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Diagnostics of canine peritoneal-pericardial diaphragmatic hernia (PPDH)

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Diagnostics of canine peritoneal-pericardial diaphragmatic hernia (PPHD)

Summary

The study presents two cases of dogs with congenital peritoneopericardial diaphragmatic hernia of radically different clinical courses. The dorsoventral and right lateral thoracic radiographs proved helpful in establishing a diagnosis. In the first dog examined, the disorder did not precipitate any clinical signs and it was recognized as an incidental finding solely during the radiological evaluation. The radiograms confirmed the presence of gas-filled bowel loops overlying the markedly enlarged cardiac silhouette. The radiographic finding of the other dog presented with a history of developing a circulatory-respiratory compromise revealed a severe cardiomegaly along with a blurred outline of the diaphragmatic dome. The definitive diagnosis was confirmed by the ultrasonographic examination, which allowed direct visualization of the liver displacement, i.e. some liver lobes were herniated into the pericardial sac.

Keywords: diaphragm, hernia, congenital anomaly, dogs

Peritoneal-pericardial diaphragmatic hernia is the most common congenital anomaly involving the pericardium of dogs and cats (9). It occurs as a result of an embryonic development defect of the dorsolateral septum transversum in the so-called sternocostal triangle structure. Persistent communication between the peritoneal and the pericardial cavities allows the abdominal contents to herniate into the pericardial sac (2, 3). PPDH incidence is frequently associated with umbilical hernia, malformed or absence of the sternebrae and pectus excavatum (1, 8-10). Generally, Weimaraners are mentioned among the dog breeds that show a predilection for this disorder, as PPDH accounts for 0.5% of their congenital cardiac diseases (3). Feline peritoneopericardial diaphragmatic hernia is frequently identified with a similar percentage in Persian cats, whose pattern of inheritance is consistent with that of an autosomal recessive trait (6). Other potential causes for PPDH occurrence include malformations and teratogen-induced factors (8).

Recognition of diaphragmatic hernia is based mainly on radiographs (4, 7-9). In certain cases the authors of other papers propose contrast radiographic studies, like selective angiography, peritoneography, gastrointestinal evaluation (2, 5).

The available research literature indicates computer tomography or magnetic resonance imaging techniques as preferable diagnostic tools, allowing confirmation of the diagnosis in a safe and non-invasive way (3, 5).

The present study describes two cases of dogs with PPDH characterized by a different clinical course.

Case reports

Case I. A 7-year-old female boxer was presented to the Laboratory of Radiology and Ultrasonography on account of temporal pareses and pelvic limb ataxia persisting for approximately 2 months. The dog did not show any signs of other disorders nor did it have a history of earlier diseases. The only health problem reported was an umbilical hernia surgery performed after the dog had been purchased by the present owner.

Thoracolumbar spine target imaging revealed the presence of degenerative lesions in the form of *spondylosis deformans* identified between the 3rd thoracic-1st lumbar vertebrae as well as between 7th lumbar-1st sacral vertebrae. The evaluation of the thoracic spine exhibited the dorsal elevation of the trachea. Owing to the suspected pathological changes in the cardiovascular system, right lateral and dorsoventral thoracic radiographs were performed. The dorsoventral projection visualized a markedly enlarged and rounded cardiac silhouette that occupied 9 intercostal spaces, whereas at the 4th-7th rib level its width was equal to the internal diameter of the thorax. The middle shadow appeared to be saturated unequally, with numerous right bands visible within its area. The diaphragm outline remained indistinct on the right side. The radiographic examination in the lateral projection exhibited the presence of small bowel loops filled with gas overlying a substantially enlarged heart silhouette (fig. 1). The diaphragm outline

was blurred in the cardiophrenic angle region. In the visible pulmonary fields, no lowered pulmonary pneumatization was observed. The survey abdominal radiographs showed the absence of small intestine loops within the peritoneal cavity. The other visceral organs were in their normal physiological positions.

On the basis of the radiograms, a definitive diagnosis was established: congenital peritoneal-pericardial hernia with gas-filled bowel loops in the pericardial sac. The owner of the dog did not give his consent for surgical intervention.

Case II. A 4-month old male Schnautzer dog was presented with depression and dyspnea to the Laboratory of Radiology and Ultrasonography to undergo a chest radiological examination. The history revealed that the dog had lower body-weight gains than other puppies from the same litter. At the age of 10 weeks it had surgical correction of a congenial umbilical hernia.

The radiological evaluation was performed in dorsoventral and right lateral projection. The radiographs showed a markedly enlarged and round cardiac silhouette (fig. 2). It occupied 7 intercostal spaces on the lateral view, while its width at the 7^{th} rib height in the dorsoventral projection was almost equal to the thorax width. Both the anterior and posterior borders of cardiac silhouette were blurred. The radiograph visualized the caudal displacement of the diaphragm by 3 intercostal spaces as well as an indistinct outline of the diaphragmatic dome and inferior part of the diaphragmatic crura. The local lowering of pulmonary pneumatization was observed. High radiolucency was noted in the right caudal and left cranial lung lobes. Radiography demonstrated the tracheal luminal narrowing in the tho-racic segment as well as trachea dorsal displacement. Screening the abdominal cavity for the visceral organ position did not indicate any changes.

As the change in the heart silhouette shape visualized in the radiography appeared to be substantial, an attempt was made to evaluate it by an ultrasonographic examination with Honda 4000 apparatus. It was performed on both sides of the thorax in parasternal projections between 4^{th}-7^{th} intercostal spaces using a 5 MHz microconvex transducer. The obtained scans demonstrated a large, well demarcated mass of homogeneous solid echostructure and clearly visible blood vessel system resembling hepatic parenchyma located in the pericardial sac close to heart at the atria height (fig. 3). The examination of the right subcostal area showed the presence of a small-sized liver and the medial displacement of the gall bladder. The sonograms obtained at scanning in the substernal position revealed loss of continuity of the diaphragmatic dome visualized as a characteristic bending of hyperechogenic linear structure.

On the basis of survey thoracic examination findings the initial diagnosis of congenital diaphragmatic hernia was made. Due to the developing cardiorespiratory dysfunction, the animal was euthanized. The anatomopathological examination was conducted in the Department of Pathological Anatomy. Having the stern cut off, no fusion of sternebrae in the midline was noted. The pericardial sac contents consisted of (beside heart) the omentum portions and the liver lobes: left lateral, peripheral part of the right, lateral and medial lobe.

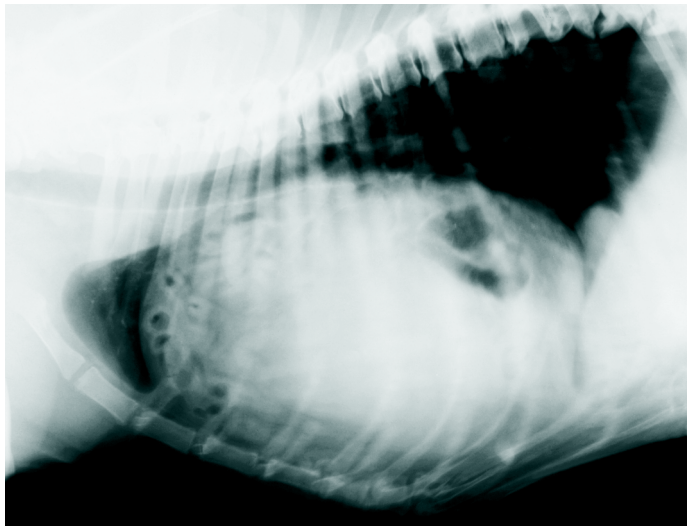

Fig. 1. Lateral view of the thorax. Cardiac silhouette appears increased in size. Intestinal gas shadows within the cardiac shadow

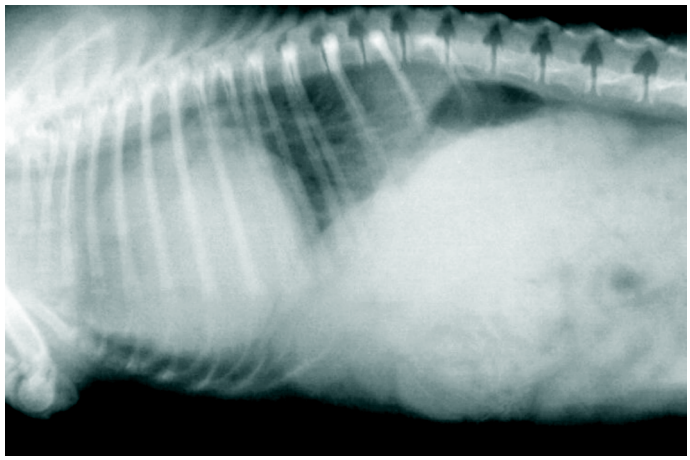

Fig. 2. Right lateral thoracic radiograph. Note markedly enlarged and rounded heart silhouette and indistinct diaphragm dome outline

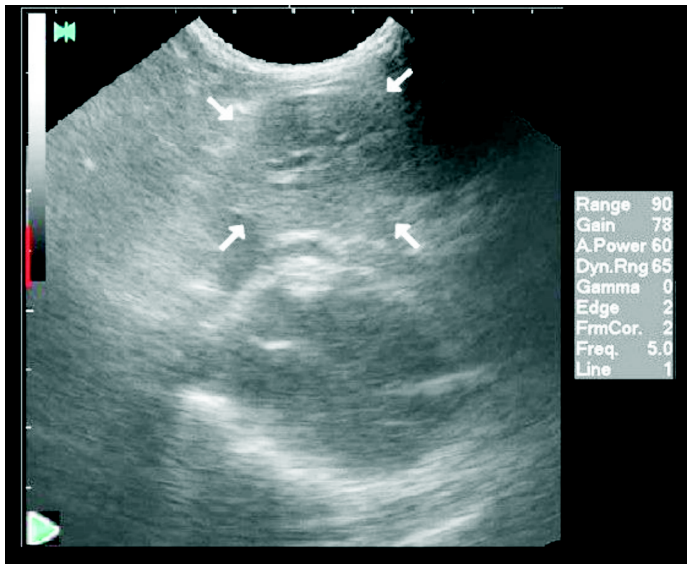

Fig. 3. Ultrasonographical image in parasternal projection. At heart atrium height, a portion of the liver visualized in the pericardial sac (arrows)

The papillary process of the caudate lobe was identified in a round opening (tear) found in the medial-inferior part of the diaphragm dome. The tear was approximately 3 cm in diameter with smooth, rather flat, cylindrical edges with no suggilation. The peri-hilar region of the right lateral and medial liver lobe along with gall bladder and the caudate process of the caudate lobe remained within the peritoneal cavity. The quadrilateral liver lobe and medial left were located immediately behind the diaphragm, but displaced to the left. The other visceral organs did not show any changes.

Discussion

The described cases were characterized by markedly different clinical signs. However, the case reports available in the literature indicate that the intensity of clinical symptoms vary subject to diaphragm defect size as well as the kind and volume of the herniated organs (3, 8). An animal may demonstrate reduced exercise tolerance. The reference data suggest that the diagnosis of peritoneal-pericardial hernia in dogs and cats may be incidental owing to the fact that the clinical signs of the disease are not specific and the animals affected – asymptomatic (2, 3). The first case reported in the present paper was strangely asymptomatic in the face of the herniation of numerous bowel loops to the pericardial sac. This dog showed motor activity impairment associated with the presence of degenerative lesions in the spinal column. Conversely, such a severe cardiorespiratory compromise as observed in the other dog under study is reported in the literature quite occasionally (3).

As for the diagnostic imaging techniques employed, the radiological evaluation proved to be decisive for the diagnosis established in the first case. The hallmark radiographical sign indicating the bowel presence in the pericardial sac was the evidence of gas identified in the herniated intestine loops as visualized on the radiogram. The other dog case, however, appeared to be far more difficult to diagnose. Evaluation of the thoracic radiographs revealed some anomalies associated with the overall cardiac silhouette size and shape that may help in building a differential list suggesting cardiomyopathy or the presence of fluid in the pericardial sac. Moreover, radiographic findings were not evident due to uniform saturation of the heart silhouette shadow that can be due to a number of causes, such as the absence of abdominal fat in young animals. Fat tissue deposit in the omentum could help identify the organs located within the pericardial sac. However, the apparent appropriate position of the organs visualized on the roentgenogram could contribute to the improper diagnosis. The only radiological sign implying the presence of a hernia was the lack of distinct demarcation between the hernia outline and cardiac silhouette.

The ultrasonographic study performed allowed the visualization of the liver presence in the pericardial sac as well as the disrupted diaphragmatic line. This diagnostic technique provided additional information and aided in the definitive recognition of peritoneal pericardial hernia disorder.

The ultrasound technique as an additional diagnostic method proves useful for dogs whose radiographic findings visualize a marked enlargement of the overall cardiac silhouette and an indistinct cardiophrenic angle. Despite scarce reference data on the employment of ultrasonographic examination for the diaphragm malformation diagnostics (4), this method seems reliable particularly for young animals with an umbilical hernia or sternal developmental anomalies. Ultrasonography has been found useful for early diagnosis of PPHD that benefits emergent surgical intervention.

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