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David Karunyakaran H

Ph.D. Scholar, Department of
Veterinary Clinical Medicine,
Madras Veterinary College,
Tamil Nadu Veterinary and
Animal Sciences University,
Chennai, Tamil Nadu, India

Canine pleural space disorders: An update

David Karunyakaran H

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Abstract

Exudative pleural diseases and pneumothorax in dogs represent major causes of respiratory distress requiring rapid diagnosis and targeted intervention. Exudative pleural effusions arise from inflammatory, hemorrhagic, or lymphatic mechanisms and include hemothorax, pyothorax, and chylothorax, each characterized by distinctive pleural fluid features and etiologies. Hemothorax commonly results from trauma, coagulopathies, or neoplasia; pyothorax is usually associated with bacterial infection secondary to migrating foreign bodies, penetrating wounds, or esophageal rupture; and chylothorax reflects thoracic duct disruption or obstruction, sometimes with breed predisposition. Accurate classification of pleural effusions using protein concentration, cellularity, cytology, and biochemical analysis is essential to distinguish transudates, modified transudates, and exudates and to guide case management.

Diagnostic approaches integrate thoracic radiography, ultrasonography, computed tomography, thoracoscopy, and pleural fluid analysis to identify underlying lesions, assess severity, and plan therapy. Treatment strategies span medical drainage (thoracocentesis or thoracostomy tubes), antimicrobials, dietary modification for chylothorax, and surgical intervention for lung lobe torsion, persistent air leaks, neoplasia, or thoracic duct ligation. Prognosis varies with etiology and timeliness of intervention but is often favorable when prompt stabilization and definitive management are achieved. This review summarizes the pathophysiology, diagnostic workup, and therapeutic options for canine exudative pleural disorders and pneumothorax, emphasizing a multimodal, evidence-based approach relevant to small animal clinical practice.

Keywords: Pleural effusion, exudates, pneumothorax, thoracocentesis

Introduction

Exudative pleural diseases

The pleural cavity in dogs is a potential space enclosed by the visceral and parietal pleura lining each lung and chest wall respectively. Though traditionally considered anatomically divided into separate right and left compartments by the mediastinum, clinical findings suggest these pleural spaces may communicate in some dogs, allowing fluid or disease processes to spread between sides. Normally, only minimal pleural fluid (approximately 0.1 mL/kg) exists in dogs to reduce friction during respiration.

Exudative pleural effusions in dogs develop due to inflammation within the pleural space, characterized by a high protein content and increased cellular (especially inflammatory cell) numbers. Such effusions result from increased vascular permeability, involving cytokine and other mediator release, or from decreased lymphatic drainage efficiency. Causes include infections, neoplasia, foreign material, hemothorax, chylothorax, and bile leakage into the pleural cavity (bilothorax)

Classification of Pleural Effusions in Dogs

Pleural fluids sampled via thoracocentesis are classified as

- **Transudates:** Low protein (<2.5 g/dL), low cellularity (<1500 cells/ μ L) usually due to increased hydrostatic pressure or decreased plasma oncotic pressure.
- **Modified transudates:** Intermediate values of protein (2.5–7.5 g/dL) and cells (1000–7000 cells/ μ L), often associated with congestive heart failure or neoplasia.
- **Exudates:** High protein (>3 g/dL) and high nucleated cells (>7000 cells/ μ L) typical of infectious or inflammatory processes.

Corresponding Author:

David Karunyakaran H

Ph.D. Scholar, Department of
Veterinary Clinical Medicine,
Madras Veterinary College,
Tamil Nadu Veterinary and
Animal Sciences University,
Chennai, Tamil Nadu, India

Hemothorax in Dogs

Hemothorax describes the accumulation of blood within the pleural space, diagnosed when the hematocrit of the pleural fluid is at least 25% of that in peripheral blood. In dogs, common causes include trauma (e.g., vehicular accidents), coagulopathies such as anticoagulant rodenticide poisoning, and neoplasms like hemangiosarcoma or mesothelioma. Less frequently, lung lobe torsion, pancreatitis, or infectious etiologies contribute to bleeding into the pleural space. Some breeds, including Afghan Hounds and Pugs, appear predisposed to lung lobe torsion, a recognized cause of hemothorax.

Treatment focuses on stabilizing the patient with fluid resuscitation, removing blood accumulation via thoracocentesis for respiratory relief, and managing the underlying cause. Surgery may be necessary for lung lobe torsion or resectable tumors. Prognosis varies widely depending on the cause and severity.

Pyothorax (Septiceous Pleuritis) in Dogs

Pyothorax is an accumulation of purulent fluid within the pleural cavity caused by bacterial infection, often resulting from migrating foreign bodies (commonly grass or plant awns), penetrating wounds, or esophageal rupture. The disease predominantly affects young to middle-aged dogs, with hunting or sporting breeds susceptible due to environmental exposure.

Clinical signs include respiratory distress, tachypnea, lethargy, fever (though sometimes absent), and cough. Diagnostic evaluation involves thoracic radiography or ultrasound revealing pleural fluid, often turbid with flocculent debris, while cytology typically demonstrates high neutrophilic inflammation with intracellular bacteria. Culture identifies aerobic and anaerobic bacteria such as *Pasteurella* spp., *Actinomyces* spp., *Streptococcus canis*, and anaerobes like *Peptostreptococcus* or *Fusobacterium*.

Treatment strategies include

- Medical management with thoracocentesis or placement of indwelling thoracostomy tubes for drainage plus systemic antimicrobial therapy.
- Surgical intervention when medical treatment fails or if imaging identifies abscesses or migrating foreign bodies, consisting of thoracotomy or minimally invasive procedures such as thoracoscopic lobectomy.

Outcomes are generally favorable, especially with prompt drainage and antibiotic treatment, though prolonged therapy (weeks to months) may be required.

Chylothorax in Dogs

Chylothorax arises due to accumulation of chyle—a lipid-rich lymphatic fluid—in the pleural cavity, resulting from impaired thoracic duct drainage. Causes include trauma, thoracic duct rupture, neoplasia causing lymphatic obstruction, mediastinal masses, and congenital lymphatic abnormalities. Certain breeds, like Afghan Hounds, show increased predisposition.

Diagnostic criteria hinge on pleural fluid appearance (milky, turbid) and biochemical analysis confirming elevated triglyceride concentration relative to blood. Additional diagnostics include thoracic imaging and evaluation for cardiac or abdominal diseases contributing to lymphatic obstruction.

Treatment proceeds from medical management aiming to control clinical signs—such as repeated thoracocentesis and dietary fat restriction—to surgical interventions including

thoracic duct ligation, cisterna chyli ablation, and pericardiectomy. Minimally invasive techniques, guided by advanced imaging like CT lymphangiography, have improved surgical success. Complications such as fibrosing pleuritis may impact outcomes. Refractory cases sometimes benefit from pleurodesis or placement of pleuroperitoneal shunts or indwelling ports.

Diagnostic Imaging and Procedures in Pleural Disease

- Include radiography, ultrasonography, computed tomography and thoracoscopy.
- Thoracic radiography commonly detects pleural effusions, collapse of lung lobes, masses, and mediastinal shifts. Complete series with multiple views is preferred for comprehensive evaluation.
- Thoracic ultrasound aids rapid bedside diagnosis, especially useful in detecting pleural fluid anatomy, fibrin strands, abscesses, and foreign bodies.
- Computed tomography (CT) offers detailed localization of pleural and pulmonary lesions, aiding surgical planning and detection of migrating foreign material.
- Thoracoscopy and bronchoscopy provide minimally invasive options for diagnosis and foreign body retrieval.

Pleural Fluid Analysis and Sampling

Fluid sampled via thoracentesis or thoracostomy tube is analyzed for cytology, culture, protein content, and cell counts to classify effusion type and guide diagnosis. Analysis helps differentiate pyothorax from other causes. It is vital to submit samples promptly and under proper conditions for accurate culture including aerobic and anaerobic pathogens, as well as special organisms like *Mycoplasma* sp.

In dogs, exudative pleural diseases cover a spectrum of serious conditions including hemothorax, pyothorax, and chylothorax. While mechanisms differ—inflammatory, hemorrhagic, or lymphatic—each condition requires accurate diagnosis through imaging and fluid analysis. Treatment ranges from medical drainage and antimicrobial therapy to surgical correction. Prognosis varies but can be favourable with timely intervention.

Canine Pneumothorax

Pneumothorax refers to the abnormal presence of air within the pleural space—the potential cavity between the lung's surface (visceral pleura) and the chest wall (parietal pleura). Normally, this space contains a small amount of lubricating fluid to facilitate smooth lung movement. When air enters this space, it disrupts the negative pressure necessary to keep the lungs inflated, leading to partial or complete lung collapse and impaired respiratory function.

Etiologies

The causes of pneumothorax in dogs can be broadly classified as:

- Traumatic Pneumothorax: Most common form in dogs, usually following external injury. Causes include:
 - Blunt trauma (e.g., hit by vehicle, kick)
 - Penetrating wounds to the chest (bite wounds, stab injuries)
- Thoracic surgery or medical procedures (iatrogenic)
- Perforation of the trachea or oesophagus
- Spontaneous Pneumothorax: Occurs without obvious trauma; subtypes include:
 - Primary spontaneous pneumothorax arises without prior lung disease, often due to rupture of lung blebs or bullae (small air-filled sacs on the lung surface).

- Secondary spontaneous pneumothorax results from underlying lung pathology such as chronic bronchitis, pneumonia, lung tumors, abscesses, or congenital lung abnormalities.
- Iatrogenic Pneumothorax: Occurs due to medical interventions, such as needle puncture during thoracocentesis, biopsy, ventilation, or improper tube placement.
- Tension Pneumothorax: A life-threatening emergency caused by a one-way valve effect—air enters pleural space but cannot exit—leading to rising intrathoracic pressure, lung compression, and decreased cardiac output.

Pathogenesis

Under normal physiology, the pleural cavity maintains a slightly negative pressure allowing the lungs to remain expanded during respiration. When air leaks into the pleural space — typically through defects or ruptures in the lung, airway, or chest wall — this negative pressure collapses, and lung tissue recoils inward. The volume of air and speed of accumulation dictate clinical severity.

- In traumatic pneumothorax, physical injury compromises the chest wall or lung tissue allowing air ingress.
- In spontaneous pneumothorax, rupture of abnormal lung sacs (bullae, blebs) results in leakage.
- Tension pneumothorax occurs when air accumulates continuously under pressure, compresses the heart and unaffected lung, rapidly causing respiratory and cardiovascular collapse.

Clinical Signs

Dogs with pneumothorax typically show:

- Rapid breathing (tachypnoea)
- Difficulty breathing (dyspnoea)
- Increased respiratory effort with "abdominal breathing" pattern (use of abdominal muscles rather than chest expansion)
- Exercise intolerance and weakness
- Mucous membranes may appear pale or cyanotic (bluish due to hypoxia)
- Standing posture with elbows abducted to maximize lung volume
- Reduced or absent lung sounds on auscultation over affected hemithorax
- Subcutaneous emphysema (air under skin) may cause palpable crackling sensation
- Signs of shock or collapse in severe or tension pneumothorax

Diagnosis

A combination of history, clinical examination, and diagnostic imaging provides the diagnosis:

- **Physical examination:** Reduced lung sounds, increased respiratory effort, and signs of distress.
- **Radiography (Chest X-rays):** The standard diagnostic modality, showing air in the pleural space, collapsed lung lobes, mediastinal shifts, and underlying causes.
- **Thoracic Ultrasound (TFAST):** Useful in emergency situations to detect free air, guide thoracocentesis.
- **Arterial Blood Gas Analysis:** Assesses oxygenation and ventilation status.
- **Computed Tomography (CT):** Provides detailed imaging to identify lesions causing pneumothorax or confirm diagnosis if unclear.

- **Thoracocentesis:** Diagnostic and therapeutic needle aspiration of air from the chest to relieve pressure and confirm air presence.

Treatment and Management

Management depends on severity, cause, and clinical status:

- Emergency stabilization
- Immediate oxygen supplementation.
- Thoracocentesis to remove free air and re-expand the lung; performed repeatedly if necessary.
- In cases of hemodynamic compromise or tension pneumothorax, urgent decompression with thoracostomy tube placement or thoracotomy may be required.
- Conservative Management:
- Some cases with minor, stable pneumothorax may resolve spontaneously with rest and oxygen.
- Strict cage rest is advised to minimize re-injury or exacerbation.
- Surgical Intervention:
- Indicated for ongoing air leaks, large lesions, or when the underlying cause (e.g., bullae, mass, abscess, foreign body) requires resection.
- Procedures include thoracotomy or minimally invasive thoracoscopy to repair lung or chest wall defects.
- Monitoring:
- Frequent reassessment including physical exams, chest radiographs to monitor lung re-expansion and air re-accumulation.
- Duration of hospitalization varies, with supportive care until air leak stops and lung function improves.

Prognosis

Prognosis is favourable if pneumothorax is promptly recognized and managed.

Dogs with minor, traumatic pneumothorax and no lung disease often recover fully. Pneumothorax due to underlying lung pathology or secondary complications may have a guarded prognosis and require more extensive treatment.

Conflict of Interest

Not available

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