Some Observations on the Arteria Vertebralis Thoracica in the Dog

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ABSTRACT

The course, ramification, anastomoses and variations of the A. vertebralis thoracica in the dog were studied on the basis of corrosion casts. In the majority of the specimens this artery originated from the Truncus costocervicalis, from where it caudally extended to the third or fourth intercostal space. Here it anastomosed with the (first aortic) A. intercostalis dorsalis IV in about 50% of all cases. It took its course dorsal to the necks of the ribs and is therefore not homologous to the A. intercostalis suprema of other domestic mammals. The differences in the course of the thoracic vertebral and the supreme intercostal artery are discussed as related to literature about the development of both vessels in other mammalian species.

Key words: Aetria vertebralis thoracica, A. intercostalis suprema, Ramus spinalis, blood supply, spinal cord.

INTRODUCTION

The arterial blood supply to the vertebral canal and to the spinal cord is organised strictly segmental in the cervical part of the vertebral column as well as caudal to the 3rd thoracic segment. Dorsal in the first three intercostal spaces, however, there is a gap in terms of a segmental blood supply: this region is vascularised by a longitudinal anastomotic chain formed by the first three or four dorsal intercostal arteries. The present name of this anastomotic chain in the dog is A. vertebralis thoracica. It is the purpose of this study to demonstrate the course, anastomoses and variations of this artery on the basis of corrosion casts from adult dogs, so that its characteristic origin can be better explained as compared to other mammals.
MATERIALS AND METHODS

Thirty adult dogs, euthanised for medical reasons, were injected with tensol-cement via the Aorta abdominalis (Bugge, 1963), whereby the plastic was coloured with “Batson’s #17 Pigment Red”. Two or three days after injection, the bodies were deep frozen followed by maceration in 10% KOH at 60°C. Excessive saponification during maceration of fat animals turned out to be a major problem in subsequent watering so that proper specimens were gained from only 12 dogs. From these 21 sides of the body - 11 on the left and 10 on the right side - could be evaluated. For documentation, photographs were taken with a Nikon F50 using a 120 mm ring flash objective system (Medical-Nikkor, 1:4) and Agfa (RSX 100) film material.

RESULTS AND DISCUSSION

In nearly all dogs that were examined, the A. vertebralis originated from the Truncus costocervicalis (Fig. 1) dorsal in the first intercostal space. Table 1 shows that except for one variation, its origin was sited caudal to the neck of the first rib (Fig. 2) from where it passed dorsal to the necks of the 2nd, 3rd and often also the 4th rib. Deviations from this pattern were found in four cases in which the thoracic vertebral artery crossed the neck of the 2nd rib ventrally or where an additional supreme intercostal artery was present. The total extension of the thoracic vertebral artery varied from the 1st to the 2nd, 3rd or in more than half of all cases as far as to the 4th intercostal space, where it anastomosed with the (first aortic) A. intercostalis dorsalis IV. Its general ramification

Figure 1 Course of the A. vertebralis in the dog, left lateral view; 1 - Truncus costocervicalis, 2 - A. cervicalis profunda, 3 - A. scapularis dorsalis, 4 - A. vertebralis thoracica (4a its origin dorsal in the 1st intercostal space), 5 - Ramus spinalis T1, 6 - R. dorsalis, 7 - A. intercostalis dors. III, 8 (first aortic) A. intercostalis dors. IV, 9 - A. vertebralis; a - 1st thoracic vertebra, b - 1st rib.
pattern could be studied best in the 2nd intercostal space where it constantly gave origin to (1.) the A. intercostalis dorsalis (II), (2.) the Ramus spinalis (T2), (3.) a relatively small Ramus dorsalis to the dorsal muscles, and (4.) a ventromedial branch to the vertebral body. In the third intercostal space, the A. vertebralis thoracica sometimes clearly decreased in diameter or even ended. In these cases the above mentioned four branches either originated from the here ending thoracic vertebral artery or from a relatively thick craniodorsally oriented branch of the first aortic A. intercostalis dorsalis IV. Coming from caudal, this branch entered the third intercostal space mainly through the fourth costotransverse interspace.

In most domestic mammals - except for the dog - the blood supply to the cervico-thoracic part of the spinal cord is provided by the A. intercostalis suprema, running on the ventral side of the necks of the ribs (Wilkens, 1976). In the dog, however, the equivalent artery passes as A. vertebralis thoracica through the costotransverse interspace between the dorsal surface of the rib’s neck and the transverse process of the vertebra. Krassnig (1913), who examined this blood vessel in several species of mammals and birds, has pointed out that a “true A. vertebralis thoracica” must meet two requirements: (1.) it originates together with the A. vertebralis cervicalis from a common trunk, called “A. vertebralis communis”, (2.) it elongates the cervical vertebral artery caudally by passing through the first costotransverse interspace. Among mammals the author regularly found this pattern only in the weasels and their

Figure 2  Variation: A. vertebralis thoracica, originating with A. vertebralis cervicalis from a common trunk (A. vertebralis communis), left lateral view, dog; 1 - A. vertebralis communis, 2 - A. vertebralis thoracica (2a its origin), 3 - A. vertebralis cervicalis, 4 - A. scapularis dors., 5 - A. cervicalis prof., 6 - R. spinalis C/, 7 - A. intercostalis dors. II; a - 1st thoracic vertebra, b - 1st rib.
allies (Mustelidae). According to the here presented findings, the A. vertebralis thoracica in the dog generally does not fulfil these criteria. An attempt to explain this peculiarity can only be made regarding the development of the vertebral artery. Several authors (Evans, 1911; Starck, 1965; Hinrichsen, 1990) describe how in man the A. vertebralis cervicalis results from longitudinal anastomoses between dorsal segmental arteries that lose their aortal origin during their further development. Hafferl (1933) showed that in other mammalian groups a similar process takes place in the cranial thoracic region leading to a longitudinal anastomotic chain of the first dorsal segmental arteries. According to Krassnig (1913), these longitudinal anastomoses firstly are seen dorsal to the necks of the first ribs. Summarizing all aspects, and as shown in Fig. 3, a general developmental scheme could either form an A. vertebralis thoracica that shares a common origin with the A. vertebralis cervicalis, and continues this artery in the cranial segments of the thorax. At the same time or later in some species a second anastomotic chain ventral to the ribs with an origin from the subclavian artery develops, which later forms the A. intercostalis suprema. In this case the further development of

**Figure 3** Basic pattern of the development of the A. vertebralis thoracica in the dog (modified for the dog after Krassnig, 1913); white dots = cranial part of A. vertebralis thoracica in the dog, black dots = cranial part of A. vertebralis thoracica in Mustelidae, hatching = course of A. intercostalis suprema in other domestic mammals; 1 - Aorta thoracica, 2 - A. subclavia, 3 - A. vertebralis communis, 4 - A. vertebralis (cervicalis), 5 - origin of A. vertebralis thoracica in the dog, 6 - origin of A. vertebralis thoracica in Mustelidae, 7 - A. vertebralis thoracica, 8 - R. dorsalis, 9 - origin of cranial thoracic dorsal segmental arteries, 10 - course of A. intercostalis suprema in other domestic mammals, 11 - (first aortic) A. intercostalis dorsalis IV, 12 - R. spinalis C8; a - Corpus vertebrae, b - Costa, C6-T6 - spinal segments.
the dorsal anastomotic chain falls back for the benefit of a more and more dominating ventral vessel. It is conceivable that in the dog the development of both vessels remains at a state when the origin of the ventral artery has already replaced a primary connection between the two vertebral arteries. From the viewpoint of evolutionary biology, it was interesting to note that this basic pattern for the development of the A. vertebralis thoracica may be reflected by the fact that we were able to demonstrate the here presented initial course of this artery also in adult dogs. In this way, the idea is corroborated that domesticated animals are conservative with regard to certain features of mammalian evolution, and, thus, can be used to give some information on evolutionary trends as already presumed earlier (Herre and Roehrs, 1990).

REFERENCES


