TWO ANOMALOUS CASES OF THE RIGHT SUBCLAVIAN ARTERY ARISING DIRECTLY FROM THE AORTIC ARCH IN DOGS

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A large number of case reports have been published on the anomalous arch of the aorta and its ramification in man. Several papers have been presented on this subject in domestic animals, such as the cow\textsuperscript{19,20}, pig\textsuperscript{6,7,22}, dog\textsuperscript{2-4,9-15,16,18,20} and cat\textsuperscript{6}. Case reports on the anomalous aortic arch and its ramification, however, are fewer in the domestic animals than in man. Anomalous cases of persistency of the right aortic arch followed by dilatation of the esophagus with obvious clinical signs\textsuperscript{2-4,6,11-15,16,18,20,25} show a high frequency of occurrence in these published papers. Many anomalous cases of the aortic arch and its ramification in domestic animals have had an opportunity to be diagnosed as such and dissected for the cause of the anomaly. On the other hand, anomalous cases without any obvious clinical sign are apt to be overlooked.

The authors found congenital anomaly of the right subclavian artery arising directly from the aortic arch and running dorsal to the esophagus in two dogs. In this report, the anomalous aortic arch and its ramification in these dogs are described. Besides, discussion is made on the development of these anomalous cases.

OBSERVATIONS

Two dogs with the similar anomalous right subclavian artery were found out among 160 adult dogs that had no apparent clinical symptoms at all.

Case 1.

At its normal site medial to the second rib on the left side, the arch of the aorta ramified into three branches; that is, the trunk of the common carotid arteries and the left and right subclavian artery. The initial parts of these three branches were close to one another (Figs. 1 and 2). Of the three branches, proximal to the heart, the trunk of the common carotid arteries arose from the aortic arch. Running toward the cranium, the termination of this trunk bifurcated into the left and right common carotid artery, but the right subclavian artery did not appear (Fig. 2).

Slightly dorsolateral to the trunk of the common carotid artery, the left subclavian artery arose from the aortic arch and ran toward the left thoracic limb.

The right subclavian artery arose directly from the aortic arch at a point slightly dorsal to the trunk of the common carotid arteries and on the right side of the origin of the left subclavian artery (Fig. 2). The anomalous artery crossed the thoracic cavity cranially on the right side of the thorax, running dorsally to the esophagus and trachea. The esophagus was surrounded by the right subclavian artery, the aortic arch, and the trachea. Especially, it was compressed strongly by the anomalous right subclavian artery. No dilatation, however, could be observed (Fig. 1). The right subclavian artery ran

toward the thoracic limb and ramified into the vertebral, costocervical, omocervical, and internal thoracic artery in the order listed (Fig. 2).

Case 2.
The anomalous right subclavian artery arose from the aortic arch, as its last branch, at a site slightly dorsal to the trunk of the left subclavian artery. The origins of these arteries and the trunk of the common carotid arteries, that arose from the aortic arch, were close to one another (Fig. 4). The other findings were almost the same as those described for case 1 (Fig. 3).

DISCUSSION

Several hundred human cases have been reported on the anomalous right subclavian artery arising distally from the dorsal aorta and running dorsally to the esophagus. This type of anomaly has been observed by Wilson\textsuperscript{24} in the offspring of vitamin A-deficient rats and by Sawin\textsuperscript{21} in his morphogenetic study on rabbits. Kitchell et al. reported this type of anomaly in a newborn piglet\textsuperscript{7} and five of 150 dogs dissected in their laboratory of gross anatomy\textsuperscript{8}. Linton\textsuperscript{12} described the developmental features of this anomaly in the dog, which were illustrated in a diagram.

In the present observation, the anomalous right subclavian artery arose from the aortic arch and ran dorsally to the esophagus. The three arteries that arose from the aortic arch, the anomalous right subclavian artery, left subclavian artery, and trunk of the common carotid arteries, had origins close to one another. The anomalous branching of the aortic arch observed in the two dogs is very rare in domestic animals. Particularly, no cases have been reported from among dogs.

According to Patten\textsuperscript{17,18} who studied the derivation of the aortic arch in vertebrate embryos, six pairs of aortic arches are formed to connect the ventral with the dorsal aorta, and seven pairs of segmental arteries are made from the dorsal aortic root. In the normal development of these aortic arches and segmental arteries, the left fourth aortic arch becomes the aortic arch and the right fourth aortic arch the right subclavian artery in the adult. The left seventh segmental artery enlarges to form the left subclavian artery. The left and right sixth aortic arch become the left and right pulmonary artery, respectively. The ductus arteriosus of the embryo formed by the left sixth aortic arch undergoes involution into the ligamentum arteriosum after birth. Thus, the normal pattern of the aortic arch and its ramification is formed in the same manner as described in a textbook\textsuperscript{23} and monographs on the anatomy of the dog\textsuperscript{24,14}.

While abnormality occurs to this order of development and these portions, various kinds of arterial abnormalities are formed. Judging from the patterns of development in the two cases of anomaly observed by the authors, several derivative patterns may be conceivable about the anomaly of early embryonic arteries. The anomalous right subclavian arteries may be derived from the system of the right aortic arch of the embryo.

SUMMARY

Two congenital cases of anomaly in the ramification of the aortic arch were found among 160 adult dogs examined. They were similar to each other. The findings are summarized and conclusions drawn as follows.

1. Three branches arose from the aortic arch, which was located at the normal site in the thoracic cavity. They were the trunk of the common carotid arteries and the left and right subclavian artery, and adjacent to one another.
2. The termination of the trunk of the common carotid arteries bifurcated only into the left and right common carotid artery. The right subclavian artery ran cranially on the right side of the thorax and passed dorsally to the esophagus and trachea.

3. Such dilatation of the esophagus as might usually be caused by the anomalous right subclavian artery could not be observed.

REFERENCES

犬の大動脈弓より直接分岐する右鎖骨下動脈破格の2例

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ヒトにおいて多数例報告されている大動脈弓とその分枝異常は、ウシ、ブタ、イヌ、ネコなどの家畜においても観察されている。

家畜において、これらの分枝異常が発見された背景を文献的に考察してみると、先天的な右側大動脈弓遺伝による食道狭窄などが主な原因となって、顕著な臨床症状を伴っている場合が極めて多い。したがって臨床症状を伴わないこれらの分枝異常にに関する報告は甚だ少ない。特に臨床症状を伴わないイヌの大動脈弓分枝異常についての報告は、迄位の右鎖骨下動脈を最終枝とする分枝異常に関するものである。今回、著者らが観察したと同様な分枝異常についての報告は見当たらない。

著者らは、160例の犬体を解剖し、そのうち、雌の雑種成犬2例に、極めて類似した右鎖骨下動脈破格を認めた。これらの状態を観察するとともに、発生学的に若干の検討を加えてみた。

それらを要約すると、次の通りである。

1. 正常位に位置する大動脈弓は、左頭動脈に相当する総頭動脈幹、左鎖骨下動脈、右鎖骨下動脈の3枝を分枝し、それらの起始部の位置は極めて近接していた。

2. 総頭動脈幹の先端は3枝のみに分枝し、左・右総頭動脈となる。本来、左頭動脈から分枝すべき右鎖骨下動脈は、左鎖骨下動脈起始部の右側から、大動脈弓より直接単独に分枝し、食道と気管の後方を向かって、斜め前方に通過していた。

3. 右鎖骨下動脈による食道の狭窄は認められなかった。

EXPLANATION of PLATES

PLATE I


Fig. 2. Case 1. Photograph of the arising position of the left subclavian artery (LS), right subclavian artery (RS), and trunk of common carotid arteries (TC) from the aortic arch (A). These three arterial origins are adjacent to one another. The anomalous right subclavian artery ramifies into the vertebral, costocervical (C), omocervical (O), and internal thoracic artery (I) in the order listed. Ventral view. RC: Right common carotid artery. LC: Left common carotid artery.

PLATE II

Fig. 3. Case 2. The trunk of common carotid arteries (TC) bifurcates into the left (LC) and right (RC) common carotid artery. The anomalous right subclavian artery (RS) passes antero-dorsally to the esophagus. Ventral view. H: Heart. P: Precava. LS: Left subclavian artery. T: Trachea.

Fig. 4. Case 2. Photograph of the divergence of the three arterial trunks arising from the
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aortic arch. Esophagus (E) and trachea have been resected. Right lateral view. H: Heart. P: Precava. RS: Right subclavian artery. LS: Left subclavian artery. TC: Trunk of common carotid arteries.