



STUDY OF RADIAL NERVE: ITS COURSE AND BRANCHING PATTERN IN THE AXILLA AND BACK OF THE ARM

Anatomy

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ABSTRACT

Background: Radial nerve is the continuation of the posterior cord of the brachial plexus in the Axilla. It is the nerve of extensor compartment of upper limb. The radial nerve is commonly damaged in the axilla and in the spiral groove. The radial nerve is at risk during the posterior plating of the humerus. **Material and Methods:** Dissection was done on 44 upper limbs from embalmed cadavers and 6 upper limbs from embalmed dead fetuses in the Department of Anatomy, at Patna medical college and Hospital, Patna, Bihar. Dissection of Radial nerve and its branches in the axilla and back of arm was carried out according to Cunningham's manual of practical anatomy. **Conclusion:** The present study is important for Surgeons, Orthopedicians, and Neurophysicians as it provides the knowledge of course and branching pattern of radial nerve in axilla and back of arm to prevent possible complications.

KEYWORDS

Radial nerve, triceps, radial groove.

INTRODUCTION

Radial nerve is the continuation of the posterior cord of the brachial plexus in the axilla. Here it gives off the nerve to the long head of triceps and then passes in to the arm posterior to the brachial artery. Almost immediately it gives off the posterior cutaneous nerve of the arm and a branch to the medial head of triceps (which accompanies the ulnar nerve into the posterior compartment), then passes inferolaterally into the groove for the radial nerve on the posterior surface of the humerus winding spirally round the posterior surface of the humerus with the profunda brachii artery, in contact with the periosteum. In the groove, the nerve gives off branches to the lateral head and a long slender branch which descends through the medial head of triceps to the muscle anconeus distal to the lateral epicondyle. Two cutaneous branches, lower lateral of the arm and posterior of the forearm, are also given off here.¹ The nerve then pierces the lateral intermuscular septum and descends in the anterior compartment between brachialis (medially) and brachioradialis and extensor carpi radialis longus (laterally). It divides in to superficial and deep branches. The superficial branch is a sensory nerve to the back of the fingers and hand. The deep branch supplies the muscles of the back of the forearm and the joints at the wrist. The radial nerve, which supplies all of the extensor muscles of the upper limb, passes diagonally around the posterior surface of the middle of the humerus in the radial groove. The most common site of radial nerve injury is in the radial groove. The radial nerve can be badly damaged in the axilla by fractures and dislocations of the proximal end of the humerus. When the humerus is displaced downward in dislocations of the shoulder, the radial nerve, which is wrapped around the back of the shaft of the bone, is pulled downward, stretching the nerve in the axilla excessively.³ Identification of radial nerve is necessary during the posterior approach to the humerus in an effort to maintain its integrity and to lessen the possibility of neurologic compromise.⁷ Hence the study of the radial nerve is undertaken, the results of this study may be useful in various surgical procedures in axilla and posterior compartment of the arm and evaluating the radial nerve injuries and their management for Surgeons, Orthopedicians, and Neurophysicians. The radial nerve is the largest branch of the brachial plexus. It arises from the posterior cord [C5,6,7,8 (T1)]. Radial nerve is the continuation of the posterior cord of the brachial plexus. After its formation it descends behind the third part of the axillary artery and the upper part of the brachial artery, anterior to subscapularis and the tendons of latissimus dorsi and teres major. With the profunda brachii artery radial nerve inclines dorsally, passing through the triangular space. It then spirals obliquely across the back of the humerus, lying posterior to the uppermost fibres of the medial head of triceps which separate the nerve from the bone in the first part of the spiral groove. Radial nerve spirals obliquely across the back of the humerus, lying posterior to the uppermost fibres of the medial head of triceps which separate the nerve from the bone in the first part of the spiral groove. The small posterior cutaneous nerve of

the arm arises in the axilla and passes medially to supply the skin on the dorsal surface of the arm nearly as far as the olecranon.

OBJECTIVES

To know the course, branching pattern and variations of radial nerve while passing through the lower triangular space. To know the course, branching pattern and variations of radial nerve in the radial groove of humerus in the back of the arm.

Review of Literature

Stanescu gives the following observations in his study of 33 cadaveric dissections performed to identify radial nerve branching patterns to the triceps brachii.⁸ Innervation of the long head of the triceps originated in the axilla in 88% and the brachioaxillary angle in 12%.⁸ Innervation of the medial head originated in the spiral groove in 52%, the brachioaxillary angle in 39%, and the axilla in 9%.⁸ The lateral head was innervated by branches arising in the spiral groove in 70%, the brachioaxillary angle in 24% and the axilla in 6%.⁸ Pattanshetti, gives the following recordings in her study of the formation and branching pattern of brachial plexus and its variations in adult human cadavers of north Karnataka.⁹ The radial nerve was present in all 60 limbs (100%) originated from posterior cord and was posterior to 3rd part of axillary artery.⁹ All the branches to triceps brachii were distributed through axilla and radial groove, in all the specimens.¹⁰

Anconeus was supplied by the branch to medial head of triceps brachii which descended in the substance of that muscle.¹⁰ In half of the specimens, the lateral head of triceps brachii was innervated before its medial head regardless of the order of branching.¹⁰ In half of the specimens, the lateral head of triceps brachii were supplied by branches leaving the nerve in radial groove. In one third of the specimens, the medial head of triceps brachii were supplied by branches leaving the nerve in radial groove. Majority of them were in contact with the bone.¹⁰ Linell mentions in his study, other than the branch to medial head of triceps brachii which arose at the upper limit of radial groove, no other muscular branch arose while the main trunk of radial nerve was in the groove.¹¹ Rajeshwari, reported a case where the left posterior division of upper trunk fails to fuse with the posterior divisions of the middle and lower trunk and gives out four branches independently.¹⁴ The posterior division of upper trunk provide four branches directly – upper subscapular, lower subscapular and axillary nerve, thus carrying fibers from C5 & C6, it also provided an additional branch which lies lateral to axillary nerve course downwards behind the subscapular artery which is called here, as the inferior division of radial nerve. The posterior divisions of middle trunk and lower trunk unite and immediately gives out the thoraco-dorsal nerve. Close to its origin thoracodorsal nerve receives a communicating branch from the posterior division of upper trunk, the rest of the nerve then courses downwards in front of the subscapular artery to form the superior

division of radial nerve. At the lower border of subscapularis muscle the two divisions of radial nerve unite to continue as the radial nerve thus comprising of fibers from C5, 6,7,8, & T1. The two divisions of radial nerve form a loop around the subscapular artery.¹⁴ Nanjundaiah reports the following bilateral variation in their case report in an adult male cadaver aged 60-70 years. The motor branch to the long head of the triceps was arising from the axillary nerve bilaterally, instead of its usual origin from radial nerve. The axillary nerve after passing through the quadrangular space instead of bifurcating, was trifurcating into the anterior branch, the posterior branch and a branch to the long head of triceps. Ng et al, reports high radial nerve palsy in a 45 year old, right handed, male bodybuilder caused by an extrinsic mass effect of muscular hypertrophy.

MATERIAL AND METHODS

This is cross sectional study were obtained from embalmed cadavers and embalmed dead fetuses from the Department of Anatomy at Patna medical college and Hospital Patna, Bihar. 50 upper limbs were procured from the Department of Anatomy. Among them 6 specimens were belong to embalmed dead fetuses. Duration of study two years.

Inclusion Criteria

All the embalmed cadavers and embalmed dead fetuses available during study period were included.

Exclusion Criteria

Deformed or traumatized upper extremities were excluded from the study.

Dissection was done on 44 upper limbs from embalmed cadavers and 6 upper limbs from embalmed dead fetuses in the Department of Anatomy, Patna medical college and Hospital Patna, Bihar. The cadavers were embalmed with 10% formalin Dissection of Radial nerve and its branches in the axilla and posterior compartment of the arm was carried out according to Cunningham's manual of practical anatomy. The upper limb in each supine cadaver was abducted and laterally rotated. Skin was incised from manubrium sterni to both xiphoid process of sternum as well as acromion process of scapula. Further, the skin was incised from xiphoid process extending upwards and laterally, along the floor of axilla, to the middle of the arm. Incision was further extended from middle of the arm up to apex of cubital fossa. The skin and superficial fascia were reflected from the deep fascia by blunt dissection. The deep fascia was then incised to expose muscles. The pectoralis major and minor muscles were reflected laterally to expose axilla. The axilla was dissected by removing loose connective tissue and fat. The axillary fascia was then incised and lymph nodes were removed to expose the cords of brachial plexus.

RESULTS

High division of radial nerve

High division of radial nerve	No of specimens	Percentage (%)
Present	22	44%
Absent	28	56%
Total	50	100%

Site of high division of radial nerve

Site of high division of radial nerve	No of specimens	Percentage (%)
Axilla	17	77.3%
LTS	5	22.7%
Total	22	100%

Origin of N-LHT

Origin	No of specimens	Percentage(%)
RN	42	84%
RN(MD)	1	2%
RN(PD)	1	2%
RN by CT with PCNA	3	6%
RN by CT with UCN	2	4%
RN by CT with PCNA +UCN	1	2%
Total	50	100%

In the present study, out of 50 specimens, RN originated from the posterior cord(PC) of brachial plexus at axilla, lies posterior to third part of axillary artery(AA), descends behind the proximal part of brachial artery(BA), passes through lower triangular space(LTS) and radial groove(RG) and accompanies the profunda brachii artery(PBA)

in 50 specimens(100%) In the present study, out of 50 specimens, 22 specimens (44%) showed high division of RN in to two divisions. The site of high division of RN was axilla in 17 specimens (77.3%) and LTS in 5 specimens (22.7%). The relation between two high divisions of RN was anterior & posterior in 13 specimens (59.1%) and medial & lateral in 9 specimens (40.9%). In case of anterior & posterior high divisions of RN, anterior division enters in to anterior compartment as RN in 13 specimens(100%). In case of medial & lateral high divisions of RN, lateral division enters in to anterior compartment as RN in 9 specimens (100%).out of 50 specimens, N-LHT originated from RN as a separate branch in 42 specimens (84%), from RN (medial division) in 1 specimen (2%), from RN (posterior division) in 1 specimen (2%), from RN by a common trunk with PCNA in 3 specimens (6%), from RN by a common trunk with UCN in 2 specimens (4%), and from RN by a common trunk with both PCNA and UCN in 1 specimen (2%). The site of origin of N-LHT was axilla in 48 specimens(96%) and LTS in 2 specimens (4%).out of 50 specimens, N-LTHT originated from RN as a separate branch in 26 specimens (52%), from RN (posterior division) in 9 specimens (18%), from RN (medial division) in 8 specimens (16%), from RN (anterior division) in 1 specimen(2%), from RN (lateral division) in 1 specimen(2%), from RN(posterior division) by a common trunk with NA in 2 specimens(4%),from RN by a common trunk with LLCNA in 1 specimen (2%), from RN(anterior division) by a common trunk with LLCNA in 1 specimen(2%), and from RN by a common trunk with both NA and PCNFA in 1 specimen(2%) . The site of origin of N-LTHT was radial groove(RG) in 49specimens(98%) and LTS in 1 specimen (2%).

DISCUSSION

out of 50 specimens, RN originated from the posterior cord(PC) of brachial plexus at axilla, lies posterior to third part of axillary artery(AA), descends behind the proximal part of brachial artery(BA), passes through lower triangular space(LTS) and radial groove(RG) and accompanies the profunda brachii artery(PBA) in 50 specimens(100%)Pattanshetti reported that the radial nerve was present in all 60 limbs (100%) originated from posterior cord and was posterior to 3rd part of axillary artery⁶. The nerve then descended behind the brachial artery and entered the spiral groove by passing through lower triangular space. On reaching the lateral side of humerus it pierced the lateral intermuscular septum and came to lie in front of lateral epicondyle of humerus.⁹Present study confirms the course of radial nerve in axilla and posterior compartment of arm.In the present study, out of 50 specimens, 22 specimens (44%) showed high division of RN in to two divisions.Pattanshetti mentions in her study that in one case (1.67%), there was high division of radial nerve in the arm before passing through the lower triangular space, to enter the spiral groove⁹. Pattanshetti recorded in her study on 60 upper limbs, in one limb (1.67%) communication was formed between radial to ulnar.⁹ Bergman mentions, the radial nerve may communicate with the ulnar nerve in the arm.¹²The incidence of communication of radial nerve was high in the present study(14%) as compared to the study of Pattanshetti(1.67%).In the present study, out of 50 specimens, N-LHT originated from RN as a separate branch in 42 specimens (84%), from RN (medial division) in 1 specimen (2%), from RN (posterior division) in 1 specimen (2%).The site of origin of N-LHT was axilla in 48 specimens(96%) and LTS in 2 specimens (4%). Stanescu recorded in his study of 33 cadaveric dissections performed to identify radial nerve branching patterns in the triceps brachii, innervation of the long head of the triceps originated in the axilla in 88% and the brachioaxillary angle in 12%.⁸ The findings of present study is comparable with Stanescu. The additional branches to LHT was found in 20 specimens (40%). The additional branches to LTHT was found in 10 specimens (20%). The additional branches to MHT was found in 7 specimens (14%). The present study found additional muscular branches either from nerve to the muscle itself before entering the muscle or directly from radial nerve and its other branches.

CONCLUSION

out of 50 specimens, RN originated from the posterior cord(PC) of brachial plexus at axilla, lies posterior to third part of axillary artery(AA), descends behind the proximal part of brachial artery(BA), passes through lower triangular space(LTS) and radial groove(RG) and accompanies the profunda brachii artery(PBA) in 50 specimens(100%)22 specimens (44%) showed high division of RN in to two divisions at axilla and lower triangular space (LTS). In all cases (100%), either anterior or lateral division continues as radial nerve in to anterior compartment of arm.

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