Indian Journal of Clinical Anatomy and Physiology 2023;10(3):185–187

Content available at: https://www.ipinnovative.com/open-access-journals

Indian Journal of Clinical Anatomy and Physiology

Journal homepage: https://www.ijcap.org/

Case Report

A case report on multiple accessory muscles and nerve variations in upper limb

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ARTICLE INFO

Article history:
Received 26-06-2023
Accepted 05-09-2023
Available online 21-10-2023

Keywords:
Anatomical variations
Accessory muscle
Median nerve
Biceps brachii
Brachioradialis
Musculocutaneous nerve

ABSTRACT

During routine dissection of formalin fixed cadavers, the brachial plexus and other upper limb structures were observed for variations. In 65-year-old male cadaver, bilateral upper limb neuromuscular variations were identified. On the left side, median nerve had three roots (one medial and two lateral) and biceps brachii had an additional head which was originating from the mid shaft of humerus and joined with the main muscle at the lower third of arm, and was innervated by musculocutaneous nerve. On the right side, the brachioradialis muscle had an accessory head which took origin from the lateral side of humerus near deltoid tuberosity and joined with main tendon in the lower part of the forearm, and was innervated by radial nerve. The association of nerve variations and accessory muscles is clinically significant. As accessory muscle may lead to nerve or artery entrapment in the limb and is likely to cause palsy or ischemia, knowledge about the neuromuscular variations is clinically significant.

1. Introduction

The median nerve (MN) forms from two roots, medial root from the medial cord and lateral root from the lateral cord of brachial plexus.[1] Occasionally, an additional root contributes to MN formation and its incidence ranges from 14.2-20%.[2]The anaesthetists should be aware of the additional roots while performing nerve block procedures. The additional roots may complicate nerve block procedure leading to needle injuries.[3] Nerve injury causes loss of function, decreased in muscle tone and loss of sensation. Knowledge of these variations will help the surgeons during radical neck dissection, peripheral nerve repairs and orthopaedic procedures to avoid iatrogenic injury. Evaluation of these variations beforehand will also guide the anaesthetists for effective brachial plexus nerve block.[4]

In the anterior compartment of arm, the key muscle is the biceps brachii (BB) and it is innervated by the musculocutaneous nerve (MCN). It's two heads originate from the scapula, short head from coracoid process and the long head from the supraglenoid tubercle. Upon joining, the two heads form a common tendon which inserts into the radial tuberosity.[1] Brachioradialis (BR) originates from the humerus (lateral supracondylar ridge) and inserts into the styloid process of radius. It is innervated by a branch from the trunk of radial nerve.[1]

Accessory head of a muscle originates from a different site on the bone but fuses with main muscle mass close to the insertion. Their incidence of accessory head of BB varies from 9-22%.[5] The accessory muscles may lead to entrapment of neurovascular structures in the limb. The entrapment of the artery may cause ischemia. The nerve entrapment may lead to paralysis of muscles of the arm and forearm, sometimes causing to motor and sensory deficits.[5] During routine dissection, variations of MN formation and

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https://doi.org/10.18231/j.ijcap.2023.041

course of MCN along with accessory muscles in the upper limb of a cadaver were identified and reported.

2. Case Report

During routine dissection on the axilla, arm and forearm of a 65-year-old male cadaver in the Department of Anatomy, multiple neuromuscular variations were noted. On the left side, the MN had three roots, two from the lateral cord and one from the medial cord of the brachial plexus. Anterior to the third part of axillary artery, the superior lateral and the medial roots joined as MN. An inferior lateral root of MN joined the median nerve in the upper third of arm, 1.5cm distal to the superior lateral root. MN then continued downwards with no further variation in the branching and course. (Figure1A)

Apart from the two heads of BB, long and short, a fleshy accessory head was observed on the left side. It originated from the mid-shaft of the humerus near the insertion of the coracobrachialis. The accessory head joined the short head of BB in the lower third of the arm, 7.6cm proximal to the lateral epicondyle of the humerus. The length, breadth and thickness of the accessory head was 11.3 cm, 1.6cm, 0.1cm, respectively. The musculocutaneous nerve (MCN), after emerging from the lateral cord, first passed through coracobrachialis and then pierced the short head of BB shortly before supplying a branch to the accessory head. (Figure 1 A)

On the right-side, the BR had a large accessory head with high origin. It was attached to the lateral side of humerus just below the deltoid tuberosity. Finally, it joined the tendon of the BR in the lower part of the forearm, 10.2 cm proximal to the styloid process of radius. The length, breadth and the thickness of the accessory muscle was 32 cm,1.8cm,0.3cm, respectively. In cubital fossa, a branch from the trunk of radial nerve supplied this accessory head from its under surface after piercing through main BR. (Figure 1 B)

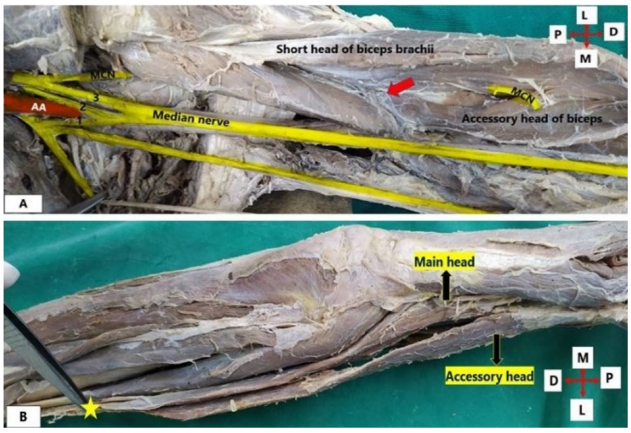

Fig. 1: (A): Left upper limb- anterior view ;1- Medial root; 2- Superior lateral root; 3- Inferior lateral root; Red arrow- Origin of accessory head of Biceps Brachii. **(B):** Right upper limb-lateral view showing accessory head of brachioradialis; Star-Union of main and accessory heads; MCN-Musculocutaneous nerve; AA-Axillary artery; L-Lateral; M-Medial; P-Proximal; D-Distal

3. Discussion

We found an additional root of MN, MCN piercing two brachium muscles, and presence of an accessory BB in the same limb. The coexisting accessory head of BB and variations in major nerves are sometimes encountered in the upper limb. The presence of MN formation from three roots with an accessory head of BB in same limb is sparsely reported. However, we did not encounter any report in literature corresponding to the MCN piercing two muscles with a three headed BB. Ongeti et al. described a variation in MN formation from three roots associated with the accessory head of BB which originated near the insertion of deltoid tuberosity.[5] Unlike three-headed muscle in the present report, Vazquez et.al. mentioned a double piercing of MCN associated with a four headed BB. Here, the first accessory head originated from area between the lesser tubercle and coracobrachialis, and the second accessory head originated from the insertion of coracobrachialis on the humerus. Both these accessory heads joined the common tendon of BB in the lower third of the arm. The MCN pierced the coracobrachialis muscle and then one of the supernumerary heads of BB.[6] Enix et.al noted a variation in which MCN entered deep to the third head of BB but did not pierce it at the level of most distal part of the humerus. The accessory head originated from the lateral side of the proximal third of the humerus on the left side, merged with the common tendon and inserted into the radial tuberosity.[6]The MCN can be compressed during the intramuscular course leads to nerve palsy.[7]

There are several studies documenting only the variation of MN formation from three roots.[3–8] There are reports of MN formation with a contribution of an additional root from either medial or lateral cord. Most of studies have reported the additional root contribution from the lateral cord.[3–8] These variations can be unilateral or bilateral. Ghosh et al. studied 60 limbs for MN formation. In 13 limbs, MN had three roots, one root from the medial and two roots from lateral cord. In three limbs, MN formed from four roots, three roots from lateral cord and one from medial cord.[3] Encarnacion et al. studied 42 limbs, in which MN formed from the three roots in 20.2% and by four roots in 2.4%.[2] MN can also form from five roots which is even more rare. Natsis et al. described five roots of MN, three from the lateral cord and, two from the medial cord of brachial plexus.[9] The identification of additional roots of MN and variation in the course of MCN are essential for the surgeons during surgical exploration of the axilla and arm.[3] Sometimes, iatrogenic injuries can happen while performing surgeries in the arm. The awareness of variations

like additional roots of MN are essential for the anaesthetists performing the brachial plexus block.[2]

The variations of BB most frequently observed in literature are with three heads. Rai et.al reported three-headed BB in three out of 42 limbs. Here, the accessory head originated from anteromedial part of humeral shaft which was similar to the present report.[10] In all cases, accessory head formed a single tendon along with the two heads of BB and inserted into the radial tuberosity. There are few studies pertaining to the accessory muscle of BR.[11–13] Incidence of accessory BR is 2.8%.[11] Herma et al. studied 208 upper limbs and noted two cases of a double superficial branch radial nerve (SBRN) associated with double headed BR. In such cases, SBRN may pass between two heads of BR and is a potential site for the compression neuropathy. This SBRN compression can lead to Wartenberg's syndrome.[12] Also, high origin of the BR can lead to compression of the radial nerve between accessory and the main BR.[13]

The formation of limb muscles and nerves supplying them occurs early in embryonic life. In the fifth week of development, the motor axons enter the limb bud. The neurons for these are arranged as medial and lateral groups in the spinal cord. Ventral muscle mass receives the axons located in medial group, whereas the dorsal muscle mass receives the axons located lateral group. The development of sensory axons takes place after that of motor axons. The development of muscle depends on the myogenic cells which are derived from somites. The myoblasts are interconnected with the tissue mesenchyme. The muscle cells in limb buds express the growth factors and pre-adhesion molecules, leading to distribution of myoblasts throughout the limb. These cells express Pax-3 during their migration into the limb bud. Any interference in the formation of myotomes may lead to accessory muscles.[14]

The accessory muscle in the limb adds to the main muscle mass and its action can reinforce the power of BB, BR, and supinator muscles. Accessory muscle crossing over brachial artery or nerves may lead to ischaemia of the limb due to compression of artery and nerve entrapment, respectively.[3] The combination of three roots of MN, three heads of BB, and MCN nerve piercing two muscles has significant clinical importance. Knowledge of such nerve variations and accessory muscles in the arm is clinically significant for the anaesthetists and surgeons while performing nerve block procedures and surgeries. These variations can cause neurovascular entrapment causing nerve palsy or ischemia of the limb. Hence such reports will guide the anaesthetists and surgeons to perform effective interventions.

4. Source of Funding & Conflict of Interest

None.

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Cite this article: Sankaran N, Raman A, Stephen PC, Verma S, Kishore A. A case report on multiple accessory muscles and nerve variations in upper limb. *Indian J Clin Anat Physiol* 2023;10(3):185-187.