

A STUDY OF COMMUNICATION BETWEEN MUSCULOCUTANEOUS NERVE AND MEDIAN NERVES

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ABSTRACT

INTRODUCTION

Neural variations of the brachium constitute an important anatomical and clinical entity. Although frequently reported, if accompanied by other anomalies, they deserve special mention in anatomical literature. The nerves of the extremities are especially vulnerable to injury because of their long course and superficial distribution.

MATERIAL AND METHODS

The present study has been undertaken on 60 upper limb routine dissections from the year 2013 - 2015. The data collected and compiled.

OBSERVATION AND RESULTS

In the present study out of 60 upper limb dissections, we got 4 variations. The specimen no 20, 37 right upper limbs and specimen 42 & 51 left upper limbs are having the communication between the musculocutaneous nerve and the median nerve. The communication between median and musculocutaneous nerve before piercing the coracobrachialis is seen in one case; the three communications after piercing the coracobrachialis muscle.

SUMMARY & CONCLUSION

Its ontogeny and clinical implications are discussed in detail. A lack of awareness of variations with the different patterns might complicate the surgical repair and may cause ineffective nerve blockade.

KEYWORDS

Brachial Plexus, Communication, Median Nerve, Musculocutaneous Nerves.

HOW TO CITE THIS ARTICLE: Maheswari KB, Sadanandam SS. A study of communication between musculocutaneous nerve and median nerves. J. Evid. Based Med. Healthc. 2016; 3(47), 2357-2361. DOI: 10.18410/jebmh/2016/520

INTRODUCTION: Variations in the formation and branching pattern of the brachial plexus are common and have been reported by several investigators (Keer, 1918, Miller, 1934, Bergman¹, Afifi And Miyauchir 1988). Iwata (1960) believed that the possibility of failure of the differentiation as a cause for some of the fibres taking an aberrant course as a communicating branch Chairapattanakom et al² (1998) are of the opinion that the lack of coordination between the formation of the limb muscles and their innervations for appearance of a communicating branch.

According to Tountas and Bergman (1993), the musculocutaneous nerve arises from the lateral cord in 90.5%, from the lateral and posterior cord in 4%, from the medial cord in 2% and has two separate bundles from the medial and lateral cords in 1.4%.

Normal anatomy of brachial plexus and formation of median and musculocutaneous nerves: brachial plexus is

formed by the ventral rami of spinal nerves having root values of C₅, C₆, C₇, C₈ and T₁. The origin of the plexus may sometimes prefixed by the contribution of C₄ root or it may be post fixed plexus by the contribution of T₁. All these roots join to form trunks. Roots C₅ and C₆ join to form upper trunk. Root C₇ forms the middle trunk. Divisions of the trunks into ventral and dorsal divisions. Again, these divisions join to form cords.

The lateral cord is formed by the union of ventral divisions of the upper and middle trunks. Medial cord is formed by the ventral division of the lower trunk. The posterior cord is formed by the union of the dorsal divisions of all the three trunks.

Musculocutaneous nerve (C₅, C₆ and C₇) arises from the lateral cord of brachial plexus, accompanies initially the axillary artery, pierces the coracobrachialis muscle and then passes downwards between the biceps brachii and brachialis. It supplies coracobrachialis, biceps brachii and medial part of brachialis muscles. Below the elbow joint, the nerve is continuous as the lateral cutaneous nerve of the forearm.

Median nerve arises from the lateral cord partly (lateral root of median C₅, C₆ and C₇) and also from the medial cord (Median root of median C₈ and T₁).

Financial or Other, Competing Interest: None.

Submission 07-05-2016, Peer Review 21-05-2016,

Acceptance 27-06-2016, Published 13-06-2016.

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DOI: 10.18410/jebmh/2016/520

Knowledge of various communications between the Musculocutaneous and Median nerve may prove valuable in traumatology of the shoulder joint, as well as in relation to repair operations (Benjamin et al. 1981; Ha'eri³ and Wiley, 1982; Seradge and Orme, 1982).

Although the communication between the different nerves in the arm are rare, those between median and musculocutaneous nerve have been described from nineteenth century (Testut, 1884, 1899, Millar, 1888, Harris⁴, 1904).

AIMS & OBJECTIVES: Our aim is to describe the exact topography of this variation and to discuss its clinical significance and a note on its embryological study.

MATERIAL AND METHODS: The present study has been undertaken on 60 upper limb routine dissections for the Undergraduate students from the year 2013-2015. The data collected and compiled is presented below.

Procedure: Incision no 1: vertical along with the sternum. Incision no 2: towards laterally upwards along with the clavicle. Incision no 3: oblique towards arm pit, encircling the area around the areola. Incision no 4: horizontally towards mid axillary line. Incision no 5: horizontal divides the arm into upper 1\3rd and lower 2\3rd. Then we have removed the two triangular skin flaps. Cleared axillary pad of fat which contains axillary group of lymph nodes and superficial veins. We have traced axillary artery first and in relation to the 2nd part of axillary artery we have seen laterally lateral cord, medially medial cords. Exposed clearly to identify the branches from these cords.

The incisions given and dissection of the brachial plexus done and found the variations while continuing dissection in front of arm in well-preserved cadavers with proper embalming and storing facilities.

Inclusion Criteria: All the upper limbs from the cadavers we included which are kept for the routine dissections in the year 2013, 2014 and 2015.

Exclusion Criteria: Other information from the dissected specimens in the museum and foetal specimens we excluded from the total count.

After observing the total 60 upper limbs, I have taken only the abnormal specimen photographs, to show details of abnormalities and to discuss the developmental basis behind that.

OBSERVATIONS AND RESULTS: Communication of the musculocutaneous nerve with the median nerve at the lower third of the right arm in specimen no 20 of right upper limb.



Figure 1

1. Musculocutaneous nerve.
2. Biceps brachii.
3. Median nerve.

In specimen no 37 of right arm musculocutaneous nerve before giving branch to the coracobrachialis muscle, it is uniting with the median nerve.



Figure 2

1. Communication between median and musculocutaneous nerves before piercing the coracobrachialis muscle.
2. Musculocutaneous nerve.
3. Continuation of median nerve.

In specimen no 42, The left arm is having, communication between musculocutaneous nerve and median nerve after piercing coracobrachialis is observed on the left side at the middle of the front of arm were seen.

**Figure 3**

1. Musculocutaneous nerve.
2. Median nerve.
3. Ulnar nerve.

**Figure 4**

1. Musculocutaneous nerve.
2. Muscular branch to the biceps.
3. Median nerve.

In specimen no 51 of left arm, the union of musculocutaneous nerve with the median nerve after piercing coracobrachialis then continue as musculocutaneous nerve and median nerve.

	Type 1	Type 2	Type 3	Type 4	Type 5
Li Minor (1992), Venieratos and Anagnostopoulou (1998)	No communication between musculocutaneous nerve and median nerve	Fibres from medial root of median nerve pass along with musculocutaneous nerve and join with the median nerve at the middle of the arm	Fibres from lateral root of median nerve pass along with musculocutaneous nerve first, then after some distance it continues with the median nerve	Fibres from lateral root of median nerve pass along with musculocutaneous nerve first, then after some distance continues as musculocutaneous nerve and median nerve	Musculocutaneous nerve is absent and the entire fibres of the musculocutaneous nerve pass through the lateral root and fibres to the muscles supplied by musculocutaneous nerve branch out directly from the median nerve
Present Study	56	-	1	3	-

Table 1

	Type 1	Type 2	Type 3
Venieratos et al	The Communication was proximal to the entrance of the musculocutaneous nerve in to the muscle.	The communication was distal to the muscle.	The nerve and the communicating branch did not pierce the muscle.
Present study	1	3	-

Table 2

Serial Number	Author	Year	Incidence (%)
1	Watanable et al.	1985	01.4
2	Kosugi, Mortia and Yamashita	1986	21.8
3	Venieratos and Anagnostopoulou	1998	13.9
4	Choi et al.	2002	26.4
5	Loukas and Aqueelah	2008	63.5
6	Guerri-Guttenberg and Ingolotti	2009	53.6

7	Macda et al.	2009	41.5
8	Present study	2015	6.6
Table 3			

DISCUSSION: Table 1 depicts the types of communication between the musculocutaneous and the median nerve have been classified in different types by Li Minor (1992), Venieratos and Anagnostopoulou (1980) and Choi et al. (2002).

Li Minor (1992) categorised these communications into following five types: in type 1, there is no communication between the musculocutaneous and the median nerve, in type 2, the fibres of the medial root of the median nerve pass through the musculocutaneous nerve and join the median nerve at the middle of the arm, where as in type 3, fibres from lateral root of median nerve pass along with musculocutaneous nerve first, then after some distance continues as median nerve. Type 4, fibres from lateral root of median nerve pass along with musculocutaneous nerve first, then after some distance continues as musculocutaneous nerve and median nerve. Type 5, musculocutaneous nerve is absent and the entire fibres of the musculocutaneous nerve pass through the lateral root and fibres to the muscles supplied by musculocutaneous nerve branch out directly from the median nerve.

Venieratos et al had classified the communications between musculocutaneous and median nerves in to three types considering the coracobrachialis muscle as the reference point.

Type 1: The communication was proximal to the entrance of the musculocutaneous nerve in to the muscle.

Type 2: The communication was distal to the muscle.

Type 3: The nerve and the communicating branch did not pierce the muscle. The same as mentioned with the help of table 2.

In the present case, the musculocutaneous nerve is carrying the third root of median nerve. So, the median nerve said to be formed by three roots: A. One from the lateral cord. B. One from the musculocutaneous nerve. C. Third from the medial cord. Similar relation was observed earlier by different authors – The median nerve, instead of having two roots may have three roots – either one each from lateral cord, medial cord and musculocutaneous nerve (Chauhan and Roy, 2002, Saritha, 2004) or two from lateral cord and one from the medial cord (Mohapatra et al., 2004) or it may have even four – roots. – Three from the lateral cord and one from the medial cord (Uzun and Seelig, 2001).

Embryological Basis: Anastomosis between the musculocutaneous and the median nerve is the most common and frequent of all the variations that are observed among the branches of the brachial plexus (Venieratos and Anagnostopoulou, 1998).

The presence of such communications may be attributed to factors influencing the mechanism of formation of limb muscles and the peripheral nerves during embryonic life. It may be altered signalling between mesenchymal cells and neuronal growth cones. Also circulatory factors at the

time of fusion of brachial plexus (Kosugi⁵, Mortia & Yamashita 1986).

Studies of comparative anatomy have observed the existence of such connections in monkeys and in some apes; the connections may represent the primitive nerve supply of the anterior arm muscles (Miller⁶, 1934).

The interpretation of the nerve anomaly of the arm requires consideration of the phylogeny and development of the nerves in upper limb. Communication between the musculocutaneous nerve and median nerve is considered as a remnant from the phylogenetic or comparative point of view. Imokawa cited from Kosugi et al, 1986. Reported that there was only one trunk equivalent to the nerve in the thoracic limb of the lower vertebrates. (Amphibians, reptiles and birds) In the context, that ontogeny recapitulates phylogeny, it is possible that the variation seen in the current study is the result of development anomaly.

Iwata (1960) believed that the human brachial plexus appears as a single radicular cone in the upper limb bud, which divides longitudinally into ventral and the dorsal segments. The ventral segments give roots to the median and the ulnar nerves with musculocutaneous nerve arising from the median nerve. He further kept the possibility of failure of the differentiation as a cause for some of the fibres taking an aberrant course as a communication branch.

According to Rani Kumar⁷(2008), the limb buds arise as outpocketing from the ventrolateral aspect of the body wall during the fourth week of intrauterine life. Each limb bud consists of a core of mesenchyme covered by a layer of ectoderm. The mesenchyme derived from the somatic layer of lateral plate mesoderm and will give rise to bones and connective tissues of the limb. The ectoderm at the tip of the limb bud thickens and forms apical ectodermal ridge. The cells away from apical ectodermal ridge gives rise to cartilage and muscles of the limb. So the limb development takes place first in the proximal region and then in the distal part.

Simultaneously, the motor component of spinal nerves from the basal plates appears from the ventral horns of the spinal cord, T. W. Sadler⁸ (2009) innervate the developing proximal limb bud muscles after forming plexus (brachial plexus) by incorporating their branches in to the developing proximal limb bud muscles.

So the two different sources of origin should develop simultaneously both muscle and its nerve. If there is any delay because of lack of signalling, nutritional, environmental or due to genetic abnormalities of developments can cause communication gap. To avoid such communication gap these communicating branches might be present in lower grade animals. The same might persistent in these anomalous cases.

Clinical Significance: In diagnostic clinical neurophysiology, variations in connections between median nerve and musculocutaneous nerve may have some significance (Choi et al. 2002). Variations were observed in the present study involving median nerve and musculocutaneous nerve might be of some importance to the surgeons.

The precise knowledge about variations in musculocutaneous nerve and median nerve may prove valuable in traumatology of arm, as well as in plastic and reconstructive repair operations. To prevent unwanted outcomes of operations conducted on musculocutaneous nerve, it is suggested that the presence of median nerve and musculocutaneous nerve communications should be ruled out (Leffert, 1985).

SUMMARY & CONCLUSION: Its ontogeny and clinical implications are discussed in detail. The present study, we identified the incidence of variation 6.6%. It is compared with the previous studies from the years 1985 to 2015. The previous study of incidence of variation ranges from 1.4 to 63.5. The total information is tabulated to show the clear range of incidence of variation with the help of table number 3.

Though we got less percentage of incidence of variation when compared with different authors who got more incidence, it is within the range of incidence and this confirmation and coincidence is very much essential for the clinicians. A lack of update and awareness of variations with the different patterns might complicate the surgical repair and may cause ineffective nerve blockade.

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