

PERITONEO-PERICARDIAL DIAPHRAGMATIC HERNIA IN A MINIATURE SCHNAUZER: CASE REPORT

Alina ȘTEFĂNESCU, Cristian Ionuț FLOREA, Crina Alexandra BOANCĂ,
Andrei RĂDULESCU, Alexandru Bogdan VIȚĂLARU

University of Agronomic Sciences and Veterinary Medicine of Bucharest, Faculty of Veterinary
Medicine, 105 Splaiul Independentei Street, 050097, District 5, Bucharest, Romania

Corresponding author email: alexandrumv@yahoo.com

Abstract

A five-months-old female Miniature Schnauzer dog, was referred with persistent vomiting and history of inappetence, lack of appetite, abdominal distention, tachypnea, and progressive weight loss. During clinical examination, the patient presented a defense reaction in the epigastric region upon deep palpation, auscultation of left side of the lungs found enhanced respiratory noises. Cardiac auscultation, revealed diminished heart sounds and intermittent borborygmi on the right hemithorax. At abdominal focused assessment with sonography in trauma, intestines were slightly distended by gas and liquid content and motility was reduced. The X-rays revealed enlarged cardiac silhouette and abnormal topography of the intestinal mass, with the cranial displacement especially on the projection area of the right heart. The radiological aspect suggests a peritoneo-pericardial hernia with the involvement of the small intestine. Peritoneo-pericardial hernia is a malformation which allows the protrusion of abdominal organs into the pericardial sac. Surgical repair was performed by herniorrhaphy with a polypropylene suture. Antibiotics were administered before and after surgery. Following herniorrhaphy, an abdominal exploration was performed. The only treatment for peritoneo-pericardial hernias is surgical and the main tool for diagnosis is radiography.

Key words: peritoneo-pericardial, hernia, dog, surgery.

INTRODUCTION

Peritoneo-pericardial diaphragmatic hernia (PPDH) is the end result of dysembryogenesis, wherein a connection stays among the pericardial and peritoneal cavity, permitting the displacement of stomach viscera into the pericardium (Banz, et al., 2010; Bjorck et al., 1970; Evans et al., 1980).

Peritoneo-pericardial diaphragmatic hernia has additionally been proposed to end result from the malformation of the septum transversum and pleuroperitoneal folds for the duration of embryonic development (Bolton et al., 1969; Less, R. D. et al., 2000).

This could be a result of a teratogen, genetic defect, or prenatal injury.

Peritoneo-pericardial diaphragmatic hernia appears to be a common incidental finding, and a breed predilection in Weimaraners and Cocker Spaniels.

Organs herniated into the pericardial sac may include the liver, the gallbladder, falciform ligament, omentum, spleen, stomach, small

intestine, and colon (Hunt et al., 2003; McClaran et al., 2023).

Radiographic findings associated with PPDH include cardiomegaly, convex projection of the caudal cardiac silhouette, abdominal organs identified within the pericardial sac, and a confluent silhouette between the diaphragm and the heart. Diagnosis may be difficult with herniation of solid organs such as the liver or spleen as they will lack radiographic contrast (Park et al., 2002; Chalkley et al., 2006).

Treatment includes surgical herniorrhaphy, however, medical management or conservative treatment is commonly used, particularly in the absence of clinical signs or in the presence of medical conditions limiting surgical repair (Banz et al., 2010; Evans et al., 1980; Burns et al., 2008).

MATERIALS AND METHODS

A five-months-old intact female Miniature Schnauzer dog, was referred for a general consultation on the 24th of August, 2023. In the

last 24 hours the dog was presenting 6 episodes of vomiting after she was groomed. Vomit was consistent with undigested food content. The dog was presented with the following symptoms: lethargy, appetite loss, dehydration (5-7%, considerable loss of skin turgor), body temperature of 38.5°C and sticky mucous membranes.

The complete blood count (CBC) was performed on Vetscan HM5 Hematology (5-part Differential) and determined: white blood cells (WBC), lymphocytes (LYM), monocytes (MON), neutrophils (NEU), eosinophils (EOS), basophils (BAS), LYM%, MON%, NEU%, EOS%, BAS%, red blood cells (RBC), hemoglobin (HGB), hematocrit (HCT), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), red blood cell distribution width-coefficient of variation (RDWc), red blood cell distribution width-standard deviation (RDWs), platelet (PLT), mean platelet volume (MPV), plateletcrit (PCT), platelet distribution width-coefficient of variation (PDWc) and platelet distribution width-standard deviation (PDWs).

Serum biochemistry was done on Vetscan VS2 Chemistry Analyzer with a comprehensive diagnostic panel that determined: albumin (ALB), alkaline phosphatase (ALP), alanine aminotransferase (ALT), amylase (AMY), total bilirubin (TBIL), blood urea nitrogen (BUN), calcium (CA), phosphorus (PHOS), creatinine (CRE), glucose (GLU), sodium (NA+), potassium (K+), total proteins (TP) and globulin (GLOB).

Blood pressure was evaluated with VET BP Doppler with manometer.

Ultrasound exam was performed on Easote My Lab 7.

Rehydration was established by fluid therapy with Ringer continuous rate of infusion (CRI), (rate and dosage: 10 ml/kg/h) and electrolyte rebalancing and partial parenteral nutrition based on levo-amino acids (rate and dosage: 6 ml/kg/24 h, 0.6-0.8 g amino acids/kg/24 h).

The amount of energy required for maintenance is best expressed as a function of the animal's metabolic weight, rather than its bodyweight. The RER (Resting energy requirement) is the basic energy requirement unit, around which the energy requirements of the various stages of

health and illness can be calculated. This is the amount of energy (measured in kilocalories) required per day for maintaining current bodyweight (and avoiding catabolism of body tissues) while a patient rests quietly in a stress-free, non-fasted, thermo-neutral environment. RER was calculated for this patient using the following formulae:

$$\text{RER} = (30 \times \text{bodyweight in kg}) + 70$$

For parenteral nutrition was used Intralipid 20% 1000 ml infusible emulsion contains purified soybean oil 200 g and excipients, anhydrous glycerol 22 g, purified egg phospholipids 12 g, sodium hydroxide (up to pH approximately 8), water for injections up to 1000 ml. Energy content: 8.4 MJ (2000 kcal)/1000 ml (Figure 1).

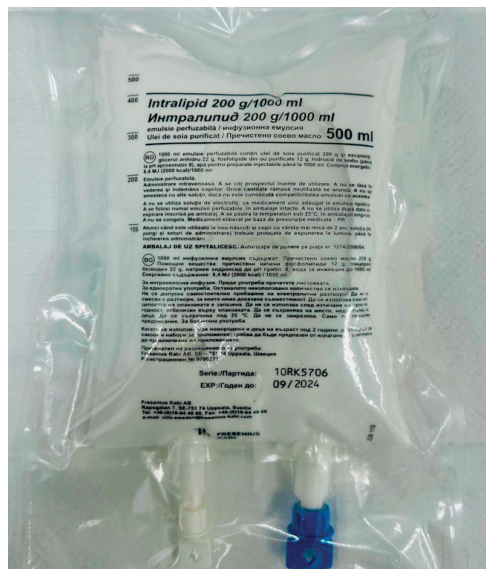


Figure 1. Intralipid 200 g/1000 ml used for patient's parenteral nutrition

Electrocardiogram (ECG) recording and monitoring was performed using Poly-Spectrum 8 Vet Rhythm, 4 clip electrodes with 6-lead ECG.

Electrodes must be positioned as follows: the red one with the inscription RA positioned on the right forelimb, the black one with the inscription RL positioned on the right hind limb, the yellow one with the inscription LA positioned on the left forelimb, the green one with the inscription LL positioned on the left hindlimb.

RESULTS AND DISCUSSIONS

On the 24th of August 2023, blood biochemistry revealed: BUN 12 (RR: 7-25 mg/dL), CREA 0.5 (RR: 0.4-1.4 mg/dL), K⁺ 4.4 (RR: 3.4-5.6 mmol/L), CA 11.3 (RR: 8.6-11.8 mg/dL), PHOS 6.6 (RR: 2.9-6.6 mg/dL). Results from complete blood cell count (CBC) showed HCB 14.1 (RR: 12-18 g/dl), HCT 43.93 (RR: 37-55%), MCHC 32.1 (RR: 31-39g/dl) and RDWc 15.7 (RR: 14-20%). Based on the blood work results the patient shows normal values taking into account age and condition. Point of care ultrasound revealed: urinary bladder in semireplation state, distended by anechoic fluid content, and thin wall; spleen with regular outline, parenchyma without changes, dimensions of 0.68 cm in hilum; left kidney with regular outline, appropriate ratio between the renal cortical and renal medullary, shows renal microlithiasis, dimensions: 3.93/2.17 cm; right kidney appearance as the left kidney, dimensions 4.02/1.99 cm; stomach was distended with abundant liquid and gaseous content, absent motility at the time of examination, parietal reaction present; intestines with reduced motility at the time of examination, distended by liquid and gas content, slight parietal reaction present; liver with no pathological changes; gall bladder pre-prandial appearance devoid by transsonic content, without stones, thin wall. On the cross section, in the right intercostal window it is revealed intestinal appearance distended by gas in the close proximity of the heart, image consistent with peritono-pericardial hernia diagnosis of susceptibility.

For gold standard diagnosis, radiographs were taken with the following incidents: latero-lateral (Figure 2) and ventro-dorsal (Figure 3) view of the chest and abdomen.

Description of the radiological report was as follows: the cardiac silhouette with an enlarged appearance, especially on the projection area of the right heart, tubular structures with a gaseous content can be observed.

Topographic changes that involved part of the intestinal mass, with their cranial displacement were observed at that time.

The radiological aspect suggests a peritono-pericardial hernia with the involvement of at least the small intestine.

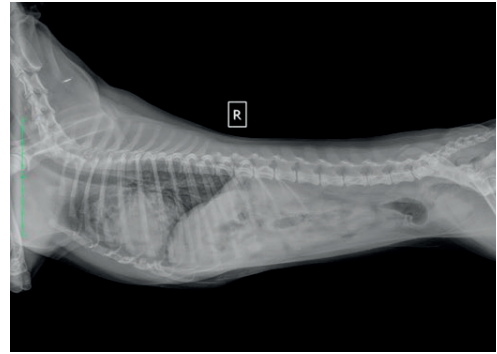


Figure 2. Patient's latero-lateral exposure on the day of primary assessment of the case

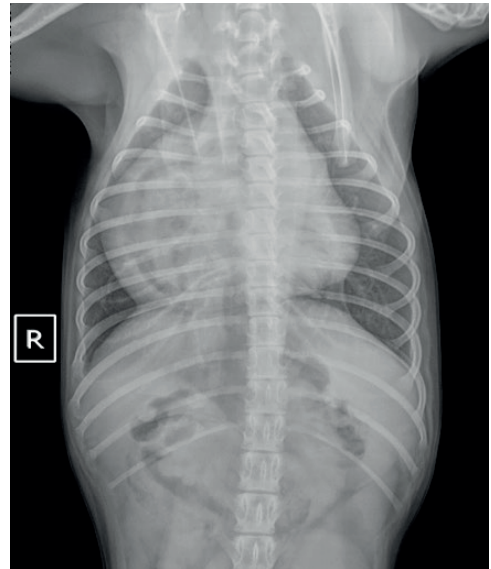


Figure 3. Patient's ventro-dorsal exposure on the day of primary assessment of the case

The patient was admitted to intense care unit for intravenous fluid therapy for electrolyte rebalancing and partial parenteral nutrition based on levo-amino acids and treatment with maropitant and pantoprazol to stop vomiting episodes.

On the 25th of August 2023 the patient started treatment with Intralipid 20% due to the fact that it had no appetite for more than 24 hours, so it was decided to start a parenteral nutrition plan according to the calculated RER. The plan consisted in intravenous administration of Intralipid 20% in three administrations per 24 hours at a rate of 0.2 ml/kg/min for 60 minutes.

On the 26th of August 2023 the patient's condition was considered optimal for surgery. The preoperative examination revealed the following aspects of blood pressure: 160-170 mmHg, systolic, Doppler method, the patient presented agitation throughout the pre-anesthetic examination. Rhythmic-arrhythmic rate on heart auscultation. Bilateral femoral pulse present, normodynamic and synchronous with the heartbeat. Vesicular murmur present bilateral on auscultation. EKG: respiratory sinus arrhythmia (Figure 4). Pre-operative blood glucose: 88 mg/dL.

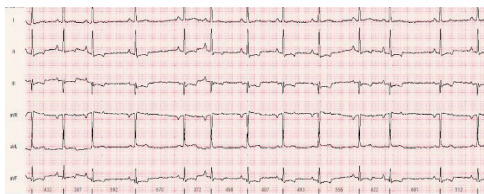


Figure 4. Electrocardiogram of the patient at the time of the preoperative anaesthetic examination

Surgical repair was made through a midline celiotomy (Figure 5). Another important factor is that the patient needs to be assisted with positive-pressure ventilation during the surgical procedure. To evaluate all internal organs, a thorough exploration of the abdominal cavity was conducted before correcting the herniated organs. After evaluating the abdominal cavity, an inspection of the entire diaphragm was performed to assess if there are tears or rents in the musculature.

To perform a safe extraction of incarcerated organs, a slight debridement of hernia ring was performed, it was directed ventrally to avoid trauma to herniated organs, lungs, vena cava, phrenic nerve, and oesophagus.

The herniated organs were represented by segments of the small intestine. Before performing sutures on the diaphragm, the pulmonary parenchyma was evaluated. Because the pericardial sac is joined with the diaphragmatic defect, suturing was performed with a polypropylene monofilament 3/0 absorbable wire with round needle, and the surgical approach was to suture the pericardial sac dorsal to ventral for a better closure of the hernia.

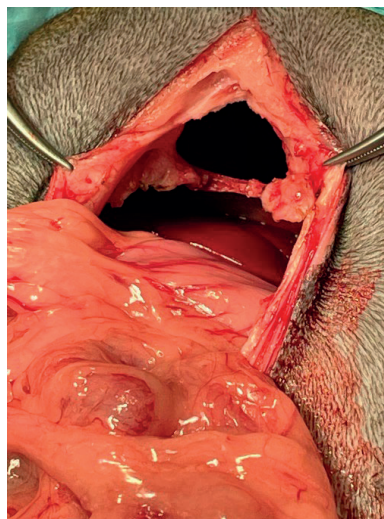


Figure 5. Intra-operative image of the peritoneopericardial defect with herniated structures of the small intestine

Patient was stable during anesthesia and had vital functions within the physiological parameters as it follows: patient had spontaneous breathing and mechanical ventilation (IPPV type) with a respiratory rate between the values: 10-12 rpm. EtCO₂ was between the values: 33-45 mmHg. SpO₂ was between values: 90-99%. Femoral pulse was present bilaterally and synchronous with the heartbeat: 95-106 bpm. The patient presented transient hypotension, responsive to fluid therapy: 126/85-166/131 mmHg, oscillometry. The patient presented mild transient hypothermia, responsive to medication and external heating operations: the patient's body temperature ranged from 35.8°C to 36.7°C. The patient benefited both intra and post-operatively from high loco-regional anesthesia. Patient had a rapid awakening, without any notable events from the anesthetic point of view, the patient was transferred to the intensive care unit with additional oxygen, heating and monitoring of vital functions.

On the following days, the patient was kept in the intensive care unit for vital functions monitoring general condition of the patient based on the following aspects: water and food appetite, urination, defecation, daily ultrasound rechecks for motility evaluation, post-operative treatment, both systemic and local.

After 48 hours in the intensive care unit, the patient showed a favorable evolution and it was discharged with the following post-operative treatment at home: a broad spectrum antibiotic from class 3 cephalosporin, probiotic to combat intestinal dysmicrobism and ensure a healthy and balanced intestinal transit, CBD oil 3% for anxiety reduction and anti-inflammatory effect, non-steroidal anti-inflammatory drugs cyclooxygenase-2 (COX-2) inhibitors for postoperative pain management and gastro-intestinal food diet.

On the 4th of September 2023, the patient was referred for the first post-operative re-check. During the anamnesis and the patient's medical history, the owner stated that the patient had no changes in general behavior, normal food appetite and normal water intake. During clinical examination the integrity and appearance of the incision line were evaluated. There were no pathological modifications. Healing stage of the incision line was favorable. Abdominal ultrasound revealed the continuity of the diaphragm and the lack of changes of the surgical intervention.

The rest of the organs in the abdominal cavity did not show significant changes during the ultrasound examination.

The following re-check on the 4th of October 2023, thoracic radiography with latero-lateral (Figure 6) and ventro-dorsal (Figure 7) exposures were performed.

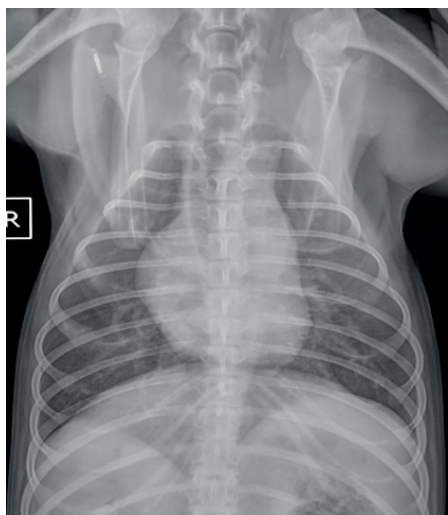


Figure 6. Ventro-dorsal exposure of the patient at 30 days after the surgery

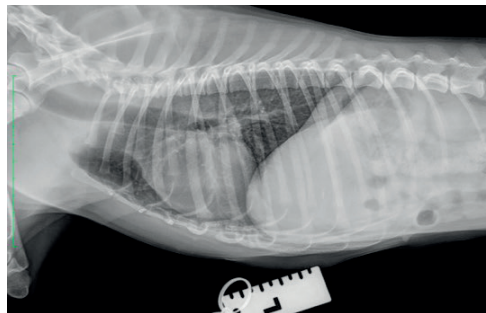


Figure 7. Latero-lateral exposure of the patient at 30 days after the surgery

On the radiography report there were no pathological modifications noted of abdominal or thoracic viscera and the diaphragm muscle is intact.

CONCLUSIONS

Peritoneo-pericardial diaphragmatic hernia (PPDH) results from embryonic developmental anomalies involving the pericardial and peritoneal cavities, possibly due to teratogens, genetic defects, or prenatal injuries.

Peritoneo-pericardial diaphragmatic hernia is often an incidental finding but patients may present symptoms such as vomiting, lethargy, and dehydration. Diagnosis involves radiographic imaging revealing characteristic findings like cardiomegaly and herniated abdominal organs within the pericardial sac.

Highlighting thorough preoperative assessment, encompassing Doppler blood pressure measurement, blood work, and glycaemia, proves crucial. This thorough examination ensures surgical preparedness, enabling timely interventions and mitigating potential complications.

Surgical herniorrhaphy is the mainstay treatment for PPDH. Preoperative stabilization, including fluid therapy and nutritional support, is often necessary to optimize patient condition for surgery.

Successful surgical repair of PPDH requires careful postoperative management, including intravenous fluid therapy, nutritional support, and monitoring of vital functions.

Follow-up assessments involve imaging studies to confirm the integrity of the diaphragm and evaluate the healing process.

Long-term prognosis of PPDH is generally favorable.

REFERENCES

- Banz, A.C., Gottfried, S.D. (2010). Peritoneopericardial diaphragmatic hernia: a retrospective study of 31 cats and eight dogs. *J Am Anim Hosp Assoc*; 46:398-404.
- Bjorck, G.R., Tigerschiold, A. (1970). Peritoneopericardial diaphragmatic hernia in a dog. *J Small Anim Pract*; 11: 585-590.
- Bolton, G.R., Ettinger, S., Rousch, J.C. (1969). Congenital peritoneopericardial diaphragmatic hernia in a dog. *J Am Vet Med Assoc.*; 55:723-730.
- Burns, C.G., Bergh, M.S., McLoughlin, M.A. (2013). Surgical and nonsurgical treatment of peritoneopericardial diaphragmatic hernia in dogs and cats: 58 cases (1999-2008). *J Am Vet Med Assoc.*; 242:643-650.
- Chalkley, J., Salinardi, B.J., Bulmer, B.J., (2006). What is your diagnosis? Peritoneopericardial diaphragmatic hernia (PPDH). *Journal of the American Veterinary Medical Association*, 228: 695-69.
- Evans, S.M., Biery, D.N. (1980). Congenital peritoneopericardial diaphragmatic hernia in the dog and cat: a literature review and 17 additional case histories. *Vet Radiol.*; 21: 108-116.
- Hunt, G.B., Johnson, K.A. (2003). Diaphragmatic, pericardial and hiatal hernia. In: *Textbook of Small Animal Surgery*, 3e (ed. D.H. Slatter), 471-487. Philadelphia, PA: WB Saunders.
- Less, R.D., Bright, J.M., Orton, C.E. (2000). Intrapericardial cyst causing cardiac tamponade in cat. *J Am Anim Hosp Assoc.*; 36:115-119.
- McClaran, J.K. (2023). Diaphragmatic and Peritoneopericardial Diaphragmatic Hernias. In *Small Animal Soft Tissue Surgery*, E. Monnet (Ed.)
- Park, R.D. (2002). The diaphragm. In: *Textbook of Veterinary Diagnostic Radiology*, 4e (ed. D.E. Thrall), 359 -375 . Philadelphia, P: WB Saunders.