CASE REPORT

Absence of the Musculocutaneous Nerve While Performing Nerve Transfer Surgery in a Patient with Brachial Plexus Injury, Rare Variant, and Review of Literature

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Abstract

Musculocutaneous nerve (MCN) is among the nerves of the anterior compartment of the arm, and it is a mixed nerve derived from the lateral cord of the brachial plexus. Here, in this study, the patient had avulsion of the upper roots of the brachial plexus and was prepared to undergo nerve transfer surgery to innervate the MCN to restore elbow flexion; its absence was a surprise and a challenge at the same time. This study aims to describe a rare variant of MCN (absence). This is a case report. A 41-year-old male patient had a brachial plexus injury after a road traffic accident. He presented with loss of elbow flexion and prepared for performing neurotization of the MCN. The surgical intervention was performed under general anesthesia without using neuromuscular blocking agents, and the absence of the MCN was noted. Knowledge of the MCN variant is essential, especially if it is the target nerve of surgical intervention.

Keywords: Brachial plexus surgery, Musculocutaneous nerve variant, Nerve transfer

Introduction

The brachial plexus innervates the skin, joints, and the muscles of the upper limb by its branches [1]. These branch elements of the brachial plexus show multiple variations reported by many authors [2]. Variations at the level of the brachial plexus branches are numerous and have been reported in the literature, but the majority of them have been reported during cadaveric dissection. In this study, the variation of intraoperative total absence of the musculocutaneous nerve (MCN) was reported while intraoperative dissection for nerve transfer surgery was done, so the challenge was great as this nerve is the target of the surgical session for performing its neurotization for regaining the function of elbow flexion. MCN is among the nerves of the anterior compartment of the arm, and it is a mixed nerve derived from the lateral cord of the brachial plexus, classically from the fifth and sixth cervical nerve roots. It then pierces the coracobrachialis muscle and supplies it; then passes between the biceps muscle and the brachialis brachii muscle and supplies them (by the nerve to the biceps muscle and nerve to the brachialis brachii) in the region of the arm; then it terminates as the lateral cutaneous nerve of the forearm that supplies the skin of the lateral forearm, while the median nerve does not branch in the region of the arm except that it branches to the pronator muscle that usually arises before the median nerve crosses the cubital fossa [3–5].

This study aims to report intraoperative findings of the absence of the MCN while performing nerve transfer surgery in a patient with brachial plexus injury.

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Case report

Our present case was a 41-year-old male patient who presented to the neurosurgery outpatient clinic with loss of shoulder abduction and elbow flexion of his left upper limb after a history of road traffic accident about 6 months ago. Clinical examination revealed a traumatic upper brachial plexus injury, which was confirmed by electrodiagnostic tests such as nerve conduction velocity and electromyography. Surgical intervention was chosen for the patient, and the surgery plan was put in place according to the clinical examination. The plan was based on two sessions. The first session involved using the Oberlin technique to restore elbow flexion by innervating the MCN by means of nerve transfer surgery from the median and ulnar nerves. The second session involved performing nerve transfer surgery (spinal accessory nerve transfer to the suprascapular nerve and radial nerve transfer to the axillary nerve).

During surgical dissection, the median nerve with its medial and lateral contributions and the M shape were identified; however, in this patient, a complete absence of the MCN was reported in the presence of obvious structure of the median and ulnar nerves.

Surgical technique

Under general anesthesia, without using neuromuscular blocking agents and through a supine position, surgical intervention was performed (Fig. 1). The MCN was missing during surgical dissection of the left arm to identify the median, ulnar, and MCNs. Moreover, during meticulous dissection to identify the coracobrachialis, biceps,}

![Fig. 1](image-url)

*Fig. 1. (A) Intraoperative picture showing the position of the patient and skin marking over the left arm. (B) Intraoperative picture showing median nerve and its roots, medial and lateral contributions, nerve to the biceps muscle, and nerve to the brachialis brachii muscle with the absence of the MCN. (C) Intraoperative picture showing median nerve and ulnar nerve. (D) Intraoperative picture showing median nerve, ulnar nerve, and the nerve to the brachialis muscle with the absence of the MCN. (E) Intraoperative picture showing the entire fascicles of the median nerve after opening its epineurium and separating the upper medial fascicles for preparation of selecting the fascicles to transfer them to the nerve to the brachialis muscle. (F) Intraoperative picture showing performing the nerve transfer from the median nerve to the nerve to the biceps muscle and nerve transfer from the ulnar nerve to the brachialis brachii muscle. (G) Intraoperative picture showing the nerve transfer from the median nerve to the nerve to the biceps muscle and nerve transfer from the ulnar nerve to the brachialis brachii muscle. (H) Picture showing the patient who was reported in this study about 4 months postoperatively. Elbow flexion improved from MRC grade 0 to grade 4+ on the MRC grading scale. The bulk of the ventral aspect of the arm was restored with the borders of the biceps muscle. M, muscle; MCN, musculocutaneous nerve; N, nerve. *The site of the suture line of the nerve transfer, and 1 and 2: the sites of the suture line of the nerve transfer.*
and the brachialis muscles, the author found a certain nerve from the median nerve attached to each muscle separately. He identified the nerve to the biceps muscle and the nerve to the brachialis brachii muscle as shown in Fig. 1. Furthermore, intraoperative stimulation of the median nerve and the ulnar nerve was done to ensure their entity and showed that they were functionally intact, while the nerves to the biceps muscle and the brachialis brachii were not showing any neuromuscular response. The epineurium of the median nerve was opened, and internal dissection of the fascicles was done; then, separation of the most upper medial fascicles was performed. Also, the epineurium of the ulnar nerve was opened and also the internal neurolysis of its fascicles and separation of the most lateral fascicles of it was done before harvesting them from nerve transfer surgery. The nerve to the biceps muscle and the nerve to the biceps brachii muscle were dissected and they were cut as proximal as possible to prepare for their neurotization. Harvesting the fascicles of the median nerve and ulnar nerve with adequate length was done opposite to the nerves of the biceps muscle and brachialis brachii muscles to provide tensionless primary repair.

**Discussion**

Absence of the MCN is a rare variant among the neural elements of the brachial plexus, and it must be considered while planning and performing nerve transfer surgery to restore elbow flexion by neurotization of the MCN.

The brachial plexus is formed by the union of the ventral rami of the cervical spinal nerves (C5, C6, C7, and C8) and the first thoracic spinal nerve (T1) and supplies motor, sensory, and sympathetic nerve fibers to the upper limb [6].

Structural variations of the brachial plexus have been reported by several authors [2]. Multiple variations were identified in the median nerve and MCN and have been discussed and classified by multiple authors, and most of the variations resemble the anomalous relationship between the median nerve and the MCN [7–9].

MCN is among the nerves of the anterior compartment of the arm, and it is a mixed nerve derived from the lateral cord of the brachial plexus, classically from the fifth and sixth cervical nerve roots. It then pierces the coracobrachialis muscle and supplies it, then supplies the biceps muscle and brachialis brachii muscle, and then supplies the lateral aspect of the forearm [6].

Variations may occur in the formation, course, connections, and termination. The absence of MCN is one of the variations in the formation [2]. In 1990, Le Minor [4] classified five types of MCN variations as follows: Type 1, there is no communication between the median nerve and MCN; type 2, the fibers of the medial contribution of the median nerve pass through the MCN and join the median nerve in the middle of the arm; type 3, the fibers of the lateral contribution of the median nerve pass through the MCN and after some distance they are separated and leave MCN to form the lateral contribution of the median nerve; type 4, MCN fibers join the lateral contribution of the median nerve and after some distance, MCN arises from the median nerve; type 5, MCN is absent, and the entire fibers of the MCN pass through the lateral contribution of the median nerve and the muscles supplied by the MCN branch out directly from the median nerve.

The absence of the MCN is defined as the anatomical variation occurring when all fibers from the lateral cord of the brachial plexus remain within the lateral root of the median nerve [1]. In 2009, Guttenberg and Ingolotti [1] reported that absence of the MCN constitutes about 3.6% of all variations of the MCN in 56 cadaveric upper limbs. Moreover, in 2009, Bhattacharai and Poudel [9] reported the variation in MCN in 6.25% of 16 cadavers (n = 32 upper limbs) unilaterally on the right side, and no statistically significant differences by sex and side were observed.

In 2011, Pacholezak and Piotrowska [10] reported the absence of MCN in a male cadaver during routine dissection and drew very impressive schematic diagrams about the absence of MCN. In 2012, Bhanu and Sankar [2] reported a complete absence of MCN in a 43-year-old female cadaver when a medical student performed their routine upper limb dissection. In 2014, Rathore et al. [5] reported a variant of the MCN connections on the left arm while maintaining classic normal anatomy on the right arm during cadaver dissection. This means that the presence of the variation of MCN in one limb does not mean the presence of the same findings on the opposite side of the same person [5,8]. In 2002, Choi et al. [8] reported the presence of 55 unilateral MCN variations in the connection among 64 dissected cadavers; all had MCN variations. In 2020, Hunter and Zdilla [11], in their systematic review reporting the absence of the MCN, studied 482 limbs from 241 individuals and reported that the absence of MCN among limbs ranged from 1.66 to 13.33% and females were underrepresented among reports, accounting for 8.7% of the population studied [3,12].

From the discussion, we can notice that most of the literature mentioned MCN in cadavers. Here in this study, the absence of MCN was noticed intraoperatively and this nerve was the target nerve of
the surgery, emphasizing the difficulty and clinical importance of understanding the possible MCN variations and dealing with them. In this study, the reported patient with MCN absence showed excellent restoration of elbow flexion about 4 months after the nerve transfer surgery with an appropriate rehabilitation course of physiotherapy (Fig. 1H).

Considering and expecting the variants of each neural element of the brachial plexus is a mandatory step for appropriate planning and successful performance and for obtaining the best clinical results. Meticulous tissue dissection for obtaining intra-operative anatomical relations will help the surgeon to distinguish any possible variants and deal with them.

**Conclusion**

Knowledge of the anatomical variations of the neural elements of the brachial plexus is essential as one or more of them may be encountered during the operative procedure, and the surgical plan may be changed, especially in the case of surgical procedures of nerve transfer.

**Conflict of Interest**

There are no conflicts of interest.

**References**