IJAE
Vol. 116, n. 2: 67-72, 2011
ITALIAN JOURNAL OF ANATOMY AND EMBRYOLOGY

Research Article: Basic and Applied Anatomy

Concurrent variations of median and musculocutaneous nerves and their clinical correlation – a cadaveric study

Virendra Budhiraja[1],*, Rakhi Rastogi[1], Ajay Kumar Asthana[1], Priti Sinha[1], Atul Krishna[2], Vikas Trivedi[3]

[1] Department of Anatomy, Subharti Medical College, Meerut, Uttar Pradesh, India
[2] Department of Surgery, Subharti Medical College, Meerut, Uttar Pradesh, India
[3] Department of orthopaedics, Subharti Medical College, Meerut, Uttar Pradesh, India

Received March 18, 2011; accepted May 17, 2011

Summary

Variations of median nerve, musculocutaneous nerve and their communicating branches are of interest for anatomists and surgeons. These variations may be vulnerable to damage in surgical procedures. We examined median nerve and musculocutaneous nerve concurrently in 58 cadavers, i.e. 116 superior extremities, and found median nerve innervating muscle of the anterior compartment of arm in the absence of musculocutaneous nerve in 11.2% superior extremities, splitting of median nerve in the arm into median nerve proper and musculocutaneous nerve in 5.12% superior extremities, and communication between median and musculocutaneous nerves in 20.7% superior extremities. Knowledge of such anatomical variations is helpful for surgeons treating neoplasm or repairing trauma.

Key words

Anatomical variations; median nerve; musculocutaneous nerve.

Introduction

Median nerve forms lateral to the third part of axillary artery by union of a lateral and a medial root originating from the lateral and medial cords of brachial plexus respectively. Median nerve does not give any muscular branch in the arm, the muscles of anterior compartment of arm (*coracobrachilis, brachialis and biceps brachii*) are innervated by musculocutaneous nerve, a continuation of the lateral cord of brachial plexus (Drake et al., 2005). Anatomical variations of median and musculocutaneous nerves have been described in human by many authors (Volla et al., 2005; Saralaya et al., 2009; Jelev et al., 2009) but such variations have not been extensively cataloged. The knowledge of the anatomical variations of the peripheral nerves in the upper extremities is important as these nerves could be injured during surgical procedures and because variations may explain unusual clinical symptoms. The present study is aimed at assessing the variations of median and musculocutaneous nerves and their clinical correlations.

* Corresponding author. E-mail: virendrabudhiraja1970@gmail.com, Simranbudhiraja21@gmail.com; Phone: +919897244802, +919897898515.

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Materials and methods

49 male and 9 female cadavers with age ranging between 36 and 73 years constituted the material for study. All the cadavers were properly embalmed and fixed in formalin. Hence 116 specimens of superior extremities from 58 cadavers were examined for anatomical variations. Dissection of extremities was carried out during undergraduate dissection classes in the Department of Anatomy of Subharti Medical College. The skin, superficial fascia and deep fascia were incised, the various muscles were retracted to visualize median and musculocutaneous nerves in the arm and unusual communications and distribution of median and musculocutaneous nerves were registered.

Results

We observed median nerve innervating muscle of anterior compartment of the arm, i.e *brachialis* and *biceps brachii*, in the absence of musculocutaneous nerve in 13 out of 116 (11.2%) specimens (Fig. 1). In these cases *coracobrachialis* was innervated by a direct branch from the lateral cord of brachial plexus. Splitting of median nerve in the arm into a lateral and a medial division was observed in 6 out of 116 (5.12%) specimens. In these specimens the medial division continued as median nerve proper, while the lateral division continued as musculocutaneous nerve to supply muscles of

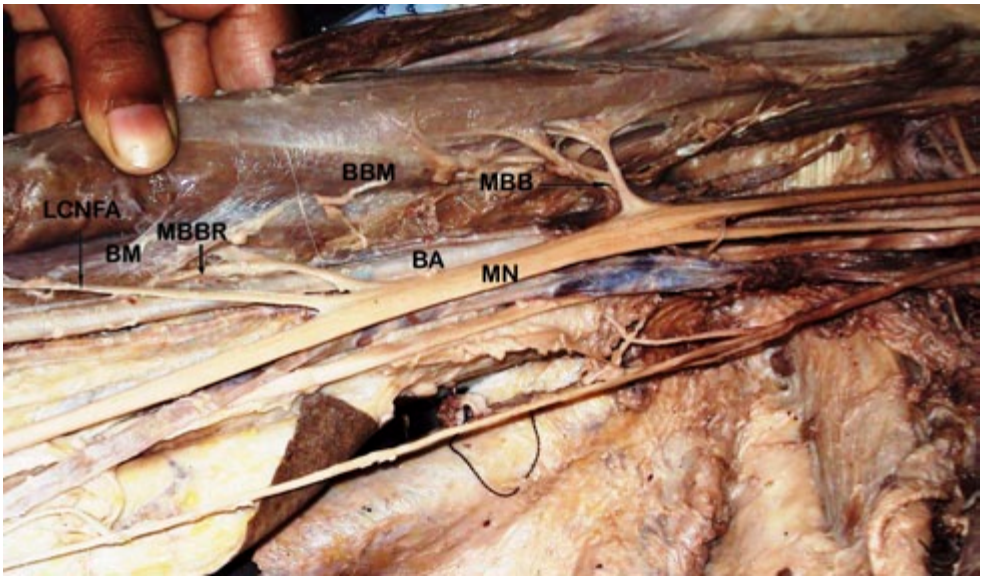

Figure 1 – Median nerve innervating *biceps brachii* and *bracialis* muscles in the absence of musculocutaneous nerve. MN: median nerve; BBM: *biceps brachii* muscle; BM: *brachialis* muscle; MBB: muscular branch to *biceps brachii* muscle; MBBR: muscular branch to *brachialis* muscle; LCNFA: lateral cutaneous nerve of forearm; BA: brachial artery.

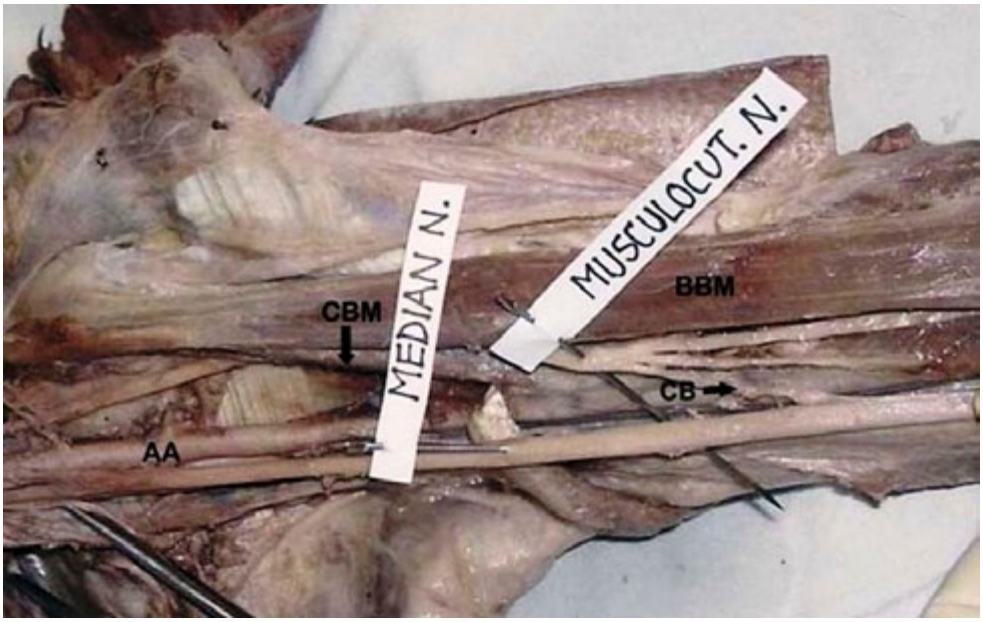

Figure 2 – Communication between median and musculocutaneous nerve. CB: communicating branch; AA: axillary artery; BBM: *Biceps brachii* muscle; CBM: *coracobrachialis* muscle.

the anterior compartment of arm. Communication between musculocutaneous nerve and median nerve was observed in 24 out of 116 (20.7%) specimens (Fig. 2).

Discussion

The musculocutaneous nerve derives from lateral cord of brachial plexus and innervates muscles of anterior compartment of arm and lateral aspect of forearm. Absence of musculocutaneous nerve has been previously reported by some authors (Jahanshahi et al., 2003; Aydin et al., 2006), but the absence of musculocutaneous nerve does not lead to paralysis of the flexor muscles of the anterior compartment of arm nor to hypoesthesia of the lateral surface of forearm, since the motor and sensory fibers can arise from other nerves. Most frequently, the motor fibers arise from median nerve and less frequently from its lateral root or from the lateral cord of brachial plexus (Gumusburun et al., 2000; Song et al., 2003; Tatar et al., 2004). In the present study we observed the absence of musculocutaneous nerve in 13 out of 116 (11.2%) specimens, where median nerve innervated *biceps brachii* and *brachialis* muscle and also provided sensory innervations to the lateral aspect of forearm. In these cases *coracobrachialis* was innervated by a direct branch from the lateral cord of brachial plexus. Clinical implications of the above mentioned variations occurs in cases where a person with such variations suffers from injury to median nerve at the axilla or in the arm and have unexpected paralysis of the flexor muscles of the arm and

hypoesthesia of the lateral surface of forearm. Prior knowledge of such variations by surgeons repairing trauma of the arm or treating tumors may be helpful to avoid accidental injury to these nerves. These variations may also explain weakness in arm flexion in patients with thoracic outlet syndrome.

Splitting of median nerve is mostly observed during surgical interventions or anatomical dissections. The division occurs at different levels but most typically in the distal third of the forearm (Lanz, 1997). Hyung et al. (2009) described splitting of median nerve in the proximal arm into a lateral and a medial division, the two divisions running separate in the proximal forearm and reuniting again in the distal forearm. Sundram et al. (2008) found splitting in the distal forearm but in their case the split portion of median nerve continued separately as a common digital nerve. Splitting of median nerve in the arm was reported by Avinash et al. (2006), where musculocutaneous nerve arose from the lateral aspect of median nerve and after supplying *biceps brachii* and *brachialis* muscles continued as lateral cutaneous nerve of the forearm. In the present study we observed splitting of median nerve in the arm into a lateral and a medial divisions, where the lateral division continued as musculocutaneous nerve and the medial division as median nerve proper, in 5.12% specimens. During shoulder reconstruction procedure it is important to identify and palpate musculocutaneous nerve, as it is vulnerable to injury from retractors placed under coracoid process (Flatow et al., 1989). Such low origin of musculocutaneous nerve from a split median nerve may produce confusion during shoulder reconstruction, which may be prevented by surgeon should being aware of such variations.

Communications between median and musculocutaneous nerves had been reported earlier by several authors (Chauhan et al., 2002; Bhattarai et al., 2009; Choi et al., 2002; Kaus et al, 1995). Venieratos and Anagnostopoulou (1998) observed three types of communication between median and musculocutaneous nerves: type I: the communication was proximal to the enterance of musculocutaneous nerve into the *coracobrachialis* muscle; type II: the communication was distal to musculocutaneous nerve exit from the *coracobrachialis* muscle; and type III: musculocutaneous nerve did not pierce the muscle (nor did the communicating branch) but just run along it. Guerri-Guttenberg and Ingolotti (2009) observed communications between musculocutaneous and median nerve in 53.6% dissections; of these, 84.6% were proximal, 7.7% distal, and 7.7% both proximal and distal to the point of entry of musculocutaneous nerve into coracobrachialis muscle. Beheiry (2004) observed two cases of type II communications between median and musculocutaneous nerves, however Uzun and Seeling (2001) observed a type I communication between median and musculocutaneous nerves. Beheiry (2004) also observed a communication not categorized by Venieratos and Anagnostopoulou in which both musculocutaneous nerve and the communicating branch first pierced the *coracobrachialis* muscle and then the communicating branch joined the median nerve. In the present study we observed type II communications in 20.7% specimens. It must be noted that the primary ventral branches of the spinal nerves that form the musculocutaneous nerve and the lateral root of median nerve are common to these two nerves (from c_5 to c_7). This common origin of the median and musculocutaneous nerves explains the frequent presence of communicating branches between these two nerves, which are found up to one third of all individuals (Prasada Rao and Chaudhary, 2000). It is important to note such anatomical variations as during surgical interventions they are prone to damage.

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