



# Diagnosis of FELINE LOWER AIRWAY DISEASE

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**L**ower airway disease (LAD) is remarkably common in cats, with estimates suggesting that 1% of the general cat population is affected. It poses a clinical challenge whether in its acute or chronic state.

## DISEASE OVERVIEW

### Definition

The term *feline lower airway disease* is often used to refer to a somewhat heterogeneous group of conditions that affect the lower respiratory tract of cats. Since no consensus definition exists for these lower airway diseases in veterinary medicine, different authors use different terminology, creating some confusion in the literature.

Feline LAD has been referred to as feline asthma, bronchial asthma, allergic asthma, bronchial disease, and chronic bronchitis.

### Classification

There are 2 predominant phenotypic categories of lower airway diseases in cats:<sup>1,2</sup>

- Asthma
- Chronic bronchitis.

The term *asthma* suggests reversible bronchoconstriction and predominantly eosinophilic airway inflammation. In contrast, *chronic bronchitis* is associated with neutrophilic inflammation.<sup>1</sup> These 2 syndromes represent opposite ends of the spectrum of feline LAD; however, some cats have both eosinophilic and neutrophilic inflammation, a condition termed *chronic asthmatic bronchitis*.<sup>3</sup>

While clinical signs of asthma and chronic bronchitis are very similar, as is their current management, it is important to differentiate between them due to different underlying pathologies. Current research is aimed at developing more disease-specific diagnostics and therapeutics.<sup>2</sup>

The **Table** summarizes the differences between feline asthma and chronic bronchitis.

### Predilection

Siamese cats are predisposed to lower airway disease, with a breed prevalence of up to 5%.<sup>4</sup> Some authors suggest there is no sex predilection,<sup>1</sup> while others have documented that females are affected more significantly.<sup>3</sup>

Asthma develops in young to middle-aged cats, with a reported mean age of 4 years (range, 1–15 years).<sup>1</sup> Although some cats are older when they experience an asthmatic crisis, a history of paroxysmal cough suggests that they likely suffered from asthma for some time.

### Etiology

**Asthma** in cats is considered an *allergic disease*.<sup>2</sup>

- Environmental aeroallergens implicated as triggers include house dust mites, Bermuda grass allergen, and pollens.<sup>2,5</sup>
- Additional presumptive predisposing factors include city environment (higher incidence than cats in rural environments) and smoking households (anecdotal).<sup>2,5</sup>

In contrast, **chronic bronchitis** is believed to result from a *previous insult*, such as an infection or inhaled irritant that permanently damaged the airways.<sup>2</sup>

**Chronic asthmatic bronchitis** is thought to be associated with chronic allergic airway inflammation (ie, allergic asthma is the underlying airway disease) that triggers airway damage, resulting in development of neutrophilic inflammation.<sup>2</sup>

### Pathogenesis

The mechanisms underlying development of feline asthma are postulated to be similar to those of allergic asthma in humans.<sup>2</sup>

TABLE. DIFFERENCES BETWEEN FELINE ASTHMA &amp; CHRONIC BRONCHITIS

PARAMETER	ASTHMA	CHRONIC BRONCHITIS
<b>Age at initial diagnosis</b>	Young to middle ages	Young to older ages
<b>Sex</b>	Either; females may be overrepresented	Either
<b>Breed</b>	Any; Siamese overrepresented	Any
<b>Clinical Signs</b>	<ul style="list-style-type: none"> <li>• Episodic respiratory distress with increased abdominal effort</li> <li>• Some cough daily</li> <li>• Some paroxysmal cough</li> <li>• Some to no history of cough before status asthmaticus</li> </ul>	<ul style="list-style-type: none"> <li>• Majority have daily cough</li> <li>• Respiratory distress only occurs with end stage disease</li> </ul>
<b>Response to acute bronchodilator trial</b>	Rapid, significant decrease in degree of respiratory distress since disease is characterized, in part, by reversible bronchoconstriction	<ul style="list-style-type: none"> <li>• Minimal since any airflow obstruction tends to be permanent</li> <li>• Not reversible</li> </ul>
<b>Thoracic Radiographs</b>	Hyperinflation present in some; partially reversible with bronchodilator therapy	Hyperinflation less likely
<b>Lower airway cytology</b>	Eosinophilic inflammation (> 17% eosinophils)	<ul style="list-style-type: none"> <li>• Predominantly neutrophilic inflammation</li> <li>• Neutrophils are nondegenerative and nonseptic</li> </ul>

A type I hypersensitivity reaction occurs in the airways. The trigger is thought to be aeroallergen exposure, which induces a preferential polarization of the immune response toward:

- Production of inflammatory mediators from T helper 2 lymphocytes
- Suppression of the T helper 1 immune response.<sup>2</sup>

#### Inflammatory mediators promote:

- IgE production and eosinophilic inflammation and infiltration, leading to the hallmark features of allergic asthma: airway inflammation, hyperreactivity, and remodeling.
- Mucus hypersecretion<sup>1,2</sup>
- Bronchoconstriction and airway hyperreactivity (ie, sensitivity of airway smooth muscle to stimuli) when released from eosinophil and mast cell granules (eg, histamine).

**Airflow limitation results from airway narrowing** due to cellular infiltrates, mucus secretion, and airway edema, leading to clinical signs, such as cough and wheeze.

- Acute bronchoconstriction exacerbates airflow limitation and can precipitate severe and potentially life-threatening clinical signs.<sup>4</sup>
- Bronchoconstriction, mediated by airway smooth muscle contraction, likely occurs, at least in part, due to an imbalance between:
  - » Mediators of bronchoconstriction (parasympathetic/cholinergic system)
  - » Mediators of bronchodilation (sympathetic/adrenergic system and nonadrenergic/noncholinergic system, the latter which includes vasoactive intestinal peptide and nitric oxide)<sup>5</sup>
- Bronchoconstriction in asthmatic cats is reversible with therapy and/or upon removal of the aeroallergenic stimulus.

## HISTORY & EXAMINATION

### Clinical Signs

Cats with LAD have variable clinical signs, typically presenting with chronic cough or in an acute respiratory crisis.

**Chronic cough** may be sporadic or noted multiple times a day, and the cat usually behaves normally between coughing episodes.

With **acute onset of respiratory distress**, a history of cough may indicate asthma as a diagnosis. Signs vary and may include:

- Occasional episodes of respiratory distress interspersed with asymptomatic periods<sup>4</sup>

### SIGNS OF HEART FAILURE

- In cats with heart failure caused by cardiomyopathy, **cough rarely occurs** (although it does occur in feline heartworm disease). A history of cough suggests a diagnosis other than heart failure.
- Cats with heart failure are commonly **hypothermic** (often < 99.5°F), which is associated with cardiogenic shock.
- Cats with heart failure may be **tachycardic** (often ≥ 220 beats/min) prior to onset of cardiogenic shock or **bradycardic** associated with decompensated shock.
- Heart rate, when associated with cardiogenic shock, typically decreases as body temperature decreases; therefore, **normal–low heart rate** in a moderately to markedly hypothermic cat can still be consistent with heart failure.
- Cats with heart failure may have a **gallop rhythm** and/or **heart murmur**.<sup>6</sup>

- Seasonal variation in presence and severity of cough<sup>3</sup>
- Vomiting after coughing.<sup>3</sup>

Many owners think that coughing is associated with hairballs, not realizing that a *hairball vomited up from the stomach* is separate from *cough*. Unfortunately, this misunderstanding means owners often dismiss coughing until signs worsen.

### Physical Examination

Examination findings depend on chronicity and severity of clinical signs.

**Cats with chronic bronchitis** may have normal findings or, if critical, moderate to severe respiratory distress (dyspnea and tachypnea).

**Cats with asthma** have predominantly expiratory dyspnea. Those more severely affected may have a marked expiratory push or even expiratory grunt. Open mouth breathing and/or orthopnea may be noted. Thoracic auscultation may reveal pronounced crackles, wheezes, or increased breath sounds. Auscultable wheezes are characteristic of airway narrowing and airflow limitation that occurs in cats with asthma.

Vital signs can also help differentiate asthmatic cats from those with other causes of respiratory distress, such as heart failure (see **Signs of Heart Failure**, page 29). Cats with LAD are usually normothermic (> 100°F), with a normal heart rate (eg, 180–220 beats/min).

### EMPIRICAL THERAPY & DIAGNOSTICS

The diagnostic approach for cats with LAD depends somewhat on the severity of clinical signs at presentation.

#### Empirical Therapy

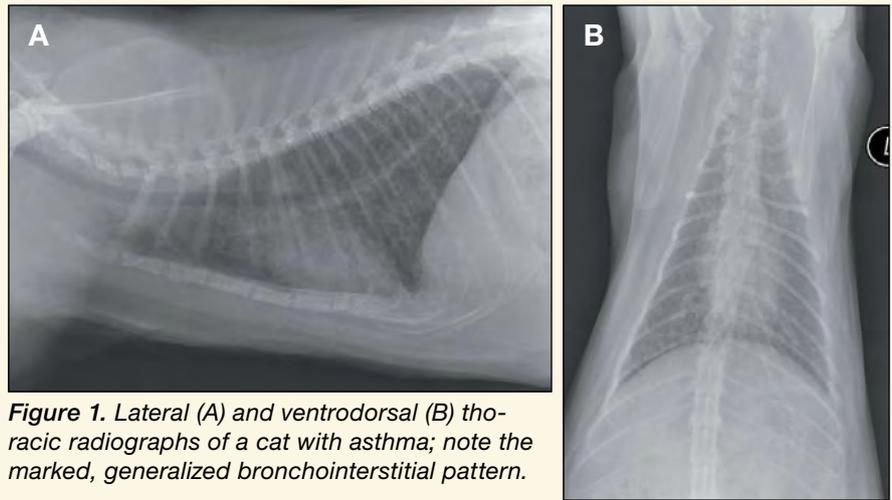
Cats with severe acute respiratory distress may be too unstable to safely undergo extensive diagnostic procedures. Rather, these cats benefit from acute empirical therapy, such as oxygen supplementation in an oxygen cage, minimal handling to reduce stress, and bronchodilator treatment trial.

If asthma is suspected, injectable glucocorticoids may be given on an emergency basis prior to determining a definitive diagnosis. A rapid, and near complete, resolution of clinical signs associated with bronchodilator and/or glucocorticoid therapy supports a diagnosis of feline allergic asthma.

#### Thoracic Radiographs

Abnormalities on thoracic radiographs consistent with allergic asthma include generalized:<sup>7</sup>

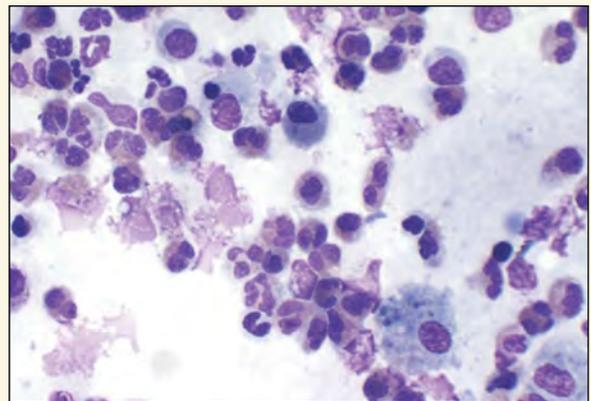
- **Bronchial to bronchointerstitial pattern (Figure 1):** A bronchial pattern is characterized by “doughnuts” and “tramlines”; an interstitial pattern reflects increased opacity of the pulmonary interstitium.
- **Hyperinflation (air trapping):** On a lateral radiographic projection, evidenced by flattening of the diaphragm,



*Figure 1. Lateral (A) and ventrodorsal (B) thoracic radiographs of a cat with asthma; note the marked, generalized bronchointerstitial pattern.*



*Figure 2. Lateral thoracic radiograph of a cat with asthma and mild secondary spontaneous pneumothorax. Atelectasis of the lungs associated with the pneumothorax has resulted in retraction of the lung lobes from the chest wall and diaphragm, increased interstitial opacity in the pulmonary parenchyma, and the underlying bronchial pattern.*



*Figure 3. Fluid cytology from a cat with asthma; note the high proportion of eosinophils and the somewhat “muddy” orange eosinophil granules.*

expanded lung fields, hyperlucent lungs, and increased distance from the caudal aspect of the cardiac silhouette to the diaphragm.

Occasionally cats with asthma will have a collapsed right middle lung lobe, and can also present with spontaneous pneumothorax<sup>8</sup> (Figure 2) or caudal rib fractures.<sup>9</sup> A patchy alveolar pattern has also been described in cats with LAD.<sup>3</sup>

Normal thoracic radiographs do not rule out LAD in cats. However, thoracic radiographs are important as they help exclude other causes of respiratory distress (eg, heart failure, neoplasia).

### Cardiac Ultrasound & Echocardiography

Focused cardiac ultrasound can be used to assess the heart and help rule out cardiac causes of respiratory distress.

In emergent situations, evaluation of the left atrial to aortic ratio in a right-sided, short axis view can be a particularly useful test. In cats, the normal left atrial:aortic ratio is < 1.5; LA:Ao ratios of > 2 are very suggestive of heart failure.<sup>10,11</sup>

While complete echocardiography is best performed by a cardiologist, noncardiologists can be trained to perform focused cardiac ultrasound for some applications in the veterinary emergency room.<sup>12</sup>

### Lower Airway Cytology

Obtaining samples for lower airway cytology is the only way to definitely diagnose LAD. These samples can be obtained by an endotracheal wash or bronchoalveolar lavage (BAL). BAL samples can be obtained bronchoscopically, but blind BALs are performed much more commonly. See **Step by Step: Blind Bronchoalveolar Lavage** for a brief description of the technique; a more detailed description can be found in the literature.<sup>13</sup>

Airway samples should be submitted for cytology and aerobic culture and susceptibility, including culture and/or polymerase chain reaction for *Mycoplasma* species.

- **Allergic asthma** is characterized by predominantly eosinophilic airway inflammation (> ≈17% eosinophils) (Figure 3), although other inflammatory cells may be present.
- **Chronic bronchitis** is characterized by neutrophilic inflammation; neutrophils are nondegenerate and nonseptic.
- **Chronic asthmatic bronchitis** is characterized by mixed inflammation with significant eosinophilic and neutrophilic components.<sup>2,3</sup>

### Endobronchial Evaluation

Bronchoscopy and BAL have been described in cats with LAD.<sup>14</sup> Endobronchial abnormalities were not different in cats with asthma when compared with those found in other lower respiratory tract diseases, notably pneumonia and neoplasia. Nonspecific findings included excessive mucus accumulation, stenosis of bronchial openings and nodular epithelial irregularities, airway hyperemia, airway collapse, and bronchiectasis.<sup>14</sup> I rarely perform bronchoscopy in cats.

### Additional Diagnostics

Additional diagnostics recommended in cats with LAD include:

#### STEP BY STEP:

#### BLIND BRONCHOALVEOLAR LAVAGE

1. Consider premedication with a bronchodilator.
2. Following induction of light general anesthesia and endotracheal intubation, pass a soft catheter (eg, 8F red rubber) down the endotracheal tube and into the lower airway until it lodges in a bronchoalveolar unit. *Do not force the catheter in further than it will easily go, due to risk for iatrogenic pneumothorax.*
3. With the catheter in place, rapidly infuse a volume of sterile saline (5–15 mL); then remove fluid from the lower airway by applying suction to the catheter with a syringe.
4. If the catheter is lodged in the lower airway, the initial fluid retrieved will not include air; pull the catheter back to suction additional fluid and air.
5. If an adequate sample is acquired, 1 lavage may suffice. However, this procedure can be repeated up to 3x to yield enough sample volume for analysis.
6. Following lavage, lower the cat's head to allow passive drainage of fluid from the airway through the endotracheal tube. This additional fluid can be collected in a sterile specimen container.
7. Administer supplemental oxygen until extubation is possible and during anesthesia recovery as necessary.

- **Routine hematologic and biochemistry tests:** In most asthmatic cats, complete blood counts and biochemistry analyses are normal, although a peripheral eosinophilia (> 1500 cells/mcL) may be present.
- **Feline immunodeficiency and leukemia virus tests (FIV/FeLV):** Recommended in cats that live outdoors or in multicat households as concurrent retroviral disease may affect prognosis.
- **Baermann fecal test:** Evaluates for potential lung worm infection.
- **Heartworm antigen and antibody testing:** Should be performed routinely in cats with signs of LAD given the increasing recognition of feline heartworm-associated respiratory disease (HARD).
  - » The SNAP Feline Triple Test (idexx.com) detects heartworm antigen, FIV, and FeLV.<sup>15</sup> However, because the test measures female reproductive antigen, cats may test negative if infected with small worm burdens, only adult male worm(s), or larval forms.<sup>16</sup>
  - » *In a cat with consistent clinical signs and a positive antigen test, retest to confirm positive status; a repeat positive test confirms a diagnosis of HARD.*
  - » *In a cat with signs of LAD and a negative antigen test, follow-up with an antibody test. A positive antibody test in a cat with consistent clinical signs suggests current infection with juvenile or adult worms.* ■

Part Two of this article, **Treatment of Feline Lower Airway Disease**, will be published in an upcoming issue of Today's Veterinary Practice.

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BAL = bronchoalveolar lavage; FeLV = feline leukemia virus; FIV = feline immunodeficiency virus; HARD = heartworm-associated respiratory disease; LAD = lower airway disease

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