



Multiple Variations in The Branching Pattern of The Brachial Plexus and The Brachial Artery - A Case Report

KEYWORDS

Median nerve, Coracobrachialis muscle, Brachial artery.

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ABSTRACT

In the routine dissection of the right upper limb in a male cadaver the following interesting variations were found. The median nerve was formed by union of three roots - one medial and two laterals, it was found to be medial to the brachial artery throughout the arm. The coracobrachialis muscle had an additional muscular slip of insertion to the medial supracondylar ridge of the humerus. The brachial artery trifurcated into ulnar artery, radial artery and a muscular branch. The knowledge of these anatomical variations is highly significant for radiological and surgical interventions.

Introduction:

Anomalies associated with the brachial plexus and brachial arteries were frequently reported in the existing literature. But, this kind of multiple variations are unique rarity. Knowledge of these kinds of variations are much essential for anatomists, surgeons, anaesthesiologists, physicians, cardiologists and radiologists, depicts a clear cut idea for problems arose in the area due to unusual presentations, as well as aids the way to carry out any procedures meticulously.

The formation of brachial plexus is by the union of anterior rami of lower four cervical and first thoracic spinal nerves. In the axilla, the cords and branches are seen and are related to axillary vessels. The median nerve (MN) is formed by the union of two roots - one lateral (C5, C6 and C7) and one medial (C8, T1), but in our case it was formed by three roots – one medial and two laterals, and the nerve was on the medial aspect of brachial artery in the arm till it became one of the contents of the cubital fossa. These kinds of variations in the formation and course are having greater surgical and clinical significances.

The coracobrachialis takes origin from coracoid process of the scapula and inserted into the medial border of shaft of humerus, at the level of nutrient foramen. The present case showed its unusual insertion to the medial supracondylar ridge of the humerus by its extended muscular slip. This variant insertion may result in neurovascular deficits.

In our case at the level of neck of radius, instead of bifurcating into radial and ulnar artery, the brachial artery trifurcated into radial, ulnar and an equally sized muscular branch. Awareness of these variations before any surgical procedures will help in avoiding some catastrophe.

Case report:

Variations are observed in a 60 years old male cadaver during routine undergraduate cadaveric dissection in the department of anatomy, Sri Ramachandra medical college & research institute, Porur, Chennai. Apart from these variations studied, no other congenital malformations were noticed in this cadaver.

The formation of typical Y shaped union of median nerve was observed in axilla at its normal position, in addition to two roots, an additional thin lateral root from lateral cord crossed over the 3rd part of axillary artery and joined the medial root of median nerve. In its course in arm, the median nerve was found to be medial aspect of brachial artery.

The origin of coracobrachialis was from coracoid process of scapula along with short head of biceps and it got inserted into the medial border of shaft of humerus. From its distal insertion into the medial supracondylar ridge of the humerus a fibrous sheath fanned out and got attached to the medial intermuscular septum, and finally merged with fascia covering triceps and antebrachial fascia. This distal insertion created a fibro osseous tunnel for ulnar nerve (UN) and inferior ulnar collateral artery (IUCA).

The brachial artery terminated in the normal level, but instead of bifurcation, we observed trifurcation. The brachial artery trifurcated into three equally sized vessels such as radial, ulnar and a muscular artery.

Discussion:

The median nerve (MN) is formed by the union of two roots viz., lateral (C5, C6 and C7) and medial (C8, T1). The lateral root arises from the lateral cord and the medial root arises from the medial cord of the brachial plexus, and the two roots join either anterior or lateral to the 3rd part of axillary artery¹. In the present case report, the formation of median nerve was by three roots one medial and two laterals, an additional thin slender lateral root which descended downwards and medially from the lateral cord. This root crossed over the 3rd part of axillary artery and joined the medial root of median nerve just 1.25cm above the typical 'Y' shaped formation of median nerve (Figure 1).



Figure 1- shows the formation of median nerve by three roots.
LC-Lateral Cord, LR-Additional Lateral Root, MR-Medial Root of Median Nerve, MN-Median nerve, AA-Axillary Artery.

During 7th week of gestation, limb musculature is formed by condensation of mesenchyme near the base of the limb buds. Axons of the spinal nerves grow distally to reach the developing limb buds. Probably, the axons during the devel-

opment would have taken aberrant course giving such variations in this case. Such variations are explained on the basis of embryological development².

Chauhan et al reported a case with the formation of median nerve by three roots; the additional third root was originated from musculocutaneous nerve³. There are many studies in the literature which reported the median nerve formation by three roots - one from medial cord and two from lateral cords of brachial plexus, similar to the present observation^{4,5, 6,7}. Satyanarayana et al reported that median nerve formation by four roots - three laterals and one medial root⁸.

Rao et al suggested that the vascular surgeons and radiologists should be aware of these kinds of variations while performing any interventional procedures in that region⁹. Saeed et al reported that, any injury in the proximal part of the arm leads to nerve injury ending up in a group of manifestations in the form of sensory, motor, vasomotor and trophic changes⁴.

Normally, in the upper part of arm, the median nerve lies lateral to the brachial artery, while descending it crosses the brachial artery from lateral to medial side. This crossing over occurs at the level of the insertion of coracobrachialis¹. In the present case the median nerve was found to be medial to the brachial artery in its course in the arm (Figure 2). Christina et al also observed the same variation¹⁰. The Knowledge about such kind of variations is of great clinical significance among plastic surgeons especially in post-traumatic evaluations and peripheral nerve repair¹¹.



Figure 2 - shows the course of median nerve in the arm
The nerve lies medial to the artery throughout the arm.
MN - Median nerve, BA - Brachial artery

The Coracobrachialis originates from the apex of coracoid process, and the origin is along with the short head of biceps brachii, and it gets inserted into the medial border of the shaft of humerus at the mid shaft level. Accessory slips if present may get inserted into lesser tubercle, medial intermuscular septum and medial epicondyle¹.

In the present case the origin and insertion of coracobrachialis was normal in its architecture, from its distal insertion, an additional muscular slip extended to the medial supracondylar ridge of the humerus (Figure 3). The caudal end of this extension showed a fibrous sheath which fanned out and got attached to the medial intermuscular septum. This fibrous sheath finally merged with fascia covering triceps and antebrachial fascia. This mode of distal insertion created a fibro osseous tunnel for ulnar nerve (UN) and inferior ulnar collateral artery (IUCA) (Figure 4, 5).



Figure 3 - shows the Coracobrachialis muscle and the additional musculotendinous slip.
CB- Coracobrachialis
AMS- Additional muscular slip

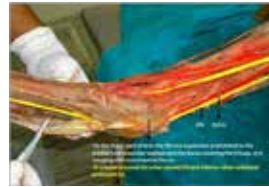


Figure 4 - shows the right elbow (Flexed)medial view.

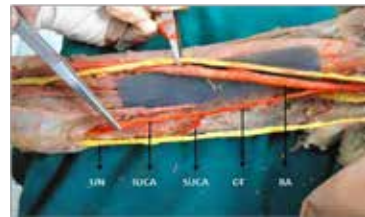


Figure 5 - shows the neurovascular bundle in the tunnel created by the variant insertion of coracobrachialis.
UN-Ulnar nerve, IUCA-Inferior ulnar collateral artery, SUCA-Superior ulnar collateral artery, CT-Common trunk, BA-Brachial artery.

Grim M et al reported that during embryological development muscle primordial fails to disappear and might be reason for the presence of an unusual lengthy accessory insertion (may be representing coracobrachialis longus)¹⁴. Many author's quoted in the literature that these kinds of variations were the downward extensions of the superficial part which extended up to the medial epicondyle^{15, 16, 17}. Wood also described the same but the extended insertion as a ligamentous band which covered the ulnar nerve, and he stated that if an anomalous supracondylar process (supratrochlear spur) was present the band is likely to get inserted into that¹⁶. Guha et al reported that an additional muscular tendon passed inferiorly, crossing over median nerve and brachial artery anteriorly, before it got attached to the medial epicondyle of the humerus resulted in neurovascular compression syndrome¹⁸ and the variations described were similar to the present case.

Sometimes a fibrous strip from the coracobrachialis tendon passes downwards from its humeral insertion to the long head of triceps which is the homologue of the dorso-epitrochlearis brachii of apes and it may lead to wasting ulnar flexors of the forearm¹. The knowledge about this kind variation was very much helpful in using coracobrachialis as a transposition flap while correcting the deformities of infraclavicular, axillary areas and in post-mastectomy reconstruction¹⁹. The vascularised coracobrachialis muscle is important while performing anterior compartmental arm surgeries in case of trauma, tumour and neurovascular disease as well as in the treatment of longstanding facial paralysis²⁰. The existence of abnormal insertion should always be kept in mind in a patient presenting with ulnar nerve entrapment together with symptoms of artery compression.

Normally, at the level of neck of radius, the brachial artery divides into two terminal branches, namely radial and ulnar arteries. But in our present case, instead of bifurcation brachial artery trifurcated into three equally sized vessels such as radial, ulnar and a muscular artery (Figure 6) .



Figure 6 - shows the trifurcation of brachial artery at the neck of radius into radial artery, ulnar artery and muscular artery.
BA - Brachial artery, RA - Radial artery, UA - Ulnar artery, MA - Muscular artery.

Trifurcation of brachial artery was reported by many authors in the literature, but most common third artery encountered was either common interosseous artery or median artery, but never radial recurrent artery^{21, 22}. In our case, the third artery was muscular artery (Figure 6) which disappeared by passing deep to the muscle in its downward course.

Conclusion:

Anatomical variations of the peripheral nerves can result in nerve palsy syndromes. The distribution and the branching patterns of nerves of upper limb are very much important for clinico-surgical evaluation and the treatment of these syndromes. Neurovascular entrapment due to extended insertion of coracobrachialis muscle was observed in this case at the elbow which may result in clinical symptoms. Anatomists and surgeons should be aware of these variations while performing meticulous dissection and surgeries in order to prevent any damage to the structures. Knowledge of existence of variations in the brachial artery is very much essential for physicians, surgeons, radiologists, cardiologists, vascular and plastic surgeons .

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