

Brachial Plexus Nerve Variations: Median-Musculocutaneous Communication in the Middle Arm - A Case Report

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ABSTRACT

Introduction: the study investigated variations in the brachial plexus nerves, noting common occurrences in trunks, cords, and smaller branches, with a higher frequency in cords. A 67-year-old male cadaver was anatomically examined, revealing a unique median nerve variation connecting with the musculocutaneous nerve after passing through the coracobrachialis muscle. Terminal branches showed greater variability than trunks and cords, with a classic arrangement in 75% of cases. Notably, the musculocutaneous nerve branches connected with the median nerve in 3% of specimens, and the medial antebrachial cutaneous nerve exhibited variations in branching origins. This study highlights a rare case of a connecting branch between musculocutaneous and median nerves, causing unusual sensory innervation in the upper trunk and palmar region.

Keywords: Variation; Brachial plexus; Median nerve; Musculocutaneous nerve.

Introduction

The brachial plexus is a complex network of nerves that originates from the lower cervical and upper thoracic spinal roots (C5-T1). This plexus is responsible for innervating the muscles and skin of the upper limb. The brachial plexus is formed by the anterior rami of the lower four cervical nerves and the first thoracic nerve, which arrange into the medial, lateral, and posterior cords¹. These cords give rise to the terminal branches that supply the various regions of the upper limb. Anatomical variations of the brachial plexus have been documented since the nineteenth and early twentieth centuries, and understanding these variations is crucial for clinical diagnosis, interpretation of neurophysiology, and safe surgical procedures in the axilla, neck, and elbow regions².

The brachial plexus arises from the spinal roots (anterior rami) of the cervical and thoracic spines (C5-T1), which innervate the muscles and skin of the upper limb. Although the normal formation of the brachial plexus is well-defined, recent studies have shown that the patterns of innervation can vary significantly, ranging from simple cutaneous nerve variations to complex muscle innervation patterns. Regardless of these variations, the brachial plexus is typically composed of three main trunks (superior, middle, and inferior) that split into anterior and posterior divisions, which then merge to form the three cords (lateral, medial, and posterior) that give rise to the terminal branches^{3,4}.

The major branches of the brachial plexus, such as the musculocutaneous, axillary, median, radial, and ulnar nerves, originate from these cords and provide

innervation to the muscles and sensory functions of the upper limb. Understanding the anatomy and variations of the brachial plexus is essential for the clinical interpretation of nerve dysfunctions, neurophysiology, and the prevention of injuries during surgical procedures in the axilla, neck, and elbow regions.

Case report

The cadaver of a 67-year-old male who died due to colorectal tumor associated with pulmonary-hepatic metastasis was fixed using the intrafemoral vein fixative injection technique. After embalming (immersion in fixative solution), the cadaver was dissected. During the dissection of the left axillary cavity, the following observations were made: the musculocutaneous nerve, after separating from the lateral cord in the arm region, passed through the coracobrachialis muscle and was placed in the anterior compartment of the arm; the median nerve was formed by the union of the lateral and medial cords of the brachial plexus, located in front of the axillary artery, and then descended on the medial side of the arm towards the cubital fossa; interestingly, the median nerve had a communicating branch with the musculocutaneous nerve after passing through the coracobrachialis muscle (Figures 1 to 4). This anatomical variation in the relationship between the musculocutaneous and median nerves is noteworthy. Understanding such variations in the brachial plexus anatomy is crucial for accurate clinical diagnosis, interpretation of neurophysiological findings, and safe surgical interventions in the axillary, neck, and elbow regions.

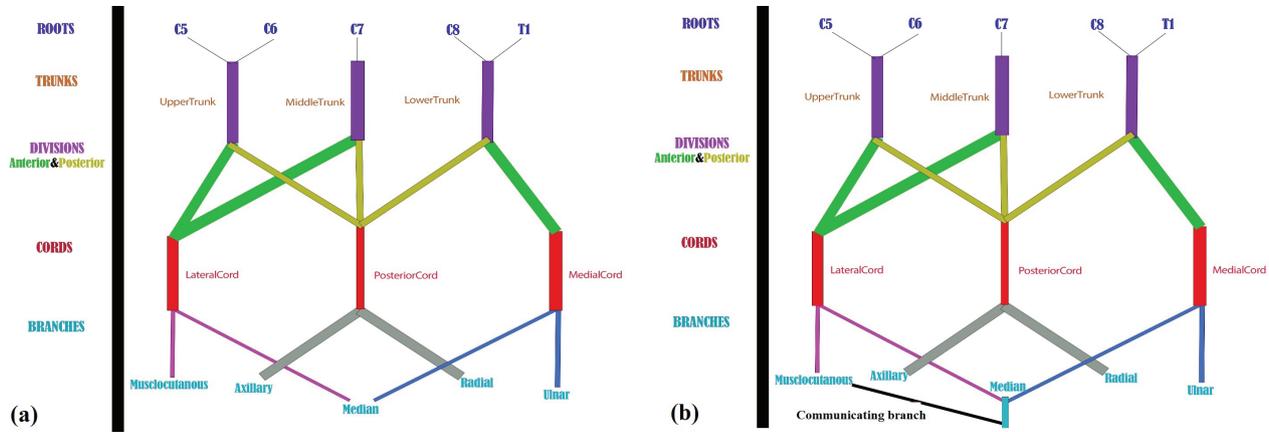


Figure 1. Schematic diagram of the brachial plexus and the formation of the median and musculocutaneous nerves anatomically (a) and (b) communicating branch of musculocutaneous to median nerve.

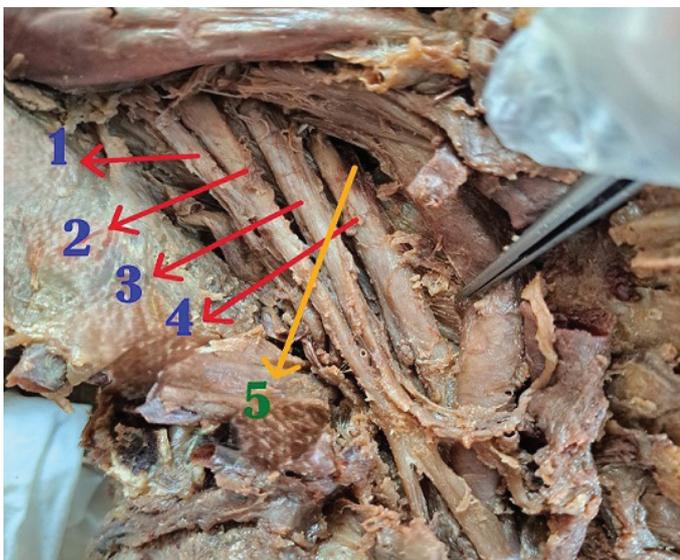


Figure 2. The spinal roots of the brachial plexus. Where represents (1) C5, (2) C6, (3) C7, (4) C8, and (5) T1 spinal nerves.

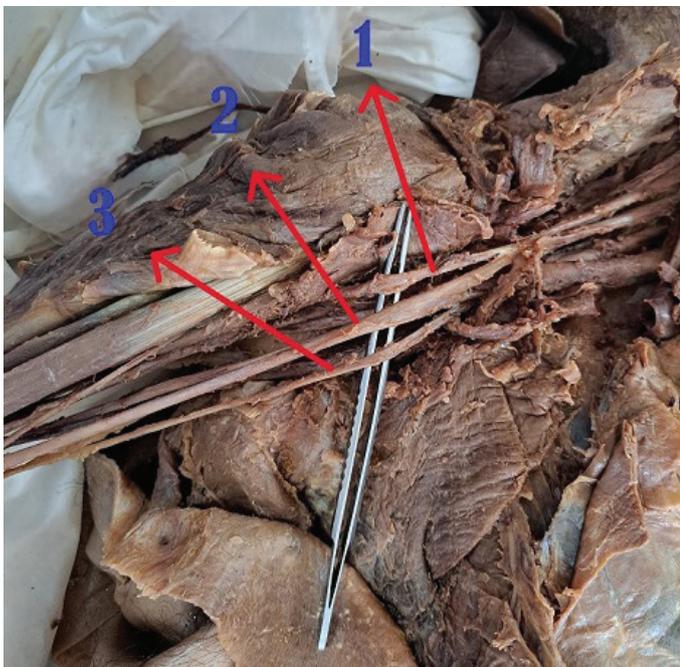


Figure 3. Formation of the median and musculocutaneous nerves in axillary region. Where represents (1) medial cutaneous nerve of arm, (2) median nerve, and (3) musculocutaneous nerve.

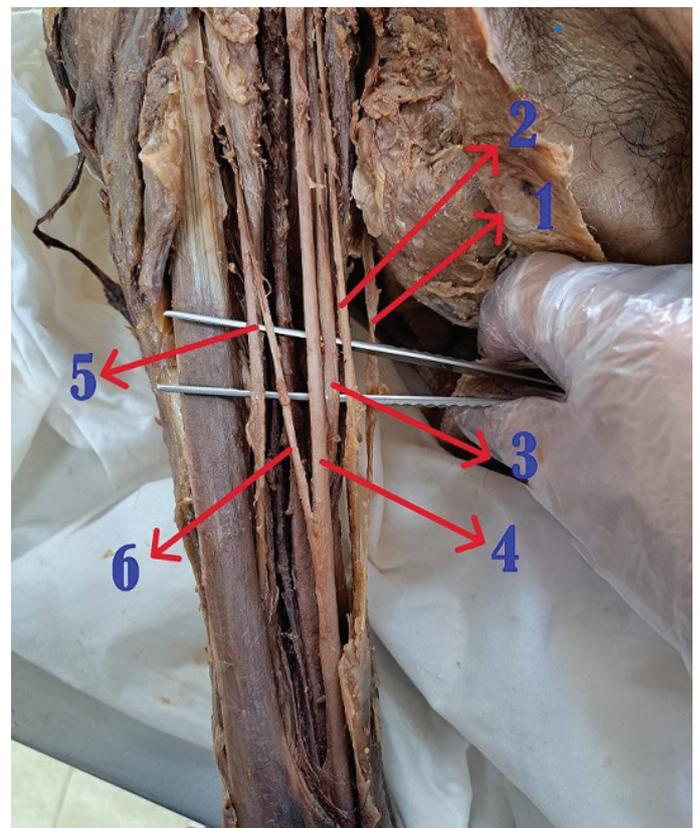


Figure 4. The brachial plexus and the formation of the median and musculocutaneous nerves alongside communicating branch of musculocutaneous to median nerve in cadaver. Where represents (1) medial cutaneous nerve of arm, (2) medial cutaneous nerve of forearm, (3) Ulnar nerve, (4) median nerve, (5) musculocutaneous nerve, and (6) communicating branch of musculocutaneous to median nerve.

Discussion

Variations in the brachial plexus can occur in terms of its anatomical position, formation of nerve structures, interconnections between branches, and nerve pathways. Typically, there is no direct link between the musculocutaneous nerve of the lateral cord and the median nerve; however, in this study, as in previous research, such a connection was observed in the arm region⁵. Anatomical variances between these nerves are not uncommon, with 23.8% of 130 dissected upper limbs showing a communicating

branch. This case report highlights a rarer variation where only 3.1% of specimens displayed a communicating branch between the coracobrachialis and biceps brachii muscles⁶. Understanding these variations is crucial, especially in surgical contexts where musculocutaneous nerve injuries can result in functional and sensory impairments in the arm. It is essential to explore nerve variations in clinical studies to comprehend the prevalence of such anomalies across diverse populations. Minor Le's examination in 1992 illustrates the range of anomalies related to the median nerve and musculocutaneous nerve variations⁷.

In this study, the variation in the median and musculocutaneous nerves and their connection type is categorized as minor. Various deviations in the brachial plexus have been documented; for instance, Venieratos *et al.* outlined three communication patterns between the musculocutaneous and median nerves. The first type involves communication between these nerves prior to traversing the coracobrachialis muscle. In the second type, the connection occurs after passing through the muscle, while in the third type, the musculocutaneous nerve bypasses the muscle, yet a connection between the median nerve and musculocutaneous nerve exists⁸.

Furthermore, Clarke *et al.* (2021) identified a fourth type of connection in addition to the three types mentioned. In this fourth type, although the two nerves are connected before the coracobrachialis muscle, a second connection occurs after exiting the muscle, occurring approximately 8% of the time, contrasting with the first type at 45%, the second type at 35%, and the third type at 9%⁹. The connections observed between the median nerve and the musculocutaneous nerve in this study closely resemble the second type of connection detailed in Clarke's research. Subsequently, in a different investigation, the median nerve branched into two nerve components, with one branch forming

a connection with the nerve of the lateral cord in the arm region. In a study by Felipe *et al.* in 2021, four types of anastomoses between the ulnar nerve of the medial cord and the median nerve were documented, indicating the potential for the median nerve to establish various connections with nerves in the arm or forearm¹⁰.

Conclusion

The connection between the median nerve and the musculocutaneous nerve in the middle region of arm involves fibers of the lateral cord of the median nerve passing through, supplying an anastomotic branch. While the involvement of C6-C7 fibers might contribute, this is not visibly seen during dissection. This anatomical variation is vital for neurophysiological and surgical contexts. Electroneurography can help identify fiber functions for surgeries. It plays a significant role in treating median nerve lesions like in neurofibromatosis. The anatomy can aid in neurotization procedures for proximal nerve lesions. Surgeons must be cautious during elbow and forearm surgeries to prevent impairments in mobility and sensation.

Highlights

- Understanding anatomical variations helps prevent injury during surgical procedures
- It could be utilized for neurotization techniques
- Electroneurography enables the identification of functional fibers, enhancing the utility of this variation

Ethical Statement

The work did not involve neither human subjects nor animal experiments.

The dissection described in this case report was attending during the Gross Anatomy Course.

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