Original article

Communication between median and musculocutaneous nerve

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Resumo

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. The variations of the median nerve and the musculocutaneous nerve, like the communication between the two, may prove valuable in the traumatology of the shoulder joint. It may also be correlated to the entrapment syndromes of the musculocutaneous nerve in which a part of the median nerve also passes through the coracobrachialis and may exhibit the symptoms similar to those encountered in the median nerve neuropathy as in the carpal tunnel syndrome. In the present case, in the right upper limb of a 60 year old male, the musculocutaneous nerve after its origin from lateral cord gave a branch to corachobrachialis muscle and then fused completely with median nerve. Later then supplied the other two muscles of the front of forearm, i.e. biceps brachii and brachialis and the lateral cutaneous nerve of arm. Its ontogeny, phylogeny and clinical implications are discussed in detail. A lack of awareness of variations with different patterns might complicate surgical repair and may cause ineffective nerve blockade.

Keywords: brachial plexus, communication, median nerve, musculocutaneous Nerve.

1 Introduction

Variations in the formation and branching pattern of the brachial plexus constitute an important anatomical and clinical entity and have been reported by several investigators (KERR, 1918; MILLER, 1934; BERGMAN, AFIFI and MIYAUCHIR, 1988). The median, musculocutaneous and ulnar nerves after their origin from the brachial plexus, pass through the anterior compartment of the arm without receiving any branch from any nerve in the neighbourhood (HOLLINSHEAD, 1976). Although the communications between the different nerves in the arm are rare, those between the median nerve (MN) and musculocutaneous nerve (MCN) have been described from nineteenth century (HARRIS, 1904). Knowledge of anatomical variation of these nerves at the level of upper arm is essential in light of the frequency with which surgery is performed in the axilla and the surgical neck of the humerus (LEFFERT, 1985). One such case was found in the Department of Anatomy, Government Medical College, Amritsar, Punjab, India; where a communication was seen between MN and MCN in the right arm of a 60 year old adult male cadaver.

2 Case report

During routine undergraduate dissection, in the right upper limb of a 60 year old adult male cadaver, the MCN arose normally from the lateral cord of brachial plexus. The MN was formed by the union of a lateral root coming from lateral cord and a medial root coming from medial cord, in front of the third part of axillary artery. The MCN as a whole did not pierce corachobrachialis but instead gave a branch to it which entered the corachobrachialis muscle. After this, the MCN, ran downwards and medially for about 4 cm, crossed the third part of axillary artery and joined the MN, 3.5 cm after its formation. The other two muscles of the front of the arm viz. biceps brachii and brachialis were supplied by the median nerve after it received the musculocutaneous nerve. Similarly the lateral cutaneous nerve of arm also emerged from median nerve (Figure 1 and 2).

3 Discussion

Anastomosis between the MCN and the MN is by far the most common and frequent of all the variations that are observed among the branches of the brachial plexus (VENIERATOS and ANANGNOSTOPOULOU, 1998). Table 1 depicts the incidence of communication between musculocutaneous nerve and median nerve irrespective of its site or type as reported earlier from time to time. It is seen to vary between a wide ranges of 1.4% to 63.5%.

The communication between the MCN and the MN have been classified in different types by Li Minor (1992), Venieratos and Anagnostopoulou (1998) and Choi et al. (2002).

Li Minor (1992) categorized these communications into following five type: In type I, there is no communication between the MN and the MCN, in type II, the fibers of the lateral root of the MN pass through the MCN nerve and join the MN in the middle of the arm, whereas in type III, the lateral root fibers of the MN pass along the MCN and after some distance, leave it to form the lateral root of the MN. In type IV, the MCN fibers join the lateral root of the MN and after some distance the MCN arises from the MN. In type V, the MCN is absent and the entire fibers of the MCN pass through the lateral root and fibers to the muscles supplied by MCN branch out directly from the MN (Figure 3).

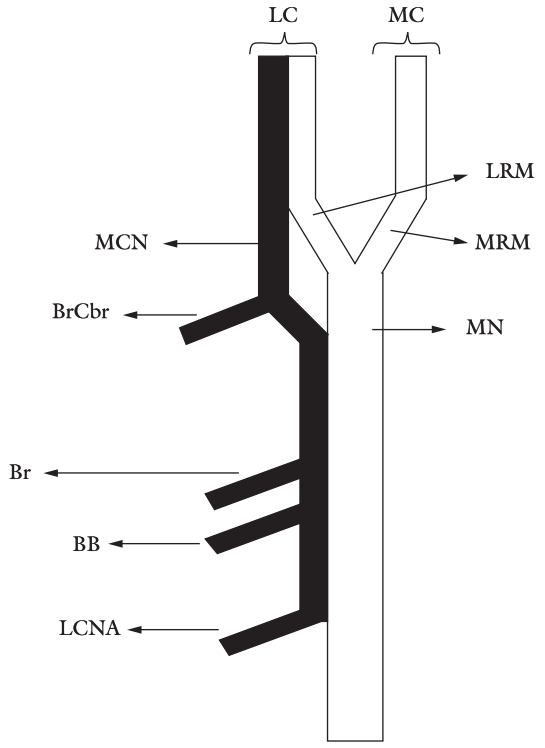

Figure 1. Line diagram showing communication between Median Nerve and Musculocutaneous Nerve in the present case. LC- Lateral Cord, LRM-Lateral Root of Median Nerve, MRM-Medial Root of Median Nerve, MN- Median Nerve, MCN-Musculocutaneous Nerve, BrCbr-Branch to Corachobrachialis, Br- Branch to Brachialis Muscle, BB-Branch to Biceps Brachii, LCNA-Lateral cutaneous Nerve of Arm.

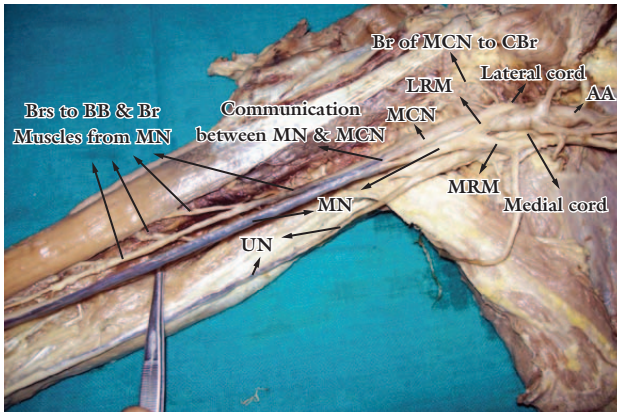

Figure 2. Observe the communication between the musculocutaneous nerve and the median nerve. MN: median nerve; MRM: medial root of median nerve; LRM: lateral root of median nerve; UN: ulnar nerve; MCN: musculocutaneous nerve; AA: axillary artery; BB: biceps brachii muscle; Br: bracialis muscle; CBr: corachobrachialis muscle; Brs: branches.

Similarly based upon its site with relation to the coracobrachialis muscle Venierators and Anagnostopoulou (2000) classified this communication into three types. In type I, communication between MCN and MN is proximal to the entrance of the MCN into the coracobrachialis, whereas in type II, the communication is distal to the muscle and in type III neither the nerve nor its communicating branch pierces the muscle.

Later on Choi et al. (2002) in a study on 138 cadavers classified these communications into three types. The first pattern comprised of fusion of both nerves (19.2%). Pattern 2 showed the presence of one supplementary branch between both nerves (72.6%). This type was further subdivided as Pattern 2a, where a single root from MCN, contributes to the connection (69.9%) while in Pattern 2b there are two roots from MCN (2.7%). Pattern 3 showed presence of two branches between both nerves (6.8%).

Connection between the MCN and MN in the present study could not be incorporated exactly into any of the types described by Li Minor (1992). However it fits into type II of Venieratos and Anagnostopoulou (1998) or into type II (2a) of Choi et al. (2002).

The most frequent variation is the presence of a communicating branch that emerges from the MCN and goes distally to join the MN, an anastomosis observed in the lower third of arm (VENIERATOS and ANANGNOSTOPOULOU, 1998; BERGMAN, AFIFI and MIYAUCHIR, 1988). If this branch is given off in upper third of the arm, it is generally considered as third (double lateral) root of the median nerve (BERGMAN, AFIFI and MIYAUCHIR, 1988). In the present case, the musculocutaneous nerve in upper third of the arm, passed medially downwards and joined the MN. It can be considered as the double lateral root of the MN or in other words the MN nerve can be said to be formed by three roots: a) one from the lateral cord; b) one from the MCN; c) and the third from the medial cord.

Similar variation 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 MCN (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).

3.1 Ontogeny

The presence of such communications may be attributed to random factors influencing the mechanism of formation of limb muscles and the peripheral nerves during embryonic life. Significant variations in nerve patterns may be a result of altered signaling between mesenchymal cells and neuronal growth cones (ABHAYA, BHARDWAJ and PRAKASH, 2003) or circulatory factors at the time of fusion of brachial plexus cords (KOSUGI, MORTIA and YAMASHITA, 1986).

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 fibers taking an aberrant course as a communicating branch.

Chiarapattanakom et al. (1998) are of the opinion that the limb muscles develop from the mesenchyme of local origin, while axons of spinal nerves grow distally to reach the muscles and/or skin. They blamed the lack of coordination

Table 1. Showing the incidence of communication between the musculocutaneous nerve and the median nerve.

Sr. no.	Author	Year	Incidence (%)
1	Watanabe 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	Maeda et al.	2009	41.5

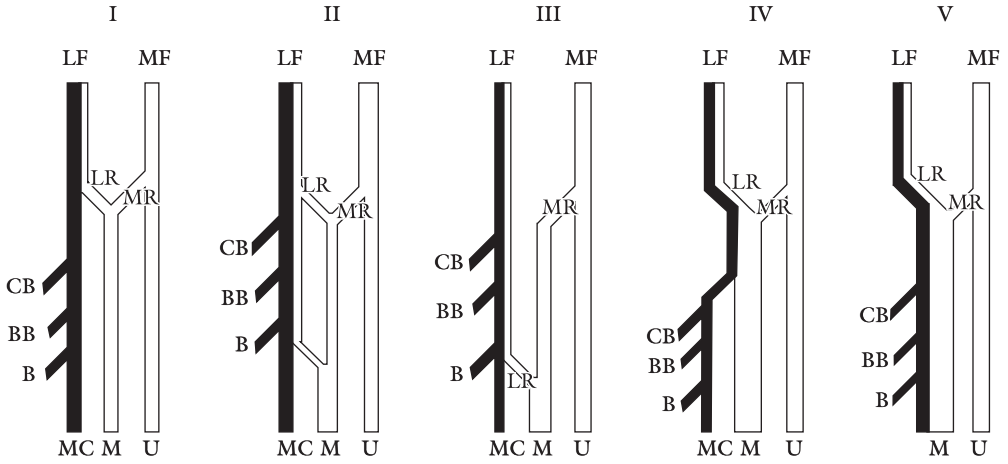

Figure 3. Li Minor classification of communication between musculocutaneous and median nerve (Type I to V). LF: Lateral cord; MF: Medial cord; MC: Musculocutaneous nerve; M: Median nerve; U: Ulnar nerve; CB: Coracobrachialis muscle; BB: Biceps brachii muscle; B: Brachialis muscle.

between the formation of the limb muscles and their innervation for appearance of a communicating branch.

3.2 Phylogeny

Chauhan and Roy (2002) strongly recommend the consideration of the phylogeny and the development of the nerves of the upper limb for the interpretation of the nerve anomalies of the arm. Considering the communication between the musculocutaneous and the median nerve as a remnant from the phylogenetic or comparative anatomical point of view and that the ontogeny recapitulates the phylogeny, they feel that the variations seen are the result of the developmental anomaly.

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 (MILLER, 1934).

3.3 Clinical significance

The anatomical variation described here has practical implications, since injury to the median nerve in the axilla or arm would, in this case, have caused unexpected paresis or paralysis of the flexor musculature of the elbow and hypoesthesia of the lateral surface of the forearm, in addition to the classical signs that are already well known. Injury to the median nerve could occur in cases of open or closed trauma to the arm, such as bullet and blade wounds or during surgeries on the axilla or arm. The median nerve and its roots are close to the axillary vein, which is used as the most cranial limit for axillary lymph node dissection, a procedure used in treating certain tumors, such as breast carcinoma and melanoma. If the dissection extends more cranially than normal, injury to the median nerve (or to its medial root) may occur, with consequent dysfunction of the flexor musculature of the elbow if the anatomical variation described here is present. It would not be unlikely for such accidents to occur even with the most eminent surgeons, considering that the classical concept is that the median nerve does not give rise to branches in the arm (FREGNANI et al., 2008).

The clinical relevance of such variations might also be correlated to entrapment syndromes. Entrapment of MCN is rare and has its origin either in physical activity (FALSENTHAL et al., 1984) or in violent passive movements of arm and forearm (KIM and GOODRICH, 1984). This knowledge may prove useful for clinicians in order to avoid an unnecessary Carpal tunnel release (VENIERATOS and ANAGNOSTOPOULOU, 1998).

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