



Traumatic diaphragmatic hernia in a clinically normal dog

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Abstract — A 3.5-year-old border collie was presented for routine ovariohysterectomy. A preoperative physical examination revealed no abnormalities, but, under anesthesia, the patient became dyspneic and cyanotic. Plain radiography indicated the presence of a diaphragmatic hernia. The herniated structures were returned to the abdomen and the diaphragmatic defect was surgically repaired.

Résumé — **Hernie diaphragmatique traumatique chez un chien cliniquement sain.** Un Collie des bords de 3.5 ans a été présenté pour une ovario-hystérectomie de routine. Aucune anomalie n'a été constatée à l'examen physique préopératoire, mais sous anesthésie, le patient a présenté de la dyspnée et de la cyanose. Une simple radiographie a révélé la présence d'une hernie diaphragmatique. Les structures herniées ont été repoussées dans l'abdomen et le diaphragme a été réparé par chirurgie.

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A 3.5-year-old, female border collie, presented for a routine ovariohysterectomy, had no history of trauma, and all preoperative physical examination parameters were within normal ranges. The dog was premedicated with a combination of butorphanol (Torbugesic; Ayerst, Montreal, Quebec), 3 mg; acepromazine (Atravet; Ayerst), 2.25 mg; and glycopyrrolate (Glycopyrrolate; Sabex, Boucherville, Quebec), 0.15 mg, mixed in the same syringe and administered SC. Anesthesia was induced with thiopental (Pentothal; Abbott, Montreal, Quebec), 110 mg, IV, and maintained on a mixture of oxygen and isoflurane (Aerrane; Janssen, Toronto, Ontario). The patient was monitored with both a pulse oximeter and an apnea alert device. Shortly after the peritoneal cavity had been opened, the oxygen saturation began to decline steadily, and cyanosis and labored respiratory efforts were observed. Doxapram hydrochloride (Dopram; Ayerst), 20 mg, IV, was administered with no effect. Oxygen saturation reached a low of 55%, but manual ventilation returned saturation to between 90% and 95%. Cardiovascular function remained strong throughout the entire episode of hypoxia, and careful inspection of the anesthetic equipment revealed no apparent dysfunction. Airway patency was verified on multiple occasions during surgery. The problem was attributed to a ventilation and perfusion mismatch, secondary to an unidentified primary respiratory insult.

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L. Marcus Litman will receive a copy of *Saunders Comprehensive Veterinary Dictionary* courtesy of Harcourt-Brace Canada.

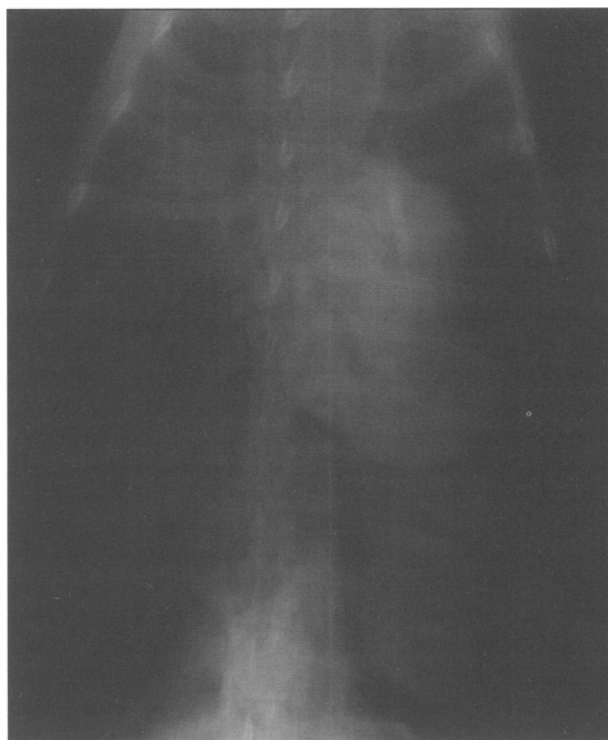


Figure 1. Thoracic radiographs of a clinically normal border collie with no history of trauma that developed cyanosis and hypoxia during routine ovariohysterectomy. Gas-filled loops of bowel are evident in the thorax.

The dog was maintained on 100% oxygen after surgery. Plain lateral and dorsoventral thoracic radiographs revealed bilateral pneumothorax with marked atelectasis. A 22-gauge butterfly catheter with a 3-way stopcock was used to enter the thoracic cavity. Little

improvement in oxygenation was observed, even after more than 700 mL of air had been removed from the cavity. A 2nd set of radiographs revealed a large soft tissue opacity and loops of bowel within the lung fields (Figure 1).

A 2nd ventral midline incision from the level of the xiphoid process to the umbilicus permitted observation of a 4- to 6-cm defect in the ventral midline of the diaphragm. Fibroplasia at the margins of the wound suggested that the defect had been present for weeks to months. Several loops of jejunum, the omentum, and the entire spleen were removed from the thorax without the need to enlarge the defect or break down any adhesions. The diaphragm was repaired with simple interrupted sutures of 2.0 polyglactin 910 (Vicryl; Johnson and Johnson, Peterborough, Ontario). The excess air in the thorax was evacuated by applying positive pressure ventilation just prior to tying the last suture. Recovery from anesthesia was prolonged, and the dog was treated with cefazolin (Cefazolin; Novopharm, Toronto, Ontario), 30 mg/kg BW, IV, q8h, for the first 24 h postsurgery. The dog was released the next day with instructions to the owner to administer cephalixin (Novolexin; Novopharm, Toronto, Ontario), 20 mg/kg BW, PO, q8h, for 10 d. When examined on day 45 postsurgery, the dog appeared completely healthy and was normally active.

It is not unusual for a diaphragmatic hernia to occur without clinical signs or history of trauma, as in this dog. In a study of 406 diaphragmatic hernias that occurred during a 25-year period, the mean time from occurrence to presentation was 53 d, with a range of 1 h to more than 5 y (1). An intact diaphragm is not essential for life; however, as in this case, affected animals may decompensate under the hypoventilatory stress of anesthesia (1,3).

The presence and severity of clinical signs may vary with the length of time the hernia has existed, specific organs that have herniated and the degree to which their blood supply has been compromised, the degree of pulmonary or cardiovascular compromise, and concurrent trauma (2). Many clinical signs attributed to diaphragmatic hernia (muffled heart or lung sounds, borborygmi in the thorax, and a tucked-up abdomen) have proven unreliable for diagnosis (1,3).

Diaphragmatic hernias are most often caused by automobile trauma and occur in male dogs under the age of 2 y (4,5). This case was unusual in that there were no known episodes or obvious signs of trauma, but the dog was used to herd dairy cattle and might have been kicked. Herniation of the abdominal contents most likely occurred or was exacerbated when the dog was put on a tilt table for ovariohysterectomy.

In this case, the diagnosis of diaphragmatic hernia was relatively straightforward with the aid of plain radiographs. Loops of bowel and soft tissue opacities were seen in the chest after the pneumothorax had been reduced. Other radiographic changes consistent with diaphragmatic hernia are loss or interruption of the diaphragmatic shadow, cranial or lateral displacement of the heart and lungs, or cranial displacement of abdominal contents (6–8). Changes on plain radiographs are often subtle or may be obscured by excess fluid in the

thorax (6–8). Less conventional positioning for plain radiographs can provide additional information, if the initial survey films are equivocal. Ventrodorsal films, obtained with a horizontal beam and the patient in an upright, forelimbs raised, position may improve visualization of herniated organs in the thorax or show that the abdominal contents are in their normal positions (6).

Contrast radiographs of the proximal gastrointestinal (GI) tract may be diagnostic, if the stomach or intestines are herniated. They may also aid in diagnosis when the liver has herniated by revealing cranial displacement of the GI tract in the abdomen (6,7). Barium sulfate is contraindicated if perforation of the bowel is suspected (6).

Positive-contrast celigraphy may be indicated where other radiographic techniques have failed (6–8). Sterile iodinated contrast medium for IV use is injected into the abdomen near the umbilicus, the patient is rolled over, and, or, the pelvis is elevated to distribute the medium evenly to the cranial abdomen (8). If possible, right and left lateral, ventrodorsal, and dorsoventral radiographs should be taken (8). The essential criteria for diagnosing a diaphragmatic hernia are contrast medium in the thorax, absence of a normal liver lobe outline in the abdomen, or loss of the normal outline of the diaphragm (8). If a large volume of free fluid is present in the abdomen or thorax, it may dilute the contrast medium, making interpretation more difficult, so the abdomen should be drained prior to celigraphy, if possible (6,8). Contraindications for positive-contrast celigraphy include peritonitis, hypovolemia, and known hypersensitivity to iodinated contrast media (6,8).

Ultrasonography may be useful in diagnosing selected cases of diaphragmatic hernia (6). The absence of a curved, hyperechoic line (representing the diaphragm-lung interface) between the cardiac silhouette and the abdominal viscera is consistent with a diaphragmatic hernia (6).

In this case, the delay between injury and surgical intervention was probably a factor in the success of surgical repair. A study by Boudrieau and Muir (5), in which they tracked the results of 159 surgical hernia repairs in dogs, showed an overall mean mortality rate of 20%. This study and several others revealed significantly higher mortality rates for dogs undergoing surgery less than 24 h or more than 1 y postinjury (5). When surgery was performed within the first 24 h, deaths were most often attributed to multisystem organ failure due to cardiovascular insufficiency or other traumatic injuries (5). When hernias exist for more than 1 y, chronic organ entrapment causes adhesions; loss of domain (repartitioning of abdominal cavity space, such that easy replacement of displaced organs is hindered); tissue necrosis; gastric outflow obstruction; and metabolic disturbances, such as hypokalemia, hypochloremia, and alkalosis (2,5,9). Most authors agree that the prudent course of action is to stabilize the animal for the first 24 h and then correct the problem surgically as soon as it is feasible to do so (2–4). There are 3 exceptions to this principle: ongoing thoracic hemorrhage, bowel rupture, and severe respiratory embarrassment. All require immediate surgical intervention (2,4,5).

Acknowledgments

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Answers to Quiz Corner/Les réponses du test éclair

1. b — Serum creatinine assay should be used to confirm renal disease in ruminants because a large excess of urea nitrogen can be eliminated through the saliva and the ruminal mucosa.
b — *On doit utiliser le dosage de la créatinine sérique pour confirmer une maladie rénale chez les ruminants, étant donné qu'une grande quantité de l'azote uréique peut être éliminée par la salive et la muqueuse du rumen.*
2. c — *Streptococcus suis* type II does not cause dermatitis. Lesions of the other diseases listed are not suppurative.
c — *Streptococcus suis de type II ne cause pas de dermatite. Les lésions des autres affections énumérées ne sont pas suppuratives.*
3. a — Anthrax is most likely to occur in rural areas because these areas have the highest numbers of susceptible large animals.
a — *La fièvre charbonneuse est plus susceptible de se manifester dans les régions rurales, étant donné que ces régions possèdent un plus grand nombre de gros animaux vulnérables.*
4. d — Treatment must include administration of appropriate antimicrobial drugs and lavage of the affected synovial sheath.
d — *Le traitement doit comprendre l'administration d'antimicrobiens appropriés et un lavage de la synoviale vaginale tendineuse affectée.*
5. a — Rectal prolapse commonly occurs in animals from weaning to 12 mo of age. An increased frequency may be associated with a variety of factors, the most consistent of which is chronic coughing.
a — *Le prolapsus rectal se produit communément chez les animaux à partir du sevrage jusqu'à l'âge de 12 mois. Une augmentation de la fréquence peut être associée à un grand nombre de facteurs, le plus constant étant la toux chronique.*
6. a — Chemotherapy is typically disappointing with this tumor.
a — *La chimiothérapie ne donne généralement pas de bons résultats avec ce type de tumeur.*
7. c — In groups of cats, viruses are most likely to be transmitted by contact or aerosol.
c — *Dans un groupe de chats, les virus sont plus susceptibles d'être transmis par contact ou par l'air.*
8. e — Ascites is common in dogs with severe cirrhosis and does not cause decompensation.
e — *L'ascite est fréquente chez le chien qui souffre de cirrhose grave et ne cause pas de décompensation.*
9. d — The age, breed, clinical signs, and microcytosis all point toward a portosystemic vascular anomaly.
d — *L'âge, la race, les signes cliniques et la microcytose semblent tous indiquer une anomalie vasculaire portosystémique.*
10. b — The diameter of the lumen of the pylorus is increased by suturing a longitudinal incision transversely.
b — *Le diamètre de la lumière du pylore est augmenté en suturant une incision longitudinale transversalement.*