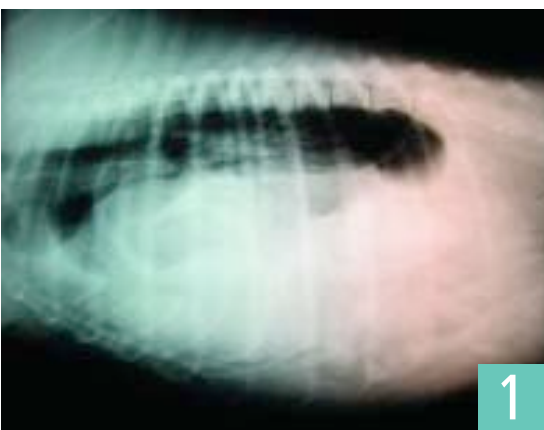
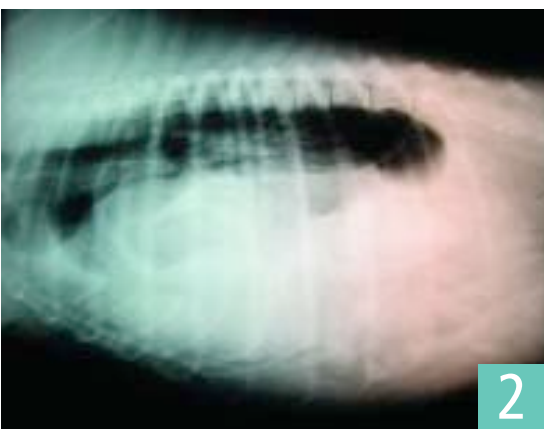


Diaphragmatic Hernia

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Plain films demonstrated increased soft-tissue density in the thorax and some pleural effusion.



A barium-contrast study showed that the stomach and a portion of the proximal small intestine were displaced cranially into the thorax.

A 6-year-old, spayed, 22.2-kg, female chow chow was presented with coughing, dyspnea, and anorexia. The dog began to display signs of dyspnea, tachypnea, occasional retching, depression, and inappetence the day before examination. The owner reported no previous health problems. The dog had a vague history of being “tapped” by a truck sometime in the recent past.

On physical examination, the temperature was 102.4° F, heart rate 170 bpm, and femoral pulse was adequate, but the dog was tachypneic. Auscultation of the thorax revealed increased heart sounds and adequate lung sounds over the right hemithorax. Muffled heart sounds and decreased lung sounds were auscultated ventrally over the left hemithorax. Dull percussion sounds were elicited over the ventral aspect of the left caudal thorax. CBC was normal. The only significant abnormality on the biochemical profile was an increased alanine transaminase level (472 U/L). Plain radiographs revealed increased soft-tissue density in the left hemithorax (**Figure 1**). A barium-contrast study showed an opacity in the thorax that appeared to be the stomach (**Figure 2**). The dog was given intravenous fluids and constant-rate infusion pain medication consisting of morphine and ketamine. Pulse oximetry measurements remained between 90% and 95% throughout the evening.

The dog was diagnosed as having diaphragmatic hernia, and surgery was done the following day. The stomach and proximal duodenum, a portion of the left liver, and the spleen were displaced into the thoracic cavity through a Y-shaped rent that extended from the sternum dorsally for approximately 14 cm. The hernia was closed with 0 polypropylene suture in a simple inter-

rupted pattern. A 16-French chest tube was placed. The tube was removed 24 hours later, and the dog was discharged 2 days after surgery.

ASK YOURSELF ...

Which of the following statements best characterizes diaphragmatic hernias?

- They manifest immediately after a traumatic incident and usually require emergency surgery.
- More than 90% of chronic cases of diaphragmatic hernia have dyspnea as the primary presenting sign.
- More than 70% of cases need additional imaging studies beyond plain films of the thorax (ultrasonography, positive-contrast celigraphy, positional radiography, upper gastrointestinal barium-contrast studies)
- The mortality rate associated with the repair of chronic diaphragmatic hernias (within a year after injury) is similar to that of acute diaphragmatic hernias when repair is delayed for at least 24 hours after known injury.

continues

INSIGHTS FROM CLINICAL CASES . DISCUSSION

CORRECT ANSWER: D

In most cases of acute diaphragmatic hernia, clinical signs are related to the respiratory system (cyanosis, dyspnea, tachypnea, exercise intolerance), but they may arise from the gastrointestinal system as well. Gastrointestinal signs (which may occur without respiratory dysfunction) include vomiting, diarrhea, weight loss, and signs of pain after eating. The author has managed several cases of chronic diaphragmatic hernia in which weight loss over a period of months was the only sign.

DIAGNOSTIC IMAGING

Diaphragmatic hernia often cannot be diagnosed with conventional thoracic radiography. In the presence of significant pleural effusion, radiographs should be done after removal of fluid by thoracocentesis. Signs to look for include loss of the diaphragmatic line, presence of gas in the stomach that has been displaced into the thorax, intestinal loops, dorsal or lateral displacement of lung lobes, and loss of the cardiac silhouette. Ultrasonography is used to show discontinuous diaphragmatic echoes and to identify abdominal organs within the thorax. If ultrasonography is not available, positional radiography may be helpful. Horizontal beam or erect ventrodorsal projections may help confirm diaphragmatic hernia. A barium-contrast gastrogram or upper gastrointestinal study definitively proves that the stomach and/or small intestine is displaced into the thoracic cavity as seen in the case here. Positive-contrast celiography is done using a water-soluble contrast medium.¹ Leakage of contrast material into the thorax confirms a defect in the diaphragm.

Repair of hernias within 24 hours of occurrence should be done only in animals that continue to have severe respiratory distress and cyanosis despite appropriate resuscitative measures (fluid therapy, pain management, oxygen supplementation). Other indications for early surgical intervention include displacement of a large quantity of viscera into the thorax that may have accounted for the animal's discomfort, distention of the stomach with air, and strangulation of a segment of intestine.

Delaying surgery at least 24 hours after injury is



The day after surgery the dog began to vomit some coffee-ground material and had mild melena.

associated with a lower mortality rate.² The higher mortality rates in animals that have immediate surgery (i.e., repair of acute diaphragmatic hernia) probably result from associated injuries; these animals also have a greater risk for anesthesia-associated complications.

Some evidence suggests that a diaphragmatic hernia repaired 1 year or longer after injury results in an increased mortality rate. Removal of pleural fluid, formation of pulmonary edema, iatrogenic injury to major vessels and organs, bowel strangulation, late-term pregnancy, and septicemia may be factors related to death of animals with chronic diaphragmatic hernia.²

BASIC REPAIR CONCEPTS

Some basic concepts apply to diaphragmatic hernia repair. If reduction of the hernia is difficult, enlarge the rent. If that fails, perform partial sternotomy to help break down adhesions in the chest and facilitate replacement of viscera into the abdomen. In anticipation of partial sternotomy, extend preoperative aseptic preparation of the skin cranioventrally over the thorax. Repair the hernia by placing sutures dorsally and continuing in a ventral direction. While some authors think it is critical to debride before closure, this author generally does not find it necessary to do so. Although the diaphragm in the case reported here was closed with an interrupted suture pattern, a continuous pattern is preferred because of the need for simplicity and brevity. I prefer to use nonabsorbable suture (polypropylene) for the herniorrhaphy. If the diaphragm has torn away from the costal attachment, the repair may need to include circumcostal placement of sutures. If a large amount of viscera has been displaced outside of the

abdomen through a chronic diaphragmatic hernia, closure of the linea alba can be difficult after reduction of the viscera due to the decreased volume of the peritoneal cavity. This is termed visceral "loss of domain." The author had one case in which tachypnea was present for 48 hours after repair of a chronic diaphragmatic hernia, presumably due to a temporary and significant increase in intraabdominal pressure.

Place a chest tube in all cases to help monitor hemorrhage/pneumothorax. Serious hemorrhage is more likely after repair of chronic diaphragmatic hernia because of disruption of adhesions during repositioning of abdominal viscera.

On rare occasions, gastroduodenal ulceration may be associated with diaphragmatic hernia. The pathophysiology is unclear. However, vomiting digested blood or signs of melena (**Figure 3**) should alert the clinician to this possibility; this condition usually responds to antacid therapy.

PROGNOSTIC COMPARISON

The prognosis for survival after diaphragmatic hernia in dogs is good, with mortality rates ranging from 14% to 28%.^{2,3} In one study, mortality rates in dogs with acute or chronic diaphragmatic hernia were similar.² In this same study, the mortality rate was higher in cats with acute diaphragmatic hernia (20%) undergoing surgery versus those with chronic diaphragmatic hernia (11.8%). In another study, cats that were older or had low to mildly increased respiratory rates and concurrent injuries were more likely to die after surgical repair of diaphragmatic hernia.⁴ Most patients that survive surgical repair of either type of hernia have complete resolution of signs following surgery, and recurrence is rare. ■

See Aids & Resources, back page, for references, contacts, and appendices.

TAKE-HOME MESSAGES

- Some cases of chronic diaphragmatic hernia can be difficult to diagnose because the patient may present with nonrespiratory signs.
- Surgical success is highest in cases in which surgery is performed more than 24 hours, but less than 1 year, after injury.