

Unusual and Unique Variant Branches of Lateral Cord of Brachial Plexus and its Clinical Implications- A Cadaveric Study

ASHWINI AITHAL PADUR¹, NAVEEN KUMAR², SWAMY RAVINDRA SHANTHAKUMAR³, SUREKHA DEVADAS SHETTY⁴, GAYATHRI SHARATH PRABHU⁵, JYOTHSNA PATIL⁶

ABSTRACT

Introduction: Adequate knowledge on variant morphology of brachial plexus and its branches are important in clinical applications pertaining to trauma and surgical procedures of the upper extremity.

Aim: Current study was aimed to report variations of the branches of the lateral cord of brachial plexus in the axilla and their possible clinical complications.

Materials and Methods: Total number of 82 upper limbs from 41 formalin embalmed cadavers was dissected. Careful observation was made to note the formation and branching pattern of lateral cord. Meticulous inspection for absence of branches, presence of additional or variant branches and presence of abnormal communications between its branches or with branches of other cords was carried out.

Results: In the present study, we noted varied branching pattern of lateral cord in 6 out of 82 limbs (7%). In one of the limb, the median nerve was formed by three roots; two from lateral cord and one from medial cord. Two limbs had absence of lateral pectoral nerve supplemented by medial pectoral nerves. One of which had an atypical ansa pectoralis. In 2 upper limbs, musculocutaneous nerve was absent and in both cases it was supplemented by median nerve. In one of the limb, coracobrachialis had dual nerve supply by musculocutaneous nerve and by an additional branch from the lateral cord.

Conclusion: Variations of brachial plexus and its branches could pose both intraoperative and postoperative complications which eventually affect the normal sensory and motor functions of the upper limb.

Keywords: Ansa pectoralis, Median nerve, Musculocutaneous nerve, Pectoral nerves

INTRODUCTION

The brachial plexus supplies the upper limb and consists of roots, trunks, divisions and cords. Lateral cord of the brachial plexus is formed in the axilla by the union of anterior divisions of upper and middle trunks and it lies on the lateral side of the second part of the axillary artery. It gives 3 named branches; lateral pectoral nerve (C5, C6, C7) that pierces the clavipectoral fascia before supplying the pectoralis major muscle, musculocutaneous nerve (C5, C6, C7) which pierces the coracobrachialis muscle, supplies the muscles in the front of the arm and then continues as lateral cutaneous nerve of the forearm, and a third branch known as lateral root of median nerve (C6, C7) which joins with the medial root of median nerve arising from medial cord to form the trunk of the median nerve [1].

Anomalies in the formation or persistence of an abnormal communication between the branches are considered as common variations of lateral cord [2]. However, variation in its branching pattern is rare and it should be kept in mind while performing surgical approaches of axilla and arm region to avoid post surgical complications posed by its iatrogenic injury. Prior anatomical knowledge of any variations is thus very important to avoid such nerve injuries.

AIM

Therefore, this study was aimed to report variations of the branches arising from the lateral cord of brachial plexus in the axilla and their possible clinical implications.

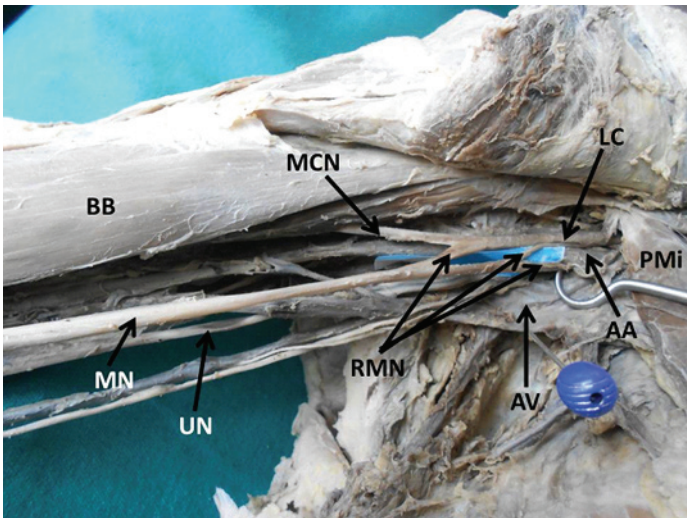
MATERIALS AND METHODS

Present study involved the examination of 82 upper limbs of 41 formalin embalmed human cadavers (40 males and one female) in the past four years, which were obtained from the Department of Anatomy. The axillary region of all the limbs were dissected cautiously and attached fascia was cleared from the cords of

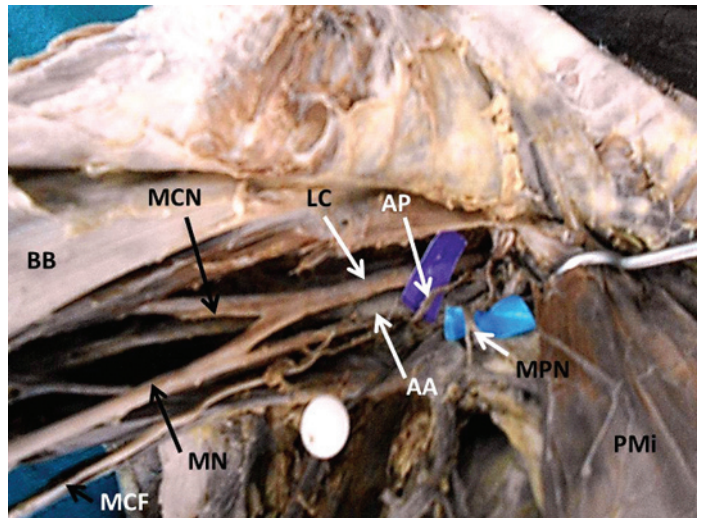
brachial plexus. All three cords of brachial plexus were exposed carefully. Meticulous observation was made to note the formation and branching pattern of lateral cord. The observations included absence of branches, presence of additional or variant branches and presence of abnormal communications between its branches or with branches of other cords if any, etc. The dissection was further continued towards the anterior compartment of the arm to note any alternative nerve supply to the structures to be supplied by the branches of lateral cord when they are absent and to investigate further course and distribution of the variant or additional branches when persisted. Variations of other cords and branches of brachial plexus were not included in the study. One photograph from each of the variations was taken for documentation.

RESULTS

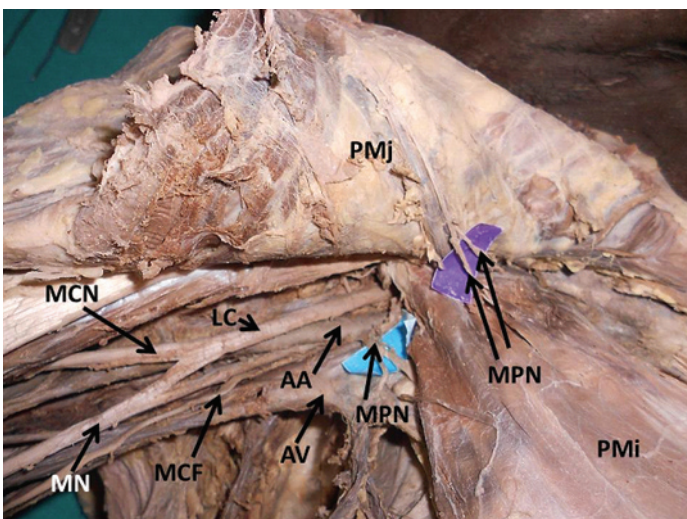
In the present study, we noted 4 different varied branching pattern of lateral cord of the brachial plexus in 6 out of 82 upper limbs (7%). In one limb of right side, the median nerve was formed by three roots than the usual two roots. Out of the three roots two roots (upper and lower) arose directly from the medial side of lateral cord and one root from the medial cord [Table/Fig-1]. The upper root arising from the lateral cord was thinner in caliber when compared to the lower root. These three roots encircled the axillary artery between them and formed the trunk of median nerve. In two upper limbs, lateral cord was deprived of lateral pectoral nerve. In both the cases, it was supplemented by multiple medial pectoral nerves which pierced the pectoralis minor muscle and then supplied the pectoralis major muscle from its deeper plane [Table/Fig-2]. In one of above 2 limbs, very rare variation wherein the ansa pectoralis which is usually seen connecting the medial and lateral pectoral nerve; arose as a twig directly from the medial side of lateral cord, looped around the third part of axillary artery and then joined with the medial pectoral nerve in deeper plane [Table/Fig-3,4]. In two limbs, one right and another left we found that musculocutaneous nerve was absent. In its absence, the muscles



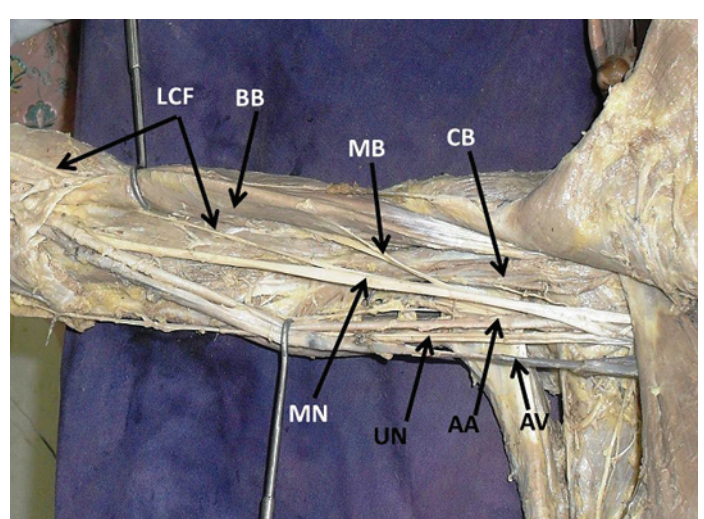
[Table/Fig-1]: Showing unusual formation of the median nerve (MN) by three roots (RMN). Two roots from the lateral cord (LC) and one root from the medial cord. Other structures seen are: MCN- Musculocutaneous nerve, UN- Ulnar nerve, AA- Axillary artery, AV- Axillary vein, PMI- Pectoralis minor muscle, BB- Biceps Brachii.



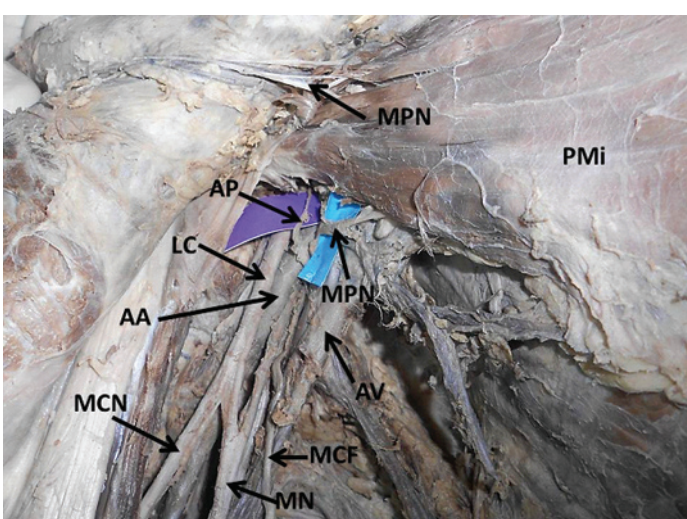
[Table/Fig-4]: Showing the closer view of ansa pectoralis (AP) arising directly from the lateral cord (LC) and looping around the axillary artery (AA). MPN- Medial pectoral nerve, MCN- Musculocutaneous nerve, MN- Median nerve, MCF- Medial cutaneous nerve of forearm, PMI- Pectoralis minor, BB- Biceps Brachii.



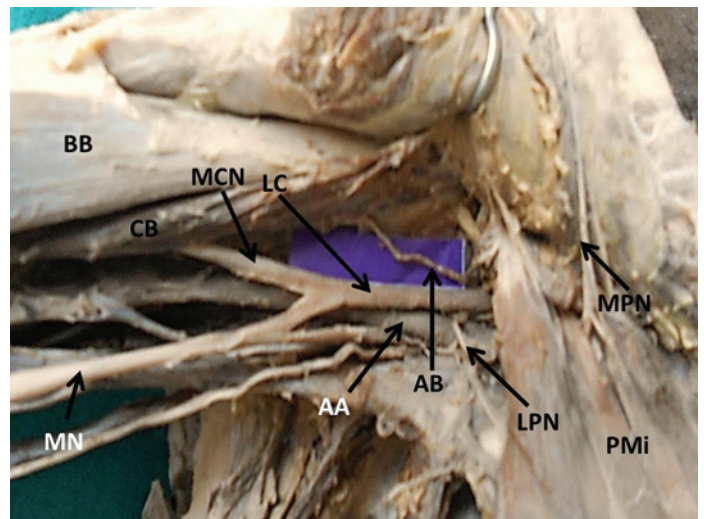
[Table/Fig-2]: Showing the absence of lateral pectoral nerve supplemented by multiple branches of the medial pectoral nerve (MPN) which supplied the pectoralis minor (PMi) and pectoralis major (PMj) muscle. MCN- Musculocutaneous nerve, LC- Lateral cord, AA- Axillary artery, AV- Axillary vein, MN- Median nerve, MCF- medial cutaneous nerve of forearm.



[Table/Fig-5]: Showing the absence of musculocutaneous nerve, supplemented by Median nerve (MN) that also gave lateral cutaneous nerve of forearm (LCF). Biceps Brachii (BB) and coracobrachialis (CB) were supplied by muscular branches of median nerve (MB). AA- Axillary artery, AV- Axillary vein, UN- Ulnar nerve.



[Table/Fig-3]: Showing the presence of atypical ansa pectoralis (AP) arising from the lateral cord (LC), which looped around the axillary artery (AA) and joined with the medial pectoral nerve (MPN). PMI- Pectoralis minor, AV-Axillary vein, MCN- Musculocutaneous nerve, MN- Median nerve, MCF- Medial cutaneous nerve of forearm.



[Table/Fig-6]: Showing the presence of an additional branch (AB) from the lateral cord (LC) and supplying the coracobrachialis muscle (CB) which was also supplied by musculocutaneous nerve (MCN). BB- Biceps brachii, MN- Median nerve, AA- Axillary artery, LPN- Lateral pectoral nerve, MPN – Medial pectoral nerve. PMI- Pectoralis minor.

of anterior compartment of arm were supplied by branches from the median nerve. In both the cases, the lateral cutaneous nerve of the forearm was represented by a separate branch arising from median nerve [Table/Fig-5]. In another right upper limb we found

a very rare variation wherein the coracobrachialis muscle was supplied by an additional branch coming from the lateral side of the lateral cord [Table/Fig-6]. Thus the coracobrachialis had dual nerve supply by musculocutaneous nerve and by an additional

branch from the lateral cord. All the above seen variations were unilateral.

DISCUSSION

Variations of the brachial plexus have been reported by many researchers in the past. But, in the present study we are reporting unique findings related to the lateral cord. Our study was aimed to provide additional knowledge on lateral cord variations to clinicians and surgeons. This might help to avoid damage during surgical procedures involving the nerves of the upper limb as in plastic and reconstructive surgery.

Median nerve is associated with many variations. In the present study we found that median nerve was formed by three roots. Such type of variation has been observed in the past [3-5]. Sharmila et al., have reported a case wherein the median nerve was directly coming from the lateral cord without any contribution from the medial cord through medial root [6]. It has been opined by many researchers that the presence of such a variation in formation of median nerve may be of immense clinical interest to neurologists diagnosing nerve lesions and surgeons who deal with the topographical anatomy of the neural structures during radical neck dissection. Also, the additional branch of the lateral cord may compress upon the axillary artery which may cause vascular insufficiency [7].

The musculocutaneous nerve (MCN) is a major branch of lateral cord. There is ample number of reports about the absence of MCN [8-12]. It has been opined that absence of MCN may not lead to paralysis of the flexor compartment of the arm since the motor and sensitive fibres can arise from the other nerve. In the present study, in two limbs, the MCN was absent and the above muscles were supplied by branches from the median nerve. The structural abnormalities and variations of MCN have recently become significant and very important while performing neurotization of brachial plexus lesions, shoulder arthroscopy and shoulder reconstructive surgery [13].

Anatomical knowledge of the pectoral nerves is of clinical importance during mastectomy, neurotization or other surgical procedures in the axilla. In the present study we have noted the absence of lateral pectoral nerve (LPN) in two limbs. Absence of LPN is regarded as a rare variation and in our literature review we did not find any study reporting such type of variation. Rajalakshmi et al., have reported a case where three pectoral nerves were arising from the lateral cord of brachial plexus [14]. Gupta et al., have reported the presence of two lateral pectoral nerves which arose from upper and middle trunks of the brachial plexus [15].

We found that in the absence of LPN, pectoralis major and minor muscles were supplied by medial pectoral nerves (MPN). Such a variation should be in the mind of a surgeon performing relevant surgical procedures involving these muscles and the pectoral region. The pectoralis major myocutaneous flap provides a simple, reliable, and versatile method of primary reconstruction of various head and neck defects [16-18]. Hence such variations are very important during breast surgeries using pectoral muscle flaps and pectoral nerve transfers [19]. Multiple MPN as seen in our case can be at high risk during mastectomy or breast reconstruction procedures [20].

A peculiar type of variation that we came across during our study was unusual persistence and communication of ansa pectoralis (AP). Although the term "ansa pectoralis" has been used previously [21] to describe the communication between the MPN and LPN, no reports exist in the literature, which specifically define or describe the AP.

Loukas et al., have studied the anatomy of ansa pectoralis (AP) and their various communications [22]. They have classified AP based on its origin. According to them, the most common type,

AP-1 (42%) arose from the deep branch of the LPN; AP-2 (28%) arose directly from the LPN and AP-3 (25%) it arose from the lower rootlets of the LPN. Rarely, the AP arose from the upper rootlet of the LPN (AP-4; 5%). But the AP found in our study does not fall into any of the above classification as it originated directly from the lateral cord. This is a rare and unique variation and such cases hardly ever reported in the anatomical literature. Textbooks of anatomy report that the loop between the LPN and MPN crossed the first portion of the axillary artery. The peculiar AP loop that we have observed in our study crossed the 3rd part of axillary artery which is very unusual. Although very small, the AP is potentially an important nervous structure. Atypical persistence of AP looping around the axillary artery may lead to the compression of the vessel, and may lessen the blood supply to the upper extremity.

Musculocutaneous nerve is the sole nerve supply to coracobrachialis muscle. Very rarely, the coracobrachialis receives additional nerve supply. In the current study, we have noted an additional branch, arising directly from lateral cord which was supplying the coracobrachialis muscle. Thus, it was found that coracobrachialis muscle was supplied by two nerves. In our literature survey we found just one case reporting such type of variation. Ravikumar et al., have reported a case where two accessory nerve twigs arising from lateral cord of brachial plexus supplied the coracobrachialis muscle [23]. Surgeons operating on this region should be aware of such type of anomalous presence of additional branches.

Variations in the formation and branching pattern of brachial plexus can be explained through neuronal growth cones [24]. Alterations in signalling between mesenchymal cells and neuronal growth cones can lead to significant variations of which once formed would persist postnatally [25]. Multiple variations in the branching pattern of lateral cord of brachial plexus as we documented through this study, might be a result from bilateral alterations in mesenchymal cells and growth cones signalling.

Clinically, the presence of these variations makes the nerves vulnerable during routine neural repair and other surgical interventions in the pectoral and axillary region. Injury to any of such variant nerves in the proximal arm may lead to manifestations including sensory, motor, vasomotor changes. It is also important to be aware of these variations during brachial plexus blockade and in nerve entrapment syndromes [26]. We believe that reports regarding these variations will be illuminating for surgical procedures of the axilla and the shoulder. Knowledge of such anomalies is also important during treatment of fractures. Better understanding and correct interpretation of clinical neurophysiology can only be possible with prior knowledge of possible anatomical variations [27].

CONCLUSION

The axillary region is commonly approached for many surgical interventions by anaesthesiologists, orthopaedicians, radiologists and plastic surgeons. Lack of knowledge regarding such variations of the nerves of the lateral cord of brachial plexus may lead to intraoperative and postoperative complications.

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PARTICULARS OF CONTRIBUTORS:

1. Lecturer, Department of Anatomy, Melaka Manipal Medical College (Manipal Campus), Manipal University, Manipal, India.
2. Assistant Professor, Department of Anatomy, Melaka Manipal Medical College (Manipal Campus), Manipal University, Manipal, India.
3. Lecturer, Department of Anatomy, Melaka Manipal Medical College (Manipal Campus), Manipal University, Manipal, India.
4. Senior Grade Lecturer, Department of Anatomy, Melaka Manipal Medical College (Manipal Campus), Manipal University, Manipal, India.
5. Lecturer, Department of Anatomy, Melaka Manipal Medical College (Manipal Campus), Manipal University, Manipal, India.
6. Lecturer, Department of Anatomy, Melaka Manipal Medical College (Manipal Campus), Manipal University, Manipal, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Naveen Kumar,
Assistant Professor, Department of Anatomy, Melaka Manipal Medical College (Manipal Campus)
Manipal University, Manipal, Karnataka – 576104. India.
E-mail: naveentonse@gmail.com

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