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VARIATIONS IN THE FORMATION OF THE CORDS OF BRACHIAL PLEXUS – A CASE REPORT

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<p>Article Info <i>Received 15/02/2015</i> <i>Revised 27/03/2015</i> <i>Accepted 12/04/2015</i></p> <p>Key words: Brachial plexus; Variations, Anomaly, Trunks, roots, Nerve.</p>	<p>ABSTRACT Brachial plexus is a complex structure, variations in formation of roots, trunks, divisions and cords are common. During routine dissection of a 55-year-old male cadaver, a rare case of variation of the brachial plexus characterized by the presence of only two cords on the right side was observed. Similar variation was not observed on the contra-lateral side. Our aim is to contribute to existing knowledge of the variations in the Anatomy of Brachial plexus, explaining its morphological and clinical significance. The details of this variation and its clinical significance are discussed herein.</p>
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INTRODUCTION

Brachial plexus is formed by the union of the ventral rami of the lower 4 cervical nerves and the greater part of the ventral ramus of the first thoracic nerve (C5-T1). The fourth cervical nerve usually gives a branch to the fifth cervical, and the first thoracic nerve frequently receives one from the second thoracic. The contributions made to the plexus by C4 and T2 are subject to frequent variation.

The upper trunk of the plexus is formed by the union of ventral rami of C5 and C6; middle trunk is formed by the C7 root and the lower trunk is formed by the union of ventral rami of C8 and T1. Each trunk divides into ventral and dorsal divisions. The ventral divisions of upper and middle trunks join to form the lateral cord; the ventral division of the lower trunk continues as the medial cord and the posterior divisions of all three trunks join to form the posterior cord of the brachial plexus. The lateral cord gives 3 branches i.e. lateral root of the median nerve, lateral pectoral nerve and the musculocutaneous nerve. The medial cord gives 5 branches i.e. medial cutaneous nerve of the arm, medial cutaneous nerve of the forearm, medial pectoral nerve, medial root of the median nerve and ulnar

nerve. The posterior cord gives 5 branches i.e. upper subscapular nerve, lower subscapular nerve, thoracodorsal nerve, axillary nerve and radial nerve. The roots and trunks of the brachial plexus are sandwiched between the scalenus anterior and medius muscles. The cords are arranged around the axillary artery, the lateral cord lying lateral to the artery, the medial cord medial to it, and the posterior cord dorsal to the artery. The branches are given off from the cords in the axilla. It gives cutaneous and muscular branches to the upper limb, and any injury at this level can lead to significant disability.

As the brachial plexus supplies cutaneous and muscular innervations to the upper limb, its anatomical variations have important clinical implications. Therefore, it is important for the anatomist, surgeon, anesthesiologist, and radiologist to be aware of anatomical variations that deviate from the classic anatomy.

Case report

This case was reported during routine dissection of a 55-year-old embalmed male cadaver conducted for undergraduate medical students in the Department of

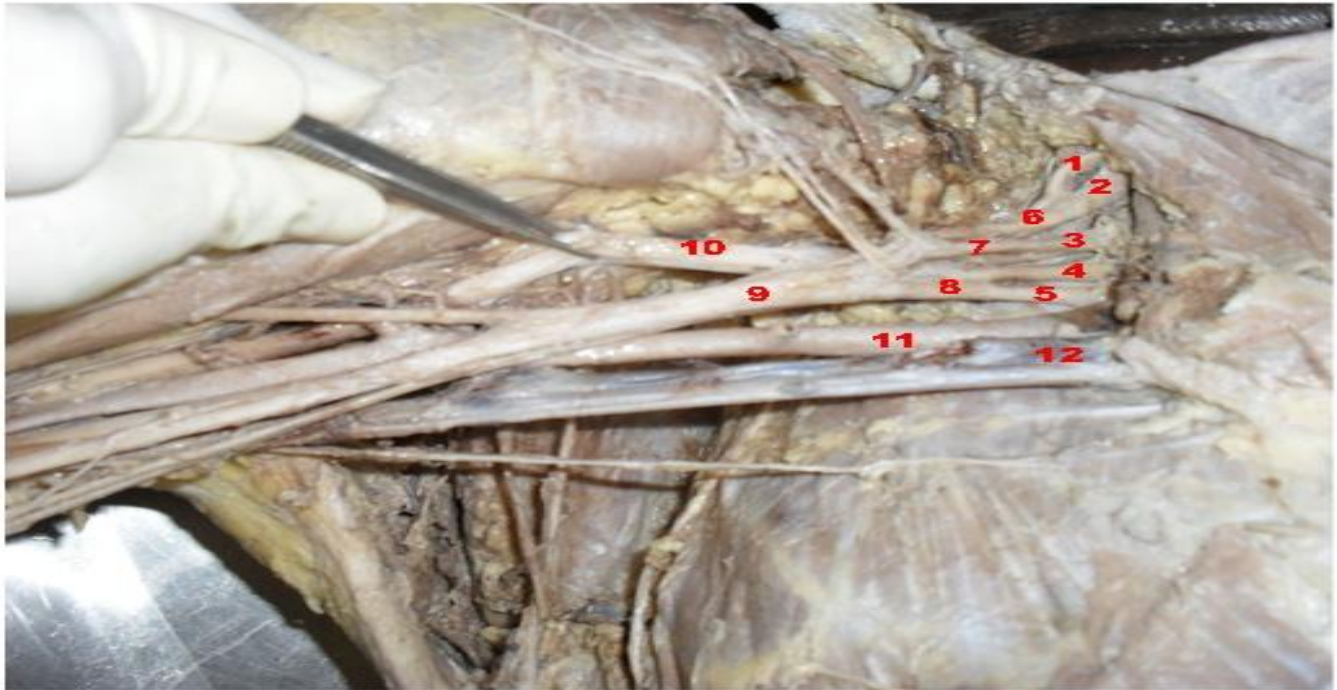


Anatomy, KMC International Center, Manipal. Unilateral variation of the brachial plexus was observed at the cord level.

Ventral divisions of all the three trunks on the right side joined to form superior cord and posterior divisions of all the three trunks joined to form inferior cord, instead of three cords namely lateral, medial and posterior cords normally. Superior cord represented union of lateral and medial cords. Inferior cord represented

Posterior cord. The branches of lateral and medial cords were given off by the superior cord. The superior cord gave musculocutaneous, median, ulnar nerves, medial cutaneous nerve of arm and forearm, medial and lateral pectoral nerves. The inferior cord gave, upper and lower subscapular, thoracodorsal, radial, and axillary nerves. Further course and distribution of these branches from superior and inferior cords were normal.

Figure 1.



1. Anterior primary ramus of C5
2. Anterior primary ramus of C6
3. Anterior primary ramus of C7
4. Anterior primary ramus of C8
5. Anterior primary ramus of T1
6. Upper trunk of brachial plexus
7. Middle trunk of brachial plexus
8. Lower trunk of brachial plexus
9. Superior cord of brachial plexus
10. Inferior cord of brachial plexus
11. Axillary artery
12. Axillary vein

DISCUSSION

Brachial plexus is a complex structure, variations in formation of roots, trunks, divisions and cords are common. Embryologically the guidance of developing axons is controlled by chemoattractants and chemorepellants. Deviation from normal signaling between mesenchymal cells and neuronal growth cones may lead to significant variations. It is very important to be aware of the variations of the cords of the brachial plexus and its relation to axillary artery during neurotization of brachial

plexus lesions, shoulder arthroscopy by anterior glenohumeral portal and during reconstructive surgery of the shoulder joint. Unusual relationship of axillary artery with cords fails the nerve block of infraclavicular part of brachial plexus. Injury to Superior cord could result in serious compromise of upper limb function. This type of variation could have potential clinical implications while performing axillary surgery [1]. The ventral rami of the C5 and C6 nerve roots, without joining to form the superior



trunk, independently divided into anterior and posterior divisions, which joined the lateral and posterior cords, respectively. Additionally, the suprascapular nerve that normally originates from the superior trunk initiated exclusively from the C5 nerve root in this variation. Variation of the suprascapular nerve characterized by direct origin from the C5 nerve root may have clinical implications in the setting of a cervical nerve root impingement. The absence of the superior trunk may increase the likelihood of nerve root avulsion in the context of traction injury of the brachial plexus. Moreover, the variation may have clinical implications during the anesthetic administration of an intrascalene nerve block [2].

Variations in the branching pattern of brachial plexus can be due to unusual formation in the development of trunks, divisions and cords. Explanation of anatomical variations of brachial plexus can be traced by understanding normal embryological development of it. Its development starts at 34th to 35th day of intrauterine life and definitive adult pattern is evident by 46th to 48th day of intrauterine life. Axillary artery has an important association to the divisions of the cords. Thus during development, if axillary artery had variant relation to brachial plexus, the divisions of the cords would be modified [3].

The knowledge of variations in the formation of brachial plexus is very useful for neurosurgeons. It will be of great use in the surgical treatment of tumors of nerve sheaths such as schwannomas and neurofibromas. The awareness of the variations might also help in treating the non-neural tumors like lipoma. Orthopedic procedures of the cervical spine also need a thorough knowledge of the normal and abnormal formation of brachial plexus. Since the roots and trunks of brachial plexus show variations, and the variations can be found by ultrasound examinations, it is better to look for variations before planning the surgery in this area. Though the variation of the brachial plexus may not alter the normal functioning of the limb of the person, it is very important in clinical neurosurgery and orthopedic procedures [4].

Knowledge of variations in anatomy is important to anatomists, radiologists, anesthesiologists and surgeons, and has gained more importance due to the wide use and reliance on computer imaging in diagnostic medicine. Also, the presence of anatomic variations of the peripheral

nervous system is often used to explain unexpected clinical signs and symptoms. But according to our study, the plexuses did not show that sex, color or side of the body had much if any influence upon the presence of variations [5].

The anatomical arrangement of brachial plexus is complicated. It is necessary to be aware of the individual variations in the development of the clinical picture, diagnosis and surgical treatment, because it can prevent surprises from some findings during surgery. Our study enabled to identify and describe exceptional and hitherto undescribed anatomical variations in the formations of the nerve roots of brachial plexus [6].

Occasionally the fibres of the posterior cord may arise from only the seventh and eighth cervical nerves. The first thoracic nerve may fail to contribute to the posterior cord or may be the sole source of the medial cord. Instead of the usual three cords, only two cords, a smaller and larger, may be present. In such cases, the larger cord will replace either the medial and lateral or the medial and posterior cords. Cases of a single cord have been reported [7].

Morphologically the brachial plexus still shows, despite much adaptation to the evolutionary changes in the upper limb musculature, a clear reflexion of the original flexor-extensor organization of a primitive fin. The posterior cord represents the extensor nerve supply, the medial and lateral cords, and the flexor supply [8].

CONCLUSION

It is very important to be aware of the variations of the cords of the brachial plexus and its relation to axillary artery during neurotization of brachial plexus lesions, shoulder arthroscopy by anterior glenohumeral portal and during reconstructive surgery of the shoulder joint, in the surgical treatment of tumors of nerve sheaths such as schwannomas and neurofibromas, so that it can prevent surprises from some findings during surgery. The awareness of the variations might also help in treating the non-neural tumors like lipoma. Orthopedic procedures of the cervical spine also need a thorough knowledge of the normal and abnormal formation of brachial plexus. Though the variation of the brachial plexus may not alter the normal functioning of the limb of the person, it is very important in clinical neurosurgery and orthopedic procedures.

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