

Study of Variations in the Origin and Course of Musculocutaneous Nerve

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Abstract-

Variations in the origin, course, branching pattern, termination and connection of the musculocutaneous nerve are not uncommon. The musculocutaneous nerve arises from the lateral cord of brachial plexus, opposite the lower border of pectoralis minor, pierces the coracobrachialis, descends laterally between the biceps and brachialis to the lateral side of arm and just below the elbow it pierces deep fascia lateral to the tendon of biceps brachii to continue as lateral cutaneous nerve of forearm. The aim was to study the variations in the origin and course of musculocutaneous nerve. Variations like musculocutaneous nerve did not pierce the coracobrachialis muscle, musculocutaneous nerve forming communications with median nerve were found in the present study. Knowledge of these variations is important for surgeons, clinicians and anatomists. Awareness of possible variations is essential to avoid unexpected complications during surgical procedures such as brachial plexus block, arthroscopy of shoulder joint and repair of fractures of humerus.

Keywords - Lateral cord, Musculocutaneous nerve, coracobrachialis muscle, Median nerve.

Introduction

Brachial plexus and their variations are very well known. Musculocutaneous nerve is one of the nerves which showed numerous interesting variations during routine dissection. Hence the present study was conducted and variations in the musculocutaneous nerve were studied. Musculocutaneous nerve arises from the lateral cord (C5-7) of brachial plexus opposite the lateral border of pectoralis minor muscle. It pierces coracobrachialis and descends laterally between biceps and brachialis to the lateral side of the arm. Just below the elbow it pierces the deep fascia lateral to the tendon of biceps, and continues as the lateral cutaneous nerve of the forearm. Musculocutaneous nerve supplies coracobrachialis, both heads of biceps and most of brachialis. The branch to coracobrachialis is given off before the musculocutaneous nerve enters the muscle: its fibres are from the seventh cervical ramus and may branch directly from the lateral cord. Branches to biceps and brachialis leave after the musculocutaneous nerve has pierced

coracobrachialis: the branch to brachialis also supplies the elbow joint. The musculocutaneous nerve supplies a small branch to the humerus, which enters the shaft with the nutrient artery. The median nerve has two roots from the lateral (C5,6,7) and medial (C8,T1) cords, which embrace the third part of axillary artery, and unite anterior or lateral to it. If the lateral root of median nerve is small, the musculocutaneous nerve (C5,6,7) connects with median nerve in the arm. (1)

Numerous variations like non piercing musculocutaneous nerve, its communication with median nerve were found in this study. These variations in the musculocutaneous nerve are important in surgical and orthopaedic cases. In previous studies different types of classifications of variations of musculocutaneous nerve are given. In present study the findings were recorded and also compared with previous classification.

Knowledge about these variations is important for surgeons, clinicians and anatomists. Awareness of

possible variations is essential to avoid unexpected complications during:

- surgical reconstructive procedures such as arthroplasty in recurrent shoulder dislocation,
 - in arthroscopy of shoulder joint
 - Repair of fractures of humerus.
 - performing neurotization of Brachial plexus
 - In brachial plexus blocks, so that these structures can be identified and protected.
- (2)

MATERIALS AND METHODS

40 cadavers (35 male & 5 female) 80 upper limbs were dissected in the Department of Anatomy, Dr D Y Patil Medical College & Research Centre, Pimpri, Pune to study the variations in the musculocutaneous nerve. The cadavers were embalmed in 10% formalin. All limbs were meticulously dissected and variations in the musculocutaneous nerve were noted and photographed.

RESULTS

80 upper limbs (40 rt 40 lt) were dissected to study variations in the musculocutaneous nerve. Following observations were recorded. Total eleven cases showed variation in the origin and course.

Following types of variations were found:

Type 1 – Non piercing coracobrachialis and having two communicating branches with median nerve

Median nerve was formed normally in the axilla by lateral and medial roots.

Branch to the coracobrachialis was given from the lateral cord, instead of musculocutaneous nerve.

Musculocutaneous nerve was given from the lateral cord in the axilla at the level of formation of median nerve. Then it passed down, without piercing the coracobrachialis muscle and in the middle of arm it gave branches to biceps muscle and brachialis muscle. In the arm the course of musculocutaneous nerve was not normal, it was passing along medial side of biceps muscle instead of passing between biceps and brachialis muscle.

There were two communicating branches between musculocutaneous and median nerve.

This finding was seen unilaterally in 3 cases on the left side while in 1 case on right side.

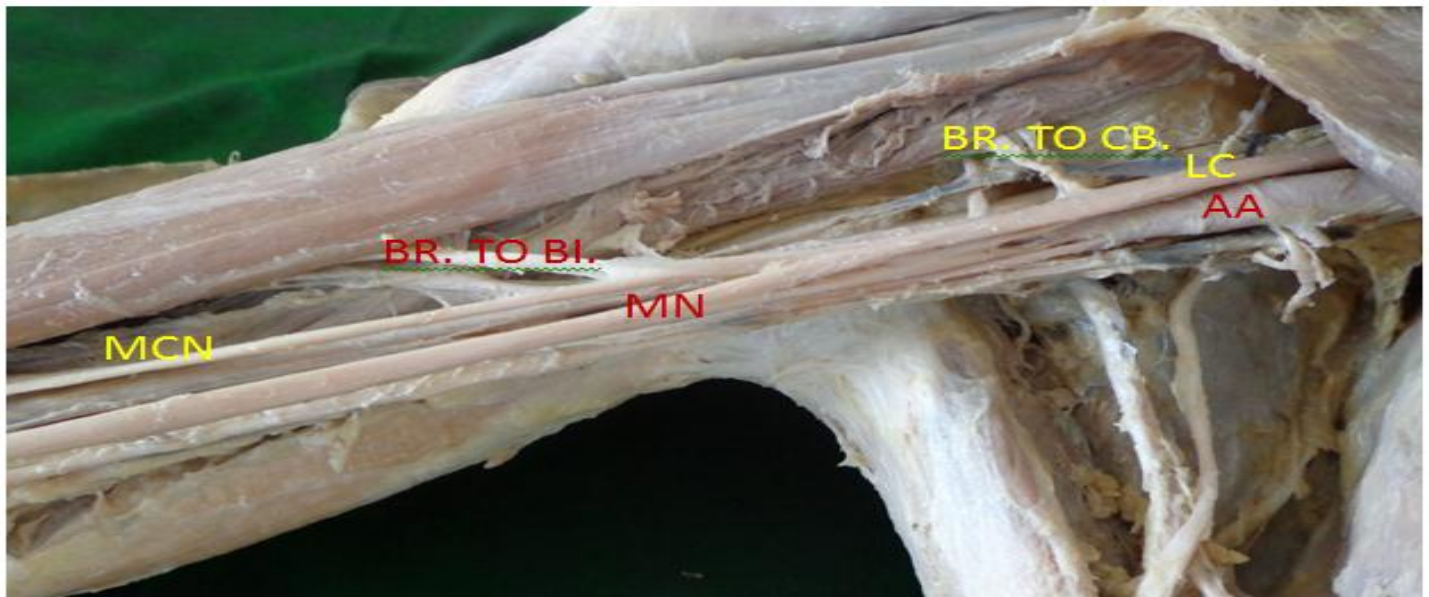
Figure 1 -Non piercing coracobrachialis and having two communicating branches with median nerve.

- LC-lateral cord, MN-median nerve, MCN – musculocutaneous nerve,
- BR TO CB.- branch to coracobrachialis, BR TO BI.- branch to biceps,
- BR TO BR- branch to brachialis, CB – communicating branch,
- CBM – coracobrachialis muscle, BIM- biceps muscle AA- axillary artery.

Type 2 – Non piercing coracobrachialis without communication with median nerve

The musculocutaneous nerve arose from the lateral cord. Branch to the coracobrachialis muscle was given from lateral cord. The musculocutaneous nerve passed along the medial side of the arm without piercing the coracobrachialis muscle. Branches to biceps and brachialis muscle were given in the lower part of the arm and further it passed down to cubital fossa. It also gave lateral cutaneous nerve of forearm. This type of finding was found in 3 cases, two on right side and one on left side.

Figure 2- Non piercing coracobrachialis without communication with median nerve



- LC-lateral cord, MN-median nerve, MCN – musculocutaneous nerve,
- BR TO CB. - Branch to coracobrachialis, BR TO BI. - Branch to biceps,
- AA- axillary artery.

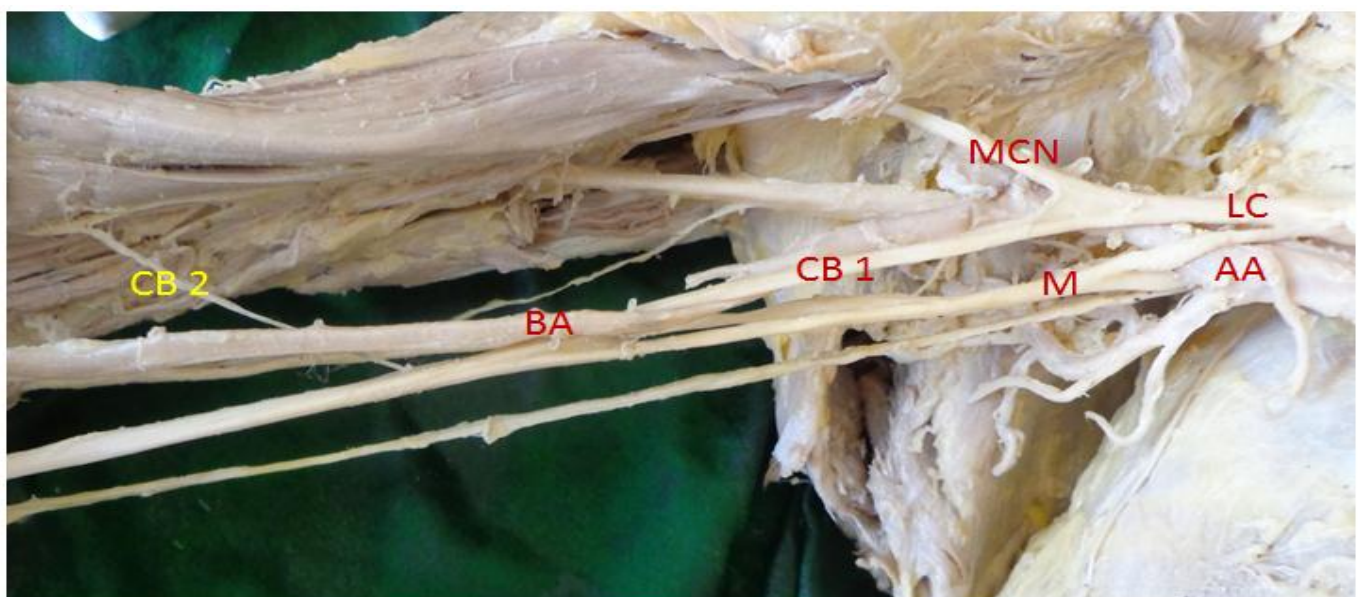
Course of musculocutaneous nerve is also normal.

Type 3 – Piercing coracobrachialis muscle having two communicating branches with median nerve.

Formation of median nerve and musculocutaneous nerve is normal.

There was a thick communicating branch between median and musculocutaneous nerve, which was given out from lateral cord at the origin of musculocutaneous nerve and brachial artery was passing between this communicating branch and median nerve. There was one thinner communicating branch between median and musculocutaneous nerve in the middle of arm. This finding was seen unilaterally on the right side in 2 cases.

Figure 3 – Piercing coracobrachialis muscle having two communicating branches with median nerve.



- LC-lateral cord, MN-median nerve, MCN – musculocutaneous nerve,
- CB –communicating branch, BA- - brachial artery, AA-axillary artery.

Type 4- Non piercing coracobrachialis and having one communicating branch with median nerve

Median nerve was formed normally in the axilla by lateral and medial roots but lateral root of median nerve was very thin.

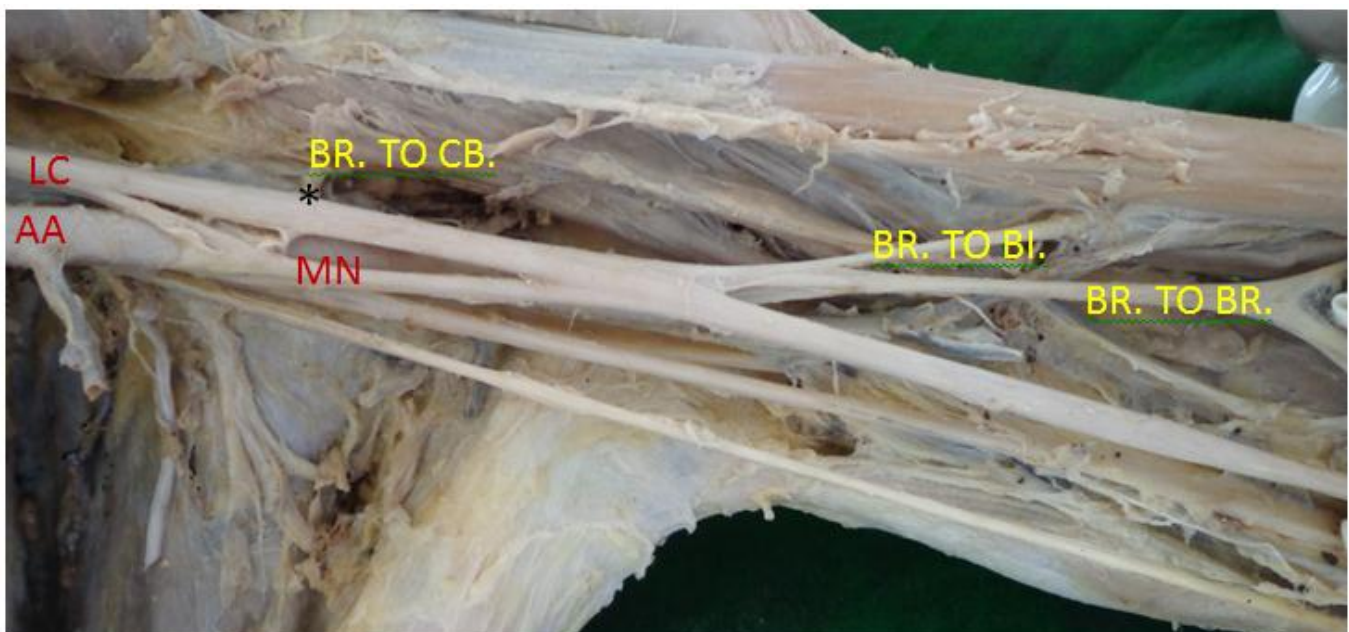
Branch to the coracobrachialis was given from the lateral cord; instead of musculocutaneous nerve. A

very thick musculocutaneous nerve was given from the lateral cord in the axilla. Then it passed down, without piercing the coracobrachialis muscle and in the middle of arm giving branches to biceps muscle and brachialis muscle. In the arm the musculocutaneous nerve was passing along medial side of biceps muscle instead of passing between biceps and brachialis muscle.

There was one communicating branch between musculocutaneous and median nerve.

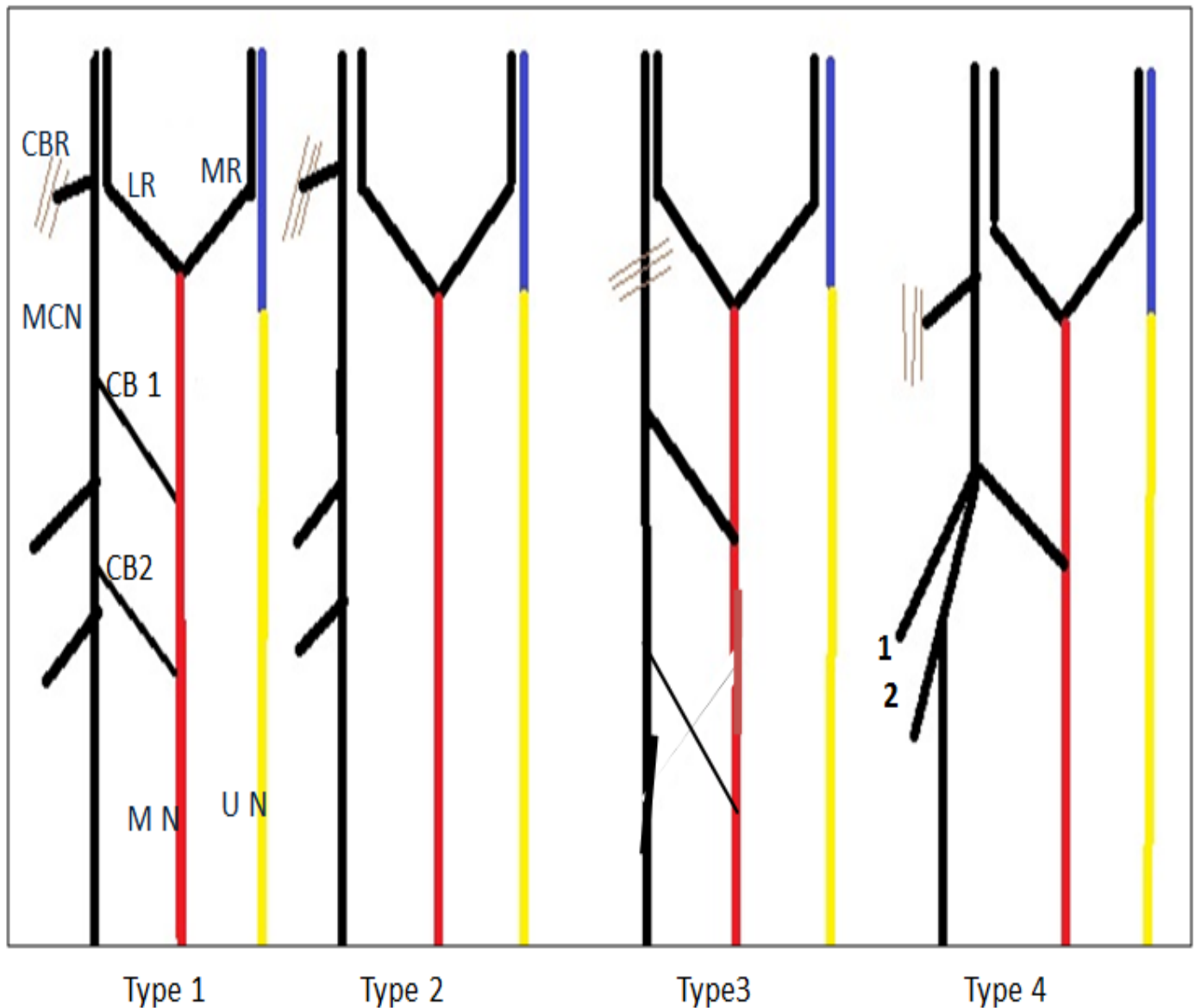
This finding was seen unilaterally in 2 cases, in one case it was on the left side while in 1 case it was on right side.

Figure 4 - Non piercing coracobrachialis and having one communicating branch with median nerve



- LC-lateral cord, MN-median nerve, BR TO CB. - Branch to coracobrachialis,
- BR TO BI. - Branch to biceps, BR TO BR- branch to brachialis.

Diagrammatic representation of findings of the present study is shown in fig (5) Figure 5



- CBR - coracobrachialis muscle, LR – lateral root, MR – medial root,
- MCN- musculocutaneous nerve, CB1- communicating branch 1 ,
- CB2- communicating branch 2 , MN- median nerve, UN – ulnar nerve,
- 1-branch to biceps, 2- branch to brachialis.

DISCUSSION-

It is not particularly uncommon to find a nerve trunk of considerable size leaving the musculocutaneous, while this lies behind the biceps and passing distally and medially to join the median nerve. This is to be regarded as a result of median nerve fibers from the lateral cord passing into the musculocutaneous rather than into

the lateral root of median, and then rejoining the median nerve at a lower level; when this occurs the lateral root of median nerve is typically small. The communication may be a tiny filament rather than a real nerve trunk. Kerr found that a branch from musculocutaneous nerve to the median had been reported in from 8.1% to 36.19% of different series, and estimated its incidence as somewhat less than 24% found in his series. Hari Rao and Ramchandra Rao reported 28 cases, found among 300 specimens, in which the musculocutaneous nerve did not pierce the coracobrachialis but instead passed between it and the biceps (3).

Raju S et al observed bilateral variations in the anterior compartment of the arm region .In the

right upper arm the motor branches to the biceps brachii and brachialis muscles found to arise from the branch of the right median nerve, and the same nerve continued as the lateral cutaneous nerve of forearm. This branch was not passing through the coracobrachialis muscle, but this muscle was innervated by direct branch from lateral cord of brachial plexus. They also observed another variation at left side of arm where MCN and MN communicated by an abnormal communicating branch which measured about 5 cm in length. Both the type of variations was found in present study. (4)

Jamuna M and Amudha G found absent musculocutaneous nerve in three cases. (5)

Bhattacharai C and Poudel PP found numerous types of communications between median and musculocutaneous nerve but in their study the musculocutaneous nerve was piercing the coracobrachialis muscle. It resembles the type 3 of the present study.

Thus this study of unusual course, branching pattern and termination of musculocutaneous nerve is of clinical importance during flap dissections, post traumatic evaluation of the arm or peripheral nerve repair and even for peripheral nerve stimulation in practice of anaesthesia. (6)

Sachdeva K. and Singla RK found that musculocutaneous nerve was not piercing the coracobrachialis muscle and it was also forming the communicating channel with median nerve and then branches to the biceps brachii and brachialis muscle were given. This resembles the type 1 classification of the present study.

Huban R Thomas et al found communication between the musculocutaneous nerve and median nerve which resemble type 4 of the present study. (7)

Dr Girish V. Patil and Dr Shishirkumar found musculocutaneous nerve passed along the medial

aspect of muscles of arm without piercing coracobrachialis muscle also there was communication between median and musculocutaneous nerve. This resembles type 1 classification of the present study. (8)

Remya K., Ashwin Krishnamurthy, Kavitha K. encountered an anomalous communication between musculocutaneous and median nerve in both the upper limbs of a 72 year old male cadaver. The communicating branch arose from the musculocutaneous nerve at a distance of 12.6 cm and 12.5 cm from the tip of coracoid process on right and left side and joined the median nerve 16.2 cm from the same bony point. (9)

Anatomical variations of peripheral nerves have clinical and surgical importance especially in posttraumatic evaluation and exploratory interventions of the arm for peripheral nerve repair and to some extent during flap dissections. Finally, although anterior approach for internal fixation of humeral fractures seems to be safer than the posterior approach because of high risk of radial nerve damage in posterior approach. Thus precise knowledge of variations in musculocutaneous nerve and median nerve may prove valuable in traumatology of the arm, as well as in plastic and reconstructive repair operations. If the surgeons find it necessary to isolate and trace the median nerve and musculocutaneous nerve distally, it is essential to be alert to the communications that may occur between them. (9)

MCN has frequent variations. It may run behind the coracobrachialis or adhere for some distance to the median nerve and pass behind the biceps.

Some fibers of the median nerve may run in the musculocutaneous nerve, leaving it to join the proper trunk; less frequently the reverse occurs, the median nerve sending a branch to the musculocutaneous. Occasionally it supplies the pronator teres. (1)

Incidence of communications between MCN & MN is shown in the table.

Table 1: Incidence of communications between MCN & MN

Workers	Year	Percentage
Watanabe et al	1985	01.4%
Kosugi et al	1986	21.8
Yang et al	1995	12.5
Venieratos et al	1998	13.9
Rao et al	2000	33.3
Aktan et al	2000	10.4
Choi et al	2002	26.4
Loukas et al	2008	63.5
Guerri et al	2009	53.9
Maeda et al	2009	41.5

Present study showed variations in musculocutaneous nerve in 13.7% of cases.

Le Minor’s Classification

Type I - No communication between MCN & MN

Type II - Some fibers of lateral root of MN pass thru MCN & join MN in middle of arm

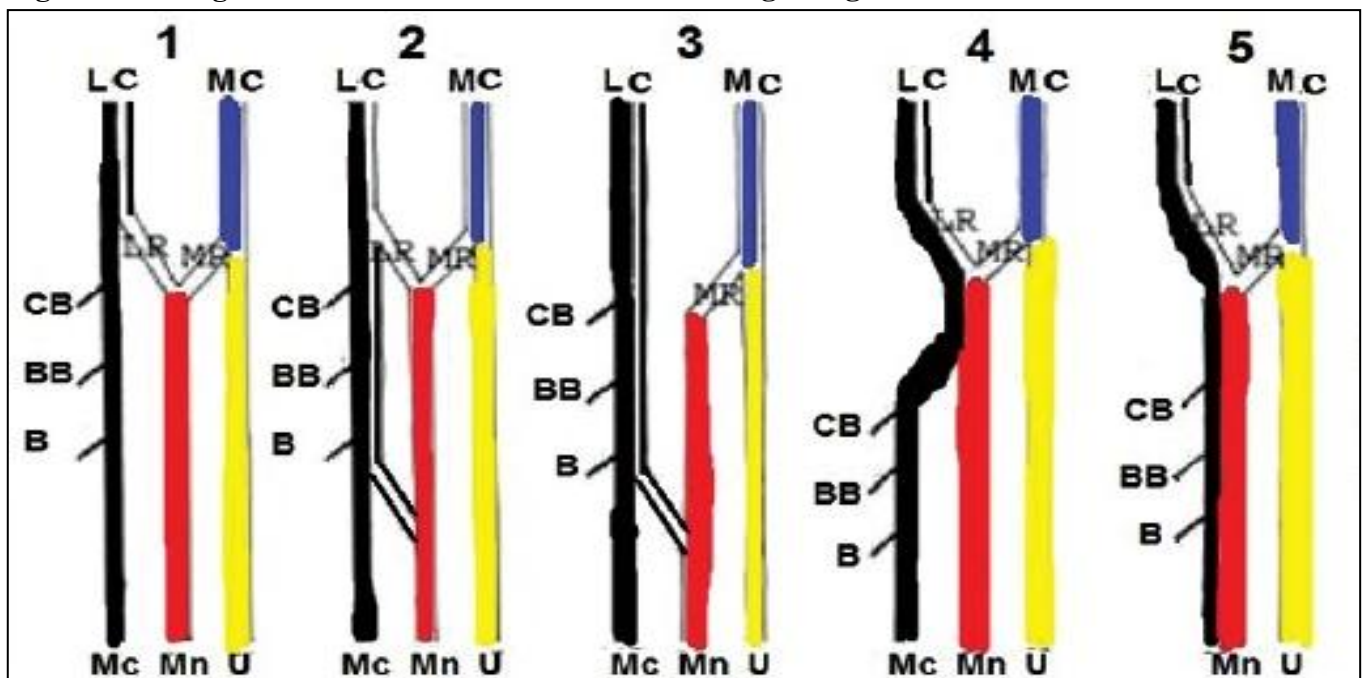
Type III - All fibers of lateral root of MN pass along MCN, after some distance leave it to form lateral root of MN

Type IV - MCN joins lateral root of MN, after some distance MCN arises from MN

Type V - MCN is absent, entire MCN fibres passes through lateral root of MN to MN. Fibres to the muscles supplied by MCN come directly from MN. (10)

(MCN – musculocutaneous nerve, MN – median nerve, U-ulnar nerve.)

Diagram showing Le Minor’s classification is shown in fig. 6 Figure 6



(MCN – musculocutaneous nerve, MN – median nerve, U-ulnar nerve.)

Venieratos and Anagnostopoulou 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. (11)

A number of variations in the course and distribution of the musculocutaneous nerve have been reported. Instead of piercing the coracobrachialis muscle, the nerve may adhere to the median nerve for some distance down the arm and then, either as a single trunk or as several branches passes between the biceps and brachialis muscles to supply all three muscles (about 22% of arms).

Sometimes only a part of the nerve follows this course; this part then rejoins the main trunk after it transmits through and supplies coracobrachialis.

In some cases, instead of the whole trunk of the nerve piercing coracobrachialis, only its muscular branch or only its cutaneous branch pierces the muscle.

The musculocutaneous nerve may be accompanied by fibers from the median nerve as it transmits coracobrachialis; a communicating branch passes from the musculocutaneous to the median nerve. Instead of penetrating coracobrachialis, the nerve may pass behind it or between it and the short head of the biceps muscle. Occasionally, the nerve perforates not only coracobrachialis, but also the brachialis or the short or long head of the biceps muscles.

Very rarely the lateral cord may pierce coracobrachialis and then divide into the musculocutaneous and lateral root of the median nerve (12).

Embryological explanation:

The limb muscles develop from the mesenchyme of the parietal layer of lateral plate mesoderm during the fifth week of intrauterine life. The axons of the spinal nerves grow distally to reach the muscles and skin. A lack of coordination between the two processes due to altered signalling may lead to the development of multiple variations (17).

CONCLUSION

Knowledge about variations in these branches of brachial plexus is important for surgeons, clinicians and anatomists. Awareness of possible variations is essential to avoid unexpected complications during surgical reconstructive procedures such as arthroplasty in recurrent shoulder dislocation, in arthroscopy of shoulder joint, repair of fractures of humerus, performing neurotization of Brachial plexus, in brachial plexus blocks, so that these structures can be identified and protected. (14)

ACKNOWLEDGEMENT

We are very much thankful to our guide, Professor and Dean Dr P Vatsalaswamy for her valuable guidance. We thank to our head of the department Dr P Manvikar for his continuous support and guidance for this study. We also thank our Professor Dr V Arole for her guidance. We also thank all non-teaching staff for their co-operation and timely help for this study.

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