BILATERAL TWO TRUNKED BRACHIAL PLEXUS- A CASE REPORT

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ABSTRACT

During the routine under graduate dissection of upper limb of an adult male cadaver, a variant pattern of bilateral two trunk brachial plexus was encountered. On both right and left sides, the upper trunk was formed as usual i.e. by fusion of C_5 and C_6 roots. Roots of C_7 , C_8 and T_1 fused to form a single trunk (termed as lower trunk in this case). Knowledge of such variations is of interest to anatomists, clinicians, anesthesiologists and especially to the surgeons. The aim of our study is to provide additional information about abnormal brachial plexus and its clinical implications. Such kind of variation is of immense importance during surgical exploration of axilla and arm region and also during nerve block. It also helps clinicians in proper understanding of some previously unexplained clinical symptoms. Further the ontogeny, phylogeny and clinical implications are discussed in detail.

Key Words: Brachial Plexus, Trunk

INTRODUCTION

Variation is the law of nature. Every human is unique anatomically to such an extent that even identical twins are not exactly alike (Romanes, 1986). Variations of brachial plexus and its terminal branches are not uncommon and have been documented as prefixed or postfixed plexus or communications between different branches (Kerr, 1918 and Hollinshed, 1958). Usually the brachial plexus is formed by the ventral rami of spinal nerves C_{5} - C_{8} and T_{1} . The ventral rami of C_{5} and C_{6} unite to form the upper trunk, C $_{7}$ becomes the middle trunk, and C_{8} and T_{1} form the lower trunk. These three trunks bifurcate into anterior and posterior divisions. All the posterior divisions unite to form the posterior cord. The lateral cord is formed by the union of anterior divisions of the upper and middle trunk. The medial cord is formed as a continuation of anterior division of the lower trunk (Williams *et al.*, 1995)

For a surgeon to have the variational pattern of brachial plexus at his finger's ends is essential in light of not only the frequency with which surgery is performed in the axilla and the surgical neck of humerus (Leffert, 1985 and Uysal *et al.*, 2003) and the rapid development of microsurgical techniques (Andrzejczak *et al.*, 2001) but also to give explanation when encountering an incomprehensible clinical sign (Gumusburun And Adiguzel, 2001).

Apart from the surgeon, the brachial plexus variations are of interest not only to the radiologist and anaesthesiologist placing needles in the neck to administer anaesthetic blocks but also to the neurosurgeons, neurologist, vascular surgeons and orthopaedic surgeons (Makhoul and Machleder, 1992 and Collins *et al.*, 1995).

Harry, Bannett and Guha, (1997) lamented that though such anatomical variations may be clinically significant, yet many are inadequately described or quantified. One such case having two trunks of brachial plexus on both the sides of the same cadaver was encountered in our department which is being reported here.

CASES

During the routine under graduate dissection of upper limb of an adult male cadaver in the department of anatomy, Govt. medical College, Amritsar, India, the following variants of brachial plexus were encountered.

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On right side, the upper trunk was formed as usual i.e. by fusion of C_5 and C_6 roots. Roots of C_7 , C_8 and T_1 fused to form a single trunk (termed as lower trunk in this case). Lateral cord was formed from fibres coming from anterior division of upper trunk (C_5 , C_6) and fibres coming from anterior division of lower trunk (C_7 , C_8). The medial cord was formed by fibres of anterior division of lower trunk (C_8 , T_1). Further branching of lateral and medial cord was normal figure 1.



Figure 1: Showing Two Trunked brachial Plexus on right Side

Axillary artery AA: Roots of brachial plexus C.-T.: Medial cord MC: MCN: Musculocutaneous nerve Median nerve MN: Medial root of median nerve MR: Lateral cord LC: Lateral root of median nerve LR: Lower trunk LT: Suprascapular nerve SSN:

On the left side, upper trunk was formed as usual i.e. by fusion of C_5 and C_6 . Roots of C_7 , C_8 and T_1 joined to form one trunk (termed as lower trunk). This lower trunk gave two anterior divisions upper and lower and one posterior division. The upper anterior division joined with anterior division of upper trunk to form lateral cord. The lower anterior division continued as medial cord (further distribution being normal). The posterior division of lower trunk joined with posterior division of upper trunk to constitute posterior cord figure 2.

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Figure 2: Showing Two Trunked brachial Plexus on left Side

- AA: Axillary artery
- AN: Axillary nerve
- C₅-T₁: Roots of brachial plexus
- MCN: Musculocutaneous nerve
- MN: Median nerve
- MR: Medial root of median nerve
- MCFA: Medial cutaneous nerve of forearm
- LAD: Lower anterior division of lower trunk
- LC: Lateral cord
- LR: Lateral root of median nerve
- LT: Lower trunk
- PC: Posterior cord
- SSN: Suprascapular nerve
- UAD: Upper anterior division of lower trunk
- UN: Ulnar nerve
- UT: Upper trunk

DISCUSSION

Variations in relation to origin of roots, formation of trunks, divisons, cords and branches have been reported earlier by many workers (Kerr, 1918; Singer, 1932; Omer and Spinner, 1980 and Uysal et al.,

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2003). However such a variation with formation of two trunks instead of three and that too on both sides of the same cadaver is extremely rare. Only Nayak *et al.*, (2005) had earlier encountered an absence of middle trunk with C_7 root joining C_5 and C_6 to form upper trunk; the lower trunk being formed by C_8 and T_1 .

But their case was a unilateral one. So the case being reported here is different from theirs in two aspects. One, the C_7 root joins C_8 and T_1 to form lower trunk in our case instead of with C_5 , C_6 to form upper trunk. Secondly, our case showed bilateral representation which is even rarer.

Earlier, Singer (1932) had reported a case in which all the three trunks had fused to form a single cord. This may be slightly similar to our one in that there all the three trunks were fused but in our case we can say middle and lower trunk fused forming one common trunk. But our case is a bilateral one while Singer (1932) was silent about the condition of the contralateral limb of his cadaver.

Ontogeny

According to Keibel and Mall (1912) the base of the arm bud is situated opposite the lower four scervical and first thoracic vertebra. There is some variation in the position of the limb buds relative to the spinal axis at the time of entrance of the spinal nerves opposite the base of each limb bud. The anterior primary division of spinal nerves undergo an exuberant growth and form a solid sheet or plexus of fibres extending towards the base of the limbs.

Rao and Chaudary (2000) are of opinion that developmentally the human brachial plexus appears as a single radicular cone in the upper limb bud. Initially a plexus is formed by anastmoses between spinal nerves and then it develops into a solid plate that finally divides into separate trunks. Early in the development the successive anterior primary rami are joined by connecting loops, especially in the cases of the nerves supplying the limb bud to form cervico brachial plexus. The posterior division supplies the extensor muscles and surface and anterior division supply the flexor muscles and surface (Hamilton *et al.*, 1962). According to Keibal and Mall, (1912) the brachial plexus consist of a continuous sheet of fibres which on reaching the developing humerus is split into a dorsal and ventral division, the former corresponds to the posterior cord and latter to the lateral and medial cord.

The guidance of the developing axons is regulated by expression of chemoattractants and chemorepulsants in a highly co-ordinated site specific fashion.

Tropic substances such as brain-derived neurotropic growth factor, *neutrin-1*, *neutrin-2*, *c-kit ligand* etc. attract the correct growth cones that happen to take the right path (Larson, 2001). Any alterations in signalling between mesenchymal cells and neuronal growth cones or circulatory factors at the time of fission of brachial plexus cords can lead to significant variations (Sannes *et al.*, 2000).

Ontogenically, the present variation may be due to failure on part of radicular cone of nerves of upper limb to divide into different trunk. It may be attributed to the disproportionate display of chemoattractants and chemorepulsants.

Phylogeny

If we trace the phylogeny, no trunk formation is seen in amphibians, reptiles and dogs. Two trunks are formed in Marsupials and Lemurs. However in them the two lowest roots form an inferior trunk and others a superior trunk. Similarly in Gorilla, two trunks are formed with root value $C_{4, 5, 6}$ for the first trunk and $C_{7, 8}$, T_1 for the second trunk. Thus the present case is more close to gorilla with upper trunk formed from C_5 , C_6 roots (C_4 not contributing on either side) and lower trunk from C_7 , C_8 , T_1 .

Clinical Implications

The knowledge of variations in the formation of brachial plexus is important not only for the anatomist but also for the radiologists, anesthesiologists, neurosurgeons and orthopedic surgeons (HARRY, 1997).

Such a variant brachial plexus with two trunks, the lower trunk having root value C_7 , C_8 , T_1 may give confusing clinical picture if affected by Klumpke's paralysis. In such cases, the injury may not remain to T_1 or C_8 only rather it may extend to C_7 as well so the clinician must be familiar with such an anomaly when encountering an extended Klumpke's paralysis case.

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