

Unilateral Absence of Musculocutaneous Nerve-Replaced by Median Nerve

Teli Chandrika G.*, Kadlimatti H.S.** , V. Vijayaraghavan***

Abstract

During gross dissection of right upper limb of a 50 yrs old female cadaver, it was observed that the lateral cord followed its usual path without giving rise to the musculocutaneous nerve, and continued as the lateral root of the median nerve, and a small loop of fibres from lateral cord itself joined the median nerve. There was a connecting band of nerve fibres between lateral and medial cord. The biceps brachii, brachialis and coracobrachialis muscles were innervated by branches that emerged from the median nerve in the arm, longest of these took a curvilinear lateral path between the biceps brachii and brachialis muscles, and appear on the lateral margin of the forearm. It then followed a descending path over the brachioradialis muscle as the lateral antebrachial cutaneous nerve

Keywords: Musculocutaneous nerve; Median nerve; Unusual innervations.

Introduction

The brachial plexus is the most variable part of the peripheral nervous system.[1] The prevalence of variations ranges from 12.8 up to 53%.[1,2] The musculocutaneous nerve is derived from the lateral cord of brachial plexus and its muscular recipients are: biceps brachii, coracobrachialis and brachialis. Additionally, this nerve supplies the lateral margin of skin of the forearm. After branching to form the musculocutaneous nerve, the lateral cord continues as a lateral root of the median nerve, joining the medial root at the level of the distal margin of the pectoralis minor muscle in front of the axillary artery. The median nerve does not have any muscular branches in the arm. Variations of the

musculocutaneous nerve may occur in 6.25% of cases[3] and its absence has been reported with a prevalence ranging from 1.7 to 15%.[4-6] In this case, we observed the absence of the musculocutaneous nerve, with innervation of the anterior compartment of the muscles of the arm by the median nerve.

Case Report

During gross dissection of right upper limb of a 50 yrs old female cadaver, it was observed that the lateral cord followed its usual path without giving rise to the musculocutaneous nerve, and continued as the lateral root of the median nerve (Fig 1), and a small loop of fibres from lateral cord itself joined the median nerve. There was a connecting band of nerve fibres between lateral and medial cord. The only branch of the lateral cord was the lateral pectoral nerve. The biceps brachii, brachialis and coracobrachialis muscles were innervated by branches that emerged from the median nerve in the arm. The first of these was small and short, supplying the coracobrachialis muscle, branching out into 3 small filaments. The second set of branches emerged from the median nerve, at a point close to the caudal

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Figure 1: Lateral Cord [LC] Followed its Usual Path without Giving Rise to the Musculocutaneous Nerve, and Continued as the Lateral Root of the Median Nerve [LMN] (Figure 1), and Small Loop of Fibres Joining the Median Nerve. There was a Connecting Band [CB] of Nerve Fibres between Lateral and Medial Cord. BA - Brachial Artery, BV-Basalic Vein.

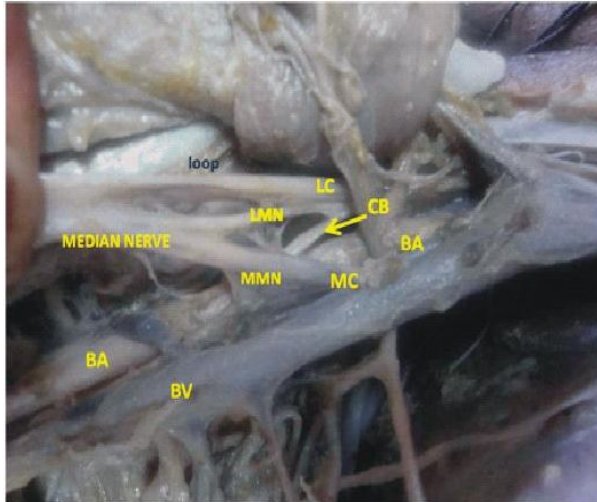


Figure 2: The Biceps Brachii [BB], Brachialis[B] and Coracobrachialis Muscles were Innervated by Branches that Emerged from the Median Nerve[MN] in the Arm. Third Longest of these Nerves [Arrow] Took a Curvilinear Lateral Path between the Biceps Brachii and Brachialis Muscles, and Came to the Surface at the Lateral Margin of the Forearm Continuing as the Lateral Antebrachial Cutaneous Nerve .BA -Brachial Artery

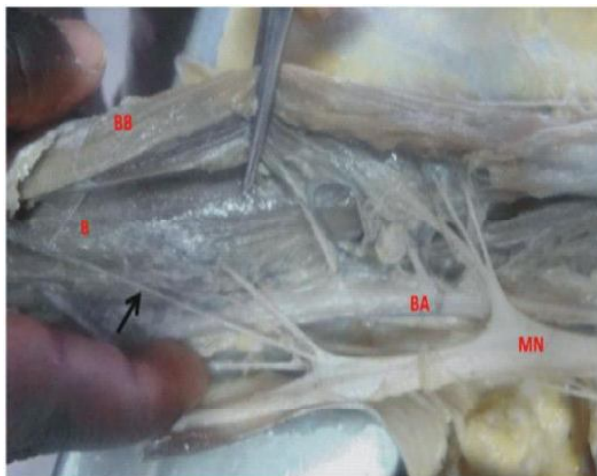


Figure 3: The Third Longest of the Nerves [Arrow] from Median Nerve Took a Curvilinear Lateral Path between the Biceps Brachii and Brachialis Muscles, and Came to the Surface at the Lateral Margin of the Forearm Continuing as the Lateral Antebrachial Cutaneous Nerve [LABCN]

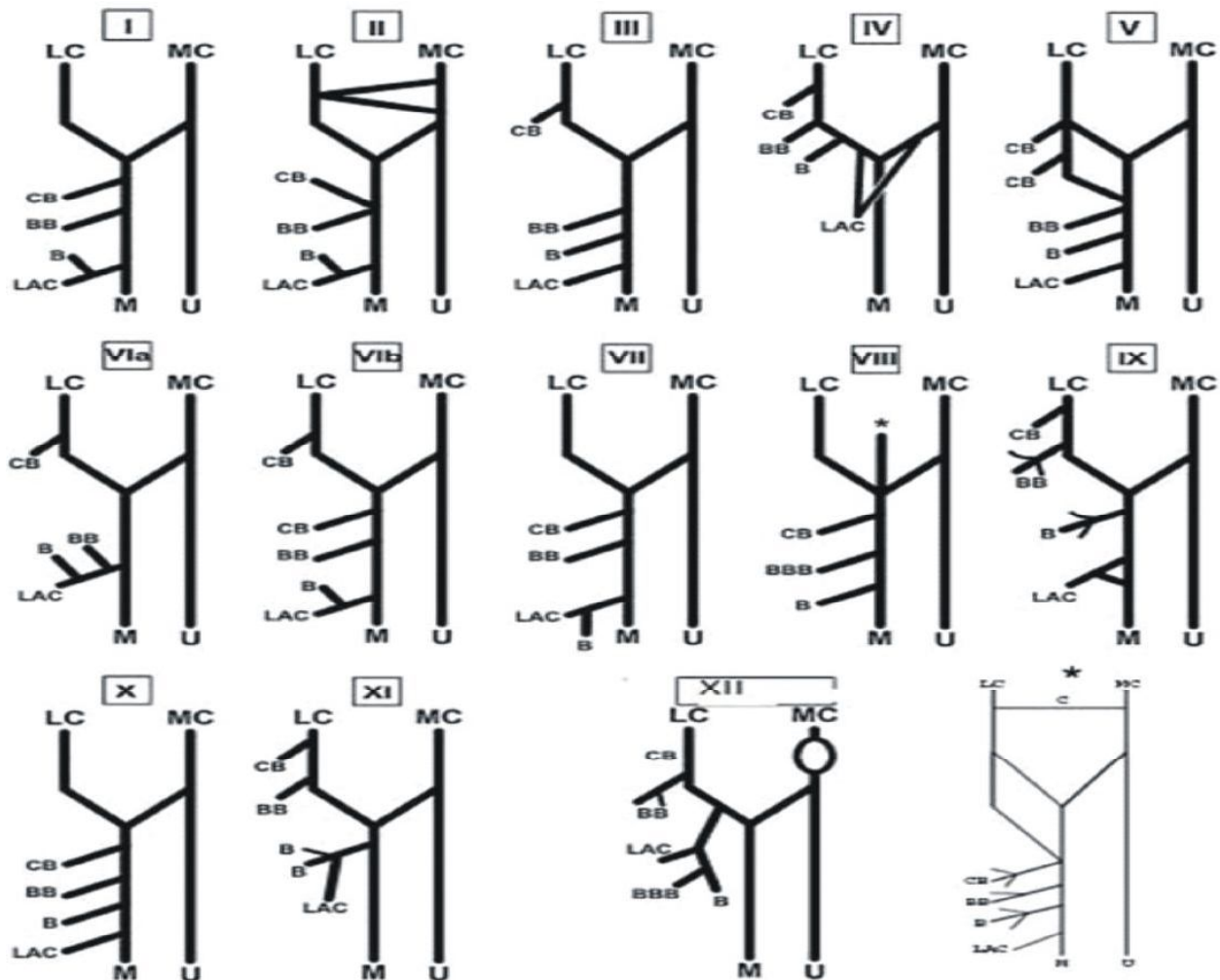


extremity of the coracobrachialis muscle, and headed laterally to the depth of the biceps brachii muscle, to innervate it (Fig 2). The third set of branches, after giving two branches to the brachialis muscle, third longest of these took a curvilinear lateral path between the biceps brachii and brachialis muscles, and came to the surface at the lateral margin of the forearm. It then followed a descending path over the brachioradialis muscle as the lateral antebrachial cutaneous nerve (Fig 3). No other anatomical variations were found in the brachial plexus or the nerves of the arm, forearm and hand.

Discussion

The musculocutaneous nerve is formed by motor-sensory fibres coming from the primary ventral rami of the C5 to C7 spinal nerves. After emerging from the lateral cord, it heads towards the coracobrachialis muscle, pierces and continues deeply between the brachialis and biceps brachii muscles, to innervate all

Figure 4: Comparison of Muscular Branches Innervating Muscles in the Anterior Compartment of the Arm if the Musculocutaneous Nerve is Absent.[Described In The Literature] LC Lateral Cord, MC Medial Cord, CB Coracobrachialis Muscle, BB Biceps Brachii Muscle, B Brachialis Muscle, LAC Lateral Antebrachial Cutaneous Nerve, BBB Third Head of Biceps Brachii Muscle, M Median Nerve, U Ulnar Nerve I Fregnani,II Aydin, III Gumusburun, IV Nakatani, V Song, Viab Prasada, VII Sud, VIII Arora, IX Beheiry, X Ihunwo, XI Le Minor XII Pacholczak *Present Study



three of these muscles. Close to the cubital fossa, it comes to the surface laterally to the biceps brachii muscle and anteriorly to the brachialis muscle, and becomes known as the lateral antebrachial cutaneous nerve. This takes a descending path along the lateral margin of the forearm and leaves cutaneous branches to the lateral surface of the forearm.[7] There is little data in the literature on the prevalence of absence of the musculocutaneous nerve. Beheiry dissected 60 arms and noted absence of the nerve in only

one of them (1.7%).[5] Prasada Rao and Chaudhary[6] did not find this nerve in 8% of the 24 arms they dis-ected. Sometimes the absence of this nerve is only apparent. Nakatani *et al* published a report on three cases in which the lateral fas-ciculus, median nerve and musculocutaneous nerve were wrapped in a single sheath of con-nective tissue. After removal of this sheath, the musculocutaneous and median nerves were separated out.[8]

Absence of the musculocutaneous nerve

does not lead to paralysis of the flexor musculature of the elbow and hypoesthesia of the lateral surface of the forearm, since the motor and sensitive fibres can arise from other nerves. The most common situation is that its fibres originate from the median nerve or, less frequently, from the lateral root of the median nerve or from the lateral fasciculus of the brachial plexus.[9,10,11] Thus, this anatomical variation has no clinical manifestation and it is unlikely to be identified until a dysfunction of some of the nerves mentioned above appears.

The median nerve is formed by the confluence of the lateral and medial roots of the brachial plexus, which originate respectively from the lateral cord (C5 to C7) and medial cord (C8 and T1). Normally, it does not give rise to any branch in the axilla or arm, and is destined for motor innervations of almost all the muscles of the anterior compartment of the forearm (except for the flexor carpi ulnaris muscle and the medial half of the flexor digitorum profundus muscle) and some muscles of the hand (the muscles of the thenar eminence and the two most lateral lumbrical muscles). It also sensitively innervates the skin of part of the palm, and part of fingers I, II and III and the lateral half of finger IV.[2]

It must be noted that the primary ventral rami of the spinal nerves that form the musculocutaneous nerve and the lateral root of the median nerve are common to these two nerves (from C5 to C7). Considering that in the present case the musculocutaneous nerve was absent, it is not a surprise that the nerve fibres heading for the flexor musculature of the elbow and the skin of the lateral surface of the forearm (coming from the C5 to C7 spinal nerves) would accompany those of the median nerve in the lateral fasciculus and, from there, would follow the median nerve along its path in the forearm. This common origin of the median and musculocutaneous nerves also explains the frequent presence of communicating branches between these two nerves, which are found in up to 1/3rd of all

individuals.[12] Venieratos and Anagnostopoulou described three types of communication: type I, in which the communication is proximal to where the musculocutaneous nerve enters the coracobrachialis muscle; type II, in which the communication is distal to the point of entry into the muscle; and type III, in which the communication and the nerves do not penetrate the muscle. Type II is the most common (45.4%), followed sequentially by type I (41.0%) and type III (13.6%).[13]

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 muscles 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. Iatrogenic injuries to the median nerve during surgery on the axilla or arm might also cause the clinical situation described above. 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 that is 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. There could be similar occurrences during surgery on the arm if the surgeon believes that these are nerve branches of little importance and then the sections the branches of the median nerve that are heading for the flexor musculature of the elbow. 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.

The embryological development of the

upper limb may help in explaining this anatomical variation. Mesenchyme, which comes from the dorsolateral part of the somites, migrates and forms the muscles into the limb bud. At the same time, mesenchyme is penetrated by the ventral primary rami of the appropriate spinal nerves, located opposite to the bud. Contact between nerve and muscle cell is necessary to provide mesenchymal condensation to form muscles. Nerves supplying the limbs are joined by connecting loops of nerve fibres to form plexuses. The median nerve is formed by a combination of ventral segmental branches and the musculocutaneous nerve arises from it. Disturbances in this process, taking place in the 4th-7th weeks of development, lead to anatomical variations in the innervations of muscles by appropriate nerves.[6] In accordance with the study of embryological development, absence of the musculocutaneous nerve is noted meaning that this nerve did not arise from the median nerve, thus its fibres run in the median nerve. The musculocutaneous nerve did not exist[6,9] rather than fusion of this nerve with the median nerve took place. One is inclined to agree with Gumusburun and Adiguzel[9] and Song *et al*[10] that in this case the median nerve provides the function of the absent musculocutaneous nerve. Surgeons should particularly take into consideration these possible anatomical variations when trying to explain unusual symptoms which may occur during examination of patients with median nerve injuries or thoracic outlet syndrome.[5] Absence of the musculocutaneous nerve is usually not revealed because its fibres run with the median nerve. After injury of the median nerve (with an abnormal distribution) in the region of the armpit or shoulder, unexplainable complications are often presented. Apart from common symptoms such as the loss of pronation and reduction in flexion of the hand and wrist, paralysis of the thenar muscles and loss of sensation in certain regions of the hand which are revealed when the median nerve has its normal anatomical course, clinicians may also encounter additional symptoms such

as: weakness in forearm flexion and supination and hypoesthesia of the lateral part of the forearm. Beheiry suggests a different way to prove the absence of the musculocutaneous nerve in healthy patients such as unobtainable nerve condition test of the musculocutaneous nerve.[5] It is important for surgeons, clinicians and anatomists to be aware of possible anatomical variations to avoid unexpected complications.

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