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Cadaveric Study of Anatomical Variations in the Musculocutaneous Nerve and in the Median Nerve

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Abstract

Introduction The musculocutaneous nerve and the median nerve are branches from the lateral cord of the brachial plexus with a root value of C5, C6, and C7. The medial root of the median nerve is a branch of the medial cord. The present study aims at observing any variations in these peripheral nerves, so that this knowledge can be utilized by surgeons, anesthesiologists, and orthopedicians during surgical procedures and nerve block.

Materials and Methods The present study was carried on 30 adult embalmed cadavers (60 upper limbs) in the department of anatomy of the Kasturba Medical College , Manipal, India. The infraclavicular part of the brachial plexus was dissected, and any anatomical variations in the formation and in the branching pattern of the musculocutaneous nerve and of the median nerve were noted and photographs were taken.

Results The median nerve was noted to be formed from 3 roots in 8 out of 60 dissected upper limbs (13.33%). The musculocutaneous nerve was absent in 5% of the dissected limbs, and communications between these 2 nerves were noted in 13.33% of the dissected limbs.

Conclusions Noted variations of the nerves may be of help to surgeons operating in the axillas and in the arms.

Keywords
- communication
- lateral cord
- macroscopic human anatomy
- median nerve
- musculocutaneous nerve

Introduction

The brachial plexus is formed by the ventral rami of the lower four cervical nerves and by the first thoracic nerve, and it supplies the upper limbs. C5, C6, C7, C8 and T1 roots unite to form trunks (upper, middle, and lower) that divide into anterior and posterior divisions. The anterior divisions of the upper and middle trunks unite to form the lateral cord, which lies laterally to the axillary artery. The musculocutaneous nerve is a continuation of the lateral cord and leaves the axilla by piercing the coracobrachialis muscle. It supplies all of the muscles of the anterior compartment of the arm and continues as a lateral cutaneous nerve of the forearm. The median nerve is formed by two roots; the medial root of the median nerve from the medial cord, and the lateral root of the median nerve from the lateral cord. Both roots join to form

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the median nerve in front of the third part of the axillary artery. The median nerve crosses the brachial artery from the lateral to the medial side in the middle of the arm and does not originate any branches in the arm. In the literature, various anatomical variations were described by many authors. The knowledge regarding these variations can serve as a useful guide for surgeons operating in the axillas and in the arms.[1]

Materials and Methods

The present study was conducted on 60 upper limbs dissected in the anatomy department of the Kasturba Medical College, Manipal, India, over a period of 2 years. The cadavers were embalmed and preserved in a weak formalin solution. The infraclavicular part of the brachial plexus was dissected according to the guidelines of the Cunningham's manual of Practical Anatomy.[2] During the dissection, the normal pattern, as well as variations from the normal pattern, were noted and photographed. The number of the variations was noted and the result was tabulated using a regular statistics method. The study was started after obtaining the Institutional Ethical Clearance. Any variations from normal was noted and tabulated (►**Table 1**).

Results

1) Formation of the median nerve by three roots was seen in 8 out of 60 cases. Out of the three roots of median nerve, two roots was given by the lateral cord of the brachial plexus and one root was given by the lateral cord of brachial plexus as seen in ►**Figure 1**.
2) Absence of the musculocutaneous nerve was seen in 3 out of 60 cases (5%). In the absence of the musculocutaneous nerve, the muscles of the anterior compartment of the arm were innervated by the median nerve as seen in ►**Figure 2**.
3) Communication between the median and the musculocutaneous nerves was seen in 8 specimens out of 60 (13.33%). There was a case in which the formation of the median nerve by three roots as well as communication between the median and the musculocutaneous nerve was observed, as seen in ►**Figure 3**.

Discussion

Variations of the lateral cord are not rare and have been reported by many authors in the past, such as Venieratos et al,[3] Beheiry,[4] Budhiraja et al,[5] and Chitra.[6] The comparison with similar studies has been shown in ►**Table 2**. The causes for these anatomical variations in these peripheral nerves are not well understood. It is mentioned that, in humans, the muscles of the upper limbs are derived from the paraxial mesoderm during the 5th week of development.[7] The axons of the spinal nerves grow toward the mesenchyme. If there is any altered signaling between them, it results in significant variations in the nerve pattern.[8]

Venieratos et al[3] described three different types of communications between the musculocutaneous and median nerves in relation to the coracobrachialis muscle. In 16 out of 79 cadavers, 22 communications were found between the musculocutaneous and median nerves. In six subjects, they were present bilaterally. There were three types based on the sites of communications.

Type I: The communication was proximal to the entrance of the musculocutaneous nerve into the coracobrachialis muscle;
Type II: The communication was distal to the coracobrachialis muscle;
Type III: The nerve, as well as the communicating branch, did not pierce the coracobrachialis muscle. Bilateral communications were not necessarily of the same type.

In the present study, the communication between the median nerve and the musculocutaneous nerve was distal to the coracobrachialis muscle.

In the present study, the musculocutaneous nerve was absent in 3 cases out of 60 (5%). Among these three cases, one case of bilateral absence of musculocutaneous nerve was seen. The coracobrachialis muscle was innervated by a thin branch directly from the lateral cord. The rest of the muscles of the anterior compartment were supplied by the median nerve and, finally, one branch from the median nerve continued as a lateral cutaneous nerve of the forearm. This case was similar to one reported by Beheiry.[4] There was no communication between the median nerve and the musculocutaneous nerve observed in this case. The third case of absence of musculocutaneous nerve in the present study was seen in the right upper limb of an adult male cadaver. In the absence of the musculocutaneous nerve, all of the muscles of the anterior compartment of the arm were supplied by the median nerve, which later originated a branch that continued as a lateral cutaneous nerve of the forearm. Budhiraja et al[5] reported the absence of the musculocutaneous nerve in 13 cases out of 116 (11%). In the present study, the

Table 1 Showing all the noted variations

Specimen number	Observed variations	Present in number of dissected upper limbs ($n = 60$)	Percentage
1	Extralateral root of Median nerve	8	13.33%
2	Absence of musculocutaneous nerve	3	5%
3	Communication between the median nerve and themusculocutaneous nerve	8	13.33%

Table 2 Showing comparison of present study with the other studies done by other authors

Authors	Sample size	Absent musculocutaneous nerve	Innervation to muscles of anterior compartment of the arm	Communiction between the median nerve and the musculocutaneous nerve
Beheiry[4]	60	1.66%	Median nerve except coracobrachialis which is supplied by direct branch of lateral cord	5%
Chitra[6]	50	–	–	26%
Joshi[13]	170	5.5%	Median nerve except coracobrachialis which is supplied by direct branch of lateral cord	14%
Budhiraja et al[7]	116	11%	Median Nerve supplying all muscles of anterior compartment of arm in absence of musculocutaneous nerve except coracobrachialis which is supplied by direct branch of lateral cord	26.7%
Dahiphale et al[11]	40	–	–	25%
Balachandra et al[17]	20	–	–	5%
Sah SK et al[9]	26	19..23%	_	_
Naveen Kumar et al[10]	70	3%	–	–
Present Study	60	5%	In absence of musculocutaneous nerve all muscles were supplied by median nerve and not by any direct branch from lateral cord	13.33%

musculocutaneous nerve was seen piercing the coracobrachialis muscle in all of the cases in which it was present.

Communication between the median and the musculocutaneous nerves was observed in 8 cases out of 60 (13.33%). Among these noted communications, five were seen on the left side, and three on the right side. In 1 case out of 60 communications between the median and the musculocutaneous nerves was seen on both arms of an adult male cadaver. According to the studies of Beheiry,[4] Budhiraja et al,[5] Dahiphale et al.,[11] Chitra,[6] and Choi et al.,[12] communications between the median and the musculocutaneous nerves was seen in 5% of the cases, in 20.7% of the cases, in 25% of the cases,

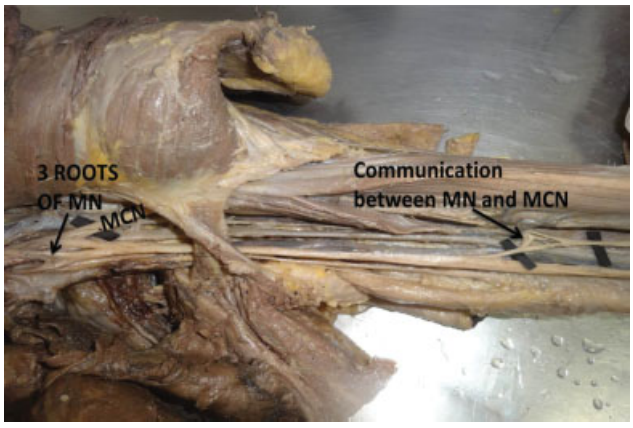

Fig. 1 Three roots of the median nerve with communication between the median nerve (MN)and the musculocutaneous nerve (MCN).

Fig. 2 Absence of musculocutaneous nerve and muscles of the anterior compartment of the arm supplied by the median nerve. Abbreviations: LCNF, lateral cutaneous nerve of the forearm; MN, median nerve.

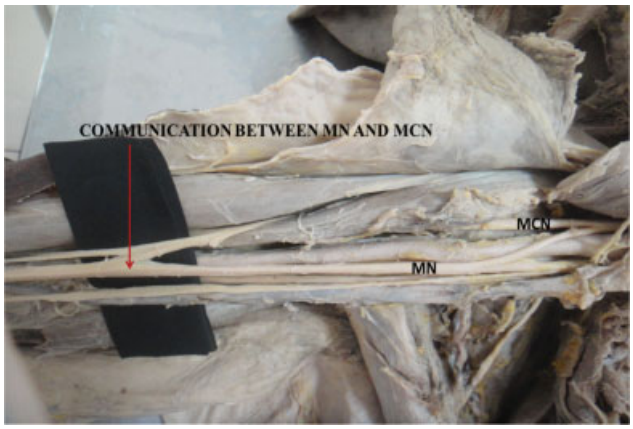

Fig. 3 Communication between the median nerve (MN) and the musculocutaneous nerve(MCN). Absence of musculocutaneous nerve. Median nerve supplying all of the muscles of the anterior compartment of the arm.

in 26% of the cases, and in 46.4% of the cases, respectively. Joshi et al[13] reported absence of the musculocutaneous nerve in 5.5% of the cases, and communication between the median and musculocutaneous nerves was noted in 14% of the cases. The result of the present study is related very closely to this study. In the present study, the communication between the median and the musculocutaneous nerves was more common on the left side, as seen in the study by Choi et al.[12]

In the present study, formation of the median nerve by three roots was noted in 8 out of 60 cases (13.33%). In all of these cases, two roots were coming from the lateral cord, and one root from the medial cord (four on the left side and four on the right side). In one case, there was also communication between the median and the musculocutaneous nerves. A similar case of formation of the median nerve by three roots was described by Sargon et al.,[14] Saeed et al.,[15] and by Das et al.[16]; with two roots from the lateral cord and one from the medial cord. Balachandra et al (2015) observed 3 roots of the median nerve in 5% of the cases with absence of the musculocutaneous nerve.[17]

The variations reported in the present study are of importance to surgeons during arthroscopic shoulder reconstructive surgery, nerve block, and in any surgery performed for pathologies involving the coracobrachialis muscles. Knowledge regarding these nerve variations may also be of use in case of treatment for fractures of the midshaft of the humerus. Chances of damage to these nerves can be due to trauma, to tractions, and to compression. It is observed that variant nerves are more prone to compression neuropathy. The knowledge of these variations also helps in correlating particular clinical manifestations with the involved nerve damage. In patients of breast carcinoma undergoing mastectomy, the coracobrachialis muscle is used as a flap to cover the defect after the mastectomy. Therefore, it becomes important to have knowledge regarding the normal anatomy as well as any observed variations in the muscle.[18]

Conflicts of Interests
The authors have no conflicts of interests to declare.

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