

The spinal nerves forming the brachial plexus in mole-rats (*Spalax leucodon*)

A. AYDIN, M. KARAN

Faculty of Veterinary Medicine, Firat University, Elazig, Turkey

ABSTRACT: In this study, the brachial plexus in the mole-rat was investigated. Six adult mole-rats were used and the brachial plexus of each was dissected. It was found that the brachial plexus in the mole-rat was formed by the rami ventralis of C5. A single root was formed from a major part of the ramus ventralis of C5 and through the joining of the whole of the ramus ventralis of C6, C7, C8 and T1. Thus, in mole-rats, the spinal nerves forming the brachial plexus and the joining of these spinal nerves to each other differ from other rodents and mammals.

Keywords: spinal nerves; rami ventralis; brachial plexus; the mole-rats (*Spalax leucodon*)

List of abbreviations

m = musculus, C5 = ramus ventralis of C5, C6 = ramus ventralis of C6, C7 = ramus ventralis of C7, C8 = ramus ventralis of C8, T1 = ramus ventralis of T1

The rodents, which are the widest order of placental mammals, comprise more than half of the mammals currently known. The mole-rat (*Spalax leucodon*) is a representative of the Spalacidae family, which constitutes a group of the order Rodentia (Karol 1963; Weichert 1970; Kuru 1987; Demirsoy 1992).

There are several studies concentrating on the spinal origins of the brachial and lumbosacral plexus which give off nerve branches dispersing to the fore and hind limbs on the brachial plexus. Studies have been carried out in dogs (Miller et al. 1964), in cats (Getty 1975), the wervet monkey (Booth 1991), Chacma baboon (Booth et al. 1997), rabbit (Aslan 1994; Yilmaz et al. 1995), rat (Green 1968; Chiasson 1980), porcupines (Aydin 2003, 2004) and squirrels (Aydin 2011). The lumbosacral plexus has been investigated in dogs (Miller et al. 1964; Getty 1975), rabbits (Barone et al. 1973; McLaughlin and Chiasson 1987), rats (Green 1968; Chiasson 1980; Asato et al. 2000), porcupines (Aydin et al. 2009; Aydin 2009) and squirrels (Aydin 2010). Specifically in the mole-rat (*Spalax leucodon*), there is a report on the morphology of the circulus arteriosus cerebri (Aydin et al. 2008). While there exist many reports on the spinal origin of the brachial plexus,

to our knowledge, no investigation has been reported on the brachial plexus of mole-rats (*Spalax leucodon*). Thus, the purpose of this study was to document the spinal nerves forming the brachial plexus in mole-rats (*Spalax leucodon*).

MATERIAL AND METHODS

In the present study, six adult mole-rats, trapped by farmers, were used. After the animals were anaesthetised with pentathol (6 ml/kg), skin and muscles were carefully dissected in order to document the spinal nerves forming the brachial plexus. The brachial plexus in both forelimbs were examined and pictured. For terminology, the Nomina Anatomica Veterinaria (2005) was used.

RESULTS

The brachial plexus in the mole-rats was formed by the rami ventralis of C5, C6, C7, C8 and T1. Just after the origin, the ramus ventralis of C5 gave two thin branches and one of these branches extended to the cranial, the other branch to the dorsal end of the



Figure 1. Medial view of the brachial plexus of the mole-rats (*Spalax leucodon*)

C5 = ramus ventralis of C5, C6 = ramus ventralis of C6, C7 = ramus ventralis of C7, C8 = ramus ventralis of C8, T1 = ramus ventralis of T1, F = trunk of the brachial plexus A1 = costa I, t = branch constituted by the union of branches coming from C5 and C6; 1 = phrenic nerve, 2 = the common branch giving the suprascapular and the cranial pectoral nerve, 3 = cranial pectoral nerve, 4 = suprascapular nerve, 5 = axillary nerve, 6 = subscapular nerve, 7 = musculocutaneous nerve, 8 = ramus proximalis for the biceps brachii muscle, 9 = ramus distalis for the brachial muscle, 10 = cutaneus antebrachii medial nerve, 11 = radial nerve, 12 = median nerve, 13 = ulnar nerve, 14 = cutaneus antebrachii caudal nerve, 15 = caudal pectoral nerve, 16 = thoracodorsal nerve, 17 = caudal pectoral nerve, 18 = long thoracic nerve, 19 = lateral thoracic nerve, a = ascendent pectoral muscle, b = corachobrachial muscle, c = biceps brachii muscle

neck, and the continuation of the branch joining with the ramus ventralis of C6 participated in the formation of the brachial plexus. The branch formed by the joining of the rami ventrales of C5 and C6 gave off the phrenic nerve before participating in the formation of the brachial plexus. A single root was formed by a major part of the ramus ventralis of C5 and with the joining of the whole of the ramus ventralis of C6, C7, C8 and T1. The branches which originated from this formation, respectively, were the common branch giving the suprascapular and the cranial pectoral nerves, the caudal pectoral nerve, the axillary nerve, the subscapular nerves, the musculocutaneous nerve, the

radial nerve, the median nerve and the ulnar nerve. The ulnar nerve gave the cutaneus antebrachii caudal nerve and the musculocutaneous nerve gave the ramus proximalis muscle, the ramus distalis muscle and the cutaneus antebrachii medial nerve.

DISCUSSION

There exist variations in the formation of the brachial plexus within certain species. According to Green (1968) and Chiasson (1980), the brachial plexus of the rat is formed by the contribution of

the ventral rami of C5, C6, C7, C8, T1 and T2. However, Bertelli et al. (1992) reported that the ramus ventralis of T2 is not involved. Yilmaz et al. (1995) reported that the brachial plexus of the rabbit is formed by the ventral rami of C5, C6, C7, C8, T1 and T2, while Aslan (1994) and McLaughlin and Chiasson (1987) rejected the contribution of C5 and T2. The brachial plexus is formed by the ventral rami of C5, C6, C7, C8 and T1 in mice (Cook 1965; Bogusch 1987), by the ventral rami of C5, C6, C7 and C8 in squirrels (Aydin 2011), by the rami ventralis of C5, C6, C7, C8, T1 and T2 in Wervet monkeys (Booth 1991), in Chacma baboons (Booth et al. 1997) and in porcupines (Aydin 2003) and the ventral rami of C6, C7, C8 and T1 in cats (McClure et al. 1973; Getty 1975). Tipirdamaz and Erden (1988) and Dursun et al. (1994) reported that in dogs the brachial plexus is formed by the ventral rami of C6, C7, C8, T1 and T2, while Miller et al. (1964) and Getty (1975) reported that T2 is involved occasionally. The brachial plexus in mole-rats was formed by the rami ventrales of C5, C6, C7, C8 and T1, and this is in agreement with the findings in mice (Cook 1965; Bogusch 1987) and in contradiction with the remainder of the reported findings.

The constitution of the brachial plexus of mole-rats (*Spalax leucodon*) by one trunk differs from the situation in the rat (Bertelli et al. 1992), and Chacma baboon (Booth et al. 1997), where it is formed by the caudal, medial and cranial trunks, and from the situation in rabbits (Yilmaz et al. 1995), porcupines (Aydin 2003) and squirrels (Aydin 2011) where it is formed from caudal and cranial trunks.

In conclusion, the brachial plexus in mole-rats (*Spalax leucodon*) differs from other rodents and mammals by virtue of it forming from one trunk and with the ventral rami of C5, C6, C7, C8 and T1. These findings mirror the anatomy of the mouse in this regard (Cook 1965; Bogusch 1987).

REFERENCES

- Asato F, Butler M, Blomberg H, Gordh T (2000): Variation in rat sciatic nerve anatomy: Implications for a rat model of neuropathic pain. *Journal of the Peripheral Nervous System* 5, 19–21.
- Aslan K (1994): The comparative macro-anatomical investigation on the brachial plexus of the native cat (*Felis domestica*) and White New Zealand Rabbit (*Oryctolagus cuniculus*). *Istanbul University, Faculty of Veterinary Medicine Journal* 20, 197–208.
- Aydin A (2003): Brachial plexus in the porcupine (*Hystrix cristata*). *Veterinari Medicina* 48, 301–304.
- Aydin A (2004): Nerves originating from brachial plexus in the porcupine (*Hystrix cristata*). *Veterinari Medicina* 49, 123–128.
- Aydin A (2009): The dissemination of pelvic limb nerves originating from the lumbosacral plexus in the porcupine (*Hystrix cristata*). *Veterinari Medicina* 54, 333–339.
- Aydin A (2010): The spinal nerves that constitute the plexus lumbosacrales of the red squirrel (*Sciurus vulgaris*). *Veterinari Medicina* 55, 183–186.
- Aydin A (2011): The spinal nerves that constitute the brachial plexus in the red squirrel (*Sciurus vulgaris*). *Veterinari Medicina* 56, 405–408.
- Aydin A, Yilmaz S, Ozkan ZE, Ilgun R (2008): Morphological investigations on the circulus arteriosus cerebri in mole-rats (*Spalax leucodon*). *Anatomia, Histologia, Embryologia* 37, 219–222.
- Aydin A, Dinc G, Yilmaz S (2009): The spinal nerves that constitute the plexus lumbosacrales of porcupines (*Hystrix cristata*). *Veterinari Medicina* 54, 194–197.
- Barone R, Pavoux C, Blin PC, Cuq P (1973): *Atlas of Rabbit Anatomy*. Masson and Cie, Paris. 158–174.
- Bertelli JA, Mira JC, Gilbert A, Michot GA, Legagneux J (1992): Anatomical basis of rat brachial plexus reconstruction. *Surgery Radiology Anatomy* 14, 85–86.
- Bogusch G (1987): Innervations of the dermatomes in the neck of the mouse. *Acta Anatomy* 129, 275–278.
- Booth KK (1991): The brachial plexus in the vervet monkey (*Cercopithecus pygerythrus*). *Journal of Medical Primatology* 20, 23–28.
- Booth KK, Baloyi FM, Lukhele OM (1997): The brachial plexus in the chacma baboon (*Papio ursinus*). *Journal of Medical Primatology* 26, 196–203.
- Chiasson RB (1980): *Laboratory Anatomy of the White Rat*. Wm.C. Brown Company Publishers, USA.
- Cook MJ (1965): *The Anatomy of the Laboratory Mouse*. Academic Press, London, New York.
- Demirsoy A (1992): *Rodentia. The Basic Rules of Life*. Meteksan Anonim Sirketi, Ankara. 695–729.
- Dursun N, Tipirdamaz S, Gezici M (1994): Macro-anatomical investigations on the brachial plexus in Kangal dogs. *Journal of Veterinary Science, University of Selcuk* 10, 78–80.
- Getty R (1975): *Sisson and Grossman's the Anatomy of the Domestic Animals*. 5th ed. W.B. Saunders Company, Philadelphia. 1700–1718.
- Green CE (1968): *Anatomy of the Rat*. Hafner Publishing Company, New York, London. 124–153.
- Karol S (1963): *Dictionary of the Zoology Terms*. Turkish History Institution Press, Ankara. 192–193.

- Kuru M (1987): Rodentia. The Vertebrate Animals. Atatürk University, Basum, Erzurum. 551–564.
- McClure RC, Dallman MJ, Garret PG (1973): Cat Anatomy. Lea and Febiger, Philadelphia. 66 pp.
- McLaughlin CA, Chiasson RB (1987): Laboratory Anatomy of the Rabbit. Wm.C. Brown Company Publishers, Dubuque, Iowa. 60–62.
- Miller M, Christensen G, Evans H (1964): Anatomy of the Dog. W.B. Saunders Company, Philadelphia. 578–589.
- Nomina Anatomica Veterinaria (2005): 4th ed. Copyright by the World Association of Veterinary Anatomists. 79–80.
- Tipirdamaz S, Erden H (1988): Macro-anatomik investigations on the brachial plexus of the dogs. Journal of Veterinary Science, University of Selcuk 4, 317–332.
- Weichert CK (1970): The Anatomy of the Choradates. 4th ed. McGraw-Hill, London. 500–738.
- Yilmaz O, Yildiz H, Yildiz B, Serbest A (1995): Morphological and morphometrical investigations on fascicle of ventral branches forming brachial plexus and nerves originating from plexus in White New Zealand Rabbits (*Oryctolagus cuniculus*). Hundredth year University, Faculty of Veterinary Medicine Journal 6, 67–75.

Received: 2012–08–10

Accepted after corrections: 2012–08–20

Corresponding Author:

Dr. Ali Aydin, DVM, PhD, University of Firat, Faculty of Veterinary Medicine, Department of Anatomy, 23119 Elazig, Turkey
Tel. +90 424 237 00 00-3958, Fax +90 424 238 81 73, E-mail: aydina@firat.edu.tr; aliydin02@hotmail.com
