

ANATOMICAL VARIATIONS OF THE AXILLARY NERVE: A CADAV-ERIC STUDY

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ABSTRACT

Background: Axillary nerve is one of the most common nerves which is prone to iatrogenic injuries (6% of all the brachial plexus injuries). Knowledge of the anatomical variations of the axillary nerve in respect to its origin from the posterior cord of brachial plexus, its site of division into anterior and posterior branch and its mode of supply to the deltoid muscle is highly important for anatomists, orthopedic surgeons, radiologists and anesthetists for proper exploration of the axillary region.

Material and Methods: The study was carried out in the Department of Anatomy, Institute of Postgraduate Medical Education and Research, Kolkata, West Bengal. The sample size was 50 upper limbs of 25 formalin hardened human cadavers of both sexes.

Results: Out of 50 samples, in 16% cases the Axillary nerve took origin as a common trunk. Regarding the site of division of the axillary nerve into anterior and posterior branches it was found to be above the quadrangular space in 12% cases and within the quadrangular space in 88% cases. . Regarding the mode of supply of the deltoid muscle it was seen that the anterior part of the deltoid was supplied by the anterior division of the axillary nerve in 100% cases; middle part of the deltoid solely by anterior division of the axillary nerve in 60% cases and in remaining 40% cases both from anterior and posterior branch i.e. dual supply (fig-3); the posterior part of the deltoid was seen to be supplied by the posterior branch in 100% cases.

Conclusion: The knowledge of variations of axillary nerve is very important for anatomists, anesthesists, orthopaedic surgeons and general physicians during surgical interventions of the axilla and intra-muscular injections to the deltoid muscle.

KEY WORDS: Axillary nerve, Division, Quadrangular space, Deltoid.

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INTRODUCTION

The brachial plexus, which supplies motor, sensory and sympathetic fibres to the upper limb, is formed by the ventral rami of lower four

cervical nerves and first thoracic nerve (C₅, C₆, C₇, C₈ and T₁). It consists of roots, trunks, divisions and cords. The cords are three in number- lateral, medial and posterior; they are named

according to their arrangement around the second and third parts of the axillary artery. Axillary nerve is one of the terminal branches of the posterior cord of the brachial plexus; other branches being upper subscapular, lower subscapular, thoracodorsal and radial nerves.

Axillary nerve conveying fibres from C₅ and C₆ leaves the posterior wall of the axilla along with the posterior circumflex humeral artery and enters the quadrangular space, where it supplies a twig to the shoulder joint and divides into anterior and posterior branch. The anterior branch supplies the anterior part of the deltoid muscle; the posterior branch supplies the posterior part of the deltoid muscle and ends in a pseudo-ganglion after supplying the teres minor.

Axillary nerve is one of the most common nerves which is prone to iatrogenic injuries (6% of all the brachial plexus injuries) during shoulder arthroscopy, fracture of surgical neck of humerus, quadrangular space syndrome and plate fixation or retraction of the deltoid muscle [1]. Knowledge of the anatomical variations of the axillary nerve in respect to its origin from the posterior cord of brachial plexus, its site of division into anterior and posterior branch and its mode of supply to the deltoid muscle is highly important for anatomists, orthopedic surgeons, radiologists and anesthetists for proper exploration of the axillary region. Lack of proper knowledge also leads to increased injury to the nerve during intramuscular injections of the deltoid and infraclavicular brachial plexus block [2]. Literature on the above is scanty and altogether lacking in the Eastern India population. The present study has been undertaken to study the incidence of such variations in the course of the axillary nerve and its clinical importance.

MATERIALS AND METHODS

The study was carried out in the Department of Anatomy, Institute of Postgraduate Medical Education and Research, Kolkata, West Bengal. The sample size was 50 upper limbs of 25 formalin hardened human cadavers of both sexes. All normal cadavers were included; cadavers with traumatized and deformed upper limbs were excluded from the above study. The dissection was carried out as given in Cunningham's manual³ with the help of dissecting

instruments. The origin of axillary nerve from the posterior cord (separate or common trunk), distance of the origin from the anteromedial aspect of coracoid process, its site of division (above, within or below the quadrangular space) into anterior and posterior branch and mode of supply to the deltoid muscle were noted.

RESULTS

In the present study it was noted that out of 50 upper limbs, in 84% cases the axillary nerve took origin directly from the posterior cord of the brachial plexus and in the remaining 16% (8 upper limbs) it originated as a common trunk. It was observed that out of 8 specimens, a common trunk for axillary, thoracodorsal, upper and lower subscapular nerves was found in 5 cases (fig.-1) and a common trunk for lower subscapular and axillary nerve was seen in the remaining 3 cases (fig.-2).

The mean distance of origin of axillary nerve from the anteromedial aspect of the tip of coracoid process was found to be 3.82cm. Regarding the site of division of the axillary nerve into anterior and posterior branches it was found to be above the quadrangular space in 12% cases (fig-1 and fig 2) and within the quadrangular space in 88% cases. Regarding the mode of supply of the deltoid muscle it was seen that the anterior part of the deltoid was supplied by the anterior division of the axillary nerve in 100% cases; middle part of the deltoid solely by anterior division of the axillary nerve in 60% cases and in remaining 40% cases both from anterior and posterior branch i.e. dual supply (fig-3); the posterior part of the deltoid was seen to be supplied by the posterior branch in 100% cases. The mean distance from the deltoid tuberosity to the point of entry of the nerve into the anterior part of deltoid was 7.46cm; into the middle part 5.80cm when supplied by anterior division and 5.06 cm when supplied by posterior division; into the posterior part of deltoid 8.26cm supplied by posterior division. Similar mean distance when taken from posterolateral aspect of acromion process was found to be 10.98cm for anterior part; middle part 5.40cm for anterior division and 7.32cm for posterior division; and 7.49cm for the posterior part of the deltoid muscle.

Fig. 1: Showing the axillary nerve course above the quadrangular space.

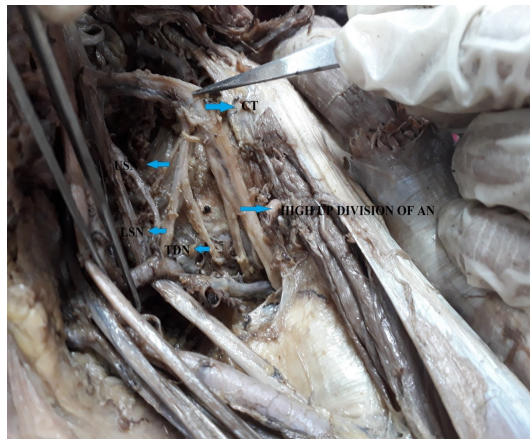


Fig. 2: Showing the axillary nerve course above the quadrangular space.

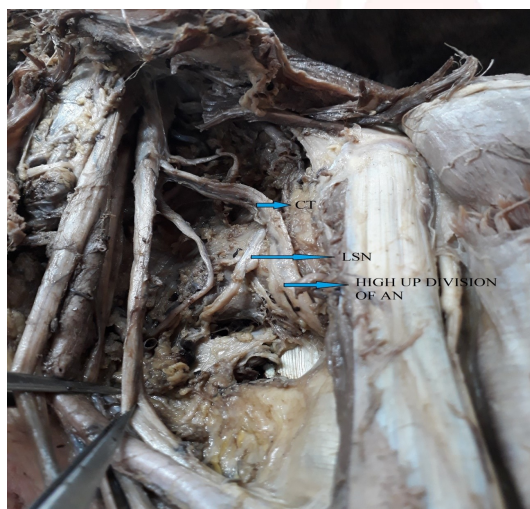


Fig. 3: Showing the dual supply of middle fibers of deltoid by both divisions of Axillary Nerve.



DISCUSSION

The incidence of origin of axillary nerve as a common trunk varies from 1%- 22.9% in various studies [4-9] and is given in table 1. In the present study it was seen to be 16% which is within normal range and no bilateral variation was noted.

Table 1: Showing the percentage of origin of axillary nerve as a common trunk from posterior cord by various authors in previous studies:

Author (year of study)	Origin from posterior cord of brachial plexus	Origin as a common trunk from posterior cord of brachial plexus
Darji et al (2013) [4]	99%	1%
Bhosale SM et al(2014) [5]	87.50%	12.50%
Rastogi R et al (2012) [6]	77.10%	22.90%
Gaur S et al (2012) [7]	92%	8%
Chaudhary P et al(2011) [8]	96.67%	3.33%
Gurushantappa PK et al(2015) [2]	100%	0%
Tiwari S et al (2017) [9]	82%	18%
Present study (2018)	84%	16%

The embryological basis for the origin of axillary nerve as a common trunk from posterior cord of brachial plexus is as follows. Position and width of a limb bud determine its innervations; limb bud is supplied by nerves of region where it is implanted. Segregation of the developing structures within the limb bud directs growing nerve fibres (axons) and determines their grouping into bundles leading to formation of roots and trunks. As the expression of chemoattractants and chemorepulsants regulate the axons in a highly coordinated site specific fashion, any alternations in signaling between the mesenchymal cells and neuronal growth cones can lead to significant variations [6]. The variations occur at the junction or separation of individual parts and may be due to an unusual formation during the development of the trunks, divisions or cord.

Table 2: Comparing the distance of origin of Axillary nerve from the anteromedial aspect of tip of coracoid process and posterolateral aspect of acromion process among various previous studies with that of present study:

Author (year of study)	Mean distance (cm) from the anteromedial aspect of coracoid process	Mean distance (cm) from the posterolateral aspect of acromion process
Gurushantappa PK et al (2015) [2]	3.56	7.46
Tubbs RS et al (2011) [10]	4	-
Uz A et al (2007) [11]	-	7.8
Burkhead WZ et al (1992) [12]	-	5
Tiwari S et al(2017) [9]	3.67	6.43
Present study (2018)	3.82	-

Clinically, trauma of posterior wall of the axillary region could present with a wide range of degrees of muscle impairment. For example, lesions involving common trunk for axillary nerve and thoracodorsal nerve may produce more extensive functional lesions including latissimus

dorsi, deltoid and teres minor muscles [7,15].

The mean distance of origin of axillary nerve from the anteromedial aspect of the tip of coracoid process and posterolateral aspect of acromion process as found in various studies is compared with our present study and is given in table 2.

The site of division of axillary nerve into anterior and posterior branches was found to be above the quadrangular space in 12% cases (high up division) and in the remaining 88% cases it was within the quadrangular space. We have not found any case where the division has occurred below the quadrangular space i.e within the deltoid muscle. The site of division of axillary nerve into anterior and posterior division has been compared with that of previous studies in the table 3.

Table 3: Comparing the site of division of axillary nerve into anterior and posterior division among previous studies with that of present study.

Author (year of study)	Division above quadrangular space	Division within quadrangular space	Division below quadrangular space
Gurushantappa PK et al (2015) [2]	0%	88%	12%
Tiwari S et al(2017) [9]	0%	100%	0%
Leechavengvongs S et al (2015) [13]	0%	100%	0%
Loukas M et al(2009) [1]	0%	65%	35%
Elizabeth C et al(2005) [14]	0%	33%	66%
Present study(2018)	12%	88%	0%

In the present study we noted the mode of innervation of the deltoid muscle. In all the specimens the anterior part of the deltoid was supplied only by the anterior division: the middle part in 60% cases only by anterior division and in remaining 40% cases has got dual innervation i.e both by anterior and posterior division; the posterior part of the muscle was supplied by posterior division in all the cases. This when compared to a study done by Gurushantappa et al [2] revealed that anterior part of muscle supplied by anterior division in 100% cases; middle part 56% only by anterior division and 44% dual nerve supply by both divisions; posterior part only by posterior division in 92% cases and 8% cases has dual innervation.

The mean distance from the deltoid tuberosity to the point of entry of the nerve into the anterior part of deltoid was 7.46cm; into the middle part 5.80cm when supplied by anterior division and 5.06 cm when supplied by poste-

rior division; into the posterior part of deltoid 8.26cm supplied by posterior division. Similar mean distance when taken from posterolateral aspect of acromion process was found to be 10.98cm for anterior part; middle part 5.40cm from anterior division and 7.32cm from posterior division ;and 7.49cm for the posterior part of the deltoid muscle. Proper anatomical knowledge of the axillary nerve and its mode of supply to the deltoid including the topography reduce the risk of injury to the nerve during intramuscular injections of the deltoid, intra-articular and intra-bursal steroid injections.

CONCLUSION

Anomaly of axillary nerve arising as a common trunk from the posterior cord of brachial plexus is a common phenomenon (12%). This knowledge is very important for orthopaedic surgeons while exploring the axillary region in treatment of fractures of surgical neck of humerus and also surgeons and anesthetists during brachial plexus blocks. Also, the mode of supply of deltoid muscle from the anterior and posterior divisions of axillary nerve is very important during intramuscular injections to reduce the risk of injury to the axillary nerve.

ABBREVIATIONS

USN- Upper subscapular nerve
LSN- Lower subscapular nerve
TDN- Thoracodorsal nerve
AN- Axillary nerve
CT- Common trunk

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Conflicts of Interests: None

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