Unusual Branching Pattern of the Lateral Cord of the Brachial Plexus Associated with Neurovascular Compression

Case report

Hitendra K. Loh, Shikha Singh, Rajesh K. Suri

The brachial plexus consists of a network of nerves that innervates the upper limbs and its musculature. We report a rare formation of the lateral cord of the brachial plexus observed during the dissection of a 47-year-old male cadaver at the Department of Anatomy, Vardhman Mahavir Medical College, New Delhi, India, in 2016. The lateral cord was exceptionally long with twin lateral pectoral nerves and twin lateral roots of the median nerve. The proximal lateral root of the median nerve was thick in comparison to the medial root of the median nerve. The distal lateral root of the median nerve was a second branch of the axillary artery, which is unique. The axillary artery was the first branch of the lateral cord of the brachial plexus; the second branch was a direct branch of the axillary artery. The axillary artery was thin in comparison to the lateral cord of the brachial plexus. The axillary artery, which is a continuation of the brachial artery, pierces the clavipectoral fascia to supply the pectoralis major muscle. Surgeons, anaesthesiologists, radiologists and anatomists should be aware of such anatomical variations as they may result in neurovascular compression.

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and branching patterns of the distal part of the brachial artery are extremely rare. These may include variations in the course beneath the supracondylar process, through the brachialis or pronator teres muscles or a low division under the pronator teres muscle. Awareness of neural variations in the brachial plexus region is essential for surgeons, anaesthesiologists, radiologists and anatomists. The presence of anatomic variations in the peripheral nervous system may also explain unusual clinical findings or symptoms. This case describes an interesting and rare variant of the LC of the brachial plexus with a duplication of the LPN, twinning of the lateral root of the MN, the absence of the medial pectoral nerve, an atypical formation of the MN and an abnormal course of the McN.

Case Report

A routine undergraduate medical dissection of an embalmed 47-year-old male Indian cadaver took place at the Department of Anatomy, Vardhman Mahavir Medical College, New Delhi, India, in 2016. During the dissection, an unusual variation of the left brachial plexus was noted [Figure 1]. The LC was unusually long at 8.9 cm and gave rise to a double LPN. The proximal LPN (LP1) was thicker, pierced the clavipectoral fascia and entered the superficial surface of the pectoralis major muscle. The distal LPN (LP2) was slender, branched one centimetre away from the LP1 and entered the pectoralis minor muscle from its deeper aspect. The LC also supplied double lateral roots of the MN. The proximal lateral root of the MN (LRM1) was slender and originated 3.7 cm from the formation of the LC. The distal lateral root of the MN (LRM2) measured 9.2 cm in length, was significantly thicker and arose 9 cm from the formation of the LC [Figure 2].

Upon reaching the CB, the LRM2 pierced the muscle belly and joined the MN in the mid-arm. At the formation of the MN, the LRM1 was slender and entered the pectoralis minor muscle from its deeper aspect. The LC also supplied double lateral roots of the MN. The proximal lateral root of the MN (LRM1) was slender and originated 3.7 cm from the formation of the LC. The distal lateral root of the MN (LRM2) measured 9.2 cm in length, was significantly thicker and arose 9 cm from the formation of the LC [Figure 2].

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Discussion

The current report describes a case in which there were two LPNs present: the LP1, which supplied the pectoralis major muscle after piercing the clavipectoral fascia, and the LP2, which supplied the pectoralis minor directly. The occurrence of a duplicate LPN arising from the anterior division of the upper and middle trunk instead of the LC has been previously reported in the literature. A common trunk of origin of the medial pectoral nerve and the LPN from the middle trunk of the brachial plexus has also been documented. Awareness of variations in the anatomy and course of the pectoral nerves is crucial during surgery; for example, when using pectoral muscle flaps during breast surgeries or when the brachial plexus pectoral nerves are transferred to supply a paralysed arm during traction injury repairs.

Cases in which the LC of the brachial plexus pierces the CB muscle and divides into the McN and the lateral root of the MN are very rare. In the present case, the LC was longer than usual and gave rise to the LP1, LP2 and LRM1 before dividing into the McN and the LRM2 upon reaching the CB muscle. The McN then continued between the BB and CB muscles in the arm instead of piercing the CB muscle; hence, the MN presented with double lateral roots (the LRM1 and LRM2). Moreover, the LRM1 was very thin compared to the LRM2 which joined the MN in the mid-arm. This difference in thickness, along with the abnormal course of the LRM2 through the CB, is clinically significant. Durgesh et al. reported a case in which the McN passed along the medial edge of the CB muscle without penetrating it. Jamuna et al. reported a case whereby the McN joined the MN after piercing the CB muscle and Abhaya et al. reported a rare case in which the LC directly pierced the CB before dividing into the McN and the lateral root of the MN. Abnormal variations in the formation and course of the McN are important as they may affect the outcomes of surgical interventions for shoulder joint trauma, flap dissections, explorative procedures, axillary blocks and post-traumatic evaluations.

Anatomical variations in the brachial plexus arise during embryonic development. In a developing embryo, the upper limb bud appears by the 27th gestational day. After the fifth gestational week, motor axons originating from the spinal cord enter the limb buds and the brachial plexus forms as a single radicular cone by the 34–35th gestational day. Following this, the brachial plexus splits into ventral and dorsal segments and the roots of the MN and ulnar nerve are derived from the ventral segments. By the 48th gestational day, the localisation of the upper limb nerves is established. Communication between the McN and the MN can therefore be attributed to their common embryological derivation during the development of the brachial plexus. Altered signalling amongst mesenchymal cells and neuronal growth cones during the union of the brachial plexus cords has been previously found to result in variations in neural anatomy.

In the current case, there were two potential sites which may have resulted in neurovascular compression in the arm: the entrapment of the LRM2 through the CB muscle or a potential injury to the LRM2 in the middle arm and the irregular course of the McN and the brachial artery through the brachialis muscle in the lower arm. Entrapment injuries in the arm may lead to paresthesia along the preaxial border of the forearm, weak elbow flexion and other manifestations of a MN injury. Entrapment of the MN and brachial artery is widely studied. However, it is rare for anatomical variations to occur in the proximal part of the brachial artery in the muscles of the arm and forearm.

The MN and the brachial artery cross the mid and lower arm as the main neurovascular complex. However, their proximity to the medial intermuscular septum and the medial side of the BB and brachialis muscles make them vulnerable to various entrapment syndromes; moreover, while MN entrapment can occur at several sites from the upper arm to the carpal tunnel, it is especially common at sites below the elbow. The MN and brachial artery can also be compressed by the lacertus fibrosus in the lower arm. This is critical as the nerve can lose its suppleness and become stretched by joint movement when it becomes attached to adjacent structures. Although nerve compression is easily managed and can be resolved by releasing the neurovascular structure from the entrapment, clinicians should be aware of potential entrapment injuries as they can lead to neuropathy, loss of muscle strength and atrophy.

Conclusion

This case describes the unusual occurrence of a double LPN, double lateral roots of the MN and an anomalous course of the McN. These rare variations are potential sites for neural or neurovascular compression in the middle and distal arm, respectively. Radiologists, neurovascular surgeons, anaesthesiologists and anatomists should consider such potential variations when dealing with the brachial plexus region.
References