Case report

A rare formation of median nerve associated with three headed biceps brachii

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Abstract

A rare neural variation was observed during routine educational dissection of upper extremity. Unusual variation in the formation of median nerve associated with three headed biceps brachii muscle was observed. The median nerve was being formed at in the distal third of arm by three different widely separated roots. The distribution of muscular branches of median nerve was normal but musculocutaneous nerve was not piercing coracobrachialis muscle. The embryological basis and clinical implications of this distinctive variation is discussed here. The coexistence of these variations has not been reported in the literature.

Keywords: median nerve, brachial plexus, variation, biceps brachii.

1 Introduction

The classical textbook description of formation of median nerve is that it is formed by union of two roots from the lateral (C 5, 6, 7) and the medial (C8, T1) cord either anterior or lateral to third part of axillary artery. The median nerve (Mn) thus formed enters the arm at first lateral to the brachial artery and near the attachment of coracobrachialis, it crosses anterior to it and then descending medial to it. It enters the forearm and gives vascular, muscular, articular and cutaneous branches. There are many variations reported in the text about communications between the branches of the brachial plexus but none had reported two widely separated separate roots of Mn emerging from lateral cord and uniting separately with medial root of median nerve. A rare variation in the formation of median nerve has been reported here which may be of clinical pitfalls in various neurosurgical procedures or surgical approaches to shoulder region or some entrapment syndromes.

2 Case report

During the routine educational dissection of the formaline fixed left upper extremity of a 50 year old cadaver we encountered a distinctive unilateral variant formation of Mn along with variation in the insertion of biceps brachii muscle. The present case report describes an exceptional formation of Mn, with an extra third root (PLr) arising directly from the lateral cord (LC) and joining with the medial root of median nerve, medial to axillary artery. The LC of brachial plexus gave an extra branch to medial root of median nerve proximal to both musculocutaneous nerve or lateral root of median nerve. The LC was giving four branches viz., lateral pectoral nerve, a proximal branch to medial root of median nerve (PLr), musculocutaneous nerve and the distal lateral root (DLr) of median nerve respectively (Figure 1). The musculoctaneous nerve passed superficial to coracobrachialis muscle without piercing it. The PLr was being given from the LC between the lateral pectoral nerve and the terminal divisions of LC, namely musculocutaneous nerve and DLr. The PLr was uniting with the medial root of median nerve immediately after its emergence from medial cord of brachial plexus. The DLr was emerging 5.5 cm distal to the PLr and was uniting with the medial root at the junction of middle third and distal third of the arm. All the three roots were passing superficial to the brachial artery. The Mn was finally formed in the distal third of arm. The Mn thus formed passed superficial to the additional attachment of biceps brachi muscle on the medial supracondylar ridge. The variations of the LC and its extra branch make it a complicated clinical and surgical approach which is discussed with the developmental background. Further distribution of the atypical Mn thus formed in the upper extremity was standard. The arterial pattern was also usual. The right Mn was normal.

The proximal attatchment of the biceps brachii was usual. The muscle followed a typical path and the majority of the muscle fibres formed a round tendon and was inserted to the radial tuberosity of radius. But some of the fibres from the medial side below the level of the middle of the arm formed a separate muscle bundle and continued as a narrow musculo-tendinous slip (Figure 2). This slip was attatched to medial supracondylar ridge of humerus just medial to attachment of brachialis muscle. This musculotendinous slip was deep to median nerve as well as brachial artery. This slip was innervated by the musculocutaneous nerve as the other two heads. The vascular supply of this third head was also from the brachial artery.

3 Discussion

The anatomical variations in the formation and course of median nerve are well documented and have clinical significance to surgeons, neurologists and anatomists. The described variations of median nerve include formation by two roots of median nerve in the distal half of arm which provides an image of two median nerves in the upper

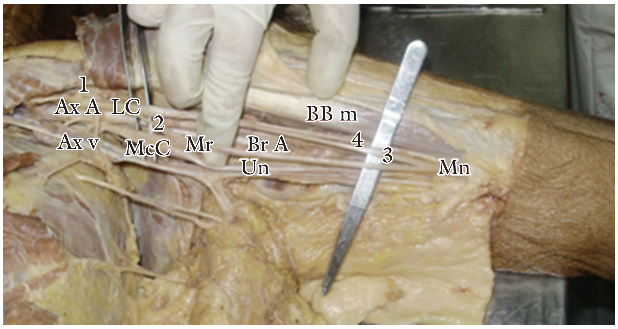

Figure 1. Formation of Median nerve medial to axillary artery by three roots. LC lateral cord. 1 Lateral pectoral nerve. 2 Proximal lateral root of median nerve. 3 distal lateral root of median nerve. 4 Musculocutaneous nerve. McCMedial cord. Mr medial root of median nerve. Mn median nerve. Ax A Axillary artery. Axa v axillary vein. Br a brachial artery. BB m Biceps brachii muscle.

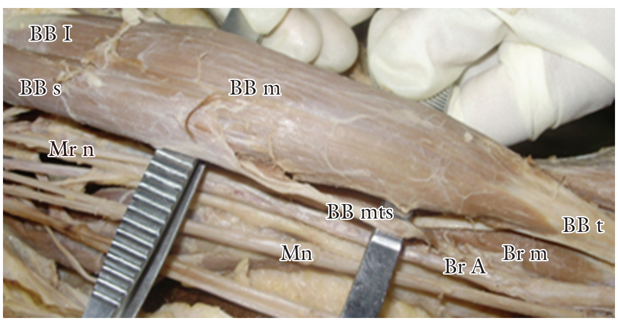

Figure 2. Musculo-tendinous slip of biceps brachii muscle. BB m Biceps brachii muscle. BB t Biceps brachii tendon. Br m Brachialis muscle. BB mts musculotendinous slip of Biceps brachii . BB l long head of Biceps Brachii. BB s short head of Biceps brachii.

shoulder region and arm. A supplementary third trunk of median nerve from lateral cord in arm associated with anastomosis between musculocutaneous nerve and median nerve has also been reported (BEHEIRY, 2004). Contrarily, in the present study, no such communication was observed. An out of the ordinary finding which was observed in the present case was the association of the median nerve to the axillary artery. Usually the medial root of the median nerve crosses the axillary artery to unite with the lateral root to form the Mn which is anterior or lateral to the axillary artery but in this study the PLr was crossing the axillary artery anteriorly and joining the medial root to form Mn, medial to the artery. Past studies on fetuses had reported the variations of the brachial plexus to be more common in females and on the right side (UYSAL, SEKER, KARABULUT et al., 2003). Contrarily, the present undocumented anomaly was noted on the left side in a male cadaver whereas the right side being absolutely normal. This extra branch of lateral cord crossing the artery anteriorly may apply pressure and produce ischemic symptoms. Knowledge of such variations is extremely important to surgeons who work in this area. The angiographic studies can determine the normal and variant vessels but information of neural variations is feasible only at the time of surgeries or cadaveric studies. This rare variation in the formation of median nerve in the arm bears remarkable clinical significance. It has been reported that the variant nerve sharing abnormal origin, course and distribution are more to accidental injuries and entrapment neuropathies (ROBERTS, 1992). Clinicians and surgeons should be aware of such rare variation while performing surgical procedure in this region. Damage to such a variant nerve in the proximal arm may lead to a galaxy of manifestations including sensory, motor, vasomotor and trophic changes. The possible clinical implications of these variations relating either to the surgical approach to the shoulder joint and entrapment syndromes are important. Unusual pattern of brachial plexus and median nerve are frequently related to anomalies of axillary or brachial artery. However, in this case no irregular arterial pattern was observed.

Associated with these anomalies in the present case was the origin of musculo-tendinous third head from the medial supracodylar ridge and insertion to the bicipital aponeurosis was also seen. Although individual presence of third head in 10% cases has been reported in the literature but associated neural variations have not been reported. It was anterior to the brachialis muscle but posterior to brachial artery. The functional importance of the third head with the humeral origin is to strengthen the flexion of elbow joint irrespective of the position of shoulder joint.

4 Embryological basis

The limb musculature starts developing in the seventh week of intra uterine life as condensation of mesenchyme near the base of the limb buds. The muscle tissue splits into flexor and extensor compartments with further elongation of the limb buds. 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 enter into the mesenchyme. Initially, each ventral ramus with separate dorsal and ventral branches, but in a little while these branches merge to form large dorsal and ventral nerves which supply extensor and flexor group of muscles respectively. Soon after the above mentioned rearrangement of nerves, they go into the limb buds and establish a close contact amid the differentiating mesodermal condensations and this early contact between the nerve and muscle cells is must for their entire functional differentiation (SADDLER, 2010).

It was discovered that the expanded end of an axon, the growth cone, is the principal sensory organ of the neuron (RAMON and CAJAL, 1890). Characteristically the growth cone is illustrated as an expanded region that is regularly dynamic, changing shape, extending and pulling out small filopodia and lamellipodia that evidently 'search' the local environment for a suitable surface along which extension may occur. During development, the growing axons of neuroblasts navigate with precision over extensive distances, often pursuing multifarious courses to arrive at their targets. Ultimately they make functional contact with their suitable end organs such as neuromuscular endings or synapses with other neurons.

During the outgrowth of axonal processes the earliest nerve fibers navigate significant distances over perceptible virgin areas, regularly occupied by loose mesenchyme (TENNYSON, 1969). Axon guidance is considered to involve short-range, neighboring guidance signals and long-range diffusible signals, any of which can be either attractive and accommodating, or repulsive and inhibitory for growth. Short-range signals need factors which are present on cell surfaces or in the extracellular matrix, e.g. axon extension requires a permissive, physical substrate, the molecules of which are actively recognized by the growth cone. They also require negative signals which inhibit the progress of the growth cone. Long-range cues come from gradients of distinct factors diffusing from far-away targets, which cause neurons to twist their axons in the direction of the source of the attractive signal. Once growth cones have enticed their target region, they then have to establish terminals and synapses. If neurons are unsuccessful to obtain adequate amounts of precise neurotrophic factors during the synaptogenesis, apoptosis takes place. Concurrent firing of neighbouring neurons that have found the correct target region may be entailed in eliciting discharge of factors, therefore reinforcing accurate connections. These mechanisms clarify the numerical communications between neurons in a motor pool and the muscle fibers innervated (BANNISTER, BERRY and COLLINS, 2005). It implies that apoptosis of collaterals may endow with mature neuronal architecture. Over or under expression of one or multiple factors may be responsible for the variations in the formation, relation and distribution of the motor nerve fibers. These variations could also crop up from neurotrophic factors at the time of fusion of the cords of brachial plexus.

References

BANNISTER, LH., BERRY, MM., COLLINS, P., DYSON, M., DUSSEK, JE., FERGUSON, MWJ. *Gray's Anatomy.* 38th ed. Elsevier Churchill Livingstone, 2005. p. 231-232.

BEHEIRY, EE. Anatomical variations of the median nerve distribution and communication in the arm. *Folia Morphologica*, 2004; vol. 63, n. 3, p. 313-318.

RAMON, Y and CAJAL S. *Origen y terminacion de las fibras nerviosas olfatorias.* Bacelona: GacSan, 1890. p. 1-21.

ROBERTS, WH. Anomalous course of the median nerve medial to the trochlea and anterior to the medial epicondyle of the humerus. *Annals of Anatomy*, 1992, vol. 174, n. 4, p. 309-311. http://dx.doi.org/10.1016/S0940-9602(11)80290-6

SADDLER, TW. *Langman's Medical Embryology.* 11th ed. Lippincott Williams & Wilkins, 2010. p. 150-151.

TENNYSON, VM. The fine structure of the developing nervous system. In HIMWICH, WA. *Developmental Neurobiology.* Springfield Ill, 1969. chap. 3, part 2.

UYSAL, II., SEKER, M. and KARABULUT, AK. and ZIYLAN, T. Brachial plexus variations in human fetuses. *Neurosurgery*, 2003, vol. 53, n. 3, p. 676-684. PMid:12943583. http://dx.doi.org/10.1227/01.NEU.0000079485.24016.70

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