The arteries originating from the aortic arch and the patterns of their branches in ground squirrels (*Spermophilus citellus*)

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ABSTRACT: In this study, the aim was to investigate the anatomy of the aortic arch in ground squirrels (*Spermophilus citellus*). Five ground squirrels were investigated. The materials were carefully dissected and the arterial patterns of arteries originating from the aortic arch were examined. The brachiocephalic trunk and the left subclavian artery were separated from the aortic arch. The brachiocephalic trunk first gave the left common carotid artery, and then the right subclavian and common carotid artery detached from it. In all the animals examined, at the cranial thoracic entrance and after leaving from this entrance, similar branches arising from the left and right subclavian arteries were the common branch of the internal thoracic artery and the intercostal suprema artery, separate branches as the vertebral and descending scapular arteries and a common branch of the cervical superficial, the cervical profund, the suprascapular arteries and the spinal ramus. After separation of these branches, the continuation of the artery gave the external thoracic artery on the external face of the thoracic cavity and then formed the axillar artery. The axillary artery separated into the subscapular and the brachial arteries. In conclusion, the pattern of arteries originating from the aortic arch and the branches of these arteries were partially similar to what has been observed in red squirrels, and thus differ from other rodents and domestic mammals.

Keywords: arteries; aortic arch; ground squirrels (*Spermophilus citellus*)

The rodents (*Rodentia*), which are the widest order of placental mammals, comprise more than half of all described mammals. The ground squirrels (*Spermophilus citellus*) are representatives of the Sciuridae family that constitutes a group of the order *Rodentia* (Karol, 1963; Weichert, 1970; Kuru, 1987; Demirsoy, 1992). There are different studies related with the aortic arch of both domestic (Getty, 1975; Singh et al., 1983; Lee and Lee, 1984; Tipirdamaz et al., 1998; Dursun, 2000) and laboratory animals (Cook, 1965; Green, 1968; Young et al., 1979; McLaughlin and Chiasson, 1987; Popesko et al., 1990a,b). In red squirrels, the immunohistochemical localisation of calbindin-D28k (Aydin et al., 2005), the morphology of circulus arteriosus cerebri (Aydin, 2008), the spinal nerves that constitute the plexus lumbosacrales (Aydin, 2010), and in the ground squirrel, the arteries originating from the circulus arteriosus cerebri (Aydin et al., 2009), and the aortic arch (Aydin, 2011), have been studied. However, there has been no investigation on the arteries originating from the aortic arch and the branches of these arteries in ground squirrels. Hence, the aim here was to investigate the arteries originating from the aortic arch and the branches of these arteries in ground squirrels.

MATERIAL AND METHODS

Five adult ground squirrels, trapped by farmers, were used. After they were anaesthetized with penthathol (6 ml/kg), the thoracic cavities of all animals were opened, and a 5 mm in diameter, 7 cm-long plastic pipe was placed into the left cardiac ventricle. The arterial blood was drained and red coloured latex was 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, the left and right subclavian artery, were examined and then pictured. For terminology, the Nomina Anatomica Veterinaria (2005) was used (World Association of Veterinary Anatomists).

RESULTS

In ground squirrels, the aorta formed the aortic arch by reaching the vertebral column in a caudodorsal course.

Firstly, the brachiocephalic trunk and secondly the left subclavian artery separated from the aortic arch. The brachiocephalic trunk first gave the left common carotid artery and in continuation it divided into the right subclavian and common carotid artery.

In ground squirrels, at the cranial thoracic entrance and after leaving from this entrance both the left and right subclavian arteries gave a similar pattern of branches. These branches were as follows; firstly, at the cranial thoracal entrance the common root gave the internal thoracic and the intercostal suprema arteries, at the cranial thoracal entrance towards the cranial, the vertebral and descending scapular arteries branched out and a common branch was formed by the cervical superficial, the cervical profund, the suprascapular arteries and the spinal ramus. On both sides, after these branches the continuation of the artery gave the external thoracic artery at the external part of the thoracic cavity, and formed the axillary artery. Also, the axillary artery was divided into the subscapular and the brachial arteries.

From the common root formed by the cervical superficial, the cervical profund and the supras-

Figure 1. View of the arteries originating from the aortic arch and the branches of these arteries in the ground squirrel *(Spermophilus citellus)*. A = aorta; Bt = brachiocephalic trunc; Ls = left subclavian artery; Lc = left common carotid artery; Rc = right common carotid artery**;** Rs = right subclavian artery; C = cor ; C1 = costa I; C2 = costa II; C3 = costa III; C4 = costa IV; 1 = common root constituted by the onion intercostal suprema artery and internal thoracic artery; 2 = intercostal suprema artery; 3 = internal thoracic artery; 4 = vertebral artery; 5 = scapular descending artery; 6 = common root constituted by the ramus transversus, ramus ascendens, ramus deltoideus, ramus prescapularis, ramus spinalis and suprascapular artery; 7 = external thoracic artery; 8 = axillary artery; 9 = subscapular artery; 10 = brachial artery; 11 = ramus deltoideus; 12 = suprascapular artery; 13 = ramus transversus; 14 = ramus prescapularis; 15 = ramus ascendens; 16 = ramus spinalis

capular arteries and the spinal ramus first the spinal ramus detached and then the running branch gave the transversal ascending, deltoid and prescapular rami and the suprascapular artery, and as the last branches the cervical profund and the cervical superficial arteries (Figure 1).

DISCUSSION

In ground squirrels, firstly the brachiocephalic trunk and secondly the left subclavian artery originated from the aortic arch. In other animals, from the aortic arch only the brachiocephalic trunk in ruminants and equidae (Getty, 1975; Nickel et al., 1981; Dursun, 2000), the brachiocephalic trunk and the left subclavian artery in pigs (Getty, 1975; Nickel et al., 1981; Dursun, 2000), carnivorae (Getty, 1975; Miller et al., 1964; Nickel et al., 1981; Singh et al., 1983; Tipirdamaz et al., 1998; Dursun, 2000), rabbits (Singh et al., 1983; McLaughlin and Chiasson, 1987; Popesko et al., 1990a), Guinea pigs (Cooper and Schiller, 1975; Popesko et al., 1990a) and red squirrels (Aydin, 2011), the brachiocephalic trunk, the left common carotid artery and the 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) and porcupinae (Atalar et al., 2003) were reported to originate. Our results are similar to the reports for the pig, carnivorae, rabbit, guinea pig and red squirrel.

In the present study, the brachiocephalic trunk firstly gave the left common carotid artery and in continuation it detached into the right subclavian and common carotid artery. In ruminants and equidae (Getty, 1975; Nickel et al., 1981; Dursun, 2000) the brachiocephalic trunk gave firstly the left subclavian, secondly the right subclavian arteries and the running branch form the bicarotid trunk; in pigs (Getty, 1975; Nickel et al., 1981; Dursun, 2000), the brachiocephalic trunk firstly gives the right subclavian artery and the continuation of the branch gives the bicarotid trunk; in carnivorae (Getty, 1975; Miller et al., 1964; Singh et al., 1983; Nickel et al., 1981; Tipirdamaz et al., 1998; Dursun, 2000), rabbits (McLaughlin and Chiasson, 1987; Singh et al., 1983; Barone et al., 1973), guinea pigs (Cooper and Schiller, 1975) and red squirrels (Aydin, 2011), the brachiocephalic trunk firstly gives the left common carotid and the right subclavian arteries, and the running branch is designated as the right common carotid artery. It was reported that in the rabbit and guinea pig (Popesko et al., 1990a), the brachiocephalic trunk gives the left and right common carotid and the right subclavian arteries from almost 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) and porcupines (Atalar et al., 2003), the brachiocephalic trunk is divided into the right common carotid and subclavian arteries. Our results are concordant with the findings from carnivorae, rabbits, red squirrels and guinea pigs, but are not in agreement with the reports from other species mentioned above.

In ground squirrels, after the subclavian arteries leave the cranial thoracic entrance, the common root formed by the internal thoracic and intercostal suprema arteries, the separate branches as the vertebral and the descending scapular arteries, and the common branch of the cervical superficial, the cervical profund, the suprascapular arteries and the spinal ramus dispersions were partially similar to the anatomy of red squirrels. In ruminants and equidae (Getty, 1975; Nickel et al., 1981; Dursun, 2000), pigs (Getty, 1975; Nickel et al., 1981; Dursun, 2000), 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; Popesko et al., 1990a;), guinea pigs (Cooper and Schiller, 1975; Popesko et al., 1990a), rats (Green, 1968; Chiasson, 1980; Popesko et al., 1990b), mice (Cook, 1965; Popesko et al., 1990b), hamsters (Popesko et al., 1990b) and porcupines (Atalar et al., 2003) their branching patterns were different from those of ground squirrels, except for the suprascapular artery; all the branches of both the subclavian arteries branch out either in the thoracic cavity or near the cranial thoracic entrance.

In conclusion, in ground squirrels the brachiocephalic trunk and the left subclavian artery were seen to originate from the aortic arch and this dispersion pattern was similar to the what has been described in pigs (Getty, 1975; Nickel et al., 1981; Dursun, 2000), carnivorae (Miller et al., 1964; Getty, 1975; Nickel et al., 1981; Singh et al., 1983; Tipirdamaz et al., 1998; Dursun, 2000), rabbits (Singh et al., 1983; McLaughlin and Chiasson, 1987; Popesko et al., 1990a), guinea pigs (Cooper and Schiller, 1975; Popesko et al., 1990a) and red squirrels (Aydin, 2011). Also, the division patterns of the subclavian arteries into branches at the cranial thoracic entrance and just after leaving this entrance, and the unique branch formed by the

cervical superficial, the cervical profund, the suprascapular arteries and the spinal ramus in ground squirrels differed from what has been reported in other rodents and mammals.

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