The morphology of the arteries originating from the arcus aorta and the branches of these arteries in mole-rats (*Spalax leucodon*)

A. Aydin[1], Z.E. Ozkan[2], R. Ilgun[3]

[1]School of Medicine, Adiyaman University, Adiyaman, Turkey
[2]Faculty of Veterinary Medicine, Firat University, Elazig, Turkey
[3]Faculty of Veterinary Medicine, Republic University, Sivas, Turkey

ABSTRACT: In this study, the aim was to investigate the anatomy of the aortic arch arteries in mole-rats (*Spalax leucodon*). Six adult mole-rats were used for this purpose. Coloured latex was injected into the left ventriculus of the hearts of all animals. The materials were carefully dissected and the arterial patterns of arteries originating from the aortic arch were examined. The brachiocephalic trunk, the left common carotid and the left subclavian arteries were detached from the aortic arch. The brachiocephalic trunk separated into the right subclavian and common carotid arteries. The branches separating from the subclavian arteries were on the right, the common branch giving the profund cervical, the internal thoracic, and the costocervical trunk, and on the left the internal thoracic and the costocervical trunk were in the common root and the profund cervical artery was independent and on both sides after giving the common branch of the superficial servical and the external thoracic artery. This continued as the axillary artery which was then separated into the subscapular and the brachial arteries. Thus, the arteries originating from the aortic arch and the branches of these arteries were found to be different from other rodents and domestic mammals.

Keywords: arteries; aortic arch; mole-rats (*Spalax leucodon*)

Rodents, which are the widest order of placental mammals, comprise more than half of all known mammals. 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 describing the aortic arch in both domestic (Getty 1975; Singh et al. 1983; Lee and Lee 1984; Tipirdamaz et al. 1998; Dursun 2000), and laboratory animals (Green 1968; Young et al. 1979; McLaughlin and Chiasson 1987; Popesko et al. 1990a,b). In mole-rats (*Spalax leucodon*), the morphology of the circulus arteriosus cerebri (Aydin et al. 2008), and the spinal nerves that constitute the brachial plexus (Aydin and Karan 2012) have been studied. However, there was no investigation on the arteries originating from the aortic arch and the branches of the arteries in mole-rats. Hence, the aim of this study was an investigation of the arteries originating from the aortic arch and the branches of the arteries in mole-rats.

MATERIAL AND METHODS

Six adult mole-rats trapped by farmers were used for the anatomical analysis. After the mole-rats were anaesthetised with pentathol (6 ml/kg), the cavum thoracis of all the animals were opened and a 1 cm diameter plastic pipe 7 cm in length was placed into the cardiac left ventricle. Arterial blood was drained and then the vasa were cleared by injecting 0.9% physiological serum into the pipe placed into the left ventricle. Coloured latex was then injected by hand into the left ventriculi through this pipe. After storage at 4 °C for one day, the arteries originating from the aortic arch were dissected carefully. The arterial patterns of arteries originating from the aortic arch, truncus brachicephalicus, arteria carotis communis sinistra and arteria subclavia sinistra were examined and pictured. For the terminology, the Nomina Anatomica Veterinaria was used (World Association of Veterinary Anatomists 2005).

RESULTS

The aorta formed the arcus aorta by reaching the vertebral column with a caudodorsal course in mole-rats. The brachiocephalic trunk, left common carotid artery and left subclavian artery branched from the arcus aorta at the cranial thoracic aperture.

The first branching artery from the arcus aorta, the brachiocephalic trunk, was separated into the right subclavian and right common carotid arteries, and then the right common carotid artery was dispersed to the region of the head by passing through the thoracic aperture. The right subclavian artery gave branches dispersing to the right forelimb and the right anterior part of the chest. Just after separating from the right common carotid artery, the branches detaching from the right subclavian artery were as follows: first, the common branch giving the profound cervical artery, the internal thoracic and the costocervical trunk; second, the vertebral artery; and third, the common branch of the superficial cervical and the external thoracic artery, extending as the axillary artery. The axillary artery separated into the subscapular and the brachial arteries.

The second root originating from the arcus aorta was the left common carotid artery and this branch also dispersed into the left region of the head passing through the cranial thoracic aperture.

The third root originating from the arcus aorta was the left subclavian artery. The branches detaching from the left subclavian artery were as follows: the common branch giving the internal thoracic artery and the costocervical trunk, the profound cervical, the vertebral, the superficial cervical arteries and the external thoracic artery. After giving the common root, the common branch continued as the axillary artery which separated into the subscapular and the brachial arteries (Figure 1).

The profound cervical and the internal thoracic arteries detaching from the right subclavian artery and the internal thoracic artery with the costocervical trunk detaching from the left subclavian artery

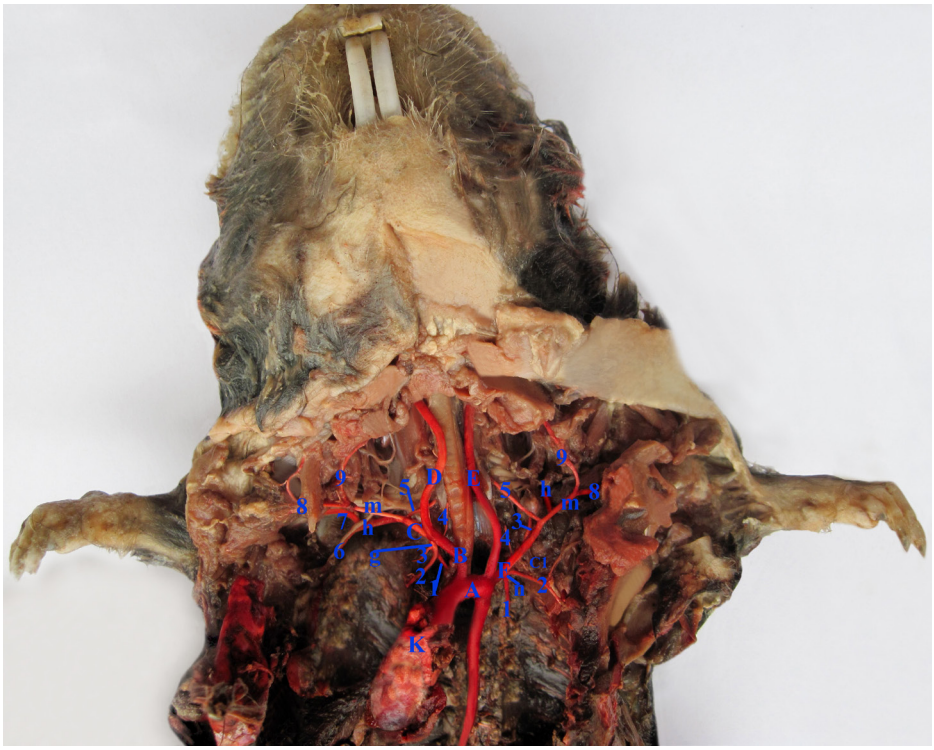

Figure 1. View of the branches of these arteries and the arteries originated from the aortic arch in the mole-rats (*Spalax leucodon*)

A = aortic arch, B = brachiocephalic trunk, C = right subclavian artery, D = right common carotid artery, E = left common carotid artery, F = left subclavian artery, K = cor , C1 = costa I, C2 = costa II, g = the right common root constituted by the junction of the cervical profund, the costocervical trunk and internal thoracic artery, h = axillary artery, m = the common root constituted by the junction of the cervical superficial and the external thoracis artery, n = the left common root constituted by the junction of the costocervical trunk and internal thoracic artery, 1 = costocervical trunk, 2 = internal thoracic artery, 3 = cervical profund artery, 4 = ramus spinalis, 5 = vertebral artery, 6 = brachial artery, 7 = subscapular artery, 8 = external thoracic artery, 9 = cervical superficial artery

were separated into the supreme intercostal and the descending scapular arteries.

DISCUSSION

The brachiocephalic trunk, left common carotid and left subclavian arteries were here described to branch from the arcus aorta in mole-rats (*Spalax leucodon*). With respect to other species, in ruminants and equine species (Getty 1975; Nickel et al. 1981; Dursun 2000), in pigs (Getty 1975; Nickel et al. 1981; Dursun 2000), in carnivorae (Miller et al. 1964; Getty 1975; Nickel et al. 1981; Singh et al. 1983; Tipirdamaz et al. 1998; Dursun 2000), brachiocephalic trunk is originated alone, in rabbits (Singh et al. 1983; McLaughlin and Chiasson 1987; Popesko et al. 1990a), in Guinea pigs (Cooper and Schiller 1975; Popesko et al. 1990a), in red squirrels (Aydin 2011) and in ground squirrels (Aydin et.al. 2011), the brachiocephalic trunk and left subclavian artery, in rats (Green 1968; Chiasson 1980; Popesko et al. 1990b), mice (Cook 1965; Popesko et al. 1990b), hamsters (Popesko et al. 1990b), porcupines (Atalar et al. 2003) and humans (Arinci and Elhan 1997; Putz and Pabst 2008), the left common carotid artery and left subclavian artery originated from the brachiocephalic trunk. Thus, the results presented here are similar to reports in the rat, mouse, hamster, porcupine and humans.

In our study the brachiocephalic trunk separated into the right subclavian and right common carotid arteries. According to other researchers, in ruminants and equine species (Getty 1975; Nickel et al. 1981; Dursun 2000) first the left subclavian, and second the right subclavian arteries and the continuing branch formed the bicarotic trunk. In pigs (Getty 1975; Nickel et al. 1981; Dursun 2000) the brachiocephalic trunk first gives the right subclavian artery and the continuing branch formed the bicarotic trunk. In carnivorae (Miller et al. 1964; Getty 1975; Nickel et al. 1981; Singh et al. 1983; Tipirdamaz et al. 1998; Dursun 2000), rabbits (Barone et al. 1973; Singh et al. 1983; McLaughlin and Chiasson 1987), Guinea pigs (Cooper and Schiller 1975), red squirrels (Aydin 2011), and ground squirrels (Aydin et.al. 2011) it first gives the left common carotid, then the right subclavian arteries, and finally the continuing branch is the right common carotid artery. In rabbits and Guinea pigs (Popesko et al. 1990a) the brachiocephalic trunk gives the left and right common carotid, and the right subclavian arteries nearly from the same point. In rats (Green 1968; Chiasson 1980; Popesko et al. 1990b), mice (Cook 1965; Popesko et al. 1990b), hamsters (Popesko et al. 1990b), porcupines (Atalar et al.2003), and humans (Arinci and Elhan 1997; Putz and Pabst 2008) the brachiocephalic trunk separates into the right common carotid and the right subclavian arteries. Our results are in agreement with the reports in the rat, mouse, hamster, porcupine and humans, and differ from observations made in other species.

In mole-rats (*Spalax leucodon*), after exiting the cranial thoracic aperture, the brachiocephalic trunk gives in the right, just after separating from the right common carotid artery, the following branches detaching from the right subclavian artery: firstly, the common branch giving the profund cervical artery, the internal thoracic and the costocervical trunk, in the left the internal thoracic artery and the costocervical trunk are in the common branch, and the profund cervical artery is independent and after giving the common branch of the cervical superficial and the external thoracic arteries it continues as axillary artery. In ruminants and equine (Getty 1975; Nickel et al. 1981; Dursun 2000), in pigs (Getty 1975; Nickel et al. 1981; Dursun 2000), in carnivorae (Miller et al. 1964; Getty 1975; Nickel et al. 1981; Singh et al. 1983; Tipirdamaz et al. 1998; Dursun 2000), in rabbits (Barone et al. 1973; Singh et al. 1983; McLaughlin and Chiasson 1987; Popesko et al. 1990a), in rats (Green 1968; Chiasson 1980; Popesko et al. 1990b), in mice (Cook 1965; Popesko et al. 1990b), in hamsters (Popesko et al. 1990b) in porcupines (Atalar et al.2003) it is stated that the subclavian arteries disperse into the branches in the thoracal cavity or near the cranial thoracic aperture. Our results differ from those above and are instead similar to descriptions from Guinea pigs (Cooper and Schiller 1975; Popesko et al. 1990a), red squirrels (Aydin 2011) and ground squirrels (Aydin et al. 2011), in that we observe branching near the cranial thoracic aperture or after leaving this aperture.

In conclusion, the brachiocephalic trunk, the left common carotid and the left subclavian arteries originate from the arcus aorta in mole-rats (*Spalax leucodon*), and this result is similar with reports from rats (Green 1968; Chiasson 1980; Popesko et al. 1990b), mice (Cook 1965; Popesko et al. 1990b), hamsters (Popesko et al. 1990b), porcupines (Atalar et al. 2003) and humans (Arinci and Elhan 1997; Putz and Pabst 2008). The subclavian arteries gave the branches at the cranial thoracic aperture or just after going out from this aperture, and this is similar with reports from

Guinea pigs (Cooper and Schiller 1975; Popesko et al. 1990a)), red squirrels (Aydin 2011) and ground squirrels (Aydin et al. 2011), while differing from those from other rodents and domestic mammals.

REFERENCES

Arinci K, Elhan A (1997): Human Anatomy II. Faculty of Human Medicine, Ankara University, 26–30.

Atalar O, Yilmaz S, Burma O, Ilkay E (2003): The macroanatomical investigations on the aortic arch in porcupines (Hystrix cristata). Anatomia, Histologia, Embryologia 32, 367–369.

Aydin A (2011): The arteries originating from the aortic arch and the branches of these arteries in red squirrels (Sciurus vulgaris) Veterinarni Medicina 56, 131–134.

Aydin A, Karan M (2012): The spinal nerves that constitute the brachial plexus of in mole-rats Veterinarni Medicina 57, 430–433.

Aydin A, Yilmaz S, Ozkan Z E, Ilgun R (2008): Morphological Investigations on the Circulus Arteriosus Cerebri in Mole-Rats (Spalax leucodon). Anatomia, Histologia, Embryologia 37, 219–222.

Aydin A, Ozkan ZE, Yilmaz S, Ilgun R (2011): The arteries originating from the aortic arch and the branches of these arteries in ground squirrels (Sciurus vulgaris). Veterinarni Medicina 56, 469–472.

Barone R, Pavaux C, Blin PC, Cuq P (1973): Atlas of Rabbit Anatomy. Masson and Cie, Paris. 121–122.

Chiasson RB (1980): Laboratory Anatomy of the White Rat. W.C. Brown Company Publishers, Iowa. 66–69.

Cook MJ (1965): The Anatomy of the Laboratory Mouse. Academic Press, London, New York. 105–109.

Cooper G, Schiller AL (1975): Anatomy of the Guinea Pig. Harward, University Press, Cambridge, Massachusetts. 149, 180–181.

Demirsoy A (1992): Rodentia. The Basic Rules of Life. Meteksan Anonim Sirketi, Ankara. 695–729.

Dursun N (2000): Veterinary Anatomy II. Medisan Yayinevi, Ankara. 211–213.

Getty R (1975): Sisson and Grossman's the Anatomy of the Domestic Animals. 5th ed. W.B. Saunders Company, Philadelphia. Equine (565–568), Ruminants (960–966), Pig (1306–1310) Dog (1595–1598), Cat (1599–1602).

Green CE (1968): Anatomy of the Rat. Hafner Publishing Company, New York and London. 173, 178, 240.

Karol S (1963): Dictionary of the Zoology Terms. Turkish History Institution Press, Ankara. 192–193.

Kuru M (1987): Rodentia. The Vertebrate Animals. Ataturk University, Basum, Erzurum. 551–564.

Lee HS, Lee JS (1984): Anatomical studies on patterns of the branches of the aortic arch in the Korean native goat. Korean Journal of Veterinary Research 24, 1–7.

McLaughlin CA, Chiasson RB (1987): Laboratory Anatomy of the Rabbit. W.C. Brown Company, Iowa. 41–50.

Miller M, Christensen G, Evans H (1964): Anatomy of the Dog. W.B. Saunders Company, Philadelphia. 687–695.

Nickel R, Schummer A, Seiferle E (1981): The Anatomy of the Domestic Animals. Vol. 3. Verlag Paul Parey, Berlin. 70–79.

Nomina Anatomica Veterinaria (2005): 4th ed. Copyright by the World Association of Veterinary Anatomists. 79–80.

Popesko P, Rajtova V, Horak J (1990a): Colour Atlas of the Anatomy of Small Laboratory Animals. Vol. 1. Rabbit, Guinea Pig. Wolfe Publishing Ltd., London. Rabbit, (57), Guinea Pig (186).

Popesko P, Rajtova V, Horak J (1990b): Colour Atlas of the Anatomy of Small Laboratory Animals Vol. 2. Rat, Mouse, Hamster. Wolfe Publishing Ltd., London. Rat (48), Mouse (132), Hamster(198).

Putz R, Pabst R (2008): Atlas of Human Anatomy. Sobotta, Elsevier GmBH, Munich. 332–347.

Singh AD, Singh GR, Sharma DN, Nigam JM, Bhargawa AK (1983): Arterographic anatomy of the thoracic aorta in the goat, dog and rabbit. American College of Veterinary Radiology 24, 289–291.

Tipirdamaz S, Yalcin H, Dursun N (1998): Makro-anatomik investigations on the branches of aortic arch in the kangal dog. Journal of Veterinary Science, University of Selcuk 14, 87–90.

Weichert CK (1970): The Anatomy of the Choradates. 4th ed. McGraw-Hill, London. 500–738.

Young JT, Schmidt RT, Sprague EA (1979): Branches of the aortic arch in the cynomolgus macaque (Macaca fascicularis). American Journal of Veterinary Research, 40, 1127–1130.

Received: 2013–03–01
Accepted after corrections: 2013–07–30

Corresponding Author:

Dr. Ali Aydin, Firat University, Faculty of Veterinary Medicine, Elazig, Turkey
E-mail: aydina@firat.edu.tr