Variation in relation of cords of brachial plexus and their branches with axillary and brachial arteries – a case report

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ABSTRACT

Anatomical variations in the formation, course and distribution of brachial plexus are well documented. The present report describes some rare variations with regard to relation of cords of brachial plexus, median and ulnar nerves with the third part of axillary artery and brachial artery in the left upper limb of an adult male cadaver. All three cords of brachial plexus were noted to be lateral to all three parts of axillary artery. Median nerve was lateral to brachial artery and ulnar nerve was between the brachial artery and median nerve. Further distribution of median and ulnar nerves was normal. The arterial pattern in left arm (axillary and brachial arteries) was also normal. The findings were noted after thorough and meticulous dissection of both the upper limbs (axilla, arm, cubital fossa, forearm and palm) of the same cadaver in the Department of Anatomy, College of Medical Sciences, Bharatpur, Nepal. The right upper limb revealed no abnormality. It is important to be aware of such variations while planning a surgery in the region of axilla and arm as these nerves are more liable to be injured during surgical procedures. Possible embryological explanations and clinical significance have been discussed.

Keywords: Brachial plexus, Median nerve, Ulnar nerve, Axillary artery, Brachial artery.

Anomalies of brachial plexus and its terminal branches are not uncommon and have been widely documented.[1-3] The common and more obvious variation in brachial plexus is the level of its formation, the pre-fixed and post-fixed plexus.[4] Variations may also occur in the formation of trunks, divisions, and cords; in the origin and/or combination of branches; and in the relationship to the axillary artery and scalene muscles, however, the makeup of the terminal branches (components of the nerves) is unchanged.[5]

The three cords of brachial plexus enter the axilla and are arranged according to their names around the second and third part of axillary artery. But in the first part of axillary artery, the relations are different, the lateral and posterior cords lie lateral to the axillary artery, whereas the medial cord lies behind the axillary artery.[6]

The lateral root of median nerve (LRM) coming from the lateral cord (C5, C6, C7) of brachial plexus and medial root of median nerve (MRM) coming from the medial cord (C8, T1) of brachial plexus join to form the median nerve trunk which lies anterior to the third part of the axillary artery. Before joining the lateral root, the medial root passes obliquely in front of the third part of axillary artery.[6]

Ulnar nerve (C7, C8, T1) is a branch of medial cord. In the axilla the ulnar nerve descends between the third part of axillary artery and axillary vein.[6]

The anomalous relationship of the cords and branches of brachial plexus with axillary and brachial arteries as noted in the present study can be explained in the light of embryogenic development.

The upper limb buds lie opposite the lower five cervical and upper two thoracic segments. As soon as the buds form, the ventral primary rami of the spinal nerves penetrate into the mesenchyme of limb bud. Immediately the nerves enter the limb bud, they establish intimate contact with the differentiating mesodermal condensations and the early contact between nerve and muscle cells is a prerequisite for their complete functional differentiation.[7-9]

The growth as well as the pathfinding of nerve fibres towards the target is dependent upon concentration gradient of a group of cell surface receptors in the environment. Several signalling molecules and transcription factors have been identified which induce the differentiation of the dorsal and ventral motor horn cells.[8]

Misexpression of any of these signalling molecules can lead to abnormalities in the formation and distribution of particular nerve fibres.[8]

Finally knowledge of such variations is important for surgeons to perform surgical procedures in the axillary region and arm.[10]

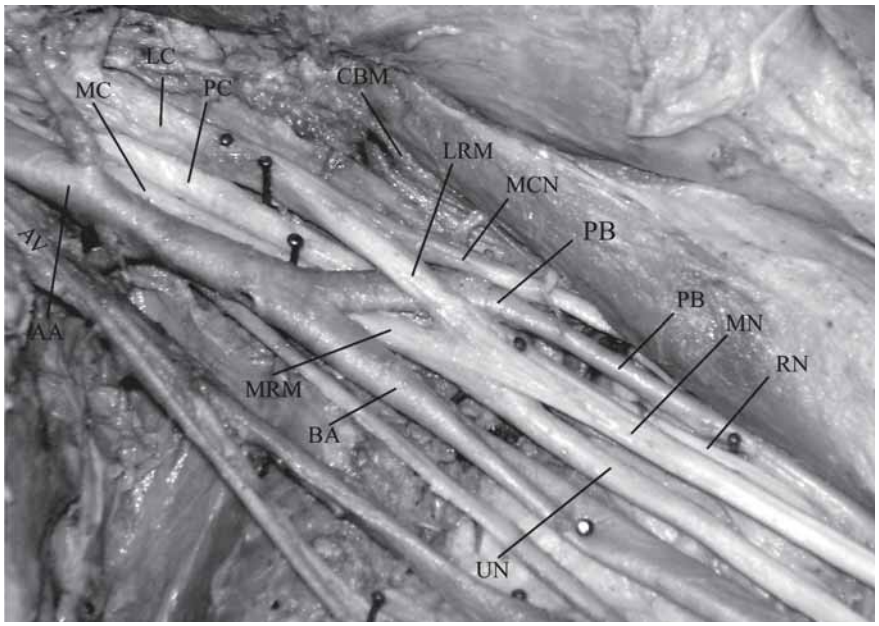

Fig. 1. Showing variation in relation of cords of brachial plexus and their branches with axillary and brachial arteries in the left upper limb of an adult male cadaver. All three cords of brachial plexus were noted to be lateral to all three parts of axillary artery. Median nerve was lateral to brachial artery and ulnar nerve was between the brachial artery and median nerve.

LC= Lateral cord, MC = Medial cord, PC= Posterior cord, LRM= Lateral root of median nerve, MRM= Medial root of median nerve, MCN= Musculocutaneous nerve, MN= Median nerve, UN= Ulnar nerve, RN= Radial nerve, AA= Axillary artery, BA= Brachial artery, PB = Profunda brachii artery, AV= Axillary vein, CBM=Coracobrachialis muscle

CASE REPORT

During routine dissection of an adult male cadaver in the Department of Anatomy, College of Medical Sciences, Bharatpur, Nepal, some rare variations with regard to relations of cords of brachial plexus, median and ulnar nerve with the third part of axillary artery and brachial artery were found in the left upper limb (Fig. 1).

All the three cords namely lateral, medial and posterior cords of brachial plexus were noted to be lateral to the third part of the axillary artery. It was also noted that they maintained the same relation with the first and second parts of axillary artery. The formation and branches of the three cords were found to be normal (Fig. 2). However, the median nerve trunk was found to be formed by union of medial root and lateral root (coming from medial and lateral cords respectively) proximal to the insertion of coracobrachialis muscle, both the roots being lateral to the third part of axillary artery. The two roots were found to unite at the aforesaid level enclosing in between them the profunda brachii artery which was found to be arising from the lateral side of brachial artery instead of its posteromedial aspect (Fig. 1-3). Further distribution of median nerve in the arm, forearm and palm was normal.

The ulnar nerve was noted to arise from medial cord at a lower level than usual overlapped by the junction of medial and lateral roots of median nerve. Furthermore, ulnar nerve was lateral to brachial artery instead of descending between axillary artery and axillary vein. In fact, ulnar nerve was found to be between the brachial artery medially and median nerve laterally. Further distribution of ulnar nerve was normal.

The arterial pattern in the left upper limb, particularly axillary and

Fig. 2. Showing upper, middle and lower trunks of brachial plexus and subclavian artery, formation of medial, lateral and posterior cords, all three being lateral to axillary artery and profunda brachii artery arising from lateral side of brachial artery and passing in between lateral and medial roots of median nerve being accompanied by radial nerve.

UT= Upper trunk, MT= Middle trunk, LT= Lower trunk, LC= Lateral cord, MC = Medial cord, PC= Posterior cord, LRM= Lateral root of median nerve, MRM= Medial root of median nerve, MCN= Musculocutaneous nerve, MN= Median nerve, RN= Radial nerve, UN= Ulnar nerve, SA= Subclavian artery, AA= Axillary artery, BA= Brachial artery, PB = Profunda brachii artery, AV= Axillary vein

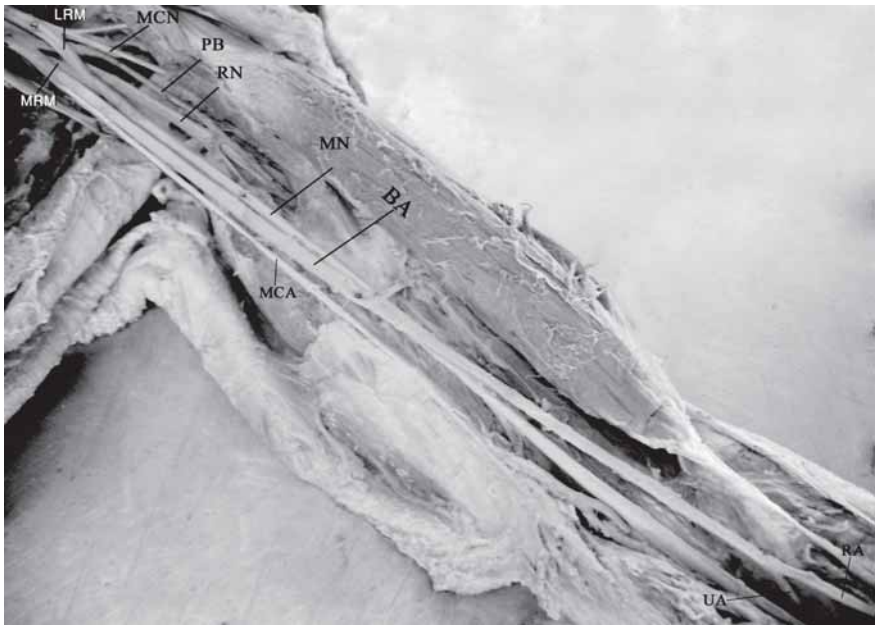

Fig. 3. Showing profunda brachii artery arising from lateral side of brachial artery and passing in between lateral and medial roots of median nerve, being accompanied by radial nerve. Also showing bifurcation of brachial artery near the elbow joint into radial and ulnar arteries.

LRM= Lateral root of median nerve, MRM= Medial root of median nerve, MCN= Musculocutaneous nerve, MN= Median nerve, MCA= Medial cutaneous nerve of arm, RN= Radial nerve, BA= Brachial artery, PB = Profunda brachii artery, UA= Ulnar artery, RA= Radial artery

brachial arteries, was normal. The right upper limb revealed no abnormality.

DISCUSSION

Anomalies related to formation, relations and distribution of brachial plexus are fairly common. Normally the brachial plexus is formed by lower four cervical ventral rami (C5, C6, C7, C8) and greater part of the first thoracic ventral ramus (T1). It consists of roots, trunks, divisions and cords (lateral cord, medial cord and posterior cord).

The three cords enter the axilla and are arranged according to their names around second and third part of axillary artery. But in the first part of axillary artery the relations are different, the lateral and posterior cords lie lateral to the axillary artery whereas the medial cord lies behind the axillary artery.[6]

The lateral root of median nerve (LRM) coming from the lateral cord (C5, C6, C7) of brachial plexus and medial root of median nerve (MRM) coming from the medial cord (C8, T1) of brachial plexus join to form the median nerve trunk which lies anterior to the third part of the axillary artery. Before joining the lateral root, the medial root passes obliquely in front of the third part of axillary artery.[6]

Ulnar nerve (C7, C8, T1) is a branch of the medial cord. In the axilla the ulnar nerve descends between the third part of axillary artery and axillary vein and lies on a more posterior plane than the medial cutaneous nerve of forearm.[6]

In the present study, it was noted in the left side that all the three cords of brachial plexus were lateral to all the three parts of the axillary artery. Median nerve trunk was formed by union of lateral and medial roots, both being lateral to third part of axillary artery, proximal to insertion of coracobrachialis and the profunda brachii artery was found to be passing in between the two roots after arising from the lateral side of brachial artery instead of its posteromedial aspect. Ulnar nerve emerged from the medial cord at a lower level than usual and was lateral to brachial artery and medial to median nerve trunk.

The variations in the formation and branching of the brachial plexus are common and have been reported by several investigators.[1,11-16] Variations may also occur in the formation of trunks, divisions, and cords; in the origin and/or combination of branches; and in the relationship to the axillary artery and scalene muscles, however, the makeup of the terminal branches (components of the nerves) is unchanged.[5]

The variations with regard to the relations of the cords of brachial plexus with axillary artery and median and ulnar nerves with brachial artery as noted in the present study can be explained on the basis of embryogenic development.

The first indication of limb musculature is observed in the seventh week of development as condensation of mesenchyme near the base of the limb buds. With further elongation of the limb buds, the muscle tissue splits into flexor and extensor compartments.

The upper limb buds lie opposite the lower five cervical and upper two thoracic segments. As soon as the buds form, ventral primary rami from the spinal nerves penetrate into the mesenchyme. At first, each ventral ramus divides into dorsal and ventral branches, but soon these branches unite to form named peripheral nerves which supply extensor and flexor group of muscles respectively.[8,9]

Immediately after the above mentioned rearrangement of nerves, they enter the limb buds and establish an

intimate contact with the differentiating mesodermal condensations and this early contact between the nerve and muscle cells is a prerequisite for their complete functional differentiation.[7,8]

Over the years, two principal theories have emerged concerning the directional growth of nerve fibres – the neurotropism or chemotropism hypothesis of Ramon y Cajal[17] and the principle of contact-guidance of Weiss.[18] The salient feature of chemotropism is that axonal growth cones act as sensors to concentration gradients of molecules in the environment and grow up the gradient towards the source, i.e. the target.

There is no doubt, however that contact guidance mechanisms operate in parallel with neurotropism. Adhesion to the structures with which the growth cone contacts also plays a role.

A group of cell surface receptors viz. neural cell adhesion molecule (N-CAM) and L1 and the Cadherins act as transcription factors which recognize and bind to components of the extracellular matrix. Thus, both cell-cell and cell-matrix interactions may be involved in axonal pathfinding.[8]

Over or under expression of one or multiple transcription factors as mentioned above have been found to be responsible for the variations in the formation, relation and distribution of the motor nerve fibers.[19]Once formed, any developmental differences would obviously persist postnatally.[7] The variations could arise from circulatory factors at the time of fusion of the brachial plexus cords.[20] The variations as noted in the present case may be attributed to the misexpression of the transcription factors as mentioned above.

Knowledge of anatomical variations of these nerves at the level of upper arm is essential in the light of the frequency with which surgery is performed in the axilla and the surgical neck of humerus.[21]

The variations of the cords of brachial plexus and its terminal branches become important during surgical exploration of the axilla and arm to avoid damage to the important nerves.[22]

The variations in the relations of median nerve in the arm bear remarkable clinical significance. Considering these variations Rao advocated that the clinicians and surgeons should be aware of such variations while performing surgical procedure in this region.[10]

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