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Case report

Multiple arterial, neural and muscular variations in both upper extremities of a single cadaver - a case report

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ABSTRACT

ABSTRACT Anatomic variations of arteries, nerves and muscles of upper limb have both clinical and surgical implications. Although individual reports have been documented about these variations, combinations of such variants bilaterally in a single cadaver are not previously described in literature. During routine dissection, in a 60 year old male cadaver it was observed that there was co-existence of communicating branch between medial and lateral cords of brachial plexus, common subscapular- posterior circumflex humeral trunk with multiple muscular branches from subscapular artery, an accessory muscle fascicle arising from brachialis muscle, entrapping the median nerve and brachial artery. Presence of persistent median artery contributing in formation of superficial palmar arch in the hand, a bifid median nerve , double tendons of abductor pollicis longus and absence of palmaris longus have been observed. Amalgamations of these variations are of great importance to surgeons, neurologists, radiologists for dealing with injuries and operations in the upper limbs.

1. Introduction

Individual variations of arteries, nerves and muscles have been well reported, but a co-existence of all these variations together in both the upper limbs of a single cadaver is rarely documented in literature. Communicating branch of cords of Brachial plexus, multiple branches of subscapular artery, accessory muscle fascicles of brachialis, persistent median artery, bifid median nerve, and duplication of tendon of abductor pollicis longus have all been well reported individually in various studies. Combination of these variations would be of great clinical and anatomical interest. Knowledge of such anatomic variations will be important for surgeons, orthopaedicians, neurologists, radiologists and physiotherapists for dealing with injuries and operations in the upper limbs. We describe here a combination of such variations in a male cadaver.

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2. Case Report

During our routine dissection studies on a 60 year old male cadaver preserved by injection of formalin based preservative at Dr.Pinnamaneni Siddhartha Institute of Medical Science &Research Foundation, we encountered variations in both upper limbs. Variations were as follows:

Right side observations:

The Lateral and Medial cords of Brachial plexus were connected with a communicating branch, which had a course in front of the axillary artery. The Lateral cord sent an abnormal communication to the Medial cord as the latter gave off the medial root of median nerve. This abnormal branch fused with the branch from Medial cord to form the medial root of median nerve. The Lateral cord gave rise to musculocutaneous nerve and continued as lateral root of median nerve. Both the roots fused over the front of third part of axillary artery to form the median nerve which later coursed along the lateral side of the artery (Fig.1). The subscapular artery ramified into four branches which included the posterior circumflex humeral artery (PCHA), a muscular branch supplying the subscapularis and the terminal branches circumflex scapular (CS) and thoracodorsal (TD) artery (Fig.1). An accessory slip of brachialis muscle originated from the anteromedial surface of

shaft of humerus, passed over the brachial artery and the median nerve, encircling them and got it fused with the muscle fibres of pronator teres after crossing the elbow joint(Fig.2).

Left side observations:

The subscapular artery ramified into five branches which included the posterior circumflex humeral artery, muscular branches supplying the subscapularis and the serratus anterior muscles and the two terminal branches circumflex scapular and the thoraco-dorsal artery. Middle collateral artery and few muscular branches to triceps brachii arose directly from the brachial artery and entered the posterior compartment of arm through the radial groove (Fig.3). The profunda brachii artery was slender and small in its calibre compared to the right limb.Persistant median artery (PMA) arising from the ulnar artery in the forearm coursed distally, deep to the transverse carpal ligament (flexor retinaculum), forming a median-ulnar pattern of the superficial palmar arch(Fig.4).There was high division of median nerve before entering the carpal tunnel (bifid median nerve).The PMA passed between the two divisions of the bifid median nerve before entering the carpal tunnel(Fig.4). The abductor pollicis longus (APL) muscle duplicated into two tendon slips, which were located in the first compartment and got inserted into the radial side of the base of the first metacarpal bone (Fig.5). Common observations on both sides included the absence of palmaris longus, presence of very slender and thin flexor digitorum superficialis tendons for the little fingers.

Figure – 1 Photograph of right axilla showing abnormal communication between lateral and medial cords; also showing branches of subscapular artery and third part of axillary artery. LC – lateral cord; MC – medial cord; lr- lateral root; mr – medial root; * - abnormal communicating branch; MN- median nerve; UN- ulnar nerve;CB- coracobrachialis AA- axillary artery; MC- musculocutaneous nerve; 1- subscapular artery; 2- posterior circumflex humeral artery; 3- circumflex scapular artery; 4- thoracodorsal artery; 5- muscular branch to subscapularis.

Figure - 2 Photograph of right arm showing accessory fascicles of brachialis encircling the median nerve and brachial artery.*- accessory muscle fascicle; BB- biceps brachii; BL- brachialis; BR- brachioradialis; BA- brachial artery; RA- radial artery; UA- ulnar artery, MN-median nerve; $ - median nerve and brachial artery painted for clarity.

Figure – 3 Photograph of left axilla showing ramification of subscapular artery. 1- subscapular artery; 2- posterior circumflex humeral artery; 3- circumflex scapular artery; 4- thoracodorsal artery; 5- muscular branch to serratus anterior; 6- muscular branch to subscapularis.

Figure – 4 Photograph of left forearm showing persistent median artery passing between the two divisions of median nerve proximal to carpal tunnel and forming the superficial palmar arch in the hand. PMA- persistent median artery; UA- ulnar artery; SPA- superficial palmar arch; @- bifid median nerve; MN- median nerve; UN- ulnar nerve; FPL- flexor pollicis longus; FDP- flexor digitorum profundus; ^FDS- flexor digitorum superficialis reflected part.

Figure – 5 Photograph of lateral view of dorsum of left hand showing duplication of abductor pollicis longus tendon.APL1- thicker slip of abductor pollicis longus tendon; APL2 – thinner slip of abductor pollicis longus tendon; EPL- extensor pollicis longus tendon; EPB- extensor pollicis brevis; Er- extensor retinaculum.

3. Discussion

The course, distribution and branching patterns of the brachial plexus nerves are important from clinical viewpoint. A more precise knowledge than that found in classical anatomical texts is necessary for clinical investigation and the surgical treatment of peripheral nerve injury (Linell, 1921) [1]. The communications between the medial and lateral cords are unusual. Moore & Dalley (1999) has reported a case in which there was an abnormal branch from the medial to lateral cord running laterally [2]. Our observation is not in consonance with the above report but is vice versa as reported in our case. K.A.Oluyemi & O.A.Adesanya has reported similar findings, with an abnormal branch coursing from lateral cord to the medial cord, the latter giving off the medial root of median nerve. A branch from posterior aspect of the medial cord divided into the radial and axillary nerves, showing absence of posterior cord [3]. Pandey SK & Shukla VK have conducted study in both the axillae of 172 cadavers and have reported 3.5% of cadavers with absence of posterior cord and showing communicating branches between lateral and medial cords which had a course in front of the axillary artery[4].Peripheral nerve is a collection of nerve fibres bound together by connective tissue, it is understandable that the median nerve may have two medial roots instead of one (i.e., the nerve fibres are grouped differently).In present case though the median nerve has two medial roots, it would be possible that one of them came from the lateral cord and fused with the medial root from the medial cord to form the median nerve[3]. In the present case, the accessory muscle fibres of brachialis were arising from the anteromedial surface of shaft of humerus, which encircled around the brachial artery and median nerve, crossed over the elbow joint and got continued with the fibres of pronator teres.Paraskevas G, Natsis K etal have reported accessory fascicles of brachialis as one of the variants of accessory muscles in the lower part of the anterior compartment of the arm that may entrap neurovascular elements[5].Sharadkumar Prahlad, Shagufta T. Sheikh etal have reported an accessory slip of brachialis muscle originating from the anteromedial surface of shaft of humerus and got inserted into the medial epicondyle of the humerus. The accessory slip of brachialis passed over the brachial artery and the median nerve [6].Embryo logically a single mass is formed by fusion of muscle primordia within the upper limb bud. Some of these primordia disappear by the process of apoptosis or cell death. Failure of muscle primordia to disappear may have resulted in presence of accessory fascicles around the neurovascular elements[7].Such accessory muscle fibres may result in compression of neurovascular structures and may have some mechanical advantages and disadvantages during the movement of elbow joint.Burak Bilecenoglu, Aysun UZ et al in their study of possible anatomic structures causing entrapment neuropathies of the median nerve, have reported that in 10% of cases accessory fibres arising from brachialis are cause of compression of median nerve above elbow joint[8].

Many observers in earlier studies state that variations of branching patterns of axillary artery are very common. In the present case, there was a common trunk for subscapular and PCHA arising from the third part of axillary artery and the subscapular arteries gave rise to collateral muscular branches bilaterally along with the circumflex scapular and the thoracodorsal arteries.Saeed et al reported 3.8% of bilateral common subscapular-circumflex humeral trunk, emerging from the third part of the axillary artery and branching into the circumflex humeral and thoracodorsal arteries[9].O linger and Benninger in a study of 83 cadavers have observed that 12% of PCHA was originating from the subscapular artery[10].Usually the scapular muscles are supplied by branches of subscapular artery, with thoracodorsal forming the major contribution and the circumflex scapular taking part in collateral circulation around scapula (scapular anastomosis). The subscapular arterial tree may be used as a source of micro vascular grafts to replace damaged or diseased portions of arteries, particularly in the hand and forearm. The muscles of the scapular region mainly the serratus anterior and latissimus dorsi are among those most commonly used in reparative surgery.R.C Jesus & M.C.H.Lopes et al in their study on 30 cadavers have observed collateral branches in 67.2% of cases arising either directly from the subscapular artery or from the thoracodorsal artery. The collateral branches of the subscapular artery were more commonly distributed to the subscapular muscle and to the shoulder joint. Their research showed branches to following muscles: serratus anterior 86.5%, latissimus dorsi 84.8% and subscapularis 62.7 % [11].In the present case the subscapular artery on left side gave direct muscular branches to serratus anterior and subscapularis and only to subscapularis on right side.

The persistent median artery in the present case arose from the ulnar artery after the later gave off the common interosseous artery on the left side.Persistant median arteries vary in their mode of origin and have been described as arising from ulnar, interosseous, radial or brachial arteries. The PMA then continued into the palm to form median-ulnar type of superficial palmar arch.Two patterns of median artery termination have been described: forearm or antebrachial (in which the artery does not reach the hand) and the palmar type. The palmar pattern is variable: the artery may terminate either in a closed arch (median ulnar or radiomedianulnar type) or in an incomplete one [12]. PMA was related laterally to median nerve in the forearm deep to flexor digitorum superficialis.The median nerve divided into two branches (bifid median nerve) in the distal third of forearm, 2cm away from the proximal border of flexor retinaculum. Several authors have described division of the median nerve by the median artery. In the present case the PMA passed between the two divisions of the median nerve within the carpal tunnel, association of a PMA with median nerve has been related to compressive pathology of the nerve in the carpal tunnel. The median artery is a transitory vessel that represents the arterial axis of the forearm during early embryonic life. It normally regresses in the 2nd embryonic month to become the small slender artery commitans nervi mediana.Persistence of the median artery is not uncommon, however its incidence is reported as ranging between 1.5 and 27.1%(Quain, 1884; Adachi & Hasebe,1928; McCormack et al.1953;Henneberg & George,1992)[13].Kuntal Vashishtha have reported bifid median nerve in four hands in which the median nerve was dividing proximal to the upper border of the flexor retinaculum and the distance varied from 5mm to 10mm from flexor retinaculum[14] . Maulik S Patel & Charudutt Jayant Sambhaji has observed that PMA which accompanies a bifid nerve lies in between the two bundles: while when it accompanies a normal undivided nerve, lies on the ulnar side of the nerve. Such an artery may lead to several complications such as carpal tunnel syndrome, pronator syndrome or compression of the anterior interosseous nerve [14]. Sometimes it is possible that the PMA is the only source of blood supply to the intrinsic muscles of hand, therefore surgical approach without adequate knowledge can lead to disastrous effects. Therefore, the presence of a PMA should be taken into consideration in clinical practice.

The tendon of abductor pollicis longus has spilt into two slips on the left side which have passed in a common compartment along with extensor pollicis brevis and have got inserted on to the radial side of base of first metacarpal, the lateral one being less thick than the medial one. Movements of the thumb are carried out by extrinsic and intrinsic muscles and have immense phylogenetic and evolutionary significance. The number, length, and thickness of APL accessory tendons have functional role as causative factor for DeQuervain's stenosing tenovaginitis.Additionally, these accessory tendons would be useful for plastic reconstructive surgeries where they could be utilized as effective transplant tissues. Many cases of duplication and triplication of APL tendons have been reported. Supernumerary tendons are also reported, the maximum number being seven reported by Melling et al.Multiplicity of APL tendons can be viewed as a functional advantage, since injuries in one tendon can be compensated for by the remaining tendons[15].To, conclude individually the above variations might be common ,but an amalgamation of such variants is not much reviewed in literature and coexistence of such arterial, neural and muscular variations should not be overlooked in surgical and diagnostic procedures.

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