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Pleural Effusion in Cats: Understanding the Causes and Diagnostic Approach

Prof Johan P. Schoeman

Pleural effusion is a significant clinical condition in cats, referring to the accumulation of fluid within the pleural space, the cavity lined by the visceral and parietal pleura and situated between the lungs and the chest wall. This fluid build-up impairs lung expansion, leading to respiratory distress that can manifest as tachypnea, dyspnea, or even cyanosis. Identifying the aetiology of pleural effusion is crucial for appropriate management and treatment.

Classification of Pleural Fluid

Pleural effusion in cats can be categorised based on the type of fluid present in the pleural space. The main classifications are:

- **Transudative effusion:** Typically caused by conditions that disrupt the balance between fluid production and absorption, such as heart failure or hypoalbuminemia. Transudates are characterised by a total protein (TP) concentration of less than 25 g/l and a total nucleated cell count (TNCC) of less than 1000/µl.
- **Exudative effusion:** Occurs due to inflammation or injury to the pleural surfaces, resulting in the leakage of protein-rich fluid. Conditions like pneumonia, neoplasia and infections frequently cause exudative effusion. Exudates are defined by a TP concentration greater than 30 g/l and a TNCC greater than 5000/µl. They can be subclassified as septic, non-septic, chylous*, or neoplastic.
- **Chylous effusion (Chylothorax):** Involves the accumulation of lymphatic fluid (chyle) in the pleural space. This often results from lymphatic obstruction or leakage. Chylous effusions are specifically defined in cats by a **triglyceride concentration exceeding 100 mg/dl (or 1.12 mmol/l)**. They can have TP/TNCC values that fall within the modified transudate or exudate ranges. Grossly, chylous fluid is often opaque and milky or pink. It may form a cream layer upon standing and does not become clear after centrifugation because the opacity is due to lipid (chylomicrons).
- **Hemorrhagic effusion:** Caused by bleeding into the pleural space. This can be associated with trauma, coagulopathies, or neoplasia. Hemorrhagic effusion occurs when blood enters the pleural space due to injury to the chest wall, lungs, or blood vessels. Fluid can appear bloody with a haematocrit of <5%, while haemothorax is variably defined as fluid with a haematocrit of at least 25% or 50% of the peripheral blood haematocrit.

A **Modified Transudate (or so-called high protein transudate)** is a classification with a TP concentration between 25 and 35 g/l and a TNCC between 500 and 10,000/µl. This is considered the least specific classification and requires integration with clinical criteria and gross fluid characteristics for interpretation. Fluid analysis is variably useful in determining the aetiology, and the results must be interpreted in the light of clinical data. While fluid properties can be diagnostic for pyothorax, neoplasia, and FIP, in other cases, they inform the diagnostic investigation.

Common Aetiologies of Pleural Effusion in Cats

Fortunately, the list of common causes for moderate to large volume pleural effusion in cats is relatively short. Published case series indicate that **Feline Infectious Peritonitis (FIP), Congestive Heart Failure (CHF), pyothorax (infectious pleuritis), and neoplasia collectively account for a large majority (88-100%) of cases** where a definitive aetiology is confirmed. **Idiopathic chylothorax** is another significant category where a cause cannot be determined despite investigation.

1. Feline Infectious Peritonitis (FIP):

Signalment/History: Effusive FIP commonly affects young cats, with about 70% of cases occurring in cats less than 1 year old. An increased risk may exist in certain breeding lines and entire cats, and it is common in mixed-breed cats. A recent history of being in a multi-cat environment and/or experiencing a stressor, such as neutering or rehoming, is often reported.

Clinical Features: Non-specific signs like lethargy, reduced appetite, and weight loss are common. Physical findings may include pyrexia, poor body condition, peritoneal (abdominal) effusion, ocular changes (e.g., uveitis, keratitic precipitates), and neurological signs. The presence of simultaneous pleural and peritoneal effusion significantly increases suspicion for FIP (among other systemic diseases). In cats with effusive FIP, 21% have both pleural and peritoneal effusions.

Fluid Characteristics: The pleural effusion in effusive FIP is associated with widespread vasculitis, leading to the exudation of high-protein fluid. The fluid is typically **high in protein (>35 g/l) but low in cellularity (<5000/µl)**, often falling within the modified transudate or even pure transudate range for cell count despite the high protein. FIP fluid is characteristically viscous, froths upon agitation due to its high protein content, and may clot upon standing. The cellular component typically consists of neutrophils and macrophages. LDH concentrations in FIP effusions are usually high (>300 IU/l).

Diagnosis: While fluid characteristics are suggestive, diagnosis relies on specific tests. The single most useful test is immunofluorescence to detect feline coronavirus (FeCoV) antigen in macrophages, which has a high positive predictive value (100%). The Rivalta's test can be used as an alternative or supportive test where immunofluorescence is unavailable, identifying exudates based on their behaviour in dilute acetic acid. Immunohistochemistry of tissue biopsies can confirm the diagnosis in ambiguous cases.

2. Congestive Heart Failure (CHF):

Signalment/History: Can affect cats of any age or breed, depending on the underlying cardiac disease. It is a frequent cause of transudative pleural effusion, especially in older animals. History may be variable.

Clinical Features: Clinical signs of cardiac disease may or may not be evident. Common findings include tachycardia, heart murmur, gallop sounds, arrhythmias, jugular distension, jugular pulsation, and sometimes ascites or hepatomegaly. Jugular distension and pulsation are suggestive of right-sided heart failure (RHF). The absence of a heart murmur does not rule out cardiac disease. Concurrent pulmonary oedema can contribute to dyspnoea and may be heard as crackles on auscultation, often dorsally.

Fluid Characteristics: Pleural effusion in CHF can be a **transudate, modified transudate, or a chylous effusion**. It results from increased capillary hydrostatic pressure due to elevated ventricular diastolic pressure in the systemic and/or pulmonary circulation.

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Left-sided heart failure (LHF) leads to a backflow of blood into the pulmonary circulation, increasing pressure in the pulmonary veins. In addition, the visceral pleural veins are thought to drain into the left atrium, and therefore, the backflow will cause fluid to leak into the pleural space. This fluid is typically low in protein and cell count, characteristic of transudative effusions. RHF may also cause pleural effusion as parietal pleural veins drain into the systemic venous circuit. RHF is a fairly common cause of chylothorax in the cat, likely resulting from increased pressure in the major lymphatics as the thoracic duct terminates in the left external jugular vein or jugulosubclavian angle.

Diagnosis: Echocardiography is the diagnostic modality of choice to rule out decompensated cardiac disease. Atrial enlargement suggests pressure or volume overload; generally, if the atria are not enlarged, CHF is less likely as the cause of effusion. Serum pro-brain natriuretic peptide (NT-proBNP) is a useful test with high sensitivity and specificity (around 90%) for detecting myocardial disease, helping differentiate cardiac from non-cardiac causes of respiratory distress. Post-drainage radiographs can be reviewed for cardiac silhouette size and pulmonary/vasculature changes. LDH levels are typically lower in cardiogenic effusions compared to neoplastic effusions.

3. Pyothorax (Infectious Pleuritis):

Signalment/History: Often affects young cats (mean 4–6 years), although any age or breed can be affected. The duration of signs is typically short (mean 1–2 weeks), and presentation can be acute. Owners may report dyspnoea, cough, lethargy, reduced appetite, and weight loss. A history of previous upper respiratory tract infection (URTI) is noted in some cases (25%). A history of **outdoor access or living in a multi-cat household is common** in affected cats.

Clinical Features: Physical findings can include pyrexia, dehydration, and poor body condition. If sepsis is severe, signs like hypoglycaemia, hypothermia, jaundice, and bradycardia may be present. Coughing is reported in up to 30% of cats with pyothorax. Cats with pyothorax in one study had significantly higher effusion cell counts, higher numbers of bacterial isolates per patient, and intracellular bacteria were detected more commonly compared to dogs.

Fluid Characteristics: Pyothorax is characterised by the accumulation of a **purulent exudate**. The fluid is typically classified as an exudate, with **high protein (>30 g/l) and very high cell counts (>7000/µl)**. Neutrophils are the predominant cell type (>85%). The fluid is often opaque and creamy, though it can be pink, green-tinged, or sanguineous, and may contain flocculent material. A **foul smell is a strong indicator of anaerobic infection**, typical in over 80% of pyothorax cases. Intracellular bacteria may be identified on cytology. Septic effusions typically have lower pH (<7.4, often ~6.9) and lower glucose levels compared to neoplastic effusions.

Diagnosis: Cytology and aerobic and anaerobic bacterial culture are indicated. Gram staining may also be useful. While gross appearance (especially odour) can be highly suggestive, lack of odour does not rule out infection. Pyothorax infections are frequently polymicrobial in cats, emphasising the need for both aerobic and anaerobic cultures. Anaerobes were isolated more often in cats (79%) than in dogs (45%) in one study. Common aerobic isolates in cats include *Pasteurella* spp. and *Actinomyces* sp. Cytological identification of intracellular bacteria is common and supports the diagnosis even if antibiotics have been administered.

Aetiopathogenesis: Infectious pleuritis is often caused by obligate and facultative anaerobes originating from the oropharynx. Recent research suggests that **penetrating damage to the thorax is the most common probable cause of pyothorax in cats, accounting for about 76% of cases** in one study. This penetrating damage can be due to bite wounds, foreign bodies (though less common than in dogs), or other traumatic injuries (outside-in or inside-out). Bite wounds were considered the most likely cause in 10/29 feline pyothorax cases in one study, often linked to a history of fighting (17%) or living in multi-animal households (61%). Lack of external wounds does not rule out a bite wound. Isolation of *Actinomyces* sp. is often associated with foreign body migration. Parapneumonic spread (following colonisation of lung tissue) seems to be a less frequent cause than penetrating trauma.

4. Neoplasia:

Signalment/History: The age distribution varies depending on the type. Bronchopulmonary neoplasia and thymoma are usually seen in older cats (>10 years). Mediastinal lymphoma, historically a very common cause, affects younger cats, particularly young Siamese breed cats. History is variable and non-specific, possibly including cough or dyspnoea. Owners might report poor body condition.

Clinical Features: Can cause dyspnoea due to the pleural effusion or the space-occupying effect of a mass. Decreased thoracic compressibility, especially anteriorly, might be felt with cranial mediastinal masses. Paraneoplastic syndromes such as myasthenia gravis, exfoliative dermatitis, and polymyositis can be associated with intrathoracic masses. Pulmonary carcinoma in cats can metastasise widely, sometimes to unusual locations like the eyes, digits, and skeletal muscles, potentially leading to signs like lameness.

Fluid Characteristics: Neoplasia can cause pleural effusion with variable characteristics, including **modified transudate, exudate, or chylous effusion**.

Diagnosis: Fluid cytology is a useful test for diagnosing neoplasia in body cavity effusions, including feline pleural effusions. Cytology has been shown to have reasonable sensitivity (61-65%) and high specificity (100%) for detecting neoplasia. However, inexperienced cytologists might confuse reactive mesothelial cells with neoplastic cells. Post-drainage chest radiographs are essential to look for masses or other abnormalities previously obscured by the fluid. Thoracic ultrasonography or computed tomography (CT) are excellent modalities for detecting, characterising, and evaluating the extent of intrathoracic masses or nodules. Guided fine-needle aspiration (FNA) or core biopsy of mediastinal or pulmonary lesions can provide a definitive diagnosis. LDH levels may be higher in neoplastic effusions compared to cardiogenic effusions. Neoplastic effusions typically have a normal or high pH (>7.4), low neutrophil count (<30%), and glucose levels between 0.5-4.5 mmol/l.

5. Idiopathic Chylothorax:

Signalment/History: Can affect cats of any age or breed, though Siamese cats may have an increased risk. Clinical signs often include cough and dyspnoea.

Clinical Features: Often, no other significant physical findings are noted besides those related to the pleural effusion.

Fluid Characteristics: Chylous effusions are defined by their **triglyceride concentration**. They have a pleural fluid triglyceride content greater than the serum triglyceride concentration, and the pleural fluid cholesterol level is less than or equal to the serum cholesterol. If only pleural fluid is available, a triglyceride concentration greater than 100 mg/dl (>1.12 mmol/l) confirms chylothorax. Grossly, chylous fluid is often opaque and milky or pink. Upon standing, it may form a cream layer. Unlike effusions opaque due to cells, chylous fluid does not become clear after centrifugation because the opacity is due to lipid (chylomicrons). Cytology often reveals small lymphocytes or neutrophils and lipid-laden macrophages, and refractile lipid droplets (chylomicrons) may be seen.

Diagnosis: Confirmation relies on measuring the triglyceride concentration in the pleural fluid. Investigation should aim to rule out known underlying causes of chylothorax in cats, principally CHF, neoplasia, and trauma. Right-sided heart failure is a fairly common cause of chylothorax in cats. Despite investigation, many cases of chylothorax in cats are ultimately considered idiopathic, meaning an underlying cause cannot be determined.

Other Documented Causes

Beyond the common aetiologies, other less frequent causes of pleural fluid accumulation in cats include:

- trauma (resulting in haemorrhage - haemothorax, diaphragmatic hernia, thoracic duct rupture, or rarely urinothorax),
- coagulopathy,
- peritoneopericardial diaphragmatic hernia,
- uraemia,
- pulmonary thromboembolism (infrequently documented in cats),
- lung lobe torsion,
- possible extension from a perinephric pseudocyst,
- pancreatitis,
- glomerulonephropathies (associated with hypoalbuminemia),
- *Aelurostrongylus abstrusus* infection.

Diagnostic Approach Summary

The approach to a dyspnoeic cat with suspected pleural effusion typically follows a structured approach:

1. Stabilisation:

This is the first and most important step. Cats with significant pleural space disease have compromised respiration and are at risk of respiratory failure. Stabilisation techniques include placing the cat in a cool, quiet environment to reduce oxygen demand, providing supplemental oxygen (chamber, mask, flow-by), establishing intravenous access, considering light sedation to reduce anxiety, and potentially performing **therapeutic thoracocentesis as a potentially life-saving measure** if dyspnoea is severe. Monitoring respiratory rate and depth is essential. Other aspects of stabilisation include addressing hypothermia, hypotension, hypoglycaemia, and fluid/electrolyte imbalances.

2. Assessment and Ranking of Differential Diagnoses:

Data from the signalment, history, and physical examination are used to rank the common aetiologies.

Signalment: Young cats: consider FIP, mediastinal lymphoma, pyothorax. Older cats: consider bronchopulmonary neoplasia, thymoma, and decompensated thyrotoxic cardiomyopathy. Siamese cats: increased risk for mediastinal lymphoma (young) and chylothorax.

History: Previous URTI in a young cat suggests pyothorax. A recent multi-cat environment/stressor in a young cat suggests FIP. Signs of hyperthyroidism in older cats. Oesophageal signs might suggest a mediastinal mass. Lack of outdoor access/rodenticide exposure makes haemothorax less likely. Coughing may be related to the effusion or the underlying cause.

Physical Examination: Gentle handling is vital. Assess mucous membrane colour/CRT, jugular veins (distension/pulsation), heart sounds (rate, rhythm, murmurs, gallops). Palpate for thyroid enlargement and reduced thoracic compressibility. Look for abdominal effusion, ocular changes, and neurological signs (suggesting FIP). Look for signs of trauma. Poor body condition, pyrexia, or hypothermia can provide clues. Breath sounds are decreased or absent with pleural space disease, often more pronounced ventrally where fluid accumulates.

3. Confirmation of Pleural Effusion:

This can be rapidly and non-invasively achieved with a single dorsoventral (DV) thoracic radiograph or ideally through point-of-care thoracic ultrasonography. Maintaining the cat in sternal recumbency is recommended. Imaging helps differentiate effusion from pneumothorax or diaphragmatic hernia. Unilateral effusion may raise suspicion for pyothorax or chylothorax. Radiographic signs include interlobar fissure lines, rounding of lung margins, retraction of lobar borders from the chest wall, widening of the mediastinum, scalloping of lung margins, effacing of the cardiac silhouette, and dorsal tracheal displacement. Ultrasound is also useful for identifying masses or diaphragmatic hernia.

4. Thoracocentesis:

This is both a diagnostic and therapeutic procedure and is often well tolerated. It can be performed with or without ultrasound guidance. As much fluid as can be easily obtained should be removed to improve respiration.

5. Fluid Analysis:

Samples are collected for analysis (TP, TNCC, differential cell count, cytology) and culture/other specific tests guided by clinical data and gross fluid characteristics.

Gross characteristics (malodorous, milky, serosanguineous, translucent) help direct further testing.

Specific tests like FeCoV immunofluorescence/Rivalta's test for FIP, triglyceride/cholesterol for chylous effusions, aerobic/anaerobic culture and cytology with Gram staining for pyothorax, and cytology for neoplasia are key.

Other tests like LDH, pH, and glucose may provide additional information, particularly for differentiating exudate types or identifying septic effusions.

6. Additional Tests:

These may include post-drainage imaging, echocardiography, CT scans, ultrasound-guided biopsies, serum tests (haematology, biochemistry, urinalysis, FeLV/FIV, total T4, heartworm tests), and potentially NT-proBNP testing.

In conclusion, while the aetiology of pleural effusion in cats is diverse, a focused list of common causes accounts for the majority of cases: FIP, CHF, neoplasia, pyothorax, and idiopathic chylothorax. While fluid analysis is critical, its interpretation must always be integrated with signalment, history, and physical examination findings to guide further diagnostics and determine the underlying cause. Recent studies highlight penetrating trauma, including bite wounds, as a common aetiology for pyothorax in cats, challenging previous assumptions about parapneumonic spread.

Further reading

Beatty J and Barrs V. (2010) Pleural effusion in the cat: A practical approach to determining aetiology. Journal of Feline Medicine and Surgery, 12, 693-707

Johnson LR et al. (2023) Etiology and effusion characteristics in 29 cats and 60 dogs with pyothorax. Journal of Veterinary Internal Medicine, 37, 1155-1165

QUESTION 1

What is the definition of pleural effusion in cats?

a) Accumulation of fluid within the lungs
b) Accumulation of fluid within the pleural space, the cavity between the lungs and the chest wall
c) Accumulation of fluid within the abdominal cavity
d) Accumulation of fluid within the pericardial sac
e) Accumulation of fluid within the mediastinum

QUESTION 2

Which type of pleural effusion is typically caused by conditions leading to an imbalance in fluid production and absorption, such as heart failure or hypoalbuminemia?

a) Exudative effusion
b) Chylous effusion
c) Hemorrhagic effusion
d) Transudative effusion
e) Pseudochylous effusion

QUESTION 3

Which of the following is considered one of the most common causes of pleural effusion in cats?

a) Trauma
b) Cardiovascular diseases, such as congestive heart failure (CHF)
c) Renal disease
d) Liver disease
e) Hyperthyroidism

QUESTION 4

In cats with effusive Feline Infectious Peritonitis (FIP), where is fluid commonly found?

a) Only in the peritoneal cavity
b) Only in the pleural cavity
c) In the peritoneal cavity, pleural cavity, or both
d) Only in the pericardial cavity
e) Only in the perinephric area

QUESTION 5

What are the characteristic fluid findings in effusive FIP?

a) Low protein, low cell count (transudate)
b) High protein, low cellularity, often viscous, may froth upon agitation, and may clot upon standing
c) High protein, high cell count (exudate)
d) High triglyceride concentration (chylous)
e) Low protein, low triglyceride concentration

QUESTION 6

Pyothorax in cats is characterised by the accumulation of which type of fluid?

a) Transudate
b) Chyle
c) Haemorrhagic fluid
d) Purulent exudate
e) Modified transudate

QUESTION 7

Which of the following is often considered the most common probable cause of pyothorax in cats, according to a recent study by Johnson et al?

a) Parapneumonic spread (following lung infection)
b) Oropharyngeal aspiration
c) Penetrating damage to the thorax (e.g., bite wounds, foreign bodies, traumatic injuries)
d) Systemic disease
e) Hyperthyroidism

QUESTION 8

In cats with suspected pleural effusion and respiratory distress, what is considered the first and most important step in management?

a) Thoracic radiographs
b) Fluid analysis
c) Stabilisation of the patient
d) Thoracocentesis
e) I/V fluid administration

QUESTION 9

What specific fluid analysis test confirms a chylous effusion in cats if only pleural fluid is available?

a) Total protein > 30 g/l
b) High total nucleated cell count > 5000/µl
c) Triglyceride concentration > 100 mg/dl (>1.12 mmol/l)
d) Low pH (<7.4)
e) High cholesterol concentration

QUESTION 10

Cytology of pleural fluid is considered a useful test for diagnosing which underlying cause in cats?

a) Congestive Heart Failure (CHF)
b) Idiopathic Chylothorax
c) Neoplasia
d) Hypoalbuminemia
e) FIP

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