Original Research Article

A cadaveric study on anatomy of axillary nerve and its clinical importance

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Abstract

Background & objectives: The axillary nerve is one of the terminal branches of the posterior cord of the brachial plexus, and it is frequently injured during orthopaedic procedures, shoulder dislocations, and rotator cuff tears. All of these possible iatrogenic injuries are the result of a lack of understanding of the nerve's anatomical differences. As a result, it is critical to investigate its possible variations and provide guidance to surgeons in order to improve clinical outcomes by lowering risk and complications. **Materials and methods:** 72 cadavers adult embalmed (55 males and 16 females), both right and left sides were dissected as per standard dissection methods. **Results:** The division of axillary nerve into anterior and posterior branches occur in quadrangular space and within deltoid muscle in 84.5% and 12% respectively.Posterior cord was formed by union of posterior division of C_5 and C_6 roots with posterior division of middle and lower trunk (there was no upper trunk) in 15.2% (11/72) of upper extremities . Posterior cord of brachial plexus was present lateral to the second part of axillary artery in 18% (13/72) of upper extremities. Axillary nerve was taking origin from posterior division of upper trunk in 9.7 % (7/72) upper extremities and thoracodorsal nerve arising from axillary nerve in 22.2% (16/72) upper extremities. **Conclusion:** It is important to be aware of such variations while planning a surgery in the region of axilla as these nerves are more liable to be injured during surgical procedures.

Keywords: Anatomy; Axillary Nerve; Orthopaedic surgery; Shoulder region.

Introduction

The axillary nerve or the circumflex nerve is a nerve of the human body, that originates from the brachial plexus (upper trunk, posterior division, posterior cord) at the level of the axilla (armpit) and carries nerve fibers from C5 and C6[1,2]. The axillary nerve travels through the quadrangular space with the posterior circumflex humeral artery and vein to innervate the deltoid and teres minor.

The axillary nerve may be encountered in the inferior margin of this interval where it runs along the subcapularis prior to diving into the quadrangular space. Laterally, it is traditionally located lateral to the proximal humerus, coursing from posterior to anterior around the proximal humerus[3]. Careful preservation of this nerve is critical, particularly in the setting of arthroplasty. Even so, neurologic lesions are relatively frequent and well-documented complications of reverse total shoulder arthroplasty[4]. Though many anatomic and cadaveric studies exist describing the location and course of the axillary nerve in this region, none have described an axillary nerve bypassing the quadrangular space and remaining anterior to the humerus within the deltopectoral interval to innervate the deltoid muscle.

It is very much necessary to appreciate the exact anatomical location of the nerve and its course to avoid the possible damages and to protect the nerve during surgeries and injections. Therefore, the objective of this present study is to explore the normal anatomy and possible variations of the axillary nerve in order to guide the surgeons and practitioners to be aware of them, and to have precise knowledge about prevalence of such variations and its clinical implication.

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Materials and methods

After the approval of the Institutional Ethical Committee, a total of 72 shoulder region specimens from 36 human adult embalmed cadavers (55 males and 16 females), belonging to both right and left sides during first year M.B.B.S undergraduates' dissection in the 4 academic years from 2018-2021 in the Department of Anatomy,JJM Medical College, Davanagere, Karnataka.

The formalin-fixedcadavers, that is 72 upper extremities constitute the material for study. During routine dissection of axilla and supraclavicular region of medical undergraduates, the skin and various muscles were reflected and superficial fascia and deep fascia were separated to visualize the formation and branching pattern of posterior cord.

Results

Study recorded variations in the formation, location, and branching pattern of posterior cord. The axillary nerve in all the specimens observed to take origin from the posterior cord of brachial plexus giving anterior & posterior branches in quadrangular space (segment of the nerve from subscapularis to long head of triceps) & beneath the deltoid muscle in 84.7%(61/72)&9 %(9/72) respectively. In all the specimens, the axillary nerve found to course from origin to inferior border of subscapularis, then to long head of triceps, surgical neck of humerus finally runs beneath the deltoid muscle. Posterior cord was formed by union of posterior division of C_5 and C_6 roots with posterior division of middle and lower trunk (there was no upper trunk) in 15.2% (11/72) of upper extremities . Posterior cord of brachial plexus was present lateral to the second part of axillary artery in 18% (13/72) of upper extremities. Axillary nerve was taking origin from posterior division of upper trunk in 9.7 % (7/72) upper extremities and thoracodorsal nerve arising from axillary nerve in 22.2% (16/72) upper extremities . Upper subscapular, lower subscapular, and radial nerve origin were normal in all 36 cadavers.

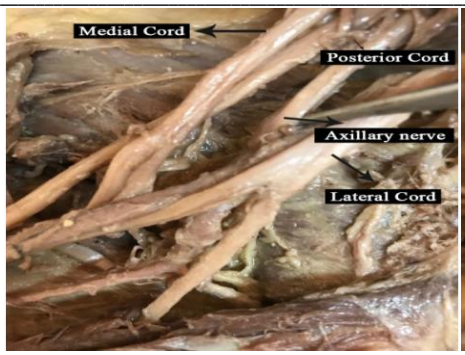

Fig 1: Showing the Origin of axillary nerve from upper trunk and cards of brachial plexus

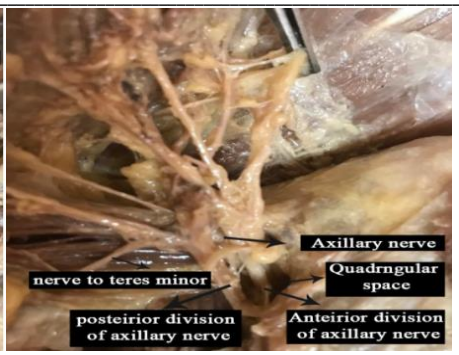

Fig 2: Showing the axillary nerve passing through quadrangular space with 2 divisions

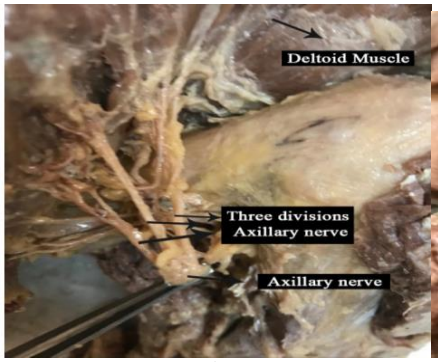

Fig 3: Showing the variatiom -3 divisions of axillary nerve instead of 2 divisions

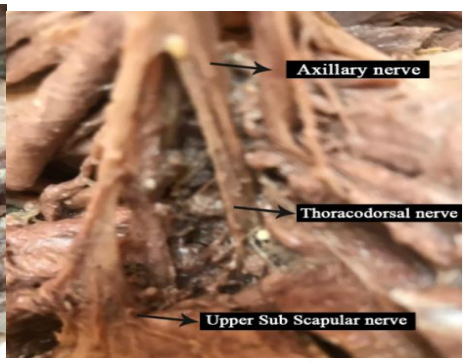

Fig 4: Showing the origin of thoracodorsal nerve from axillary nerve

Fig 5: Showing the variation-axillary artery lies lateral to axillary nerve

Discussion

A thorough understanding of the human brain system anatomy can pave the way to success in elective neurosurgery. Because of the urgent conditions of traumatised patients, quick surgical response in an emergency situation necessitates a thorough understanding of the human brain system anatomy. Variations in human anatomy are one of the most important challenges. The extremities, particularly upper limbs, are susceptible to traumas, but unfortunately, the anatomical variations of brachial plexus are not rare[5,6,7]. More than 50% of anatomical variations in cadaveric studies of human neural system have been reported to belong to the brachial plexus. The plexus supplies both motor and sensory innervations to the upper limb as well as the extrinsic thoracic muscles. The brachial plexus is constituted by the ventral rami of spinal cervical nerves including C5-C8 and the first thoracic spinal nerve T1. A complex of nerves originating from the neck and axilla shapes the brachial plexus. The brachial plexus extends laterally towards the cervico-axillary canal located below the clavicle, but above the first rib and then enters the axilla through this passage. The brachial plexus provides a network of terminal nerves innervating the upper limb[8,9,10].In present study division of axillary nerve into anterior and posterior branches occur in quadrangular space and within deltoid muscle in 84.5% and 12% respectively. Mario Loukas et al.[11], studied the axillary nerve in 50 human cadavers and observed that it took origin from the posterior cord in all the specimens and enter the quadrangular space descending infero laterally on the anterior surface of subscapularis muscle. They observed that the nerve gave branches to anterior, middle, and posterior parts of the deltoid; a branch to teres minor and the superior lateral brachial cutaneous nerve.

In the present study we also observed C_5 and C_6 ventral rami dividing independently into anterior and posterior divisions (there was no upper trunk) the posterior divisions of C_5 and C_6 then united with the posterior divisions of middle and lower trunk to form posterior cord in 15.2%(11/72) of upper extremities. Instudy done byFazan et al[12]. observed that the posterior cord was formed by posterior division of upper and middle trunk (there was no lower trunk) in 9% of brachial plexus however Chaudhary et al[13]. reported the presence of four

trunks in brachial plexus, namely, I, II, III, and IV in 3 cases of upper extremities and in all the three cases posterior cord was formed by union of posterior division of I, II, and III trunk having root value C_5–C_8.There were also reports of cases where ventral rami of C_5 and C_6 did not join to form upper trunk dividing independently into anterior and posterior divisions[14,15]. Such variations in which there was no upper trunk may increase the chance of nerve root avulsion due to downward traction injury of brachial plexus.

The non-formation of the upper trunk appears to be caused by overexpression of chemoattractants/repulsants, resulting in the separation of the C5 and C6 roots in the current investigation. These differences can be linked embryologically. The innervations of a limb bud are determined by its position and width; the limb bud is fed by nerves in the region where it is implanted. Growing nerve fibres (axons) are directed by segregation of the developing structure within the limb, which determines their grouping into bundles, which leads to the production of roots and trunks. Because chemoattractants and chemorepulsants regulate the growth of nerve fibres (axons) in a highly coordinated site-specific manner, any changes in signalling between mesenchymal cells and neuronal growth cones might cause major differences.

Axillary nerve was taking origin from posterior division of upper trunk in 9.7 % upper extremities in the present study which is much higher than Matejcik and Chaudhary et al.Matejcik[16] and Chaudhary et al[13]. in their study on brachial plexus observed axillary nerve originating from posterior division of upper trunk in three cases and one case, respectively. Bhat and Girijavallaban et al. and Jamuna described case where posterior cord split into anterior and posterior divisions. The axillary nerve in both cases took origin from posterior division of posterior cord. On the other hand, we also observed thoracodorsal nerve originates from axillary nerve in 22.2% upper extremities which was much higher than previous studies of Fazan et al. (13%)[12] and Muthoka et al. (10.3%)[17,18,19].

Conclusion

Understanding the connections between the median nerve and the musculocutaneous nerve is essential for humerus bone and shoulder joint surgery. As a result, such anatomical observational studies can yield more information. Brachial plexus variation has substantial anatomical, surgical, and therapeutic implications, particularly in the context of upper limb trauma and surgical treatments. The current instance gives clinicians more information on Brachial plexus variances, which may assist them prevent injury during plastic and reconstructive surgery techniques. These variances are particularly important to be aware of during Brachial plexus block and nerve entrapment syndromes involving distinct Brachial plexus branches.

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