Multiple Interneural Communications of Brachial Plexus - Anatomical Description and Clinical Significance

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Abstract

Brachial plexus blockade requires efficient and thorough understanding of the detailed anatomy of the plexus and the variations associated with the plexus. Anomalies associated with the branches of the plexus may complicate attempts of nerve blockade for anesthesia. The present case report presents an unusual variation of brachial plexus noticed during routine cadaveric dissection. A rare neural communication between ulnar and radial nerves was observed in the left axilla at high humeral level proximal to the entry of the radial nerve into the radial groove. The communicating ramus also gave a branch to the medial head of triceps brachii 0.3 cm distal to the origin of the communication. Further, there was also a communication between the musculocutaneous and median nerves in the distal half of the arm after the musculocutaneous nerve pierced the coracobrachialis muscle.

Though the variations of the brachial plexus have been described in the literature, yet studies regarding the communication between ulnar and radial nerves are rare and the coexistence of this variation along with median and musculocutaneous nerve communication is unique. Knowledge of such rare variations and anomalies is important to minimize the possible complications of regional anesthesia and surgery. Such an unusual variation, as noted in the present study, may prove useful in nerve grafting and neurophysiological evaluation to diagnose peripheral neuropathies. Further, their knowledge is of immense importance in traumatology of the shoulder joint, radial neck dissections and management of fracture of the surgical neck of humerus. Anatomic variations of peripheral nerves are important for Orthopedic surgeons, Neurophysicians, Physiotherapists and Radiologists. The present article is a humble attempt to reinforce awareness of such neural variations among clinicians.

Keywords: Brachial Plexus, Ulnar nerve, Radial nerve, Musculocutaneous nerve, Median nerve.

Introduction

Effective brachial plexus blockade requires a thorough understanding of anatomy of the brachial plexus as well as an appreciation of anatomic variations that may occur. The brachial plexus is the network formed by the communication between the anterior primary rami of the last four cervical and the first thoracic nerve roots, that is C_5, C_6, C_7, C_8 and T_1. It supplies all the muscles of the upper limb and the overlying skin by its varied branches. The present case report depicts a unilateral connection between radial and ulnar nerves at high humeral levels in the left axilla. The radial nerve conveying fibers from the dorsal divisions of ventral rami of C_7, C_8 and T_1, is a continuation of the posterior cord of the brachial plexus. In the axilla, it runs behind the third part of axillary artery and gives muscular branches to the long and medial heads of triceps and one cutaneous branch - the posterior cutaneous nerve of the arm. It leaves the axilla by passing through the lower triangular space along with the profunda brachii artery and travels in the radial groove supplying the lateral and medial heads of triceps. A lower lateral cutaneous nerve of the arm and the posterior cutaneous nerve of the forearm are also given off in the groove. It then pierces the lateral intermuscular septum and enters the anterior compartment of the forearm.

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The ulnar nerve, formed in the axilla as a continuation of the medial cord of the brachial plexus, conveys fibers from C_7, C_8 and T_1, passes along the medial side of third part of axillary artery in the axilla and along the medial side of the brachial artery in the proximal part of arm. The nerve pierces the medial intermuscular septum in the middle of the arm and lodges in a groove on the dorsal surface of the base of medial epicondyle of the humerus. It enters the forearm between the two heads of flexor carpi ulnaris.

Previous studies have reported myriad communications between the branches of the medial and lateral cords including ulnar, median and musculocutaneous nerves. However, there is paucity of literature on the communications between the branches of medial and posterior cords, thus quantifying the need for further research of such variations and anomalies. The present paper describes a rare and unique communication between ulnar and radial nerves in the axilla, proximal to the entry of radial nerve in the spiral groove. Interestingly, this communicating ramus also gave off a branch to the medial head of the triceps brachii.

This study aims to report this unusual and unique variation so as to assist anesthetists in their attempt to block nerves successfully and orthopedic surgeons in assessing sensorimotor symptoms while diagnosing nerve injuries.

Case Report

The present variation of brachial plexus was incidentally observed during routine dissection of the left upper limb of an adult female, fifty years old cadaver. A rare communication between radial and ulnar nerves was observed in the left axilla at high humeral level. This communicating twig commenced from the radial nerve proximal to its entry into the spiral groove and it joined the ulnar nerve, 3cm proximal to the point where the nerve pierced medial intermuscular septum. This communication, measuring 6.5cm in length was placed posteromedial to distal part of the axillary artery and proximal part of the brachial artery. It also gave a branch to medial head of triceps brachii, 0.3 cm distal to the origin of communication and measured 4cm in length. The medial head of triceps was also supplied by a branch, given directly by radial nerve in the axilla. Additionally, the dissection also displayed a communication between MCN and MN in the arm on the left side. This communicating branch, 3.5cm in length, was given off from MCN, distal to its entry into coracobrachialis muscle. It joined the median nerve 13 centimeters distal to the formation of the nerve, by union of medial and lateral roots. The other branches of brachial plexus and adjoining vessels including axillary artery and vein displayed usual anatomy. No unusual anatomical variation was observed in the right upper limb.

Discussion

Various communications between different branches of brachial plexus and its cords have been reported in previous studies.[1,2,3,4,5] The commonly reported variations of the brachial plexus include communications between the musculocutaneous, median and ulnar nerves. However, very few studies have reported the communication between radial and ulnar nerves.

This can be explained on the basis of the formation and development of brachial plexus. The nerves of the brachial plexus are believed to form in two planes, anterior and posterior .The nerves of the medial and lateral cords belong to the anterior plane and nerves of posterior cord belong to the posterior plane. Communications and variations are most frequently observed between the nerves of the same plane. Thus, explaining the common occurrence of communications between lateral and medial cords and their branches and rare occurrence of radio-ulnar communications.[3]

The current study reports the occurrence of rare unilateral neural communications between radial and ulnar nerves in conjunction with median-musculocutaneous nerves communication. The uniqueness of the present investigation lies in the fact that the radio- ulnar communication encountered in the arm also provided a twig to the medial head of triceps brachii. To the best of our knowledge, this finding has not been reported earlier. The medial head of triceps, thus is observed to receive nerve supply from three different sources, from the radial nerve in axilla and in spiral groove, and another branch from the communication between radial and ulnar nerve in the arm. In view of its innervation, the medial head of triceps brachii can justifiably be designated as a composite muscle. The anatomical scenario of present report also suggests that in the event of injury to radial nerve, the medial head of triceps brachii would be spared. Moreover, the authors strive to report this unusual neural variation in an attempt to provide anatomists a base for further studies in this direction. The operating surgeon may find these neural communications interesting especially in view of the nerves supplying the medial head of triceps and further, it may escape injury if the radial nerve

is injured. Along with the aforementioned unique and rare variation between radial and ulnar nerve, the dissection also displayed a communication between musculocutaneous nerve and median nerve, the communicating twig being given after the musculocutaneous nerve pierces coracobrachialis. It joined the median nerve thirteen centimeters distal to the formation of the nerve by union of medial and lateral roots. Such variations in the branching pattern of brachial plexus can be explained on the basis of embryological development of trunks, divisions and cords.[6] The musculature of the limb is developed from the myotomes in relation to paraxial mesoderm (Hamilton, Boyd and Mossman, 1978). Myotome enlarges rapidly both dorsally, flanking the neural tube and ventrally, where it extends into the somatopleure. At this time the fibers of ventral roots of spinal nerves, growing out of the neural tube make contact with the cells of appropriate myotome. The myotome becomes divided by a slight constriction into a dorsal epaxial portion and ventro- lateral portion, hypomere. The nerve, in a similar fashion, becomes split into a dorsal and ventral primary ramus, connected to corresponding portions of the myotome. Any developmental differences once formed would persist postnatal.[7] Moreover, the path taken by these developing axons is regulated by the expression of chemoattractants and chemorepulsants in a highly coordinated site specific fashion, any alterations in signaling controlling the mesenchymal cells and the neuronal growth cones might lead to significant variations.[8] Thus, the lack of coordination between the formation of the limb muscles and their innervation may result in the appearance of aberrant communications between different cords and their branches.[9] Further some investigators have considered Ernst Haeckel's theory of ontogeny recapitulating phylogeny, for the interpretation of the nerve anomalies of the arm (Chauhan and Roy, 2002). Studies of comparative anatomy have observed the existence of such connections in monkeys and apes; their occurrence in human beings may represent the primitive nerve supply of the anterior arm muscles.[6] Anatomic variations of peripheral nerves are important for Orthopedic surgeons, Neurophysicians, Physiotherapists and Radiologists. Such an unusual neural variation as noted in the present study may prove useful in nerve grafting and neurophysiologic evaluation to diagnose peripheral neuropathies. Further their knowledge is of immense importance in traumatology of the shoulder joint, radical neck dissections, and management of fracture of the surgical neck of the humerus. Also their proper understanding helps orthopedic surgeons in assessing sensorimotor symptoms while diagnosing nerve injuries. It has been stated that anomalous origin, course and distribution of the various branches of brachial plexus and its cords may succumb to iatrogenic injuries and entrapment neuropathies.[10] Such neural variations if ignored, may pose problems for the Radiologists and Anesthetists leading to ineffective nerve blockade. Further, the sympathetic supply to the upper limb is carried by the branches of brachial plexus; the communication between them could complicate the management of conditions such as complex regional pain syndrome.

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