

NERVE SUPPLY TO THE MANUS REGION IN CAMEL (*Camelus dromedarius*)

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ABSTRACT

Manus regions of ten embalmed adult single humped camels (*Camelus dromedarius*) revealed that the nerves innervating this region descended as continuations of musculocutaneous, radial, ulnar and median nerves of the brachial plexus. The medial cutaneous antebrachial nerve of the musculocutaneous nerve descended upto dorsomedial aspect of carpus. The cranial division of the lateral cutaneous antebrachial nerve through its lateral subdivision formed the dorsal common digital nerve II and III in middle of the metacarpus. The nerve entered the manus region mainly as dorsal and palmar branches and both continued as dorsal and palmar common digital nerves IV, respectively. The medial nerve after passing through the carpal canal to manus region, terminated into two divisions, palmar common digital nerve II and a lateral branch, 19-21 cm distal to accessory carpal. The lateral branch divided into a communicating branch to palmar common digital nerve IV and palmar axial proper digital nerve IV. The later nerve and the palmar axial proper digital nerve III, the digital continuation of palmar common digital nerve II, united to form a common digital nerve III of 4-10 cm length. The palmar common digital nerve II or in some cases median nerve itself issued anastomotic twig to dorsal common digital nerve II.

Key words : Camel, manus, nerve supply

The single humped camel is basically an important draught animal in arid and semi arid zones of Asia. The usefulness of this animal is largely dependent upon its limbs and any impairment in the nerve supply of this vital segment of the body impairs the locomotion vis-a-vis efficiency and usefulness of the animal. For the diagnosis and the treatment of lameness as well as during anaesthetic management of surgical interventions, a knowledge of normal topographic anatomy of the nerves of the limbs is very important. Keeping this view the present research work was undertaken to study the detailed course, relationship and supply of the nerves innervating the manus region of the camel.

Materials and Methods

The present study was conducted on ten adult healthy dromedary camels of either sex. The animals were deeply sedated using 6% aqueous solution of chloral hydrate through canula in the right common carotid artery. Ten per cent formalin solution was perfused by gravity through the canula for embalming (Grossman, 1959).

For the study of innervation to the thoracic limb skin was incised from the cranial to the caudal angle of the scapula along its border. The incision was extended from the caudal angle on the lateral aspect of the thorax towards the point of elbow upto the lateral margin of the chest pad and then cranially upto the apex of the sternum. The muscles viz. thoracic parts of the trapezius and rhomboideus and latissimus dorsi and deep pectoral were cut along the line of skin incision. The ventral serrate muscle was cut near its insertion on the medial surface of the scapula. The thoracic limb was lifted along its caudal border, whereas, cranially, it remained attached to the thorax. The dissected nerves were highlighted with yellow enamel paint for photographic purpose. The nomenclature used in the text is based on that of the Nomina Anatomica Veterinaria and Nomina Histologica (1983).

Results and Discussion

The thoracic limb was innervated through the nerves emanating from the brachial plexus with the exception of the nerve supply of the skin over the upper shoulder, shoulder joint, tricipital regions,

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trapezius and rhomboideus muscles. The manus region received its innervation mainly through the radial, ulnar and median nerves supplied the skin of the medial aspect of the carpus.

Radial Nerve

The radial nerve through its superficial branches, cranial and caudal lateral cutaneous antebrachial nerves entered in the manus region (Fig 1). The cranial subdivision of the caudal lateral cutaneous antebrachial nerve innervated the skin over the dorsal and lateral aspects of the carpus. The cranial lateral cutaneous antebrachial nerve which divides into two branches medial and lateral entered in the manus along the caudal and cranial borders of the accessory cephalic vein and later on the third dorsal metacarpal vein. The medial subdivision issued cutaneous twigs to dorsomedial and dorsal aspects of the carpus. It terminated into ramification in the proximal one fourth of the metacarpus, on the medial aspect. At termination, few of its bifers joined the lateral subdivision of the cranial, lateral cutaneous antebrachial nerve. Here it issued cutaneous twigs to medial aspect of the carpus and proximal one fourth of the metacarpus.

The lateral subdivision of the cranial, lateral cutaneous antebrachial nerve innervated the skin on the dorsomedial and dorsal aspects of the carpus and proximal half of the metacarpus. Here, it also received few fibres from the medial subdivision and then divided into second and third dorsal common digital nerves. The second dorsal common digital nerve passed under the third dorsal metacarpal vein and continued along the caudal border of the second palmar metacarpal vein, on the medial aspect of the metacarpus. In the distal third of this region, it received a communicating branch from the median nerve or from second palmar common digital nerve. Later, it descended over the dorsomedial aspect of the fetlock joint as third dorsal abaxial digital nerve. The third dorsal common digital nerve descended along the cranial border of the third dorsal common digital vein. The nerve then turned from medial to dorsal surface, in the middle third of the metacarpus. It further divided into third and fourth dorsal proper axial digital nerves and were accompanied by corresponding satellite veins. The distribution of radial nerve in manus region broadly confirmed the reports of Ibrahim *et al* (1982) in camel, Ghosal (1975) and Dyce *et al* (1966) in ruminants. However, the continuation of medial division of cranial lateral cutaneous antebrachial nerve forming

second dorsal common digital nerve in the metacarpal region described by El-Shaieb (1976) and Smuts and Bezuidenhout (1987) did not tally with our observations.

Ulnar Nerve

The ulnar nerve entered in the manus region through its dorsal and palmar divisions. The dorsal division supplied cutaneous twigs to palmar aspect of the carpus and palmar and palmarolateral aspect of the proximal one third of the metacarpus. The dorsal division then passed along the medial border of the accessory carpal bone and gradually turned towards the lateral aspect of the metacarpus as fourth dorsal common digital nerve (Fig 2). During this course, it supplied skin over the lateral aspect of the carpus, small strip of dorsal aspect and palmarolateral aspect of the metacarpus. In the distal third of the metacarpus, 7-9 cm above the fetlock joint, it received an anastomotic branch from the fourth palmar common digital nerve. Thereafter, the parent nerve descended in the fascia over the dorsolateral surface of the fetlock joint as fourth dorsal abaxial digital nerve.

The palmar division of the ulnar nerve, before its entry into manus, issued cutaneous twigs to the palmarolateral aspect of the carpus. The division then descended through the carpus between tendons of humeral head of deep digital flexor and superficial digital flexor muscles through the flexor retinaculum of the carpus, medial to the accessory carpal. Here, the division crossed the tributary of the median vein. Distal to the carpus, it issued branches to superficial digital flexor tendon. Then the parent nerve descended in the crevice between medial border of the deep digital flexor and suspensory ligament under the caudal cover of the superficial digital flexor tendon. In the proximal third of the metacarpus, 17 - 19 cm below the accessory carpal, it divided into superficial and deep branches. The deep branch supplied innervations to the suspensory ligament. The superficial branch descended as fourth palmar common digital nerve. It issued several cutaneous twigs to the palmarolateral aspect of the metacarpus. In the distal third of the metacarpus, the nerve emerged superficially along the lateral border of the tendon of the superficial digital flexor muscle. At this level, after issuing anastomotic branch to the fourth dorsal common digital nerve, it turned medially over the palmar surface of the lateral tendon of the superficial digital flexor. It issued cutaneous twigs to palmarolateral aspect of the distal one fourth of the metacarpus and the fetlock joint. Here it received a communicating branch from the

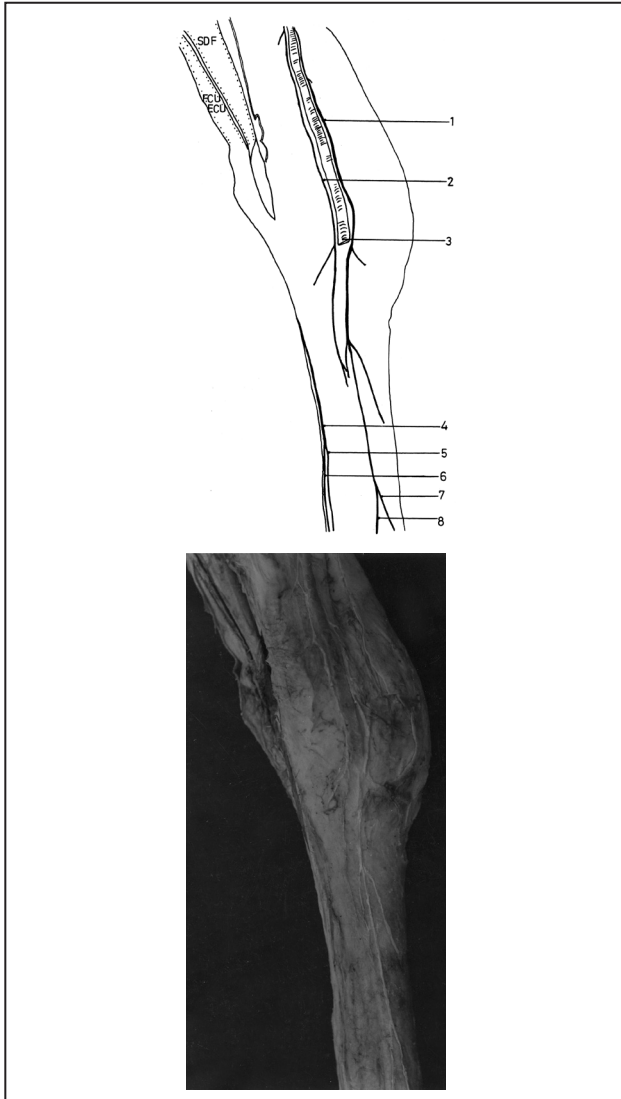


Fig 1. Left forearm and manus region showing branches of radial nerve (medial view).

SDF = Superficial digital flexor muscle

FCUECU = Common tendon of flexor carpi ulnaris and extensor carpi ulnaris muscles.

1, 2. Lateral and medial subdivisions of the cranial, lateral cutaneous antebrachial nerve, 3. Cephalic vein, 4. Median nerve, 5. Second palmar common digital nerve, 6. Lateral branch of 4, 7. Third dorsal common digital nerve, 8. Second dorsal common digital nerve.

lateral branch of the median nerve. Then the parent nerve descended over the palmar aspect of the fetlock joint to abaxial surface of fourth digit towards its toenail as fourth palmar proper abaxial digital nerve. Similar termination was reported by Ghoshal (1975), De Lahunta and Habel (1986) in ox and Garret (1988) in goat. It innervated the skin of palmar aspect of the fetlock joint and palmar abaxial surface of the fourth digit. The latter nerve passed initially over the satellite vein later on it passed deep to it and ramified profusely

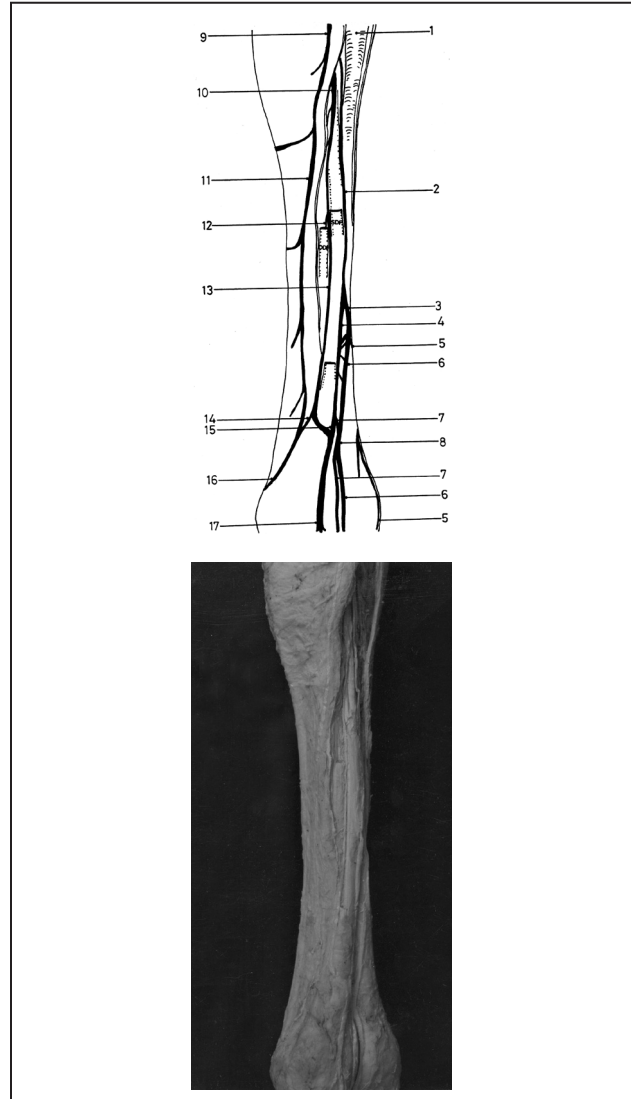


Fig 2. Left manus region showing branches of ulnar and median nerves (palmarolateral view).

1. Median vein, 2. Median nerve, 3. Second palmar common digital nerve, 4. lateral branch of 2, 5. third palmar proper abaxial digital nerve, 6. third palmar proper axial digital nerve, 7. fourth palmar proper axial digital nerve, 8. third palmar common digital nerve, 9. dorsal branch of ulnar nerve, 10. palmar branch of ulnar nerve, 11. fourth dorsal common digital nerve, 12. deep branch of 10, 13. fourth palmar common digital nerve, 14. communicating branch of 13 to 11, 15. communicating branch of 4 to 13, 16. fourth dorsal abaxial digital nerve, 17. fourth palmar abaxial digital nerve.

in the fascia. Ibrahim *et al* (1982) reported the receipt of communicating branch by the fourth dorsal common digital nerve from its counter part of the palmar aspect below the middle of the metacarpus, whereas, Smuts and Bezuidenhout (1987) recorded this just above the fetlock. El-Shaieb (1976) in camel, De Lahunta and Habel (1986), Ghoshal (1975) and Dyce *et al* (1966) in ruminants have not reported communication between

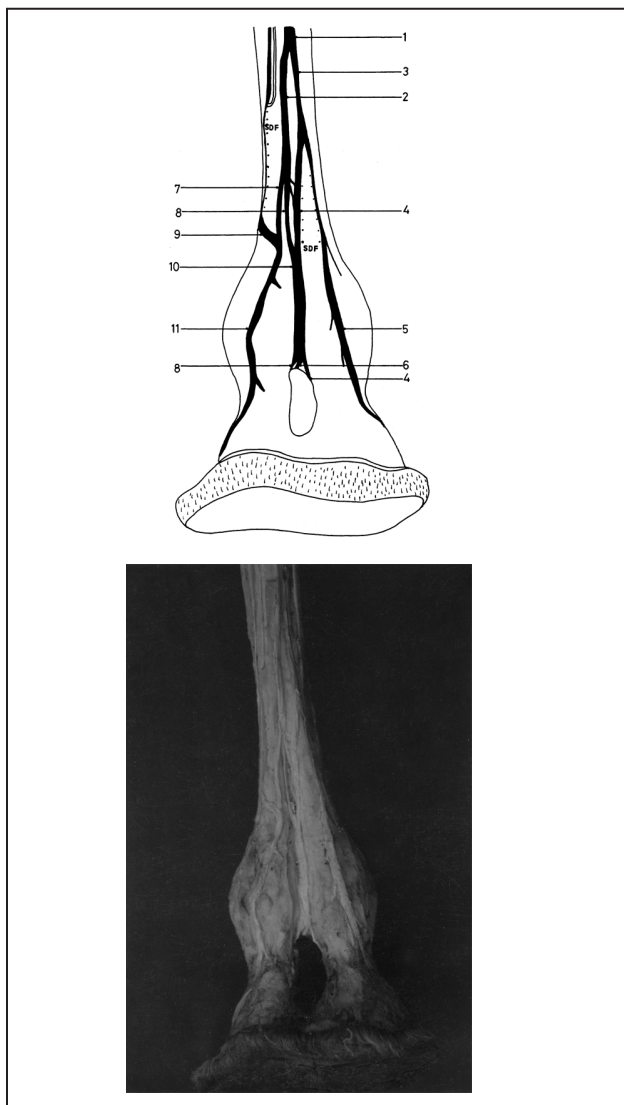


Fig 3. Left distal manus region showing branches of median and ulnar nerves (palmar view).

SDF = Superficial digital flexor muscle

1. Median nerve, 2. lateral branch of 1, 3. Second palmar common digital nerve, 4. third palmar proper axial digital nerve, 5. third palmar proper abaxial digital nerve, 6. interdigital branch, 7. communicating branch to 9, 8. fourth palmar proper axial digital nerve, 9. fourth palmar common digital nerve, 10. third palmar common digital nerve, 11. fourth palmar abaxial digital nerve.

dorsal and palmar branches of the ulnar nerves. El-Shaieb (1976), Ibrahim *et al* (1982) and Smuts and Bezuidenhout (1987) did not report the innervation of the superficial digital flexor tendon by the palmar branch of the ulnar nerve in camel.

Median Nerve

The median nerve entered the manus after passing through the carpal canal. During this passage it passed over the dorsal surface of the

median artery. In four animals it formed a loop for the passage of the median artery. The vessel and nerve were present medial to the tendon of deep digital flexor in its tendon sheath. In the proximal third of the metacarpus the median nerve turned palmaromedially. It travelled in the groove between deep digital flexor tendon and suspensory ligament under the caudal cover of superficial digital flexor. The nerve passed over the dorsal surface of the second palmar common digital artery. It supplied cutaneous twigs to palmaromedial aspect of the metacarpus. The median attained the lateral relationship of the superficial digital flexor tendon in the middle of the metacarpus. The nerve divided into second palmar common digital nerve and a lateral branch, 19 - 21 cm distal to the accessory carpal (Fig 3). El-Shaieb (1976) recorded the terminal bifurcation in the middle of the metacarpus, however, Smuts and Bezuidenhout (1987) observed it in the proximal third in camel. Whereas, in ox it has been reported either in the middle of the metacarpus (Dyce and Wensing, 1971 and De Lahunta and Habel, 1986) or in the distal half (Raghavan, 1964; Vaughan, 1964 and Ghoshal, 1975). McLeod (1958) in ox and May (1970) in sheep reported the termination of median nerve into three branches.

These two branches were present along the medial and lateral borders, respectively of the second palmar common digital artery the second palmar common digital nerve and in two specimens median nerve itself issued communicating branch to second dorsal common digital nerve. The terminal branches turn palmarolaterally over the palmar surface of the tendon of superficial digital flexor. Both these nerves issued cutaneous twigs to palmar aspect of middle third of the metacarpus. The second palmar common digital nerve, in the distal third of the metacarpus, divided into third palmar proper abaxial and axial digital nerves. The former nerve innervated the palmaromedial and palmar area of the metacarpus and fetlock joint of the third digit. It gradually descended over the abaxial surface of the third digit towards its toenail. Here it came in dorsal relationship with the satellite vein. The third palmar proper axial digital nerve descended along the medial border of the second palmar common digital artery. During this course it received anastomotic branches from the lateral branch of the median nerve. It joined the fourth palmar proper axial digital nerve in the distal third of the metacarpus, 8 -10 cm proximal to the fetlock and formed the third palmar common digital nerve of variable length ranging from 4 - 10 cm.

The lateral branch of the median nerve divided into a communicating branch and fourth palmar proper axial digital nerve. The later nerve formed the third palmar common digital nerve as discussed above. Formation of this nerve was an inconstant observation in camel (Ibrahim *et al*, 1982); ox (Habel, 1955) and ruminants (Dyce *et al*, 1971). However, El-Shaieb (1976) and Smuts and Bezuidenhout (1987) did not report its presence in camel. The nerve thus formed descended in between the satellite artery palmarly and vein dorsally. It soon divided into third and fourth palmar proper axial digital nerves, which innervated the axial part of the palmar and dorsal surfaces of the third and fourth digits, while innervated the axial part of the palmar and dorsal surfaces of the third and fourth digits, while passing towards the toenails. The third palmar proper axial digital nerve issued an interdigital branch in all specimens except in one animal in which it was issued by fourth palmar proper axial digital nerve. The nerve innervated the structures of the interdigital space. Ibrahim *et al* (1982) reported the release of this branch from fourth palmar proper axial digital nerve and its communication with the third dorsal common digital nerve in camel. The communicating branch of the lateral branch of the median nerve diverged laterally and distally and passed over the palmar surface of the lateral tendon of the superficial digital flexor to join the fourth palmar common digital nerve in the distal fourth of the metacarpus about 6 - 7 cm proximal to the fetlock joint of the fourth digit. It is in agreement with the observations in camel (Ibrahim *et al*, 1982 and Smuts and Bezuidenhout, 1987) and ox (Ghoshal and Getty, 1967 and 1968).

References

- De Lahunta A and Habel RE (1986). Applied Veterinary Anatomy, W.B.Saunders Company, Philadelphia, USA.
- Dyce KM, Sack WO and Wensing CJG (1966). Text Book of Veterinary Anatomy, 2nd Edn. W.B. Saunders Company, Philadelphia, USA.
- Dyce KM and Wensing CJG (1971). Essentials of Bovine Anatomy. Lea and Febiger, Philadelphia, USA.
- El-Shaieb M (1976). The brachial plexus of the camel (*Camelus dromedarius*). Assiut Veterinary Medical Journal 3(5): 11-20.
- Garret PD (1988). Guide to Ruminant Anatomy Based on the Dissection of the Goat. Iowa State University Press, Iowa, USA.
- Ghoshal NG (1975). Spinal nerves. In: "Sisson and Grossman's The Anatomy of the Domestic Animals". Eds. Getty R 5th Edn. W.B.Saunders Company, Philadelphia, USA.
- Ghoshal NG and Getty R (1967). Innervation of the forearm and foot in ox (*Bos Taurus*), sheep (*Ovis aries*) and goat (*Capra hircus*). Iowa State University Veterinaria 29(1): 19-29.
- Ghoshal NG and Getty R (1968). A comparative study of the somatic innervation of the antebrachium and manus of the domestic animals (*Bos Taurus*, *Ovis aries*, *Capra hircus*, *Sus scrofa domesticus* and *Equus caballus*). Iowa State Journal Science 42(4): 283-296.
- Grossman JD (1959). Embalming by intravascular injection. Bulletin by Indian Council of Agricultural Research, New Delhi.
- Habel RE (1955). Guide to the Dissection of the Cow. 3rd Edn. J.W.Edwards Publishers Inc., Michigan.
- Ibrahim IS, Moustafa MS and Abuzaid SMS (1982). Some gross anatomical observations on the innervation of the manus of the one-humped camel (*Camelus dromedarius*). Journal of Egyptian Veterinary Medical Association 42(1): 75-83.
- May NDS (1970). The Anatomy of the Sheep. 3rd Edn. The University of Queensland Press, St. Lucia, Queensland, Newzealand.
- McLeod WM (1958). Bovine Anatomy (Revised by Trotter DM and Lumb JW). 2nd Edn. Burgess Publishing Company, Minnesota.
- Nomina Anatomica Veterinaria and Nomina Histologica (1983). International Committee on Veterinary Anatomical Nomenclature. World Association of Veterinary Anatomists. Ithaca, New York
- Raghavan D (1964). Anatomy of the Ox. Indian Council of Agricultural Research, New Delhi.
- Smuts SMS and Bezuidenhout AJ (1987). Anatomy of the Dromedary. Claredon Press, Oxford.
- Vaughan LC (1964). Peripheral nerve injuries: An experimental study in cattle. Veterinary Record 76 (46):1293-1301.