

PERSISTENT RIGHT FOURTH AORTIC ARCH IN DOGS – CLINICAL SIGNS, RADIOLOGICAL AND PATHOMORPHOLOGICAL FINDINGS

D. DINEV¹, G. SIMEONOVA¹, D. DIMOV² & B. AMINKOV²

¹Trakia University, Stara Zagora, ²University of Forestry, Sofia; Bulgaria

Summary

Dinev, D., G. Simeonova, D. Dimov and B. Aminkov, 2002. Persistent right fourth aortic arch in dogs - clinical signs, radiological and pathomorphological findings. *Bulg. J. Vet. Med.*, **5**, No 3, 161–166.

The clinical signs, radiological and pathomorphological findings in four 2–2.7-month-old dogs (3 male German Shepherds and 1 female Dobermann) with persistent right aortic arch are described. The differential diagnosis of the disease with regard to other oesophageal diseases is discussed. The regurgitation of stomach content after weaning is considered as the primary clinical sign. In such cases, the age of patients necessitated the consideration of a congenital vascular ring anomaly as underlying cause of the problem.

The main radiological features were visualization of the cervical and the thoracic parts of the oesophagus, extension of the shadow of the dilated part to the heart, but without overlapping it, position of the shadow of the dilated part mostly to the left in ventrodorsal view. All those features were confirmed in a contrast radiological study.

Key words: clinical signs, dog, necropsy diagnosis, persistent right aortic arch, radiology

INTRODUCTION

The aetiology of oesophageal disorders is various – foreign bodies, spasm, strictures, diverticula, fistulae, achalasia, impaired patency secondary to vascular ring anomalies. The last cause is most commonly characterized by the presence of remnants of the embryonal aortic system. In 95% of all vascular anomalies, a persistent right fourth aortic arch is involved (Buchanan, 1994).

The persistent right aortic arch is diagnosed primarily by means of the higher blood oxygen content in the pulmonary artery compared to that in the right chamber (Ware, 1992), contrast echoaortography (Goodwin and Holland, 1995), clinical signs (Fingerott and Fossum, 1987; Houghton and Ware, 1996), contrast radi-

ography (Muldoon et al., 1997), echocardiography (Fellows et al., 1998), thoracoscopy (Isakow et al., 2000; MacPahil et al., 2001).

Sometimes, the persistent right fourth aortic arch is erroneously diagnosed with the general term megaoesophagus. In other cases when the more precise diagnosis of idiopathic megaoesophagus is being posed, the underlying cause is not always established. The diagnostics is rendered more difficult if an acquired achalasia is suspected. Another diagnostical problem is the lack of adequate data for the pathomorphological and clinical diversity of cases.

The aim of the present study was to describe the clinical signs, the radiological

as well as the necropsy findings in dogs with persistent right fourth aortic arch and to discuss the differential diagnosis of the disease with regard to other oesophageal disorders.

MATERIALS AND METHODS

During 1996-1999, 18 dogs with oesophageal problems (gastroesophageal reflux megaoesophagus, achalasia, foreign bodies, congenital anomalies) were referred for consultation and treatment to the Surgical clinical of the Faculty of Veterinary Medicine in Stara Zagora.

Subject of the present study were four animals from that group aged between 2 and 2.7 months – three male German Shepherds and one female Dobermann (Table 1).

At accepting, a thorough physical examination, native and barium radiological studies of all patients have been performed. In two dogs that finished lethally, a necropsy was made in order to confirm the diagnosis.

RESULTS

The principal clinical signs were nausea, regurgitation, refusal to eat. All those signs were observed after the weaning, when solid food was offered. The overall condition of the animals was characterized with cachexia and a medium to severe dehydration. The body temperature, the heart and respiratory rates were within the

normal limits, even when an aspiration pneumonia was present. The patients' records are given in Table 1.

The native lateral radiography revealed an air-density shadow in both the cervical and thoracic oesophageal parts in the region of the cranial mediastinum. The air mesh covered almost entirely the cardiac shadow and the cranial pulmonary mediastinal lobes. The shadows of the aortic arch and the caudal *vena cava* were not well differentiated (Fig. 1).

In ventrodorsal view, the dilation was seen to the left of midline in the cranial mediastinum (Fig. 2). The caudal border of the cyst was located over the base of the heart in both views (Fig. 1 and 2).

Dorsocaudally to the cardiac shadow, small pulmonary opacities with irregular shape and dimensions of 0.5-1 cm – typical signs of a pneumonia were observed.

The barium study in both views showed clearly the dilated cervical and mediastinal part of the oesophagus as a result of the constriction located at the base of the heart (Fig. 3 and 4). The radioscopy at 15 minute intervals did not outline the pathway of barium sulphate towards the distal part of the oesophagus and the stomach or the passage was visible as a thin band. The barium sulphate was regurgitated 15-20 minutes after its administration.

The pathoanatomical findings consisted in a huge oesophageal dilation in the left thoracic region related to the

Table 1. Records of canine patients with persistent right fourth aortic arch

Case No.	Breed	Gender	Age, months	Clinical signs
1	Dobermann	Female	2	Regurgitation, cachexia
2	German Shepherd	Male	2.7	Anorexia, cachexia
3	German Shepherd	Male	2.5	Regurgitation, cachexia
4	German Shepherd	Male	2	Regurgitation, cachexia

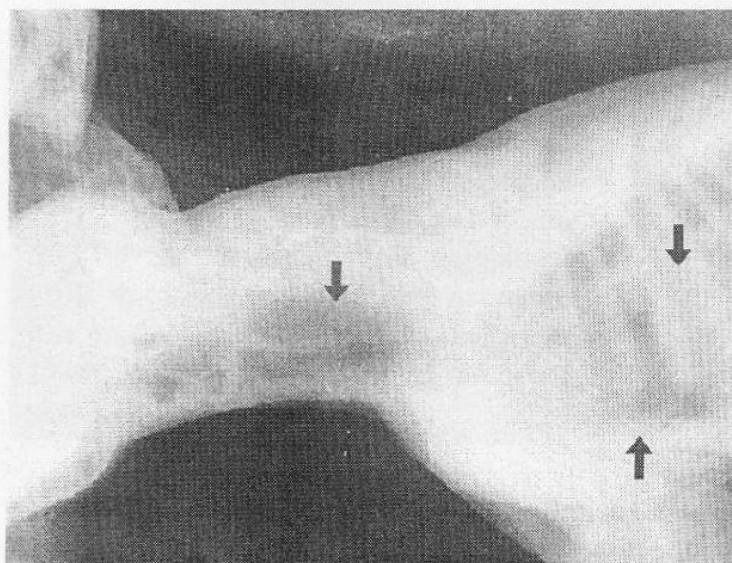


Fig. 1. Lateral radiograph of the neck and the thorax – translucent areas in the dilated cervical and thoracic oesophageal parts (arrows).

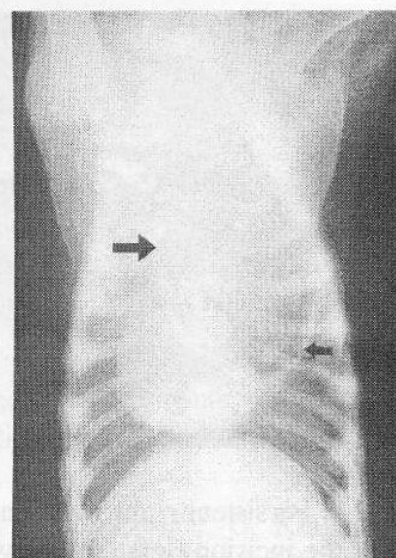


Fig. 2. Ventrodorsal radiograph of the thorax – translucence in the dilated thoracic oesophageal part on the left in the cranial mediastinum (arrows).

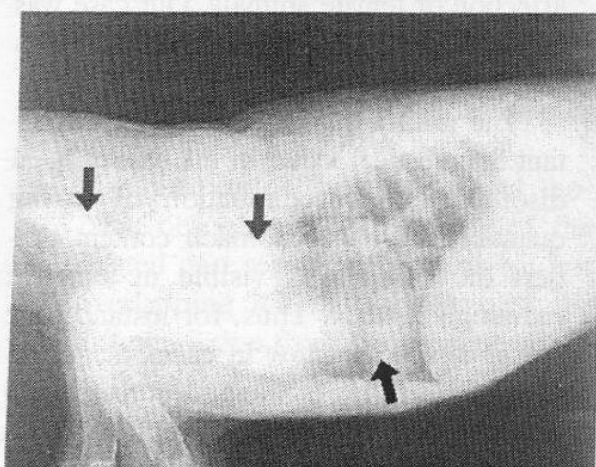


Fig. 3. Contrast lateral radiograph of the neck and the thorax of a female Dobermann (case 1) – dilated oesophageal part, filled with barium sulphate (arrow).

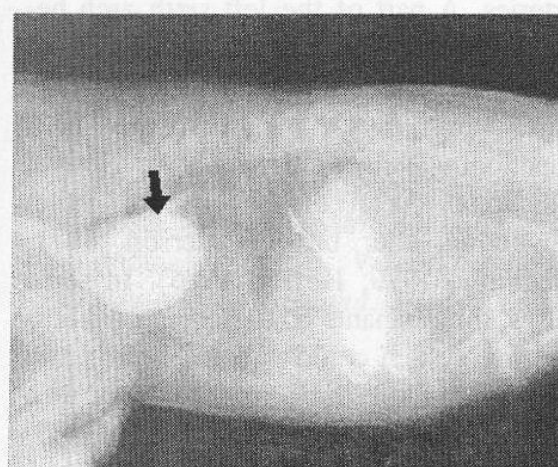


Fig. 4. Contrast lateral radiograph of the neck and the thorax of a male German Shepherd (case 2) – stricture behind the dilated thoracic oesophageal part (arrow).

persistent right fourth aortic arch that encircled the oesophagus over the heart (Fig. 5) and a significant atelectasis of the left pulmonary lobe.

DISCUSSION

Most commonly, the vascular anomalies affect the right fourth aortic arch and rarely the left one (O'Brien et al., 1980).

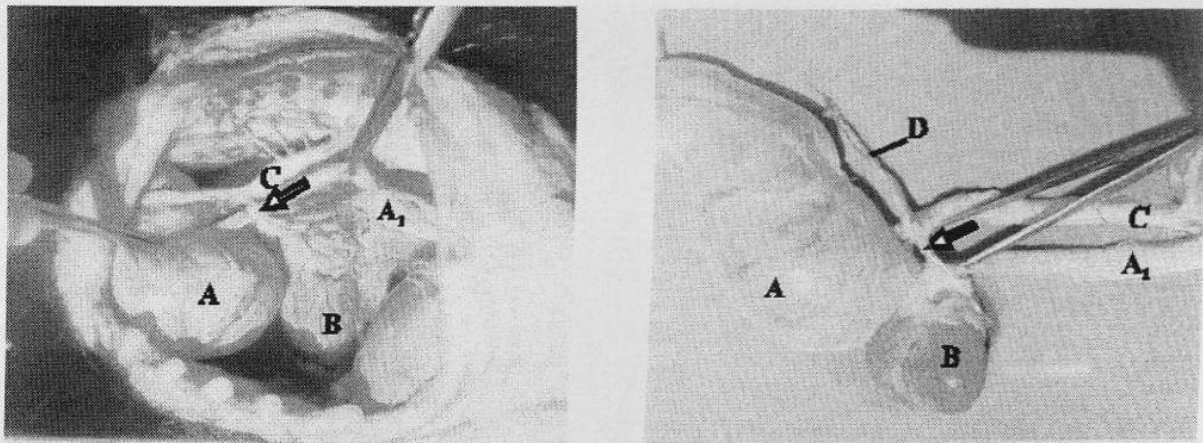


Fig. 5. Persistent right fourth aortic arch encircling the oesophagus (arrow): general view after the incision (left) and view after the dissection (right); A=dilated oesophagus anterior to *lig. arteriosum*; A1=appearance of oesophagus posterior to *lig. arteriosum*; B=heart; C=aorta; D=pulmonary artery.

During the embryonal development, the aorta is formed from the left fourth branchial artery and the two pulmonary arteries – from the sixth pair of the branchial arteries. A part of the left sixth arch becomes the ductus arteriosus. The blood passes from the pulmonary artery into the aorta and thus, bypasses the non-functioning lung of the embryo. Normal functional ductal closure occurs within few hours after birth (Patterson, 1971; Helphrey, 1979; Hoffer, 1985). In some cases, the remnants of the embryonal aortic ring system could cause serious problems, encircling the oesophagus. In such cases, a ligamentum arteriosum is formed.

The age of patients is characteristic for the clinical manifestation of other congenital gastrointestinal abnormalities too – for instance, the congenital pyloric stenosis (Van Sluijs and Happe, 1985). It was reported (Shires and Liu, 1981) that the most commonly involved breeds were the German Shepherd and the Irish Setter. For the former breed, this fact was confirmed by our studies too. The medium-size and small breeds are however af-

ected as well (Patterson, 1989; Goodwin and Lombard, 1990; Ware, 1992; Buchanan, 1994). The observation of Buchanan (1994) revealed a more frequent affection of female animals. Our case was however different (ratio of 3:1 of males vs females).

The radiological study has an important diagnostical value in all oesophageal disorders. The accumulation of a big quantity of air and stomach content renders the oesophagus visible in a native radiological study. Thus, for instance, the wedge-shaped shadow in cases of gastro-oesophageal reflux is situated in the cranial cervical part immediately over the trachea (Dinev et al., 1997).

The principal radiological sign is therefore the presence of a sacciform shadow in the thorax, reaching the cardiac shadow. In that area, the contrast substance passes as a thin band - an evidence for an obstruction. It should be taken into account that in acquired achalasia, a similar shadow is observed from the first pair of ribs upward to the lower oesophageal sphincter while the radiological picture of idiopathic megaesophagus in a

standing position reveals a wedge-shaped shadow oriented towards the diaphragm (Hoffer, 1985).

Necroscopy findings confirmed the radiological diagnosis. It should be emphasized that normally, the aortic arch is situated on the left side of the oesophagus while in cases of vascular ring anomalies it is on the right side (Ettinger and Suter, 1970); a fact, confirmed during the necroscopy of our patients as well.

CONCLUSIONS

The principal clinical sign indicative for the disease was the regurgitation of stomach content immediately after feeding. This sign was always present after the weaning (in all cases).

The presence of the forementioned sign in dogs from the large breeds at the age of about 2 months suggested the confirmation of the presence or lack of a congenital vascular ring anomaly as underlying cause of the problem.

The characteristic radiological features were:

- visualization of the cervical and thoracic oesophagus, the shadow of the dilated part reaching the heart but not overlapping it (an important sign for differentiation from megaoesophagus);
- in the ventrodorsal view, the shadow of the dilated part was situated mostly to the left, while in megaoesophagus it was to the right;
- the contrast radiological study was a reliable confirmation of the diagnosis.

REFERENCES

- Buchanan, J., 1994. Patent ductus arteriosus. *Seminars in Veterinary Medicine and Surgery*, **9**, 168–176.
- De Hoff, W., 1970. Surgical correction of patent ductus arteriosus and vascular ring anomalies. In: *Canine Cardiology*, eds S. Ettinger and P. Suter, W. B. Saunders Co., Philadelphia, pp. 578–602.
- Dinev, D., I. Borissov, M. Pascalev and D. Bakalov, 1997. Syndrome of canine gastro-oesophageal reflux. *Veterinary Science (Sofia)*, **20**, No. 1-2, 299–303 (Bg).
- Ettinger, S. and P. Suter, 1970. *Canine Cardiology*, W. B. Saunders, Philadelphia.
- Fellows, C., P. Lerche, G. King and A. Tometzki, 1998. Treatment of patent ductus arteriosus by placement of two intravascular embolisation coils in a puppy. *Journal of Small Animal Practice*, **39**, 196–199.
- Fingerioth, J. M and T. W. Fossum, 1987. Late-onset regurgitation associated with persistent right aortic arch in two dogs. *Journal of the American Veterinary Medical Association*, **191**, No 8, 981–983.
- Goodwin, J. K. and M. Holland, 1995. Contrast echoaortography as an diagnosis of right-to-left shunting patent ductus arteriosus. *Veterinary Radiology and Ultrasound*, **36**, No 2, 157–159.
- Goodwin, J. K. and C. W. Lombard, 1990. A guide for the diagnosis of congenital heart disease in puppies, Part I. Identifying congenital heart defects using clues from the physical exam. *Veterinary Medicine*, **85**, No 1, 40–47.
- Helphrey, M., 1979. Vascular ring anomalies in the dog. *Veterinary Clinics of North America: Small Animal Practice*, **9**, 207.
- Hoffer, R., 1985. Esophagus: surgical diseases. In: *Textbook of Small Ani-*

- mal Surgery, ed. D. Slatter, W. B. Saunders, pp. 654–680.
- Houghton, H. and W. Ware, 1996. Patent ductus arteriosus in dogs. *Iowa State Veterinarian*, winter, 83–87.
- Isakow, K., D. Fowler and P. Walsh, 2000. Video-assisted thoracoscopic division of the ligamentum arteriosum in two dogs with persistent right aortic arch. *Journal of the American Veterinary Medical Association*, **217**, No 9, 1333–1336.
- MacPhail, C. M., E. Monnet and D. C. Twedt, 2001. Thoracoscopic correction of persistent right aortic arch in a dog. *Journal of the American Animal Hospital Association*, **37**, No 6, 577–581.
- Muldoon, M., S. Birchard and G. Ellison, 1997. Long-term results of surgical correction of persistent right aortic arch in dogs: 25 cases (1980–1995). *Journal of the American Veterinary Medical Association*, **210**, No 12, 1761–1763.
- O'Brien, J., C. Harvey and R. Brodey, 1980. The oesophagus. In: *Gastroenterology*, ed. N. Anerson, Lea & Febiger, Philadelphia.
- Patterson, D., 1971. Canine congenital heart disease: epidemiology and etiological hypotheses. *Journal of Small Animal Practice*, **12**, 263.
- Patterson, D., 1989. Hereditary congenital heart defects in dogs. *Journal of Small Animal Practice*, **30**, 153–165.
- Shies, P. and W. Liu, 1981. Persistent right aortic arch in dogs: a long term follow-up after surgical correction. *Journal of the American Animal Hospital Association*, **17**, 773.
- Van Sluijs, F. and R. Happe. 1985. The stomach. In: *Textbook of Small Animal Surgery*, ed. D. Slatter, W. B. Saunders, Philadelphia, pp. 703–707.
- Ware, W., 1992. Disorders of the cardiovascular system. In: *Essentials of Small Animal Internal Medicine*, eds R. Melson and C. Couto, Mosby Yearbook, Missouri, pp. 115–116.

Paper received 25.03.2002; accepted for publication 03.07.2002

Correspondence:

Asoc. Prof. D. Dinev
Dept. of Veterinary Surgery,
Faculty of Veterinary Medicine,
Trakia University,
6000 Stara Zagora,
Bulgaria