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REVIEW ARTICLE

The Medial Brachial and Antebrachial Cutaneous Nerves of Posterior Cord Origin and Their Clinical Implications

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Abstract

A unilateral occurrence of the medial brachial and antebrachial cutaneous nerves originating from the posterior cord of the brachial plexus in the right upper limb of a 69 year- old male cadaver is discussed. This followed multiple branching variations including the fusion of the upper and middle trunks, generating a pair of trunks, one large superiorly and one small inferiorly. The posterior cord of the brachial plexus usually formed by the union of 3 separate posterior divisions was replaced by a fused superior and middle posterior divisions from the fused superior and middle trunks uniting with the inferior posterior division coming from the inferior trunk. Incidence of the medial brachial and medial antebrachial cutaneous nerves, which normally are derived from the medial cord taking origin from the posterior cord of the brachial plexus is very rare. It is important to understand the relevant anatomy of these cutaneous nerves, most especially that of the medial antebrachial during cubital tunnel surgery to avoid significant postoperative morbidity. Aberrant origins of these 2 medial cutaneous nerves are rare. Knowledge of branching variations of the brachial plexus are of importance to surgeons involved in the selection of nerves for appropriate end to end surgical re-anastomosis and the selection of appropriate surgical procedures, for efficient nerve block and in the correct interpretation of sonographic images by neuro-radiologists.

Introduction

The brachial plexus is a network of nerves formed by the anterior rami of four cervical nerves and first thoracic nerve (C5, C6,C7,C8 &-T1). Originating from the neck region, the many nerves of the brachial plexus engage in 3 trunk formation, 3 anterior and posterior divisions and a final recombination to form 3 cords, lateral, medial and posterior, so named after their topological relationship of these cords to the axillary artery (AA). The joining and separation into sets of threes occurs as the brachial plexus courses between the anterior and middle scalene muscles. Cord formation is followed by the brachial plexus giving off its principal terminal /peripheral nerves; chiefly the musculocutaneous (MCN) from the lateral cord, the ulnar (UN) from the medial cord, the axillary and radial nerves from the posterior cord respectively, while the median nerve (MN) is formed by contributions from both the lateral and medial cords. Subtypes of the brachial plexus could be as a result of its relationship to the clavicle. Subtypes of the brachial plexus could be as a result of its relationship to the clavicle; supraclavicular when proximal or infraclavicular when distal to the clavicle

Another nomenclature is the brachial plexus being described as either prefixed or post- fixed; prefixed when it contains C4 (C4-T1) or as post-fixed with a T2 component (C5-T2). Bonnel, F (1984) and Uysal et al (1953) reported that in 2.5-4% of cases, the T2 root contributes to the plexus. [1,2]. Bonnel described the “prefixed” and “post-fixed” subtypes in adult specimens finding 41 of 100 being “prefixed” and 4 of 100 being “postfixed” [1]. In many specimens, no inferior trunk exists [2].

The usual five branches of the medial cord of the brachial plexus include, the medial pectoral, the medial root contribution to the MN, the ulnar nerve and 2 cutaneous nerves; the medial brachial cutaneous (MBC) and the medial antebrachial cutaneous nerves (MABC) nerves respectively. The MABC emerges from the deep brachial fascia at the middle of the arm to run with the basilic vein, crossing it. The MBC and the MABC arise from the medial cord and innervate the skin of the medial arm and forearm, respectively. The MBC, is the smallest branch of the brachial plexus arising from the side branches of the medial cord from the eighth cervical and first thoracic nerves. The course of the MBC generally parallels the UN as it moves down the medial aspect of the arm. It quickly begins to branch to innervate the skin of the medial arm. In 90% of cases, this nerve communicates with the intercostobrachial nerve, which

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has its origin from the second intercostal nerve. Race C.M and Saldana M.J (1991) reported that the MBC gives off two to five terminal branches, 2 or 3 cm proximal to the medial epicondyle **[3].** The MABC nerve also courses distally, parallel to the ulnar nerve, lying lateral to it and medial to the brachial artery. Often, the MABC provides a branch to the medial aspect of the distal arm, and approximately 2 cm proximal to the medial epicondyle divides into five to eight branches to supply the skin over the olecranon and the ulnar aspect of the forearm (Race C.M. and Saldana, M.J (1991**) [3].** The MBC and the MABC arise from the medial cord and innervate the skin of the medial arm and forearm, respectively. The MBC, is the smallest branch of the brachial plexus arising from the side branches of the medial cord from the eighth cervical and first thoracic nerves. The course of the MBC generally parallels the UN as it moves down the medial aspect of the arm. It quickly begins to branch to innervate the skin of the medial arm. In 90% of cases, this nerve communicates with the intercostobrachial nerve, which has its origin from the second intercostal nerve

Case Report

During routine dissection of the upper limbs of a 67 year-old male cadaver, we encountered multiple variations in the branching of the right brachial plexus, occurring in both the supraclavicular (Figure 1a) and infraclavicular (Figure 1b) portions of the plexus

In the supraclavicular region, we observed the fusion of the upper and middle trunks, resulted in 2 instead of the usual 3 trunks typical of the brachial plexus (Figure 1a). In addition instead of the usual 3 posterior divisions of the plexus which normally join to form the posterior cord, in our cadaver.

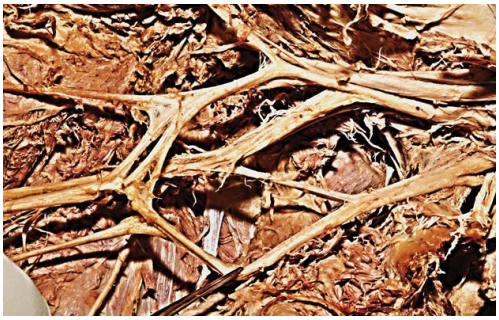

Figure 1a: Images shows the roots, trunks and formation of the brachial plexus in the R upper limb of a year-old cadaver. The 5 roots (C5-T1) are demonstrated. .There is a fused superior and middle trunks, while the inferior posterior division arises normally from the inferior trunk (C8 &T1). The lateral cord from the fused trunk gave 3 roots contributions, joining the medial root to form the median nerve. The posterior cord is formed from a common stem derived from the fused trunk joined by a posterior division from the inferior trunk.
FSMT; Fused superior and middle trunks, IT; inferior trunk. MC; medial cord, MR-medial root of the median nerve. LC; lateral cord. 1,2,3,; lateral roots of the median nerve contributed by the lateral cord, UN; ulnar nerve, MN; median nerve, MCN; musculocutaneous nerve, FPD; fused posterior divisions from upper and middle trunks.

Figure 1b: This picture shows the radial nerve as the final terminal branch of the posterior cord. Other posterior cord branch is the thoracodorsal nerve.
The ulnar nerve arises normally from the medial cord, but the medial cutanepous and medial antebrachial cutaneous nerves were derived from the posterior cord and given off medially to the ulnar nerve , arising from the radial nerve.
MBC; medial brachial cutaneous nerve, MABC; medial antebrachial cutaneous nerve, RN; radial nerve, TDN; thoracodorsal nerve.

Both cutaneous nerves coursed medially to the ulnar nerve and more medially arising from the radial nerve. The relationship of the peripheral nerves coursing inferiorly and medial to the brachial artery were unchanged. The branching patterns in both the supraclavicular and infraclavicular portions in the left brachial plexus were observed to be normal

Discussion. Among the ventral primary rami contributing to the brachial plexus, the upper two rami [C5 and C6] join, as do the lower two rami [C8 and T1]. The middle ramus [C7] continues on its own. The five ventral primary rami are thereby reduced to three nerve trunks. Each trunk then separates into an anterior and posterior divisions. All three posterior divisions unite into a single posterior cord. Variations between peripheral nerves of the brachial plexus are related more to communications between members, with most of these between the MCN and MN.

Veniaratos D and Anagnostopoulu S (1988) reported 22 communications in 16 out of 79 cadavers [**4**] . There are reports of the MCN running entirely fused with the lateral root or with the MN itself, before emerging as twigs supplying their respective flexor arm muscles [**5**]. Communications between UN and MN are restricted mostly to communications in the distal forearm region and are classified either as Martin Gruber anastomosis or as Marinacci anastomosis, a reversed type of the Martin Martin Gruber anastomosis [**6**].

Villamere et al. (2009) reported a rami of C5 and C6 independently divided into anterior and posterior division which joined the lateral and posterior cords respectively [**7**]. It is common for no discrete posterior cord to form; the posterior divisions, instead diverge to give rise to the terminal nerves and branches directly [**3**].Other described variations in the brachial plexus include failure of T1 to contribute to the posterior cord; also, the T1 root may be the only contribute to the medial cord. A pair of cords, one large and one small may replace the usual pattern of 3 cords [**8**]. Johnstone M. Muthoka et al (2001) studied the variations in the branching of the posterior cord of the brachial plexus in in a Kenya population and reported

8 of the 75 (10.7%) had the classical branching i.e., Upper subscapular, thoracodorsal , axillary and radial nerves in that order [**9**].

Aberrant variants of the MCB and MABC are not common. In about 10% of the population, the MABC communicate with the MBC or the ulnar nerve. Often, the MABC provides a branch to the medial aspect of the distal arm, and approximately 2 cm proximal to the medial epicondyle divides into five to eight branches to supply the skin over the olecranon and the ulnar aspect of the forearm [**10**].

The posterior branch of the MABC courses in proximity to the cubital tunnel and is particularly prone to injury during ulnar nerve release at the elbow. Inadvertent injury to medial antebrachial cutaneous nerve branches during surgery can result in the formation of painful neuromas that can be misdiagnosed as recurrent disease. Selective radial nerve block in our cadaver will lead to analgesia in the skin areas supplied by the MBC and MACN, while on the other hand, absent analgesia in the skin areas supplied by the MCN and MCAB nerves can be explained by such aberrant origins in selective medial cord anesthetic block.

Conflict of Interest

None.

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