Variant branching and distribution pattern of the radial nerve and musculocutaneous nerve

Satheesha B NAYAK, Naveen KUMAR, Bincy M GEORGE, Ashwini AITHAL P, Abhinitha P, Gayathri PRABHU
Department of Anatomy, Melaka Manipal Medical College (Manipal campus), Manipal University, Manipal, Karnataka India

ABSTRACT

Knowledge of anatomical variation involving the superficial branch of the radial nerve will help in several clinical interventions such as nerve transfer procedures, guiding surgical incisions, diagnostic trauma reconstructive surgery, flap harvest and in performing nerve blocks etc. We report here a variant distribution pattern of the superficial branch of radial nerve and discuss the clinical implications. In the present case, in addition to sensory distribution, the superficial branch of radial nerve also provided motor innervation to extensor carpi radialis brevis and brachioradialis muscles. Furthermore, the branch supplying the brachioradialis, pierced its tendon distally and communicated with the parent trunk to supply skin of dorsum of the hand. Because of the unusual motor distribution to these muscles, which act on wrist joint, an iatrogenic damage or traumatic injury of the nerve might jeopardize the sensori-motor qualities of the upper limb.

Keywords: Radial nerve, extensor carpi radialis brevis, brachioradialis, superficial branch, musculocutaneous nerve, radial neuropathy

INTRODUCTION

The Radial nerve is the continuation of the posterior cord of brachial plexus containing the fibers of C5, 6, 7, 8 and T1 nerves. It is known as the nerve of the posterior compartment of the arm, as it supplies the triceps muscle and provides cutaneous branches. From the posterior compartment of the arm it appears in the anterior compartment after piercing lateral intermuscular septum and ends by dividing into superficial and deep branches. [1]

Variations in the formation of radial nerve are quite common and widely reported in the anatomical literature. Examples of its exceptional variant formation include; presence of two roots arising from posterior cord, [2] originating from two roots resulting from the duplex posterior cord [3] and its incomplete origin from middle and lower trunk of brachial plexus without the contribution of upper trunk. [4] Early division of radial nerve in the axilla has also been reported, [5] wherein, both the divisions entered the radial grove and eventually anterior division continued as the main radial nerve in its further course.

The Musculocutaneous nerve is the branch of lateral cord of brachial plexus. It provides motor innervation to muscles of anterior compartment of the arm. It then proceeds distally as lateral cutaneous nerve of the forearm to supply the skin of the lateral

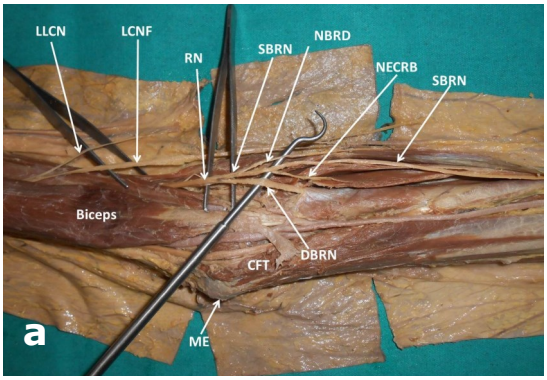
Correspondence author: Naveen Kumar
Department of Anatomy,
Melaka Manipal Medical College (Manipal campus),
Manipal University, Manipal. Karnataka India
Tel: 91-9880548636 / Fax: 91-820-2571905
E mail: naveentonse@gmail.com

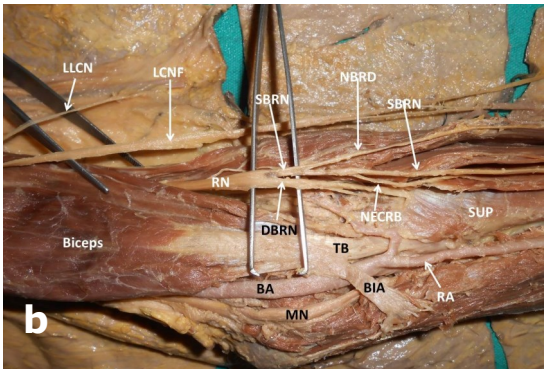
part of the forearm. [6]

Variations in the branching and distribution pattern of radial nerve have also been reported. In the present case, we report multiple variations in the pattern of branching and distribution of superficial division of radial and musculocutaneous nerves in the upper limb and discuss their possible clinical implications.

CASE REPORT

During routine dissection of left upper limb of an adult male cadaver (approximately 70 year old) we found variations in the branching pattern and distribution of the radial nerve. The radial nerve had a normal origin and course till it pierced the lateral intermuscular septum of the arm. Once it reached the anterior compartment of the arm, it divided into a superficial and a deep branch as usual. The deep branch pierced the supinator and entered the posterior compartment of the forearm and distributed in usual pattern. However, the superficial branch, before resuming its course in the forearm, gave two unusual branches (Figs. 1a and 1b). One of them supplied the extensor carpi radialis brevis (ECRB) muscle and the other one supplied the brachioradialis muscle. The branch supplying brachioradialis traversed distally through the muscle and pierced its tendon and came out. After coming out, this branch supplied the skin on the dorsum of the thumb. The superficial branch had a normal course deep to the brachioradialis and it supplied the skin of the lateral half of the dorsum of the hand and the index and the lateral half of the middle finger. The superficial branch communicated with the nerve to brachioradialis at the distal part of the forearm, near the wrist (Fig. 1c). The musculocutaneous nerve had a normal course and distribution except that the lateral cutaneous nerve of the forearm was very thick. The lower lateral cutaneous nerve of the arm arose from the lateral cutaneous nerve of the forearm (Figs. 1a and 1b).





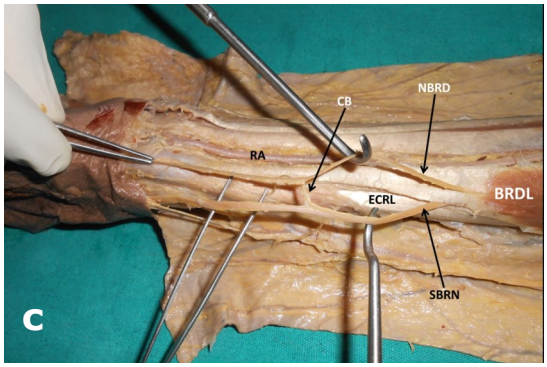


Fig. 1a: Showing variant distribution pattern of superficial branch (SBRN) of radial nerve (RN) in the forearm and the origin of lower lateral cutaneous nerve (LLCN) from musculocutaenous nerve before its continuation as lateral cutaneous nerve of forearm (LCNF). NBRD- nerve to brachioradialis, NECRB- nerve to extensor carpi radialis brevis, DBRN- deep branch of radial nerve, ME- medial epicondyle, CFT- common flexor tendon

Fig. 1b: Showing the closer view of the variant branches of RN and musculocutaneous nerves. (SUP – supinator; TB – tendon of brachialis; BA – brachial artery; MN – median nerve; BIA – bicipital aponeurosis; RA- radial artery.)

Fig. 1c: Showing the communication between SBRN and NBRD muscle. (BR- brachioradialis, ECRL- externsor carpi radialis longus).

DISCUSSIONS

Knowledge of anatomical variations of peripheral nerves is of importance to orthopedic surgeons, neurophysicians, plastic surgeons, physiotherapists and radiologists. [7] However, its detailed information can only be achieved by the anatomist through a cadaveric dissection. Nevertheless, the knowledge of variant pattern of peripheral nervous system is useful during nerve grafting and neurophysiologic evaluation to diagnose peripheral neuropathies. [8]

The variations of the peripheral branches of brachial plexus can be explained embryologically, as the axons of spinal nerves grow distally to reach the limb bud mesenchyme, the peripheral processes of the motor and sensory neurons grow in the mesenchyme, in different direction. [9]

The Superficial branch of radial nerve has been studied and several variations pertaining to the same have been reported. Linell has reported a fusion of the brachioradialis muscle tendon and the extensor carpi radialis longus tendon with the superficial branch of radial nerve piercing the fused tendon.[10] In the present case, a branch of the superficial division of radial nerve supplying the brachioradialis muscle pierced its tendon to become superficial distally and communicated with the main nerve (superficial branch of radial nerve) as a unique variation. The Superficial branch of radial nerve becoming superficial after piercing the brachioradialis muscle has been reported by Tryfonidis *et al*. [11] However, in the present case, the superficial branch had exceptionally supplied the ECRB and brachioradialis muscles through separate branches and the branch supplying the latter pierced the muscle tendon distally.

Nurul *et al.* have reported a somewhat similar case of variant distribution pattern of superficial division of radial nerve as an additional motor innervation to extensor carpi radialis longus and extensor carpi radialis brevis without the indication of piercing the tendon and reuniting with the main nerve. [12] In such cases, knowledge of variation can be considered as beneficial for the hand surgeons as it can be used as donor site for a sensate flap during reconstructive surgery. [13]

As the superficial branch of radial nerve is sensory in nature, its traumatic injury could result in the formation of a neuroma. [14] Due to its involvement in the extensor muscles which are acting on wrist, as seen in the present case, there may be severe pain during extension and even mild weakness of the wrist in case of its accidental injury. Clinically, these variations are therefore considered important during traumatic transection of the distal forearm.

Posterior Interosseous Neuropathy (PIN) is a peripheral nerve injury with the usual expression of deep ache sensation in the posterior forearm which can be accompanied by weakness of the forearm extensors and brachioradialis, and/or sensory alterations, or a combination of both. [15] When the brachioradialis is supplied by the superficial division of the radial nerve as in this case, manifestations resulting from traumatic injury of the nerve might mimic PIN which eventually could mislead the clinical interventions.

Hence, the awareness of variant branching and distribution pattern of superficial branch of radial nerve in clinical setting is of importance to pain managing therapists (physiotherapists, chiropractors and anesthesiologists) as well as clinicians and surgeons dealing with nerve entrapment or compressive neuropathies and reconstructive surgery.

Variation in the branching pattern of the musculocutaenous nerve is rarely report-

ed. A Different pattern of its abnormal communication with the median nerve has been discussed by Kumar *et al*. [16] In the present case, the musculocutaneous nerve gave rise to an abnormal lower lateral cutaneous nerve of the arm. The Unusual branching patterns of the musculocutaneous nerve is of equal significance to neurologists and orthopedic surgeons when dealing with the nerve entrapment syndromes.

In conclusion, the case report presented two unique variations, being reported for the first time. The Superficial branch of the radial nerve supplying two extensor muscles and then piercing the tendon of brachioradialis, as well as the origin of lower lateral cutaneous nerve of arm from the lateral cutaneous nerve of the forearm makes this case novel. Clinicians should be aware of these variations to make the correct diagnosis in case of nerve injuries and neuropathy.

REFERENCES

1: Sinnatamby CS. Last's Anatomy: Regional and Applied. 11th ed. London, Churchill Livingstone, 2006. pp.58-100.

2: Kuwar RB, Bilodi AK. Clasping of subscapular artery by radial nerve. Kathmandu Univ Med J (KUMJ). 2007; 5: 253–5.

3: Bertha A, Kulkarni NV, Maria A, Jestin O, Joseph K. Entrapment of deep axillary arch by two roots of radial nerve – an anatomical variation. J Anat Soc India. 2009; 58:40–3.

4: Aktan ZA, Ozturk L, Bilge O, Ozer MA, Pinar YA. A cadaveric study of the anatomic variations of the brachial plexus nerves in the axillar region and arm. Turk J Med Sci. 2001; 31:147–50.

5: Jamuna M. A rare variation of the branching pattern of radial nerve. Int J Anat Variations. 2011; 4:22–4.

6: Williams PL, Bannister LH, Berry MM. The anatomical basis of clinical practice, in Gray's Anatomy, Churchill Livingstone, Edinburgh, Scotland, 38th edition, 1995. pp.1266–72,

7: Yogesh, A. Marathe, R, Pandit, S. Musculocutaneous nerve substituting for the distal part of radial nerve: A case report and its embryological basis. J. Neurosci. Rural Pract. 2011; 2:74- 76

8: Jeng SF, Wei FC. The distally based forearm island flap in hand reconstruction. Plast Reconstr Surg. 1998; 102:400-6.

9: Brown MC, Hopkins WG, Keynes RJ. Essentials of Neural Development. Cambridge, Cambridge University Press. 1991;46–66.

10: Linell EA. The Distribution of Nerves in the Upper Limb, with reference to Variabilities and their Clinical Significance. J Anat 1921; 55(Pt. 2-3):79-112.

11: Tryfonidis M, Jass GK, Charalambous CP, Jacob S. Superficial branch of the radial nerve piercing the brachioradialis tendon to become subcutaneous: An anatomical variation with clinical relevance. Hand Surg. 2004; 9:191-5.

12: Nurul HMN, Aye AS, Fauziah O. An Anomalous Pattern of Superficial Branch of Radial Nerve - A Cadaveric Case Report Int J Morphol. 2014; 32:29-31.

13: Yan H, Gao W, Zhang F, Li Z, Chen X, Fan C. A comparative study of finger pulp reconstruction using arterialised venous sensate flap and insensate flap from forearm. J Plast Reconstr Aesthet Surg. 2012; 65:1220-26.

14: al-Qattan MM. The nerve supply to extensor carpi radialis brevis. J Anat. 1996; 188(Pt. 1):249-50.

15: Robb A, Sajko S. Conservative management of posterior interosseous neuropathy in an elite baseball pitcher's return to play: a case report and review of the literature JCCA 2009; 53:300–10.

16: Kumar N, Guru A, Melanie D, Patil J, Nayak SB. Incidences and clinical implications of communication between musculocutanous nerve and median nerve in the arm- A cadaveric study. West Indian Med J; 2013; 62:744-7.