Variations in the course and branching pattern of musculocutaneous nerve

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Abstract

**Background and aim:** The variations in the course and communicating branches of musculocutaneous nerve is of clinical importance in the treatment of recurrent compression neuropathies and in the diagnosis of median nerve lesions. Most of the reports on anatomical variations of musculocutaneous nerve are single case studies and such studies with emphasis on gender difference in a sample of Keralite population are rarely reported. The objective of the present study is to observe the variations in the course of musculocutaneous nerve with special reference to communications with other nerves of the arm and to study the correlation between gender and variations of the nerve.

**Materials and Methods:** Two hundred and sixty four arms were dissected in the department of Anatomy, Government medical college, Thrissur and studied for variations of musculocutaneous nerve. Analysis was done with epi info, using proportions, confidence interval and Chi Square test. The communications noted were classified using the available classifications of Le Minor, Venieratos and Anagnostopoulou and Choi et al. **Results:** Nerve variations were seen in 24.2 % cases which include, absence of the nerve (3.4%), nerve not piercing coracobrachialis (12.4%) and communication to median nerve (15.1%). All the variations observed were statistically not significant. The embryological basis for the axonal pathfinding is considered as a result of both guidance molecules and electrical activity that change the calcium homeostasis within the growth cone to regulate growth cone turning. **Conclusion:** Variations that were observed in the present study may give sufficient and relevant data on the nerves, among Keralite population in which studies are few.

**Key words:** neuronal communication, coraco brachialis muscle, axonal pathfinding, median nerve, ansa axillaris

Introduction

The musculocutaneous nerve, a mixed peripheral nerve shows frequent variations like anomalies in formation, variation in its course like passing in front or behind the coracobrachialis muscle without piercing it, or adherence for some distance to the median nerve, some fibers of the nerve may run in the median nerve (MN) through communicating twigs, or the entire nerve may be absent. Normally musculocutaneous nerve (MCN) is the continuation of the lateral cord of the brachial plexus formed from C5,6,7 roots. It pierces the coracobrachialis muscle and descends laterally between the biceps and brachialis muscles, supplies the flexor muscles in the front of arm and skin over the lateral part of forearm. Numerous isolated case reports on variations in the branching pattern of brachial plexus are available in the anatomical journals. The terminal branches of cords of brachial plexus do not communicate at numerous sites in the arm except for formation of median nerve. Many authors have reported connections between the MCN and MN and the incidence ranges from 5% to 63.5%. Gender difference in anomalies of musculocutaneous nerve in a sample of Keralite population is rarely reported. The objective of the present study is to present the course of MCN with special reference to communications with other nerves in the arm and to study the correlation between gender and variant MCN. The presence of variations in the course and communicating branches has clinical importance in the treatment of recurrent compression neuropathies and in distinctive diagnosis of median nerve lesions.
Materials and Methods

The study was conducted on 82 adult Cadavers dissected by the undergraduate students of Government medical college, Thrissur for a period of seven years from (2006 - 2012) and 50 still born fetuses of different periods of gestation obtained from the department of Obstetrics and Gynaecology. The fetuses were collected after getting ethical committee clearance. A total of 264 limbs belonging to 91 males and 41 females were studied. The median and musculocutaneous nerves from their origin from brachial plexus up to the elbow were dissected. Formation of MCN, its course and relations, communication with median nerve, number of communicating branches were studied in detail. Variations in the course, relations with coracobrachialis muscle and communication with median nerve were noted and photographed. Observations were tabulated in excel and statistical analysis done using epi info, qualitative data were analysed using proportions, confidence interval and Chi Square test. The communications noted were classified according to the classifications by Le Minor¹, Venieratos and Anagnostopoulou¹ and Choi et al¹.

Results

Out of 264 arms studied, anomalous nerve was seen in 24.2 % cases. Variations of the nerve reported in the present study include, absence of the nerve (3.4%), nerve not piercing coracobrachialis (12.4%) and connection to median nerve (15.1%).

Of the 264 arms, 39 (15.1%) showed musculo-cutaneous-median nerve communication with 95% confidence interval of 11 to 20.1%. Communication between the nerves was more on the right side (17.1%) than on the left side (13.2%) with confidence interval of 11 to 24.7% and 7.9 to 20.3% respectively. This difference between the sides is not statistically significant as revealed by Chi Square value of 0.755 (p = 0.385). Table 1 shows the variations of MCN and the association between the two sides. Statistically significant sex difference was not observed in the case of MCN-MN intercommunication with Chi Square value of 0.02 (p = 0.88). Table 2 shows the values of nerve anomalies for the two sexes. In the right arm of one male cadaver the nerve was connected to medial root of median nerve in the axilla. In another cadaver MCN arose from median nerve. The number of communicating branches between MCN - MN were single in all the cases. No communication of musculo cutaneous nerve with ulnar or radial nerves appeared in any of the arms. On comparison with various classifications of musculo cutaneous nerve, the present study revealed all the types described by Le Minor¹, Venieratos and Anagnostopoulou¹, except pattern I and III of classification by Choi et al¹.

Discussion

Variations of musculocutaneous nerve is of immense clinical significance and studies in Keralite population

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<th>Table 1. showing the percentage variations of musculocutaneous nerve and the association between the two sides.</th>
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<td><strong>MCN absence</strong></td>
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<td><strong>MCN-MN connection</strong></td>
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<td><strong>Not passing through CB</strong></td>
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<th>Table 2. Showing the number of arms with variations of musculocutaneous anomalies by gender.</th>
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Abbreviations: MCN-Musculocutaneous nerve; MN-median nerve; CB-Coracobrachialis muscle; MCN-MN connection: Intercommunication between musculocutaneous and median nerve.
are few. A thorough knowledge of variations other than what is available in the standard text books is needed as nerves of arm may be involved in neurovascular compressions, shoulder surgery, post traumatic repair and flap surgery. Bhattarai and Poudel observed musculocutaneous nerve variations in 6.25%, all on the right side, where there was no significant difference by gender and side. In our study nerve variations were found in 24.2% of arms.

A number of authors reported absence of the nerve in the present study the nerve was found to be absent in 3.4% of arms, the incidence ranging from 1.6% - 6.4%.

Abundance of musculocutaneous nerve was reported by Aydin et al, in which the percentage of various possible origins of the nerve according to Bergman was given as 0.4% arose from the posterior cord, 2% from median nerve, 1.4% as two separate bundles from medial and lateral cords.

Ravishankar et al reported a case of bilateral absence of musculocutaneous nerve where the muscles of arm were supplied by median nerve. In the present study, musculocutaneous nerve was bilaterally absent in three cases, two males and one female. When this nerve is absent a nerve conduction test of musculocutaneous nerve will not be possible.

According to Buch 14% of musculocutaneous nerves do not pierce coracobrachialis muscle. In the present study it was 12.4% with a male preponderance (p=0.81). Earlier studies by Le Minor, Bhattacharya, Nakatani et al and also reported that the nerve descends without passing through the coracobrachialis muscle.

Although communications between the nerves of the arm are rarely reported, musculocutaneous - median nerve communication have been reported by many authors from nineteenth century. Two communicating branches between MCN and MN were reported by Choi et al and Arora et al. Multiple communicating branches between the two nerves was reported by Chauhan and Roy in the right arm of a female cadaver. These communications may present with discrepant nerve function test results that may lead to diagnostic errors. In the present study in 15.1% of arms the musculocutaneous and median nerves were interconnected by a single communicating branch. The musculocutaneous nerve of equine and domestic ruminants - sheep and goat are connected to median nerve forming a loop, the ansa axillaris ventral to the axillary artery.

Earlier workers have classified the communications between MN and MCN. According to Le Minor there are five types. Type I no connection, type II median nerve connected to musculocutaneous nerve, type III musculocutaneous nerve connected to Median, type IV musculocutaneous nerve connected to lateral root of median nerve, type V musculocutaneous nerve absent. Venieratos and Anagnostopoulou described three types of communication between MCN and MN based on its relation with coracobrachialis muscle as the reference point. Type I communication is proximal to the entrance of MCN into coracobrachialis, type II, the communication is distal to the muscle and type III neither the nerve nor its communicating branch pierces the muscle. Choi et al, classified into 3 patterns. In pattern I, the MCN and MN were fused. In pattern 2, There was one connecting branch between the MCN & MN. In pattern 3, two connecting branches were present between the MCN and MN.

The data collected in the present study when compared with the different types of classifications described for the nerve, the most common variation found was type III of Le Minor followed by type II. Pattern I and III of Choi et al were not observed in the present study. Figure 1 shows the common type of communication observed in this study. The nerve having a course outside the coracobrachialis muscle as shown in figure 2 forms the second common variation.

Bhattarai et al could not find gender difference in the case of MCN - MN intercommunication. Ravishankar et al found statistically significant difference by gender in communication between the nerves in 6% of population (4.4% in males and 20% in females). The present study could not find any significant difference by gender for all the variations.

We could not get the statistics of variations in formation of MCN and the length of communicating
communicating fibers are fibres of median nerve which instead of passing through lateral root of median nerve, entered musculocutaneous nerve for a short distance and re-entered median nerve\textsuperscript{21}.

The embryological basis for variation in course and distribution of a nerve can be explained by the theory put forward by Ramon Y Cajal\textsuperscript{22}. During development, the path taken by a nerve depends on signals produced by concentration gradients of molecules in the environment\textsuperscript{22}. A change in this axonal guidance may be the cause of variations in the course of a nerve. The axon pathfinding is controlled by a complex interplay between attractive and repulsive guidance molecules like Netrins, Slits, Semaphorins and Ephrins. Evidence based studies shows that spontaneous rhythmic electrical activity contributes to axonal pathfinding by regulating Psal-Ncam and guidance molecule expression on motor axons. Recent hypothesis suggests a role for morphogens, including the Hedgehog, Wnt and Bone Morphogenetic Protein\textsuperscript{23}. Clinically variations of musculocutaneous nerves are important in post traumatic evaluation of arm. Electromyography of biceps brachii and nerve conduction tests may not give a reliable result in the absence of musculocutaneous nerve.

**Conclusion**

The findings of the present study may provide lending support in the field of researches on musculocutaneous nerve. A larger study is needed to bring a statistically significant result in the case of variations and it should include the exact site of communication with reference to a bony point like coracoid or acromion process and the relations of the communicating segment as the clinical effects of nerve entrapment depends on the site of communication.

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**References**


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