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Research article

PATTERNS OF COMMUNICATIONS BETWEEN MUSCULOCUTANEOUS AND MEDIAN NERVE: A CADAVERIC STUDY

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ABSTRACT

The brachial plexus is a complex communicating neural network formed in the axilla. The branching, union and reseparation of its nerve fibres frequently persists as communications between its branches, mostly the Musculocutaneous and the Median nerve. The knowledge of variable patterns of communications between Musculocutaneous nerve (MCN) and Median nerve (MN) explains the unexpected clinical signs and symptoms and also helps in having a better understanding of the field during surgeries in order to avoid neurological damage. In the present study, 38 cadavers (76 upper limbs) were dissected and the communications between MCN and MN were noted in 6.6% of the total cases (5 upper limbs). Some of these variations were rare.

Keywords: Brachial plexus, Communications, Median Nerve, Musculocutaneous Nerve.

INTRODUCTION

The median nerve is formed in the axilla by the union of lateral (C5,C6,C7) and medial roots(C8,T1) of the lateral and medial cords of brachial plexus respectively, while the musculocutaneous nerve is the continuation of the lateral cord (C5,C6,C7)[1]. These nerves subsequently traverse the anterior compartment of arm without any interconnections with the neighbouring nerves[2].

Anastamoses between different nerves in the arm are rare, but those between the Median nerve (MN) and the Musculocutaneous Nerve (MCN) have been reported since 19th century[3]. The frequent presence of communications can be attributed to the common root value (C5, C6, C7) shared by the lateral root of MN and the MCN. Williams et al. stated that few fibres of the MN may travel through the MCN and finally leave it to rejoin the main trunk[4]. The present study throws light on some rare patterns of communications which may be clinically valuable to anatomists, neurophysicians, neurosurgeons and orthopedicians dealing with entrapment neuropathies, trauma, nerve repair and surgical explorations in and around the axilla.

Aims and Objectives: The present study is carried out with an aim to provide additional information about the different patterns of communications between MN and MCN and to

emphasize on the importance of knowledge of variations during surgical procedures.

MATERIALS AND METHODS

76 upper limbs of 38 embalmed cadavers (34 Male and 4 Female) were studied. The anastomosis between the MN and MCN were observed, the findings were noted after meticulous dissection of the branches of the brachial plexus. The photographs of anastomosis were taken for proper documentation

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RESULTS

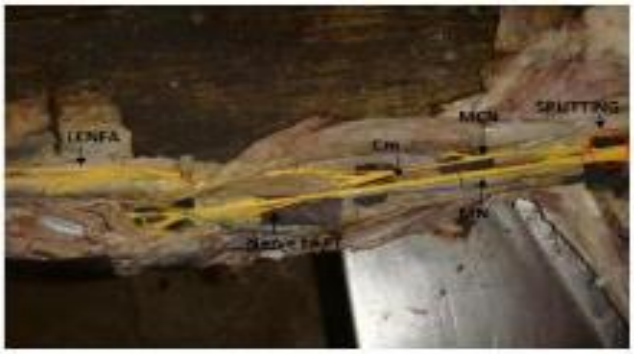

Fig.1: Splitting of Median Nerve.

Fig.2: Communication between MCN and MN.

Fig.3: Short MCN, Lateral cutaneous nerve of forearm from MN.

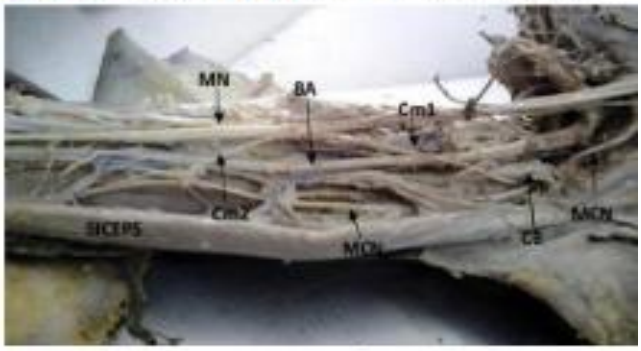

Fig.4: Double communication between MCN & MN

Fig: 5.Absence of MCN

MN: Median nerve, MCN: Musculocutaneous nerve, LCNFA: Lateral Cutaneous nerve of forearm, CM: Communication, CB: Coracobrachialis, PT: Pronator Teres, BA: Brachial artery, CM1: Communication1, CM2: Communication 2

In the present study some rare variations of the MN and MCN were noticed. The incidence of communications was 6.6% (5 out of 76 limbs).

Case 1: Bilateral variation. **Splitting of Median Nerve.** (Variation 1): In the right upper limb the formation of the median nerve was normal. The MN split into medial and lateral divisions, of which the medial division continued as MN proper and the lateral division continued as MCN to supply the muscles of the anterior compartment of the arm. Further, a twig from the MCN joined the MN distal to coracobrachialis

(CB). The branch to pronator teres arose from the MN 2-3cms above the elbow joint. The rest of the course of the nerves was observed to be normal. (Fig.1)

Communication between MCN and MN. (Variation 2): In the left upper limb of the same cadaver, a communication was noted between the MCN and MN distal to CB. The branch to pronator teres arose from the MN 4-5 cms above the elbow joint. The rest of the course of both the nerves was normal. (Fig.2)

Case 2: **Short MCN** (Variation 3): An extremely rare variation was observed in a female cadaver. In the right upper limb the MCN had an abnormally short course terminating abruptly at the level of the elbow by supplying the brachialis muscle. A branch from the middle of the median nerve in the arm coursed distally as the lateral cutaneous nerve of forearm. (Fig.3)

Case 3: Double communication between MCN and MN. (Variation 4): In a male cadaver's left upper limb, MCN bifurcated within the CB muscle, the medial branch passed medially to join the MN and returned back to the lateral branch forming a double communication between the two nerves which had a close proximity to the brachial artery. (Fig.4)

Case 4: Absence of MCN. (Variation 5)**:** In one male cadaver, absence of MCN was noted on left side and the muscles of anterior compartment of left arm were supplied by MN. (Fig.5)

DISCUSSION

The brachial plexus due to its complex formation is prone to be a common site for variations, most common and frequent being the communications between the MCN and MN[5]. Increased frequency of communications between these two nerves could be a result of their common origin from the primary ventral rami of C5, C6, C7 spinal nerves[6]. According to Iwamoto's analysis the root of communicating branch consisted of fibres arising from C5 and C6[7].

Li Minor (1992)[8] classified these variations into five types:

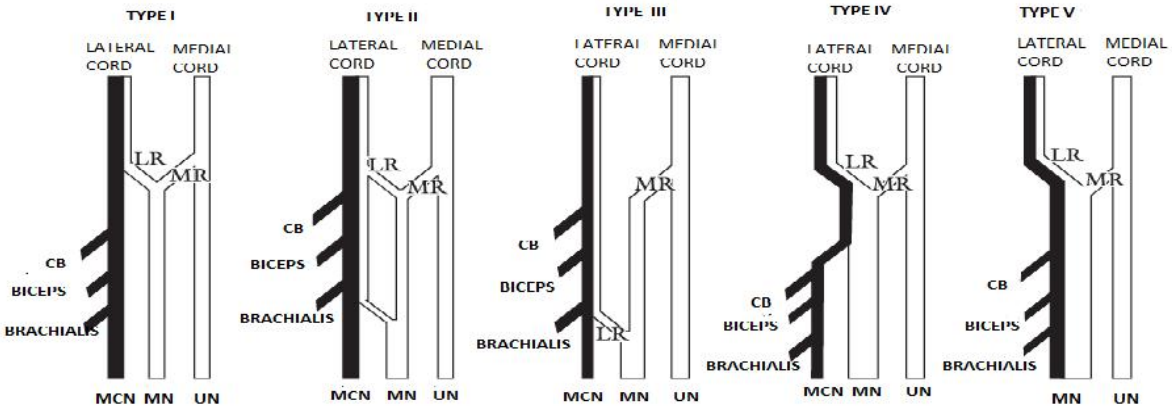

Fig.6: Schematic representation of Li Minor classification.LR-Lateral root of median nerve, MR-Medial root of median nerve, CB-Coracobrachialis, MCN-Musculocutaneous Nerve, MN-Median Nerve, UN-Ulnar Nerve.

In our study, we observed Type 2 variation [case 1 –bilaterally], Type 4 variation [Case 1 : right upper limb], Type 5 [case 4].

Case 2 and Case 3 were rare variants, which could not be classified into any of the types of Le Minor classification and have not been previously cited in the literature to the best of our knowledge. C5,6,7 fibres of MCN forming the Lateral cutaneous nerve of forearm(LCNFA) must have passed through the median nerve resulting in Short MCN and LCNFA arising from Median nerve.

Venieratos and Anangnostopoulou (1998)[5] suggested classification in relation to coracobrachialis muscle.

Type I: communication is proximal to coracobrachialis muscle;

Type II: communication is distal to muscle

Type III: neither the nerve nor the communicating branch pierce the coracobrachialis muscle.

In the present study, Type II variations were noted in Case 1 bilaterally. Case 3 could not be classified into any of these groups, as a communicating branch was seen to arise within the coracobrachialis.

Bilateral communications have been rarely cited[4,6]. In the present study, bilateral variation was noted in one male cadaver (Case 1).

Splitting of MN in the arm was reported by Avinash et al, 2006 where MCN arose from the lateral aspect of MN and after supplying biceps brachii and brachialis continued as lateral cutaneous nerve of forearm[9]. Buch reported in his cadaveric study, the MCN originated from the MN in 3-6%[10]. Budhiraja et al reported splitting of the MN in 5.12% of specimens[9]. Tsikaras et al, revealed that MCN arose from MN unilaterally in a male cadaver[11]. In the present study, similar finding was noted in Case 1: Right upper limb (Variation1).During shoulder reconstruction procedure it is important to identify and palpate MCN as it is vulnerable to injury from retractors placed under coracoid process [9]. Origin of MCN from split MN, may produce confusion during shoulder reconstruction. Awareness of such variations prevents unwanted complications.

Sargon et al, found an interconnecting branch between MCN and MN. They added that the close relation of this interconnecting nerve to brachial artery could result in compression of artery and result in the impairment of blood supply to upper limb[12]. In the present study, a double communication (Case 3) was noted in relation to brachial artery.

Absence of MCN has been previously reported by some authors (Jahanshahi et al , 2003 , Aydin et al , 2006, Budhiraja et al 2011)[9] .In the present study musculocutaneous was absent in Case 4. The absence of MCN neither leads to paralysis of flexor muscles of arm nor hypoesthesia of lateral surface of forearm since the motor and sensory fibres can arise from other nerves more frequently from Median nerve.

Review of literature reports a wide variation in the incidence of communication between MCN and MN irrespective of the site or type ranging from 1.4% - 63.5%[13] as shown in table 1.

Table.1: Incidence of Communications between Musculocutaneous and Median nerve

Author	**Year**	**Incidence (%)**
Wantanabe et al [13]	1985	01.4
Kosugi et al[14]	1986	21.8
Yang et al[13]	1995	12.5
Venieratos and Anagnostopoulou[5]	1998	13.9
Chiarapattanakom et al[13]	1998	16
Rao and Chaudhary et al[6]	2000	33.3
Choi et al [13]	2002	26.4
Loukas and Aqueelah [13]	2008	63.5
Guerri-Guttenberg and Ingolotti[13]	2009	53.6
Maeda et al [13]	2009	41.5
Sawant et al [13]	2012	30
Present study	2013	6.6

The presence of significantly variant nerve patterns can be explained on the basis of embryology and phylogenetics. The highly coordinated, site specific direction of growth, course and innervation of mesenchymal cells by the spinal nerves is under the control of chemotactic and circulatory factors[14]. Altered signals occurring at the time when the cords of brachial plexus fuse lead to such developmental defects[15]. Iwata, explained on the embryological basis that the brachial plexus appeared as a single radicular cone in the upper limb which was divided into ventral and dorsal segments. The ventral segments gave roots to MN and ulnar nerve, MCN arose from the MN[16]. Comparative anatomical studies have reported communications in monkeys and apes, persistence of variable patterns of communications in the present study are in accordance with the theory "Ontogeny recapitulates Phylogeny".

CONCLUSION

The communications between the MN and MCN though not rare and have no effect on the functioning of the upper limb, a thorough knowledge of variable patterns of communications is essential to explain the unexpected clinical signs and symptoms and is helpful during surgical interventions like neurotisation of brachial plexus, shoulder arthroscopy, shoulder reconstruction surgeries and surgical exploration of axilla.

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