

Small Animal Pleural Space Disease  
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## PART ONE

### Introduction

- Normal mechanism for respiration is via negative pressure ventilation. Chest wall expands, and due to coupling of visceral and parietal pleura lung volume also expands, creating subatmospheric pressures and drawing air into the alveoli.
- Pleural space disease results from entry of gas, fluid, or tissue into the potential space between the visceral and parietal pleura.
- Leads to uncoupling, and inefficiency of respiration.

### Clinical Signs

- Depend on severity; smaller volumes of effusion may be asymptomatic.
- With more severe disease, progressive respiratory signs noted, and potentially respiratory failure.
- Fast shallow respiratory pattern noted, sometimes with open mouth breathing in cats, increased abdominal effort, and orthopneic posture.
- Muffled lung sounds noted on auscultation, dorsally for pneumothorax and ventrally for pleural effusion.
- Borborygmi may be heard in the chest with herniated GI

### Imaging

- US ideal in emergent cases. TFAST can be rapidly performed at the bedside, requires minimal restraint, and can also be used to guide thoracocentesis. Easily identifies pleural effusion and herniated viscera, although identification of a pneumothorax is more challenging.
- Thoracic radiographs are also commonly utilized, and provide a more global view of the chest as well as allowing evaluation of the pulmonary parenchyma. Typically require more restraint than a tFAST, and for that reason may need to be delayed until after stabilizing measures have been started.

### Stabilization

- Cases must be promptly differentiated from other causes of respiratory distress. Key is identification of muffled lung sounds. Can confirm with imaging, but in a severely distressed animal a diagnostic thoracocentesis can also be performed.
- Supplemental O<sub>2</sub> provisioned, and vascular access obtained quickly.
- Thoracocentesis performed both to aid diagnosis and to relieve respiratory distress. May be necessary to tap both hemithoraces.
- Thoracostomy tube placement utilized in patients with rapidly reaccumulating fluid or air, if pleural lavage is required, for post-operative monitoring of air/fluid production, and less commonly for infusion of intrapleural treatments (such as intercavitary chemotherapy).

Standard chest tubes with rigid trochars and smaller wire guided chest tubes are both appropriate for use.

### Pneumothorax

- May occur secondary to air leakage from the lung, from penetrating thoracic wounds, be iatrogenic, or rarely occur due to esophageal rupture.
- Imaging commonly demonstrates lung lobe retraction/atelectasis, elevation of the heart from the sternum, and occasionally identifies an underlying cause, although frequently in spontaneous pneumothorax the source of the leak is not apparent.
- Horizontal beam radiograph may allow identification of small volume pneumothorax cases.
- May be treated conservatively (small leaks, trauma) by frequent intermittent or continuous aspiration of air from the pleural space, allowing the damaged area of lung to seal on its own.
- Blood pleurodesis can be considered as an adjunct to conservative treatment. 5-10ml/kg of the patient's own blood is drawn from a jugular catheter and instilled into the thoracic space so that a fibrin clot can help seal the damaged lung.
- Cases with large leaks, penetrating wounds, lung pathology requiring primary surgical attention (abscess, foreign bodies, focal neoplasia), and cases that have failed conservative management may be surgically explored, and the source of the leak repaired or removed.

### Pyothorax

- Suppurative infiltrate in the pleural space. Commonly due to penetrating wounds (especially bite wounds in cats), migrating foreign bodies, ruptured pulmonary abscesses, or esophageal perforation. Can be iatrogenic in cases with prior history of thoracocentesis or thoracic surgery.
- Often show chronic progressive but non-specific signs, with respiratory signs noted when effusion has built up to the point where lung expansion is affected. Diagnosed via pleural fluid cytology, where a strongly neutrophilic exudate often with microorganisms is noted.
- When identified cases should be started on broad spectrum antibiotic therapy, which is typically continued for 4 weeks.
- Conservative treatment may be successful, particularly in cats, and involves placement of bilateral large gauge chest tubes for regular pleural lavage and removal of contaminated fluid. Animals who respond typically show decreased fluid production within 3-5 days, and once fluid production has decreased and cytology is benign (no microorganisms observed, lower nucleated cell count) the chest tubes can be pulled and the pet sent home to continue antibiotic therapy.
- Surgical debridement and lavage of the chest is required in patients with an identified surgical lesion (foreign body, lung lobe abscess), or who have failed medical management.

### Chylothorax

- Caused by an accumulation of lymphatic fluid within the thorax. Many potential predisposing causes have been identified, but frequently cases are idiopathic.
- Chronic effusion is inflammatory; over time patients can develop fibrosing pleuritis, severely limiting lung expansion even if the fluid is removed.
- Medical therapy is generally unrewarding, consisting of a low fat diet and rutin administration.

- Many surgical therapies have been described, and it is common to treat animal with a combination of them, for example a thoracic duct ligation with a cisterna chyle ablation and a pericardectomy.
- Unfortunately, even with surgical treatment prognosis is guarded.

#### Diaphragmatic hernia

- Most commonly secondary to trauma, although rare congenital cases have been reported.
- Important to include screening thoracic radiographs in the work up of all trauma patients, even those without respiratory signs.
- Two potential causes of morbidity. Organs within the thorax prevent lung expansion, similarly to cases with pleural effusion. Second, herniated viscera can become entrapped, leading to infarction, and potentially GI or biliary obstruction depending on the affected tissue.
- Most cases urgent but not emergent, and benefit from a period of stabilization prior to surgical explore. Exceptions are made for cases with signs of entrapped viscera, respiratory distress due to severe pulmonary compression, and potentially herniation of the stomach due to its potential to expand rapidly and compromise respiration.
- Chronic cases are occasionally identified, and carry some additional potential concerns (loss of abdominal domain, re-expansion pulmonary edema, and adhesion formation).
- Surgical repair of the hernia recommended in all cases due to the risk of entrapment or respiratory compromise in the future, even if the animal is subclinical at the time of diagnosis.

#### Peritoneal-pericardial diaphragmatic hernia

- Common congenital abnormality resulting from failure of complete midline fusion of the diaphragm, resulting in a residual communication between the abdomen and the pericardial sac.
- Not technically a type of pleural space disease! Herniated visceral enters the pericardial space, not the pleura.
- Similar concerns and treatment recommendations as patients with diaphragmatic hernias, although more common to pursue benign neglect in asymptomatic animals.

## PART TWO

#### General anesthetic concerns

- Oxygenation/ventilation of critical importance. Rapidly secure airway, and be ready to utilize manual/mechanical ventilation, particularly while the thorax is open. May be necessary to remove additional fluid/air from the pleural space once the patient is under anesthesia.
- Ensure reliable vascular access during the procedure with backup catheter.
- Closely monitor vital parameters, including blood pressure, and be ready to treat hypotension, acute blood loss, cardiac arrhythmias, and hypothermia.
- Ensure adequate analgesia is provided both intraoperatively and post operatively.
- In cases of penetrating thoracic wounds, be prepared to convert to total intravenous anesthesia in case of a large atmospheric leak.

#### Diaphragmatic hernia repair

- Approach via a midline abdominal incision, but drape in chest in case it is necessary to extend into a caudal sternotomy.
- Gently retract viscera into the abdomen, being cautious of any adhesions.
- If unable to draw organs back into the abdomen, consider enlarging hernia.
- Once viscera is reduced, suture defect. Most cases can be closed primarily, but in the case of very large hernias (especially congenital cases), muscular flaps, fascia lata, PSIS, mesh, or omentum may be used for repair.
- Empty air from the chest to reestablish negative pressure, either by thoracocentesis, chest tube placement, or exit of a red rubber catheter via the diaphragmatic incision.

#### Lateral thoracotomy

- Used to access the chest when only a single hemithorax is affected.
- Must identify correct intercostal space.
- Provides better access to dorsal structures than a median approach does.

#### Median sternotomy

- Used when access to the entire chest is required.
- Excellent access to ventral structures, mediastinum, and all lung lobes.
- Poorer access to more dorsal structures such as the esophagus.

#### Thoracic explore

- Should be performed systematically, with all structures in the field evaluated for abnormalities.
- Gentle tissue handling, especially for the lungs.
- If looking for an air leak, flood the chest with sterile saline and ask anesthetist to give and hold a breath. This will cause a “champagne stream” of bubbles to rise from the damaged lung tissue, aiding its identification.

#### Commonly encountered pathology

- Pulmonary neoplasia
- Lung lobe torsion
- Pulmonary abscess
- Pulmonary bulla

#### Lung lobectomy

- May be performed either with a handsewn technique, or using a stapling device
- Hilus should be leak tested following the procedure, to ensure bronchus is adequately occluded.
- Most common to perform complete lobectomies, but in cases of multifocal pulmonary disease, partial lobectomies may be performed to retain lung capacity.
- Animals can tolerate acute removal of ~60% of their lung capacity.

#### Pyothorax

- Open treatment of pyothorax requires median sternotomy
- Mediastinum is typically thickened and often locks off small areas of abscessation.
- Mediastinum is taken down, and all necrotic/abnormal tissue is debrided. Any identified underlying cause (such as a migrating foreign body) should be addressed.
- Chest is thoroughly lavaged (300-400mL/kg), then large bore chest tubes are placed to allow continued drainage post operatively.

#### Thoracic wall reconstruction

- Commonly required in “big dog- little dog” situations.
- Begin by assessing wounds- commonly large pockets that must be opened and debrided. Debride necrotic fat, torn muscle, foreign material.
- Often severe damage to the chest wall, with fractured, skeletonized ribs.
- Assess intrathoracic structures and repair or remove damaged tissues as needed.
- Thoroughly lavage the chest and wound bed.
- Ideal to use local tissues for reconstruction, rather than using mesh due to the risk of infection. Most common is to use the latissimus dorsi, which may be released from its attachments and shifted to cover the defect. It is tacked in place to the remaining thoracic wall musculature, and fractured ribs can be apposed to create a scaffold to support the muscle.
- Chest tube and wound drain placed prior to closure.

#### Post-operative concerns

- Hypoxia common in post-thoracic surgery patients. Usually due to combination of atelectasis and hypoventilation. In most cases supplemental oxygen provision improves SpO<sub>2</sub>, and this can usually be weaned off as animal recovers from anesthesia.
- Always rule out pleural space disease contributing- check chest tube, tFAST, or perform a diagnostic tap, as air leakage post operatively is a significant concern.
- If the patient does not improve with oxygen or if they cannot be weaned off within 12-24 hours, suspect a component of pulmonary parenchymal disease. Thoracic radiographs should be obtained.
- Continue to monitor vital parameters, PCV, and fluid/air production from the chest tube.
- Ensure adequate, multimodal analgesia is maintained.