

DIAPHRAGMATIC HERNIA REPAIR

Howard B. Seim III, DVM, DACVS
Colorado State University

If you would like a copy of the video of this surgical procedure on DVD, go to www.videovet.org.

Key Points

- Most diaphragmatic hernias are not acutely life threatening
- Suture the hernial rent from dorsal to ventral
- Use a one layer simple continuous appositional suture pattern for closure
- Evacuate all thoracic air prior to closure

General Considerations and Indications

Three classifications of diaphragmatic hernia may be diagnosed; acute traumatic, chronic traumatic and congenital diaphragmatic hernia.

Acute Traumatic

This is the most common type of diaphragmatic hernia in dogs and cats. It is generally caused by vehicular trauma but can be caused by any form of trauma.

Chronic Traumatic

This classification of diaphragmatic hernia is seen when a patient has an acute traumatic hernia that was undiagnosed at the time of occurrence. Later (months to years) the hernia is diagnosed due to sudden or chronic onset of respiratory difficulty.

Congenital

The most common congenital hernia involving the diaphragm is a peritoneopericardial diaphragmatic hernia. Whenever this defect is suspected, a thorough examination (i.e., physical, radiographic, cardiovascular) for evidence of further midline congenital defects (i.e., umbilical hernia, atrial and ventricular septal defects, cleft palate) should be performed.

Applied Anatomy

The diaphragm projects into the thoracic cavity like a dome; it attaches to the lumbar vertebrae, costal arch, and sternum. Fibers arise on these skeletal parts and radiate towards the tendinous center. The diaphragm is composed of only one layer of muscle and two layers of tendon and therefore is weaker than the multilayered abdominal wall. The central tendon of the diaphragm of the cat is relatively small. In its tendinous portion, transverse fibers course from one side to the other as a reinforcing apparatus.

The muscular part is divided into the pars lumbalis, a pars costalis on each side, and the pars sternalis, all of which with the exception of the lumbar portion, have a uniform thickness of 2-3 mm in cats. The pars lumbalis of the diaphragmatic musculature is formed by the right and left diaphragmatic crura, the right crus being considerably larger than the left. Seen from the abdominal cavity each crus of the diaphragm is a triangular muscular plate whose borders give rise to the tendinous

portions. The pars costalis on each side consists of fibers radiating from the costal wall to the tendinous center. The pars sternalis is an unpaired medial part unseparated from the bilateral costal portions.

The diaphragm domes far into the thoracic cavity, and its costal part lies on the medial surface of the last few ribs and costal arch (when tears occur here, the costal arch can be used in the repair). The stomach and liver attach by ligaments to the concave peritoneal surface of the diaphragm.

Diagnosis

Diaphragmatic hernia is generally diagnosed via thoracic and abdominal radiographs. Classic findings on thoracic radiographs is loss of the diaphragmatic line, air filled visceral structures in the thoracic cavity, loss of lung fields. Abdominal radiographs may reveal a lack of abdominal viscera. Classic thoracic radiographs of a patient with a peritoneo-pericardial diaphragmatic hernia shows a large, round pericardial sac. Occasionally, air filled viscera can be identified in the pericardial sac. Patients that present with an acute traumatic diaphragmatic hernia (e.g., hit by a car) may have a massive hernia with abdominal contents replacing most of the patients respiratory capacity.

Preoperative Considerations

Immediate surgical intervention for the repair of a diaphragmatic hernia is rarely indicated. Emergency surgery should not be undertaken unless the surgeon and anesthesiologist are prepared to handle any complications and are confident they can maintain the animal's essential requirements while the animal is anesthetized. However, prompt surgical repair is indicated in acutely injured animals with severe dyspnea, cyanosis, and respiratory distress who demonstrate massive herniation, and in patients that present with an air filled stomach in the thoracic cavity (these patients can develop life threatening dyspnea if enough swallowed air enters the stomach).

The most commonly encountered patient with diaphragmatic hernia will fall between the two categories mentioned above and should be handled in a systematic manner that will not further compromise the patients already reduced breathing ability. Surgery is not considered an emergency in mildly symptomatic or asymptomatic animals with congenital hernias or traumatic hernias of at least several days' duration. Remember that any stressed, dyspneic cat should be handled very carefully as further stress can produce catastrophic results.

Anesthesia

Patient stress must be kept to a minimum during the anesthetic induction phase as any exertion by the animal can be disastrous.

Surgical Approaches

A midline abdominal celiotomy (xiphoid to pubis) is the easiest and most versatile approach. Positioning the patient's head toward the top of the table and tilting the table at a 30° to 40° angle will facilitate gravitation of abdominal viscera out of the thorax. Rarely is it necessary to extend the incision into the thorax via a median sternotomy however the animal should be prepared in case this becomes necessary.

Surgical Procedure

[See the DVD for a detailed video description of this technique.](#) When an extra pair of hands is unavailable for retraction, a Balfour self retaining retractor is a helpful piece of equipment; large Gelpi retractors work well in cats. Using the abdominal approach, an incision is made from xiphoid to pubis. Once the peritoneal cavity is opened, the diaphragm is exposed and the situation evaluated. Some hernias, especially in the area of the dorsal attachments of the crura and the aortic hiatus are not easily visualized; therefore, this area should be carefully inspected even when another laceration is present. The herniated contents are replaced in their proper position and inspected for damage.

Using large sponges or laparotomy pads moistened with warm saline, the liver and bowel are retracted caudally. Visualization of the cranial quadrant of the abdomen can be facilitated by removing the viscera from the abdominal cavity and placing it on a moistened laparotomy sponge. The diaphragmatic tear is now more easily visualized so that a careful examination of the thorax can be done both visually and manually. All thoracic fluid should be aspirated.

In acute traumatic diaphragmatic hernia, the lungs should be expanded to remove atelectasis and to inspect for pulmonary tears and persistent areas of collapse.

In chronic traumatic hernias care is taken not to inflate the lungs. When lung parenchyma is atelectatic for such a long period of time the alveoli collapse. If they are suddenly expanded with air the tight junctions of the normal alveoli are damaged and the inflated alveolus fills with fluid. This is referred to as re-expansion pulmonary edema. This is a life threatening disorder and should be avoided.

It is recommended to suture the hernia from dorsal to ventral thus making it much easier to visualize the dorsal structures (vena cava, aorta, esophagus) when suturing. The hernia is closed with a single layer, simple continuous suture pattern using synthetic absorbable suture material (Dexon, Vicryl, Biosyn PDS, Maxon) or monofilament nonabsorbable suture material (Nylon, Prolene, Novafil). Suture size recommended in cats is 3-0. It might be necessary to preplace the most dorsal sutures for better visualization of the tear during suturing. It is also helpful to reconstruct the tear with several simple interrupted sutures to facilitate visualization of the rent. When tears near the caval hiatus are sutured, care is taken to avoid constriction of the vena cava by placing sutures too close to the cava. The same principle applies to the aortic and esophageal hiatus.

Air can be evacuated from the chest using several techniques.

1. Prior to tying the last knot of the hernial closure, a Carmalt forceps is placed in the hernial rent between two sutures and gently spread open to allow access to the thoracic cavity. The lungs are inflated so as to fill the thoracic cavity. The Carmalts are removed and the last suture tied to provide an air tight and water tight seal.
2. After hernial rent closure a needle or plastic intravenous catheter is placed through the diaphragm and into the thoracic cavity. Thoracic cavity air is evacuated using a syringe.
3. Needle thoracentesis is performed after the procedure is complete.

4. A 12 - 14 French feeding tube is brought into the peritoneal cavity through a paramedian stab incision in the cranioventral body wall. The tube is passed through the diaphragmatic rent between two sutures just prior to its final closure. Make certain that all fenestrations in the tube are beyond the diaphragm. The diaphragmatic rent closure is then completed around the tube. With the use of a 3-way stop cock and 60 cc syringe, air is evacuated from the thorax until a **gentle** negative pressure is obtained. The celiotomy incision is closed in a routine fashion. When the celiotomy closure is complete, the tube is again aspirated. The patient should then be placed through a series of positional changes (ventral recumbency, right lateral recumbency, left lateral recumbency, and dorsal recumbency) while attempting to aspirate air. When negative pressure is obtained in all positions, the tube is gently pulled from the chest and abdominal incision.

5. A 12 -14 French diameter thoracostomy tube can be placed at the level of the 10th or 11th intercostal space, tunneled to the level of the 7th or 8th intercostal space and placed through the intercostal muscle and into the thoracic cavity. The patient is then placed through a series of positional changes (ventral recumbency, right lateral recumbency, left lateral recumbency, and dorsal recumbency) while attempting to aspirate air. The tube is removed when the patient has had a negative pressure for 12 - 24 hours.

All patients are monitored carefully for the next six to eight hours. If signs of respiratory abnormalities arise (dyspnea, tachypnea, etc), the right and left hemithorax should be tapped with a needle and syringe.

Postoperative Care

Postsurgical care includes systemic antibiotics and careful monitoring of the patient's breathing, temperature, and color. Cats should be kept on a warming device for at least 24 hours. Analgesics may be used to relieve patient discomfort, however care should be taken to monitor the effects of various analgesic drugs on respiratory effort. Thoracic radiographs may be taken to evaluate the chest drain and pleural space.

Summary

Successful repair of a diaphragmatic hernia depends on careful preoperative and postoperative care of the patient. During the surgical repair, the surgeon must work quickly and effectively to complete the procedure as efficiently as possible.