic month to become a small slender artery, the *committansnervi median* [1-3]. However, it may persist in 1.1-27.1% of the individuals, as has reported in different studies [4-9]. In most of the cases, it simply accompanies the median nerve which is in the hand, but it may even perforate the median nerve [8,10,11]. The later entity is however rarely seen. While Keen [12] reasoned a persistent median artery to be due to the persistence of an embryonic vessel, Jaschtchinski [13] had called this as an atavistic condition because it is normally found in the palmar arch of certain lower animals. The importance of the persistent median artery lies in the fact that the one with a large calibre may lead to an early compression of the median nerve in the carpal tunnel in patients who are prone to it eg. in myxo-oedema, rheumatoid arthritis, etc. It has also been related to the compressive pathology of the median nerve, which is secondary to arterial calcification [14], thrombosis [15] and atherosclerosis [16]. Turso et al., [17] reported an incomplete, mediano-ulnar type of the superficial palmar arch. In a case report, Ramanathan et al., [18], observed the superficial arterial system which was associated with a palmar type of the median artery in the left limb of a 52 year old cadaver.

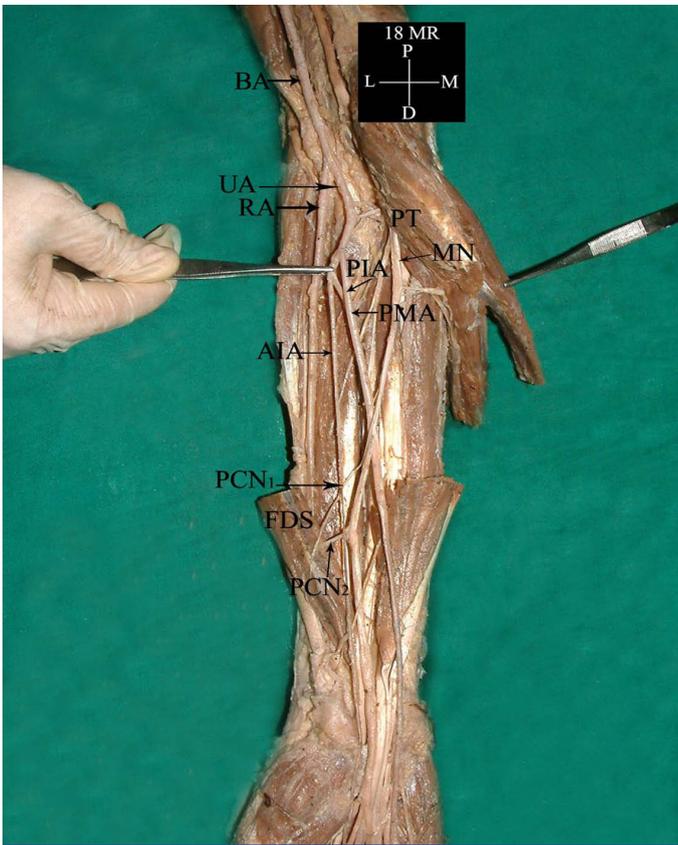
The prevalence of the persistent median artery, as has been mentioned above and as was reported by different studies, shows a wide range. This gave us an impetus to design this study, to find out the frequency with which the persistent median artery is found in north Indians and the pattern of its termination wherever it is seen.

MATERIALS AND METHODS

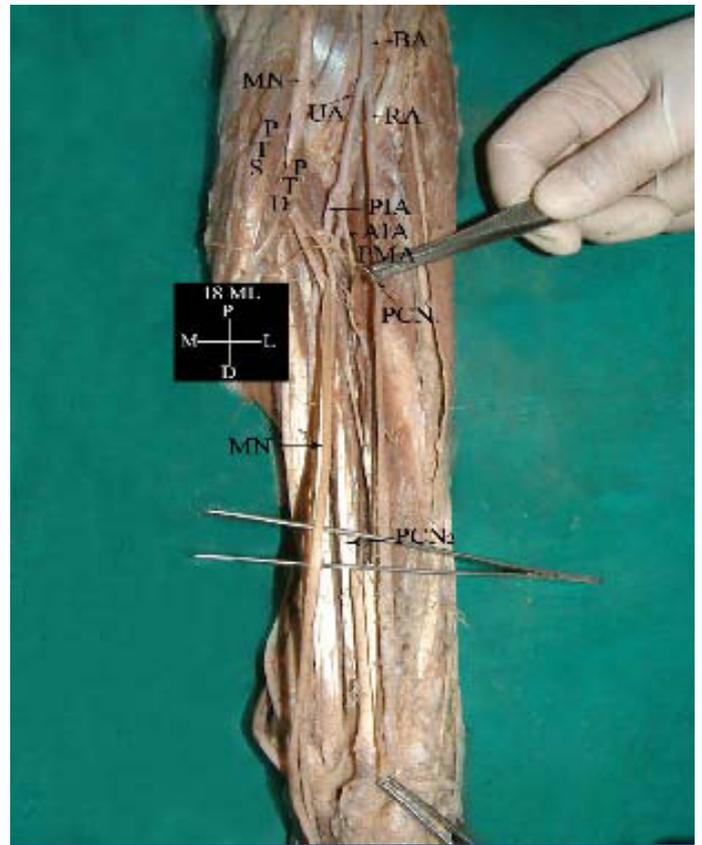
The present study was conducted on 60 upper limbs which belonged to 30 formalized and preserved cadavers (M:F::28:2) which were obtained from the Department of Anatomy, Government Medical College, Amritsar, Punjab, India. The limbs were dissected as per the dissection guidelines which were given by the Cunningham's manual of Practical Anatomy [19], to expose the median nerve and its whole course from its formation till its termination. Similarly, the persistent median artery was traced till its termination.

RESULTS

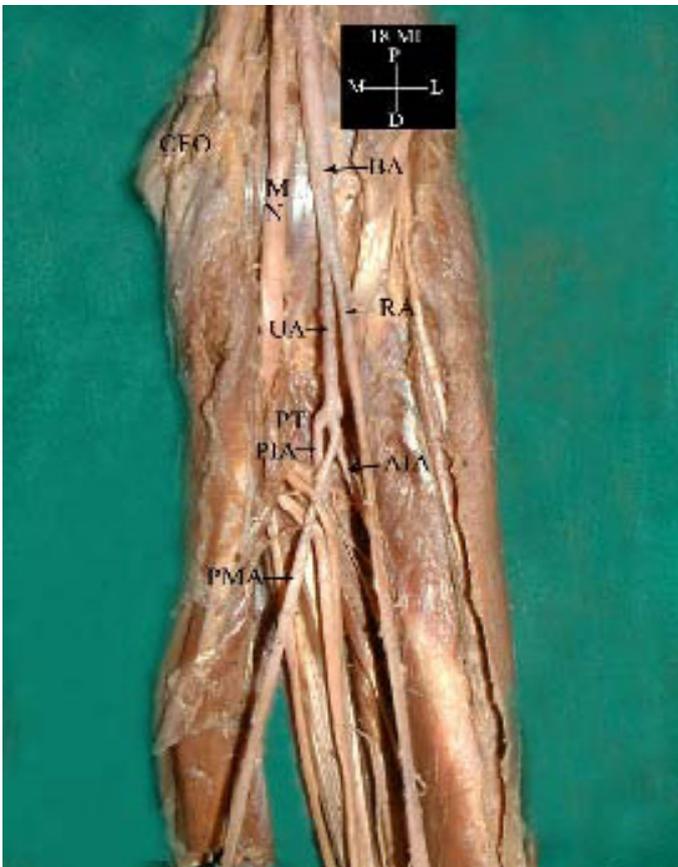
Among the 60 limbs, a persistent median artery was observed in 4 (6.6%) limbs. All the 4 limbs with the persistent median artery belonged to the male sex. In one cadaver, it was found to be bilateral, while among the other 2 limbs, one was found to be on the right side and one was on the left side. In all the limbs, the persistent median artery originated from the anterior interosseous artery, accompanied the median nerve in the forearm and it finally terminated in the hand by forming an incomplete mediano ulnar type of superficial palmar arch [Table/Fig-1]. Apart from this, in the left upper limb of the male cadaver with the bilateral variation [Table/Fig-2], the persistent median artery, after its origin from the anterior interosseous artery, penetrated the median nerve, just distal to its emergence between two heads of the pronator teres muscle and it divided the nerve approximately into two halves. The separated nerve fibres reunited immediately below the site of the penetration, thus forming a neural loop which circumscribed the artery [Table/Fig-2]. Thereafter, the penetrating median artery accompanied the median nerve and it contributed to the formation of the mediano-ulnar type of the superficial palmar arch. A bilateral high and duplicate origin of the



[Table/Fig-1]: Photograph of right upper limb showing persistent median artery.(AIA-Anterior interosseousartery,BA-Brachial artery, FDS-Flexor digitorum superficialis, MN-Median nerve, PIA-Posterior interosseousartery, PMA-Persistant median artery, PCN1-Palmar cutaneous nerve, PCN2-Palmar cutaneous nerve, PT-Pronator teres, RA-Radial artery, UA-Ulnar artery)



[Table/Fig-3]: Photograph of left upper limb showing persistent median artery penetrating median nerve.(AIA-Anterior interosseous artery, BA-Bachial artery, MN-Median nerve, PIA-Posterior interosseousartery, PTS-Pronator teres superficial head, PTD-Pronator teresdeephead, PCN-Palmar cutaneous nerve, PCN2- Palmar cutaneous nerve, PMA-Persistent median artery, RA-Radial artery, UA-Ulnar artery)



[Table/Fig-2]: Photograph of left upper limb showing median nerve penetration by a persistent median artery. (AIA-Anterior interosseousartery, BA-Brachial artery,CFO-Common flexor origin, MN-Median nerve, PT-Pronator teres, PIA-Posterior interosseousartery, PMA-Persistant median artery, UA-Ulnar artery, RA-Radial artery)

palmarcutaneous branch of the median nerve was also observed in the same cadaver [Table/Fig-3].

DISCUSSION

The median artery is a transitory artery which develops as an axis artery during the ontogeny of the arteries of upper limb in the early embryonic life, but it usually regresses after the second embryonic month to become a small slender artery [1-3]. However, it may fail to retrogress and then it may accompany the median nerve as a persistent median artery. It usually arises from the anterior interosseous or the common interosseous and it terminates either in the superficial palmar arch or the palmar carpal arch. Different studies have given different prevalence values of this entity [Table/ Fig-4], which have ranged from 1.1–16.1%.

Sl. No.	Author	Year	Percentage
1	Tandler [20]	1897	16.1
2	Jaschtschinski [13]	1897	7.5
3	Adachi [5]	1928	8.0
4	Gray [21]	1945	1.1
5	Misra [22]	1955	8.4
6	Coleman and Anson [23]	1961	9.9
7	Keen [12]	1961	9.5
8	Anson [24]	1966	8.0
9	Karlsson and Niechajev [25]	1982	4.0
10	Eid et al. [26]	2011	4.0

[Table/Fig-4]: Prevalence of Persistent Median Artery

The disparity in the percentage frequency of the prevalence of this

artery (1.1–16.1%) can be explained in part by the observation that the median artery frequently joins the superficial palmar arch as a fibrotic thread or as a very tiny vessel, which is barely dissectable. In these cases, the median artery does not contribute any part of the blood supply to the hand.

Ontogeny: The median artery is an important vessel in the embryogenic circulation of the forearm. The continuation of the axial artery in the forearm is at first an anterior interosseous artery. When the latter recedes, it is replaced by its more superficially placed branch, the median artery [27]. Later, it is replaced by the radial and the ulnar arteries. A persistent median artery represents the persistence of an embryonic vessel. This is in consonance with Arey [28], according to whom one of the causes of the anomalous blood vessels is the persistence of the vessels which are normally obliterated.

In humans, the arteries of the upper limb remain separated from the nerves. The blood vessels in the upper limb bud proliferate in the limb bud mesoderm due to the growth of the pre-existing vessels, with a characteristic branching of the vascular cells to form a vascular plexus [29]. A component of this plexus, the axial artery, forms the brachial artery in the arm and it continues as the median artery in the forearm. During this proliferative process, there is a distinct temporal and a spatial succession of the emergence and the regression of paths, so that the individual variations of the forelimb arterial tree are common [30]. So, the present variation may thus be a remnant of the capillary plexus around the median nerve that anastomosed with the anterior interosseous artery [31].

Phylogeny: The growth of a blood vessel at a particular site is necessary for providing nutrition and oxygen to that part of the embryo. An artery which penetrates a nerve is usually considered to be a phylogenetic or a developmental remnant, because this structural feature is common in the lower primates, which correlates with the extreme muscular development and the requisite, extensive blood supply [30].

CLINICAL APPLICATIONS

The importance of the persistent median artery lies in the fact that it necessitates the ligation of the radial and the ulnar arteries above its origin or even the ligation of the brachial artery, in cases of wounds of the palm [30,32,33]. A persistent median artery of a large calibre may lead to an early compression of the median nerve in the carpal tunnel in patients who are prone to it e.g. in myxoedema, rheumatoid arthritis and pregnancy which leads to the carpal tunnel syndrome [34].

An anomalous artery which penetrates the median nerve in the arm can compress it and produce symptoms of proximal median neuropathy which is similar to the Struthers ligament or a tight bicipital aponeurosis. The compressive force of the pulsating penetrating artery may produce ischaemia which is distributed unequally in the nerve, damaging those fibres which are destined to become one branch of the median nerve. These nerves are usually weak at the site of the arterial penetration and they are more susceptible to pathological conditions such as diabetes mellitus [31]. This finding may be relevant to the pathologies that require a surgical intervention.

SUMMARY AND CONCLUSION

To summarize, the persistent median artery was seen in 6.6% upper limbs, which has got an ontogenic and a phylogenic implication. Apart from this, clinically, it may be responsible for the

carpal tunnel syndrome in patients who are prone to myxoedema, rheumatoid arthritis, etc. A surgeon should be familiar with this variant, as a catastrophe may occur if he encounters such an artery but is unfamiliar with the same.

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