

PERSISTENT MEDIAN ARTERY IN THE CARPAL TUNNEL

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ABSTRACT

Introduction: Persistent median artery originates from the anterior interosseous artery in proximal one-third of the forearm and accompanies median nerve. Median artery may regress in the forearm or enter palm through the carpal tunnel deep to flexor retinaculum of wrist and supply palm by anastomosing with the superficial palmar arch.

Objective: In present study the objective was to study presence of persistent median artery accompanying median nerve and its termination

Materials and Methods: The study included 50 human cadaver upper limb specimens at the Department of Anatomy, Mysore Medical College & Research Institute, Mysore during 2011-13. These specimens fixed in 10% formalin were finely dissected and persistent median artery was traced from origin to termination.

Results: Out of 50 human cadaver specimens, persistent median artery was present in 4 specimens (8%). All the 4 median arteries originated from anterior interosseous artery and were of palmar type which reached palm. Out of 4 median arteries, 3 median arteries (6%) took part in completion of superficial palmar arch, supplying the distal aspect of palm and 1 median artery (2%) directly supplied radial two and half fingers without forming arch.

Conclusion: Knowledge of unusual variations helps in proper treatment of disorders of the median nerve. Presence of persistent median artery usually will be asymptomatic but may cause symptoms of carpal tunnel syndrome or pronator teres syndrome when subjected to compression. Rarely this artery can be taken for reconstruction

KEY WORDS: Median nerve, Variations, Carpal tunnel, Persistent Median artery, Anterior Interosseous artery.

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INTRODUCTION

Variations in the vascular patterns are common which usually result due to developmental anomaly during formation of blood vessels. Persistent median artery usually originates from the anterior interosseous artery in the proximal one-third of the forearm and accompanies median nerve. Median artery may regress in the forearm or enter palm through the carpal tunnel

deep to flexor retinaculum of wrist and supply palm by completing superficial palmar arch with ulnar or radial arteries. It develops from the axis artery which represents axillary, brachial and anterior interosseous arteries. The median & anterior interosseous arteries are the main source of blood supply to the hand during the first trimester of gestation. The median artery regresses after the ulnar and radial arteries

develop and take the sole responsibility of blood supply to the forearm and hand [1]. The median artery might also arise from common interosseous, ulnar or radial arteries.

Pecket claimed three different types of median nerve vascularisation: (a) radial and ulnar arteries forming superficial and deep palmar arches with the median nerve supplied by superficial palmar arch and by the anastomoses formed by radial and ulnar and by the forearm muscular branches (70%). (b) Either trifurcation of brachial artery into radial, ulnar and median artery or bifurcation of brachial into the radial and ulnar arteries. The median artery travels superficially to the median nerve and branches out at the palm to feed second, third and fourth digits (10%). (c) The median artery is related with the superficial palmar arch (20%). Although the existence of the median artery is not so uncommon, ranging from 1.5 to 27.1%; its survival in human adults shows the primitive arterial pattern [2].

In present study the objective was to study the presence of persistent median artery accompanying median nerve in the carpal tunnel and its termination.

MATERIALS AND METHODS

The 50 human cadaver upper limb specimens were obtained from Department of Anatomy, Mysore Medical College & Research Institute, Mysore during time period of 2011-13. Out of 50 specimens, 25 were of right and 25 were of left side. These specimens were fixed in 10% formalin solution. We excluded those cadaver specimens from our study which exhibited previous trauma to the upper limb, fractures, any kind of surgical procedures and pathologies.

The dissection was performed as per the Cunningham's manual of practical anatomy.³ the median nerve was identified in the forearm between the heads of pronator teres and traced between tendons of flexor carpi radialis & palmaris longus till flexor retinaculum. Using blunt dissection the each median artery accompanying the median nerve were traced to their origin and termination. The details were noted.

RESULTS

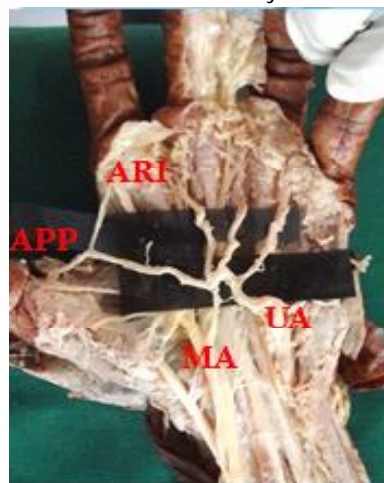
Out of 50 human cadaver specimens, persistent median artery was present in 4 specimens (8%), 2 on right (4%) and 2 on left side (4%). All the 4 median arteries originated from anterior interosseous artery and were of palmar type which reached palm. Out of 4 median arteries, 2 median arteries (4%) after passing through carpal tunnel along with median nerve took part in formation of ulnar-median-radial type of superficial palmar arch by anastomosing with ulnar and radial arteries (Fig. 1). 1 median artery (2%) anastomosed with superficial branch of ulnar artery to form ulnar-median type of palmar arch and supplied distal aspect of palm and fingers (Fig. 2). 1 median artery (2%) directly supplied lateral two and half fingers without forming arch with ulnar artery (incomplete ulnar-median type of arch, Fig. 3).

Fig. 1: Complete superficial palmar arch formed by Radial, median and ulnar artery.



UA- ulnar artery, MA- Median artery, SP br RA- Superficial palmar branch of radial artery, SPA- superficial palmar arch, MN- Median nerve.

Fig. 2: Complete superficial palmar arch formed by ulnar and median artery.



UA- ulnar artery, MA- Median artery, ARI- arteria radialis indicis, APP- Arteria princeps pollicis.

Fig. 3: Incomplete superficial palmar arch formed by ulnar and median artery.



UA- ulnar artery,
MA- Median artery,
ARI- arteria radialis
indicis,
APP- Arteria princeps
pollicis.

Table 1: Presence of persistent median artery with median nerve.

Other variations Observed in Median Nerve	Right		Left		Total %
	N	%	N	%	
Persistent median artery with median nerve	2	4	2	4	8
Persistent median artery forms superficial palmar arch	1	2	2	4	6
Persistent median artery doesn't form superficial palmar arch	1	2	-	-	2
Total	4	8	4	8	8

DISCUSSION

Persistence of median artery is a sign of primitive arterial pattern. Its existence is not uncommon and has been reported in previous literatures. In 1992 George and Henneberg reported a high incidence (27.1%) of the median artery among South African cadavers [4]. In 1997, Kopuz et al. studied the presence of persistent median artery (PMA) in neonatal cadavers and raised the hypothesis that the median artery regresses at a much later stage, most likely during the perinatal period and early infancy. In their study the incidence of PMA was 20% [5]. In 2009, Natsis K et al. studied 72 upper limbs of adult cadavers and found two cases (2.78%) of a PMA accompanying the median nerve on its route through the carpal tunnel [6]. In 2009, Mohammad A Abdulla et al. studied 55 patients who underwent open Carpal Tunnel Release at wrist joint and observed following variations. Two patients (3.64%) had bifid nerve with persistent median artery running between the two divisions [7]. The percentages of hands in which the median artery made a contribution

to the superficial palmar arch were reported to be 2.2% in Janevskis [8] work which in present study was found to be 8%. Rodriguez et al [1] confirmed that the median artery may persist in adult life in two different patterns - ante brachial and palmar type based on their vascular territory. In the ante brachial type which is considered normal, it arises mostly from the anterior interosseous artery and does not reach the palm. The palmar type may arise from any of the forearm arteries and accompanies the median nerve in the carpal tunnel. It usually terminates at the superficial palmar arterial arch or as the main blood supply to the index and long fingers. The term Persistent Median Artery refers to the palmar type of the median artery. In the above study all the 4 specimens represent palmar type of variety. When present, the median artery is the main blood supply to the median nerve, corresponding to Types 2 and 3 of vascularization of the median nerve as described by Pecket et al.[2] The incidence of palmar type has complications associated with pronator teres syndrome, carpal tunnel syndrome and anterior interosseous nerve syndrome.

Persistent median artery aneurysm and thrombosis may develop carpal tunnel syndrome resulting in compression of the median nerve. A thrombosed median artery causing carpal tunnel syndrome should be removed surgically without causing further vascular crisis and if the artery is pulsating and of considerable size, it can be saved and separated from the median nerve [9]. In 2013 K.K.Agarwal et al. reported a case of median artery originating from common interosseous artery in the left arm of the cadaver during dissection. They also reported absence of superficial palmar arch, median artery mainly supplied index and middle fingers [10]. In 2013 Prathap kumar and Roopa kulkarni reported the presence of persistent median artery in both upper limbs of a male cadaver which was arising from the ulnar artery. The median artery in each hand had accompanied median nerve throughout its course and was contributing to the superficial palmar arch along with ulnar artery. The median artery gave 1st and 2nd common digital artery which supplied the first and second web spaces [11]. In the present study

the persistent median artery accompanying the median nerve through carpal tunnel would have caused compression of median nerve leading to carpal tunnel syndrome. The median artery which supplied lateral two and half fingers formed major part of blood supply in the absence of palmar arch between ulnar and radial arteries.

EMBRYOLOGY:

Arey [12] has described developmentally the anomalies of blood vessels may occur due to

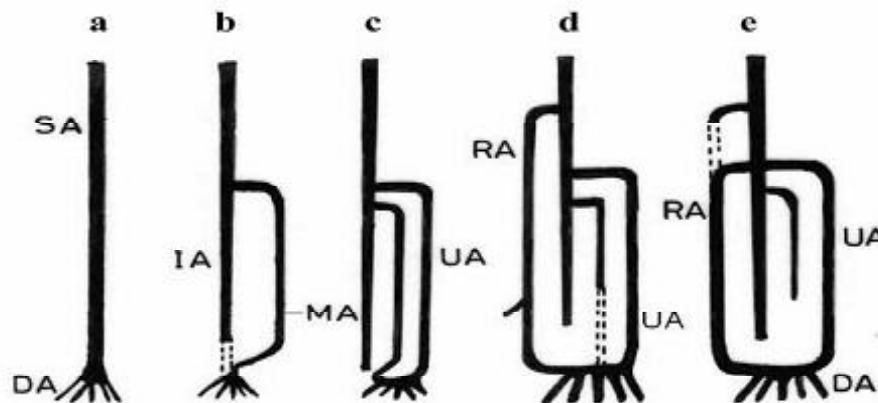
- The choice of unusual paths in the primitive vascular plexus.
- The persistence of vessels normally to be obliterated.
- The disappearance of vessels normally retained.
- Incomplete development and
- Fusion & absorption of the parts usually distinct.

axial artery (the brachial artery in the arm and interosseous artery in the forearm) with the median artery branching off from the brachial artery, which in turn annexes the vessels of hand and corresponds to stage II (Fig. 4b). In the 18-mm embryo, the ulnar artery (one of the prominent vessels of the forearm) arising from the brachial artery, unites distally with the median artery to form the arch pattern (Fig. 4c); this pattern corresponds to stage III. Following this, the radial artery (another prominent vessel of forearm) arises from the brachial artery and finally takes over the vessels of the hand corresponding to stage IV (Fig. 4d). this rearrangement (stage V) reaches completion before the end of the eighth week (Fig. 4e) [12].

CONCLUSION

Knowledge of variations of vascular patterns has gained more importance in microsurgical techniques and reconstructive hand surgeries.

Fig. 4: Schematic diagram showing stages in the development of the arterial pattern of the upper limb.



- The subclavian-axillary (SA) artery traversing the limb bud and dividing into digital arteries (DA);
- The primary axial artery brachial artery (BA) in the arm and interosseous artery (IA) in the forearm. Note the median artery (MA) arising from the brachial artery and annexing the digital branches.
- Ulnar artery arising from the brachial artery and communicating with the median artery.
- Radial artery (RA) arising from the brachial artery and completing the arch formation with the ulnar artery.
- The final rearrangement of vessels.

From the developmental point of view, the limb bud appears in the form of small elevations along the ventrolateral body wall during the fourth week and soon acquires a primitive capillary plexus in association with branches of intersegmental arteries arising from the aorta. The subclavian-axillary artery (the sole arterial stem of the upper limb) is identifiable in a 5-mm embryo, where it extends to the wrist by dividing into terminal branches for fingers (Fig. 4a). The primitive vascular pattern consists of a primary

The plastic surgeons and hand surgeons should be aware of these variations before attempting any surgical procedures like vascular repair or graft application. Persistent median artery represents the axis artery of the upper limb in the embryonic life. It regresses as age advances. Presence of persistent median artery usually will be asymptomatic but may cause symptoms of carpal tunnel syndrome or pronator teres syndrome when subjected to compression. Rarely this artery can be taken for reconstruction.

Conflicts of Interests: None

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