A morphological study to note the anatomical variations in the branching pattern of the lateral cord of the brachial plexus

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Abstract

Brachial plexus through its branches innervates the upper limb. Variations in the arrangement and distribution of the lateral cord and its branches in the infraclavicular part of the brachial plexus are common and are of significance to the neurologists, surgeons, anaesthetists and the anatomists. To look for the branching pattern of the lateral cord of brachial plexus we dissected 25 upper limbs bilaterally. We found variation in 3 limbs. In 1st limb musculocutaneous nerve (MUN) was absent and the lateral cord was supplying the brachialis (BM), coracobrachialis (CBM) and biceps brachii muscles (BBM). The lateral cutaneous nerve of forearm (LCBOF) was directly coming from the lateral cord of brachial plexus. The median nerve (MN) was formed at the junction of upper 1/3rd and lower 2/3rd of the arm by the joining of lateral and medial roots. In 2nd limb MUN was coming from MN and branch to CBM was coming from lateral root of MN and branch to BM, BBM was coming from MUN and finally MUN was continuing as LCBOF. In 3rd case we observed a communicating branch was coming from MN to MUN in the middle of arm. In 2nd case we also observed an accessory head of BBM. It is would be important to be aware of these variations while planning a surgery in the region of axilla or arm as these nerves are more liable to be injured during operations.

Keywords: lateral cord, brachial plexus, MUN, MN, communicating branch.

1 Introduction

The Brachial plexus is formed by the lower four cervical ventral rami with a variable contribution from C4 and T2 (JM, 1990). It supplies the muscles of the back and the upper limb. The C5 and C6 fuse to form the upper trunk, the C7 continues as the middle trunk and the C8 and T1 join to form the lower trunk. Each trunk, soon after its formation, divides into anterior and posterior divisions. The anterior divisions of the upper and middle trunks form the lateral cord, the anterior division of the lower trunk continues as the medial cord and the posterior divisions of all the three trunks form the posterior cord. The cords then give rise to various branches that form the peripheral nerves of the upper limb. The anterior divisions supply the flexor compartments of upper limb and the posterior divisions; the extensor compartments (SANNES, REY and HARRIS, 2000). Normally the lateral cord gives its first branch, the lateral pectoral nerve to the pectoralis major muscle and then divides into the MUN and the lateral root of the MN (Figure 1). The lateral root then joins the medial root from the medial cord to form the MN, which lies in front of third part of the axillary artery (AA) (VENIERATOS and ANAGNOSTOPOULOU, 1998).

Since the brachial plexus is a complex structure, variations in the formation of roots, trunks, divisions and cords are common. The present study deals with some of the variations present in the branching pattern of the lateral cord of the brachial plexus. Anatomical knowledge of such variations is also important for surgeons during radical neck dissection surgeries to avoid any inadvertent injury (SUD and SHARMA, 2000).

2 Materials and methods

In this study 25 formalin fixed upper limbs in the Department of Anatomy KMC, Manipal were dissected. The bodies were embalmed with femoral arterial perfusion of 10% formalin and preserved in weak formalin solution. The brachial plexus was dissected according to the guidelines of Cunningham's practical manual. During the dissection the variations from normal pattern were noted and photographed.

3 Results

In 1st upper limb we observed that the lateral cord of brachial plexus instead of dividing into 3 branches, divided into 6 branches and the MUN was absent (Figure 2). Following branches were noted from the lateral cord:

1) Lateral pectoral nerve
2) Lateral root of MN
3) LCBOF
4) Three muscular branches to CBM, BM and BBM.

We also observed that the MN formation by the lateral and medial roots from the lateral and medial cords of the brachial plexus respectively was lower down in the arm (i.e. at the junction of upper 1/3rd and lower 2/3rd) instead of in the axilla. The two roots joined in front of the brachial artery (BA) to form the MN.

In 2nd limb MUN was coming from MN and branch to CBM was coming from lateral root of MN and branch to BM, BBM was coming from MUN and finally MUN was continuing as LCBOF. In 2nd case we also observed an accessory head of BBM (Figure 3).

Figure 1. Normal branching pattern of lateral cord. MUN- Musculocutaneous nerve, AN- Axillary nerve, MN- Median nerve, RN-Radial nerve, UN- Ulnar nerve, BA-Brachial artery.

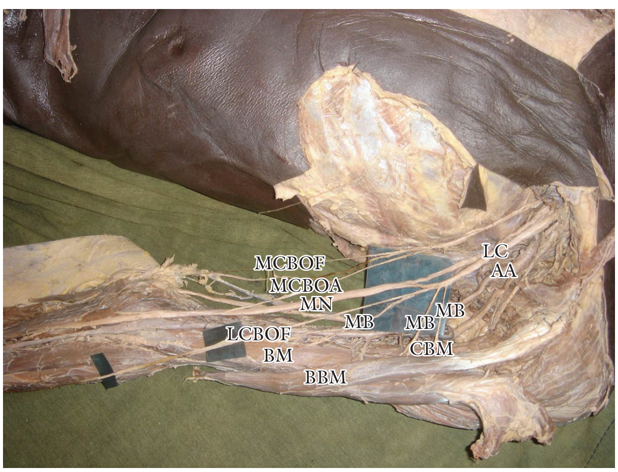

Figure 2. Variation in the branching pattern of lateral cord of brachial plexus. LC- Lateral cord, MN- Median nerve, AA- Axillary artery, MB- Muscular branches from lateral cord, MCBOF- Medial cutaneous branch of forearm, LCBOF- Lateral cutaneous branch of forearm, MCBOA- Medial cutaneous branch of arm, BM- Brachialis muscle, CBM- Coracobrachialis muscle, BBM- Biceps brachii muscle.

In 3rd case we observed a communicating branch was coming from MN to MUN in the middle of arm (Figure 4). MUN was piercing CBM as usual. Muscular branch to BBM was coming before the communicating branch but to BM after the communicating branch and after that MUN continue as LCBOF.

4 Discussion

The knowledge of variations in the course and branching of the lateral cord of the brachial plexus assumes importance while performing neurotisation of brachial plexus lesions, shoulder arthroscopy by anterior glenohumeral portal and shoulder reconstructive surgeries (CHITRA, 2007). In the past many variations have been described regarding the course of MUN and MN. Le Minor (1990) described five types of variations:

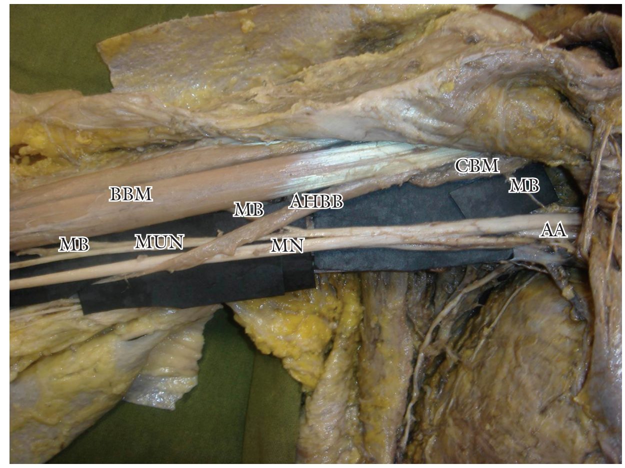

Figure 3. Variation in the origin of MUN and accessory head of BBM. MN- Median nerve, AA- Axillary artery, MB- Muscular branches, LCBOF- Lateral cutaneous branch of forearm, CBM- Coracobrachialis muscle, BBM- Biceps brachii muscle, AHBB- accessory head of biceps brachii, MUN- Musculocutaneous nerve.

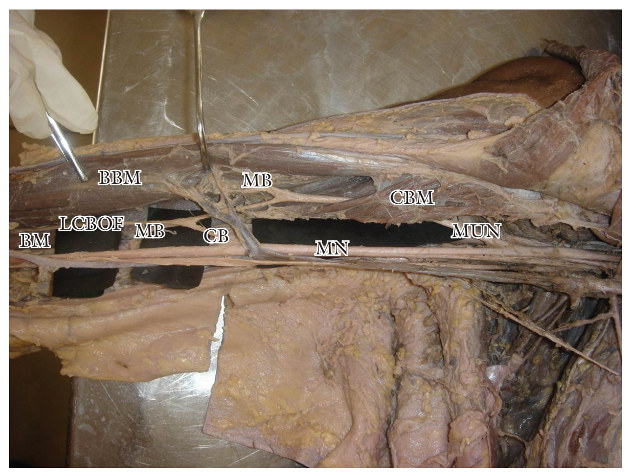

Figure 4. A communicating branch between MUN and MN. MN- Median nerve, MB- Muscular branches, LCBOF- Lateral cutaneous branch of forearm, CBM- Coracobrachialis muscle, BBM- Biceps brachii muscle, BM- Brachialis muscle, CM- communicating branch, MUN- Musculocutaneous nerve.

- Type 1: There is no communication between the MN and MUN.
- Type 2: The fibers of medial root of MN pass through the MUN and join the MN in the middle of the arm.
- Type3: The lateral root fibers of medial root of MN pass through the MUN and after some distance, leave it to form the root of the MN.
- Type 4: The MUN fibres join the lateral root of the MN and after some distance the MUN arise from the MN.
- Type 5: The MUN is absent and the entire fibres of MUN pass through lateral root and fibres to the muscles supplied by MUN branch out directly from MN.

Venieratos and Anagnostopoulou (1998) also described three different types of communication between MUN and MN in relation to CBM:

Type 1: communication between MUN and MN is proximal to the entrance of MUN into CBM.

Type 2: communication between the two nerves is distal to the muscle.

Type 3: neither the nerve nor its communicating branch pierced the muscle.

In this study in 1st case the absence of the MUN was observed which coincided with type 5 of Le Minor classification but did not correspond to any of Venieratos's classification. 1st case of our study was similar to a case found by Sud and Sharma (2000) but the muscles, which are normally supplied by the MUN and the LCBOF instead, were given off from the lateral cord of brachial plexus in our case but in their case they were coming from the lateral aspect of the MN.

The 2nd and 3rd case of our study coincide with the type 4 and type 2 of Le Minor classification. The 3rd case of our study was similar to a case found by Ibrahim, Adnan, Cem et al. (2005). We also observed in our 2nd case an accessory head of BB same as found by Arora and Dhingra (2005). We also observed variations in the branching pattern of the lateral cord of brachial plexus which was similar to the variations noted by Nakatani, Mizukami and Tanaka (1997).

The 3rd case of our study coincides with the type 2 of Venieratos's classification.

2nd case of our study was also similar to a case reported by Avinash, Bhardwaj and Prakash (2006) during routine dissection of a 33-year-old male cadaver they found dual origin of MUN. The higher origin from the lateral cord was reduced to a thin nerve, which supplied only the CBM, while the lower origin was of usual thickness that supplied the BBM and the BM and then continued as the LCBOF after piercing the deep fascia lateral to the tendon of BBM. We also found 2 origin but in our case the higher origin was from the lateral root of MN and was reduced to a thin nerve, which supplied only the CBM, while the lower origin was from the MN of usual thickness that supplied the BBM and the BM and then continued as the LCBOF after piercing the deep fascia lateral to the tendon of BBM.

Our 2nd case was also similar to a case found by Singhal, Rao and Ravindranath (2007). They found that the lateral cord gave rise to a direct branch to the CBM, the lateral root of the MN and thereafter continued as the MUN. The MUN gave two communicating branches to the MN with the lateral root giving a branch to the first communicating branch of the MN. But we found that the lateral root of MN gave rise to a direct branch to the CBM and MUN was coming from MN and a communicating branch was coming from MN to MUN in the middle of arm.

The MUN usually enters the CBM from its medial aspect approximately 5 cm. distal to the tip of the coracoid process but is shown to have frequent variations. During shoulder reconstruction surgery it is important to identify the MUN, as it is vulnerable to injury from the retractors placed under the coracoid process. The lesion of the MUN produces weakness of elbow flexion and supination and loss of sensation on the lateral aspect of the forearm (CHITRA, 2007).

During surgical procedures of the axilla and the shoulder, surgeon is exposed to the topographical anatomy of the neural structures and awareness of such variations may be of immense clinical help. Knowledge of such anomalies is also important during treatment of fractures. Better understanding and correct interpretation of clinical neurophysiology can only be possible with prior academic knowledge (SUD and SHARMA, 2000).

These variations are also of clinical importance especially in post-traumatic evaluations and exploratory interventions of the arm for peripheral nerve repair and to some extent during flap dissections. Result of an exploratory intervention of the arm for peripheral nerve repair in a patient with these variations can be successful only if the surgeon is aware of such variations. Additionally, during flap dissections, unexpected nerve damages could result (NAKATANI, MIZUKAMI and TANAKA, 1997).

Variations assume significance during nerve block of infraclavicular part of the brachial plexus. Though the variations that we have mentioned here may not alter the normal functioning of the limb of the individual, it is important to keep these in mind in surgical and anaesthesiological procedures (SANNES, REY and HARRIS, 2000).

In humans, the forelimb muscles develop from the mesenchyme of the paraxial mesoderm during the fifth week of intrauterine life (LARSEN, 1997).The axons of the spinal nerves grow distally to reach the mesenchyme. As the guidance of the developing axons is regulated by the expression of chemoattractants and chemorepulsants in a highly coordinated site specific fashion, significant variations in nerve patterns may be a result of altered signalling between mesenchymal cells and neuronal growth cones (JM, 1990) or circulatory factors at the time of fusion of brachial plexus cords (SINGHAL, RAO and RAVINDRANATH, 2007).

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