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Original Research Article

COMMUNICATION BETWEEN MUSCULOCUTANEOUS AND MEDIAN NERVES: A CADAVERIC STUDY

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ABSTRACT

Introduction: The communication between musculocutaneous nerve and median nerve is an important anatomical variation to occur having serious implications during surgical procedures on arm if unnoticed and without prior knowledge.

Materials and Methods: The present study was conducted in 80 upper limbs of 40 adult human cadavers (Female: 10 and Male: 30) in the Department of Anatomy, Siddhartha Medical College (Government), Vijayawada and the Department of Anatomy, N.R.I. Medical College, Guntur over a period of 4 years (2014 to 2018) during educational dissections.

Results: The communication between musculocutaneous nerve and median nerve was observed in present study, which is classified in accordance with previous classifications described in the literature. In present study the incidence of communication between musculocutaneous nerve and median nerve is 25%.

Conclusion: Prior knowledge of this communication between musculocutaneous and median nerves in the arm is important to avoid the surgical damage to the nerves and also explain unusual clinical presentation in shoulder injuries.

KEY WORDS: Musculocutaneous nerve, Median nerve, Communication.

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INTRODUCTION

The brachial plexus is a network of nerves located in the lower neck and axilla which is formed by anterior primary rami of C5 to C8 and T1 and supplies the chest, shoulder and upper limb. Variations in the formation and branching pattern of the brachial plexus constitute an important clinical entity and have been reported by several investigators. The musculocutaneous nerve is the terminal branch of lateral cord of brachial plexus and it pierces the coracobrachialis muscle, supplies it before piercing. Then it descends in between the biceps brachii and brachialis muscles supplying them and descends

as lateral cutaneous nerve of forearm.

The median nerve is formed by the contribution from medial and lateral cords; one root from each of them. It descends crossing the brachial artery from lateral to medial side without giving any branches in the arm.

Musculocutaneous nerve has frequent variations associated with its connection to median nerve. The knowledge of anatomical variations of the peripheral nerves in the upper extremity is extremely important as these could be inadvertently injured during surgical procedures, administration of nerve blocks in axillary region and also it explains the unusual clinical symptoms. The present study is aimed at assessing the variations in the communications between median nerve and musculocutaneous nerve which are of anatomical and clinical significance.

MATERIALS AND METHODS

The present study was conducted in 80 upper limbs of 40 adult human cadavers (Female: 10 and Male: 30) in the Department of Anatomy, Siddhartha Medical College, Vijayawada and the Department of Anatomy, N.R.I. Medical College, Chinakakani, Guntur (Dt) over a period of 4 years (2014 to 2018) during educational dissections. All the cadavers were properly embalmed and fixed in formalin. The brachial plexus of both sides were dissected carefully following standard procedure with particular importance to the communications between the musculocutaneous and median nerves and the variations observed were noted. Required ethical clearance for the present study obtained from the Ethical committee of this institution.

RESULTS

The results were categorized under the multiple variables and compared with Le Minor's observations. The variables considered in the present study are

1. Whether the formation of two nerves were normal.

2. Length of communicating branch.

3. Number of communicating branches.

In the present study, out of 80 dissected upper extremities, the communication between the two nerves was observed in 20 upper extremities. 4 cadavers show bilateral communications.

Absence of musculocutaneous nerve was observed in 7 upper extremities.

Table 1: Observations in the present study.

S.No	Sex	Formation of nerves	Length of the Communicating nerve	Number of the communicating branches
1	M	Normal	3.6cm	Single
2	M	Normal	4.1cm	Single
3	M	Normal	4.8cm	Double
4	M	Normal	3.9cm	Single
5	F	Normal	3.3cm	Double
6	M	Normal	2.9cm	Single

DISCUSSION

Absence of musculocutaneous nerve: Absence of musculocutaneous nerve was noted in seven upper limbs in present study (0.88%).

In the case of absence of musculocutaneous nerve all the three muscles viz; coracobrachialis, biceps brachii and brachialis are supplied by median nerve. This similarity also noted by Broca (1888) [1], Kerr (1918) [2], Le Minor (1992) [3], Rao and Chaudhary (2000) [4], Sud and Sharma (2000) [5], Rajashree et al (2003) [6] and Saritha (2004) [7] in their studies. Incidence of this finding is 0.3 to 2.0% according to Broca [1], 5.14% by Kerr [2] and 3.33% according to Priti Chaudary et al (2013) [8]. Rest of above described studies reported only single cases.

No case of absence musculocutaneous nerve with innervations of coracobrachialis from branches of lateral cord and of Biceps brachii by median nerve as described by Priti Chaudary et al (2013) [8].

Communications between musculocutaneous nerve and median nerve: Communications between the musculocutaneous and median nerves is by far the most common and frequent of all variations that are observed among the branches of brachial plexus. It varies between a wide range of 1.4% to 63.5% (Sachdeva and Singla 2011 [9]). Although the communications between the different nerves in the arm are rare, those between the musculocutaneous nerve and median nerve have been described from 19th century [10]. The communication between muscul ocutaneous nerve and median nerve

have been classified into five different types by Le Minor (in 1992) [3], three different types by Venieratos and Anagnostopoulou (in 1998) [11] and Choi et al (in 2002) [12].

Le Minor [3] classified these communications into following five types.

Type I: There are no connecting fibers between the musculocutaneous and median nerve as described in classic textbooks. The musculocutaneous nerve pierces the coracobrachialis muscle and innervates the coracobrachialis, the biceps brachii and brachialis muscle.

Type II: Although some fibers of the medial root of the median nerve unite with the lateral root of the median nerve and form the main trunk of median nerve, remaining medial root fibers run in the musculocutaneous nerve leaving it after a distance to join the main trunk of median nerve.

Type III: The lateral root of the median nerve from the lateral cord runs in the musculocutaneous nerve and leaves it after a distance to join the main trunk of median nerve.

Type IV: The fibers of the musculocutaneous nerve unite with the lateral root of the median nerve. After some distance, the musculocutaneous nerve arises from the median nerve.

Type V: The musculocutaneous nerve is absent. The fibers of the musculocutaneous nerve runs within the median nerve along its course. In this type the musculocutaneous nerve does not pierce the coracobrachialis muscle.

Fig. 1: Le Minor classification of communication between musculocutaneous and median nerve (Type I to V). **LF:** Lateral cord; **MF:** Medial cord; **MC:** Musculocutaneous nerve; **M:** Median nerve; **U:** Ulnar nerve; **CB:** Coracobrachialis muscle; **BB:** Biceps brachii muscle; **B:** Brachialis muscle.

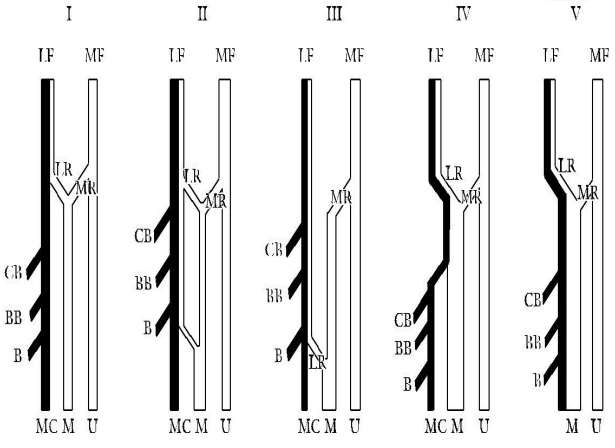


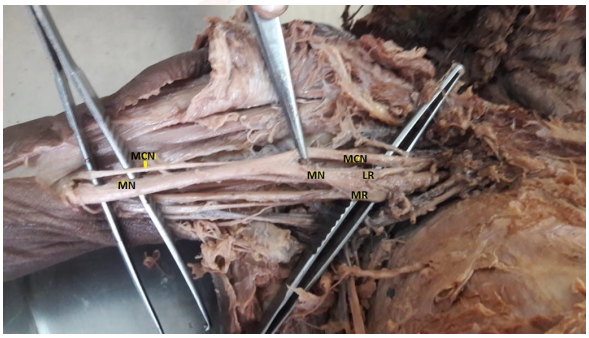
Fig. 1a: **Le Minor - Type 1 communication**

MN – Median nerve, **MCN** –Musculocutaneous nerve, **LR**- Lateral root, **MR**- Medial root.

Fig. 2: **Le Minor - Type 2 communication**

MN – Median nerve**, MCN** –Musculocutaneous nerve, **LR**- Lateral root, **MR**- Medial root, **CB** – Communicating branch, **CBr** – Coracobrachialis muscle, **BB**- Biceps Brachii muscle.

Fig. 3: **Le Minor - Type 4 communication**



MN – Median nerve, **MCN** –Musculocutaneous nerve, **LR**- Lateral root, **MR**- Medial root.

Fig. 4A: **Le Minor - Type 5 communication**

MN – Median nerve, **LR**- Lateral root, **MR**- Medial root, **CBr** – Coracobrachialis muscle, **Br** – Brachialis muscle.

Fig. 4B: Le Minor - Type 5 communication

MN – Median nerve, **BB**- Biceps Brachii muscle, **Br** – Brachialis muscle, **LCNF**- Lateral cutaneous nerve of forearm.

In present study, the communication between musculocutaneous nerve and median nerve were classified according to Le Minor classification.

Table 2: Comparison of results of the present study under Le Minor classification.

Type I	Type II	Type III	Type IV	Type V
60	11	-	2	7

Venieratos and Anagnostopoulou (2000) [11] classified this nerve communication into three types, depends upon its relation with coracobrachialis muscle.

Type I: The communication is proximal to entrance of the musculocutaneous nerve into coracobrachialis.

Type II: The communicating branch arises distal to coracobrachialis muscle from musculocutaneous nerve.

Type III: The musculocutaneous nerve and the communicating branch do not pierce the coracobrachialis muscle.

Venieratos and Anagnostopoulou [11] found 22 communications between the musculocutaneous and median nerves in 16 out of 79 cadavers. In six subjects they were present bilaterally. Nine of these 22 communications were proximal to the entrance of the musculocutaneous nerve into the coracobrachialis.

In present study, the communication between musculocutaneous nerve and median nerve according to Venieratos and Anagnostopoulou[11] classification, are of Type II (Communication was distal to Musculocutaneous nerve exit from Coracobrachialis muscle)

Choi et al (2002) [12] later classified the communications into three types in a study comprising 138 cadavers.

Pattern I: Fusion of both nerves (19.2%).

Pattern II: Presence of one supplementary branch between both nerves (72.6%).

Pattern IIa): Single root from musculocutaneous nerve, contributes to the connection (69.9%).

Pattern IIb): There are two roots from musculocutaneous nerve (2.7%).

Pattern III: Presence of two branches between both nerves (6.8%).

In present study, the communication between musculocutaneous nerve and median nerve according Choi et al [12], are of Type II and III. Anastomosis between musculocutaneous nerve and median nerve is the most common and frequent anomaly of brachial plexus. This is noted between a wide range of 1.4% to 63.5% according to Sahdeva and Singhla (2011) [9]. Guerri-Guttenberg and Ingolotti (2009) [13] observed communication between median nerve and musculocutaneous nerve in 53.6%.

Loukas and Aqueelah (2008) [14] observed communication between median nerve and musculocutaneous nerve in 63.5%.

If communicating branch between median nerve and musculocutaneous nerve is given off in upper third of arm, it is generally considered as third (Double lateral) root of the median nerve [15].

Lang and Spinner [16] reported a complete fusion of the musculocutaneous and median nerve in a case report. Wantanabe [17] et al found two cases (1.4%) of fusion of median and musculocutaneous nerves among 140 upper limbs.

Nakatani et al [18] observed absence of musculocutaneous nerve with innervations of coracobrachialis, biceps brachii and brachialis muscles and the lateral border of forearm by branches from lateral cord of brachial plexus.

Prasada and Chaudhary [19] reported two cases of absence of musculocutaneous nerve out of 24 upper limbs dissected. The median nerve took over the area of supply of musculocutaneous nerve by giving off both muscular and sensory branches. Sud and Sharma [5] reported a case of absence of musculocutaneous nerve with innervations of coracobrachialis and biceps brachii

via the median nerve. The lateral cutaneous nerve of forearm originated from the median nerve and gave off a muscular branch to the brachialis muscle.

Choi et al (2002) [12] reported the incidence of communication as 26.4% in 138 upper limbs. Venieratos and Anagnostopoulou (in 1998) [11] reported the incidence of communication as 13.9% in 158 upper limbs.

Ontogeny: Many factors influencing the formation of limb muscles and peripheral nerves during embryonic life are attributed to abnormal communication between musculocutaneous nerve and median nerve. This may be result of signal alterations between mesenchymal cells and neuronal growth cones according to Abhaya, Bharadwaj and Prakash (2003) [20] or the factors affecting circulation at the time of formation of Brachial plexus cords according to Kosugi, Mortia and Yamashita (1986) [21].

According to Iwata (1960) [22], human brachial plexus appears as single radicular cone in upper limb bud, which then divides longitudinally into ventral and dorsal segments. Possible failure of differentiation may be the cause of such abnormal communication and aberrant course. According to Chiarapattan et al (1998), lack of coordination between limb muscles formation and their innervations during embryonic development as cause of formation of abnormal communicating branch.

Phylogeny: Chauhan and Roy (2002) [23] postulated phylogeny and development of nerves of upper limb for interpretation of nerve anomalies of upper arm. This abnormal communication between nerves could be remnant of phylogenetic or comparative anatomical point of view and the ontogeny recapitulates the phylogeny.

Table 3: Comparative incidence of communication between musculocutaneous and median nerves.

Study	Incidence (%)
Guerri – Guttenberg and Ingolotti [13]	53.60%
Kerr [2]	24%
Choi et al [12]	26.40%
Venieratos and Anagnostopoulou [11]	13.90%
Present study	25%

CONCLUSION

The knowledge of communication between musculocutaneous nerve and median nerve in the arm is of significant clinical importance especially in post traumatic surgical repair of peripheral nerves and also in the anterior approach to fracture of Humerus. It also helps us explain the unexpected paralysis or paresis of flexor muscles of elbow and hypoesthesia of lateral surface of forearm, in addition to classical signs due to high median nerve paralysis occurring in axilla. It can also explain unexpected entrapment syndromes which is necessary to avoid unnecessary surgeries over carpal tunnel, as lesions of the communicating branch may give rise to symptoms similar to carpal tunnel syndrome.

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Conflicts of Interests: None

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