Lower airway disease (LAD) is remarkably common in cats, and it is classified into 2 predominant phenotypic categories: asthma and chronic bronchitis.¹,²

The term asthma suggests reversible bronchoconstriction and predominantly eosinophilic airway inflammation. In contrast, chronic bronchitis is associated with neutrophilic inflammation.¹ 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.³

### TABLE 1. FELINE ASTHMA VERSUS CHRONIC BRONCHITIS

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>ASTHMA</th>
<th>CHRONIC BRONCHITIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at initial diagnosis</td>
<td>Young to middle aged</td>
<td>Young to old</td>
</tr>
<tr>
<td>Sex</td>
<td>Either; females may be overrepresented</td>
<td>Either</td>
</tr>
<tr>
<td>Breed</td>
<td>Any; Siamese overrepresented</td>
<td>Any</td>
</tr>
<tr>
<td>Clinical signs</td>
<td>Episodic respiratory distress with increased abdominal effort; some daily and/or paroxysmal cough; some to no history of cough before status asthmaticus</td>
<td>Majority have daily cough; respiratory distress only occurs with end-stage disease</td>
</tr>
<tr>
<td>Response to acute bronchodilator trial</td>
<td>Rapid, significant decrease in degree of respiratory distress since disease is characterized, in part, by reversible bronchoconstriction</td>
<td>Minimal, since any airflow obstruction tends to be permanent; not reversible</td>
</tr>
<tr>
<td>Thoracic radiographs</td>
<td>Hyperinflation present in some; partially reversible with bronchodilator therapy (Figure 1)</td>
<td>Hyperinflation less likely</td>
</tr>
<tr>
<td>Lower airway cytology</td>
<td>Eosinophilic inflammation (&gt; 17% eosinophils) (Figure 2)</td>
<td>Predominantly neutrophilic inflammation; neutrophils are nondegenerative and non-septic</td>
</tr>
</tbody>
</table>
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 (Table 1). Current research is aimed at developing more disease-specific diagnostics and therapeutics.¹

Treatment goals for cats with LAD are to:
1. Reduce airway inflammation
2. Reduce airway hyperreactivity and bronchoconstriction, which relieves airflow limitation
3. Ameliorate airway remodeling
4. Remove the underlying cause, if known.

THERAPEUTIC APPROACH

Current therapies rely on:
- **Glucocorticoids** to reduce airway inflammation
- **Bronchodilators** to reduce bronchoconstriction and relieve airflow limitation.

Therapies to ameliorate chronic airway remodeling are limited, and are the focus of considerable research in human and veterinary medicine. Specific therapy differs in acute crises versus chronic management (Table 2, page 30).

**Acute Management**

Treatment of acute dyspnea associated with LAD in cats involves:
- Oxygen supplementation (usually in an oxygen cage)
- Minimal handling/stress reduction
- Dose of a beta2-receptor agonist bronchodilator
- An anti-inflammatory dose of dexamethasone SP (equivalent to 3 mg/mL dexamethasone) should be administered, if asthma or chronic bronchitis is highly suspected.

Response to treatment is supportive of a presumptive diagnosis of LAD.

**Chronic Management**

Long-term treatment of cats with allergic asthma and chronic bronchitis involves:
- Administration of glucocorticoids to reduce airway inflammation
- Symptomatic control with bronchodilators.

If lung worm infection is highly suspected (eg, espec-
cially in young, outdoor cats), treatment with fenben-dazole is also indicated.2

Oral, inhaled, and injectable forms of glucocorticoids and bronchodilators exist; the choice of specific products and route of delivery tends to reflect both owner and clinician’s preferences as well as patient compliance.2

GLUCOCORTICOIDS
Glucocorticoids are the mainstay of therapy for reducing airway inflammation; chronic therapy is recommended. Regardless of the route or type of corticosteroid used, the dose should be in the anti-inflammatory range.

Oral Prednisolone
An initial dose of 0.5 to 1 mg/kg PO Q 12 H (1–2 mg/kg/day) is recommended for the first 7 to 14 days. Once clinical signs are well controlled, with minimal coughing, the dose can be tapered gradually over 2 to 3 months to once a day or every other day, since signs can recur if tapering is too rapid.

Potential adverse effects include polyuria, polydipsia, polyphagia, weight gain, diabetes mellitus, alopecia, skin atrophy, poor wound healing, increased susceptibility to infection, and increased susceptibility to fluid overload that may precipitate congestive heart failure in cats with underlying heart disease.

Inhaled Fluticasone
An initial dose of 110 mcg Q 12 H using a metered dose inhaler and cat spacer (Figure 3) is recommended; however, evidence also suggests that 44 mcg Q 12 H may be sufficient.1 Owners must be educated that this medication must be given twice daily every day on a long-term basis to effectively manage signs.

Inhaled fluticasone is not useful in a crisis because it

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**TABLE 2. MEDICATIONS FOR FELINE LOWER AIRWAY DISEASE**

**ACUTE DYSPNEA MANAGEMENT**

<table>
<thead>
<tr>
<th>Glucocorticoid</th>
<th>Dexamethasone SP</th>
<th>0.15–1 mg/kg IM or IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bronchodilators</td>
<td>Beta2-receptor agonists</td>
<td>Terbutaline</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Albuterol</td>
</tr>
</tbody>
</table>

**CHRONIC MANAGEMENT**

<table>
<thead>
<tr>
<th>Glucocorticoids</th>
<th>Prednisolone</th>
<th>0.5–1 mg/kg PO Q 12 H (first 7–14 days) Taper over 2–3 months to Q 24 H or EOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluticasone</td>
<td>110 mcg Q 12 H (inhaled) Administer concurrently with oral prednisolone for first 2–4 weeks</td>
<td></td>
</tr>
<tr>
<td>Methylprednisolone acetate</td>
<td>10–20 mg/cat IM or SC Q 4–12 weeks Use as last resort treatment</td>
<td></td>
</tr>
<tr>
<td>Bronchodilator</td>
<td>Beta2-receptor agonist</td>
<td>Terbutaline</td>
</tr>
<tr>
<td>Bronchodilator</td>
<td>Methylxanthine</td>
<td>Theophylline</td>
</tr>
</tbody>
</table>
takes about 10 to 14 days to become effective. Therefore, oral prednisolone must be administered concurrently for the first 2 to 4 weeks of therapy; then tapered. If clinical signs of asthma recur on fluticasone therapy, oral prednisolone should be started again.

The advantage of fluticasone (and other inhaled corticosteroids) compared with oral or injectable glucocorticoids is minimal systemic absorption, making them potentially safer in cats with or at risk for concurrent disease, such as diabetes mellitus, cardiomyopathy, and heart failure. Disadvantages include delayed onset of action, unknown delivery to lower airways, intolerance of inhaled route by cat, and expense.

Injectable Glucocorticoids
In cats that present with acute dyspnea, short-acting, injectable glucocorticoids are indicated; specifically, 0.15 to 1 mg/kg IM or IV of dexamethasone SP.

Use of long-acting repository glucocorticoid preparations, such as methylprednisolone acetate (10–20 mg/cat, total dose, IM or SC Q 4–12 weeks as needed to control clinical signs) is reserved for chronic therapy in cats that cannot be medicated by another route, but have significant clinical signs.

Injectable doses of repository glucocorticoids are likely to result in significant adverse effects over time, including weight gain, diabetes mellitus, and reduced immunity; therefore, they represent a last resort treatment.³

BRONchodilators
Bronchodilators are used in cats with LAD that have clinically significant bronchoconstriction, generally evidenced by acute onset of dyspnea. Bronchodilator drugs generally used in cats are beta2-receptor agonists (terbutaline sulfate, albuterol sulfate) and, less commonly, methylxanthine derivatives.

Beta2-Receptor Agonists
Terbutaline, 0.01 mg/kg IM or SC, can be useful for rapid relief of clinical signs in an acute crisis. Improvement in degree of dyspnea and reduction in respiratory rate is usually seen within 15 to 30 minutes (maximum). Drug absorption is also evidenced by a mild to moderate increase in heart rate.³

Although commonly used in the clinic setting, clients can be taught to administer terbutaline at home.

- Terbutaline is available in 1 mg/mL × 1 mL vials; the dose for an average 5-kg cat is 0.05 mg = 0.05 mL SC, or 5 U on a 100 U/mL insulin syringe.
- It can also be dosed orally, 0.1 to 0.2 mg/kg PO Q 8 to 12 H, for chronic use in hard-to-control cats.

Albuterol can be administered intravenously, orally, or via a nebulizer or puffer/metered-dose inhaler (MDI), which is the formulation used most commonly in cats. It can also be nebulized inside an oxygen cage. A single dose of 90 mcg administered via MDI; using a spacer, such as an Aerokat chamber (trudellmed.com) and mask (Figure 3) is appropriate.

Reported onset of action is rapid (within minutes), with maximal effect within 5 to 20 minutes; duration of action is 4 to 6 hours. However, delivery of inhaled bronchodilators to the lower airways in cats with active bronchoconstriction may be impaired, and efficacy cannot be guaranteed.³ The question remains whether, during an acute crisis, injectable bronchodilators should be used versus inhaled medications.³

Inhaled albuterol is not indicated for chronic use due to the formulation of the drug. Albuterol is a racemic 1:1 mixture of an R- and S-enantiomer/isomer. The R-isomer is bronchodilatory and anti-inflammatory; the S-isomer is pro-inflammatory, promoting airway hyperreactivity, and included because it slows down drug metabolism and enhances albuterol’s duration of action.²,³,⁶

Levalbuterol, a pure R-isomer of albuterol, is also available. It was originally only available as a nebulizer solution, however, it is now available in an FDA-approved MDI form (Xenopenex FHA Inhalation Aerosol, xenopenex.com) that can be considered for chronic use, if indicated.

Methylxanthines
Methylxanthines are beneficial in cats with LAD via 3 main mechanisms; they:

1. Are bronchodilators, inducing airway smooth muscle relaxation via phosphodiesterase inhibition (PDE III/IV).
2. Suppress the response of the airways to stimuli; the mechanism of these effects is unknown, but not thought to be associated with PDE inhibition.
3. Exhibit anti-inflammatory properties, having been shown to reduce airway inflammation in humans with asthma and chronic obstructive pulmonary disease. While this action was only relatively recently elucidated, it occurs at lower serum concentrations than bronchodilation and may be responsible for the majority of clinical benefits.⁷

Theophylline is typically used more often in dogs than cats, given variable efficacy and, perhaps, less need for chronic bronchodilator therapy in cats. The recommended dose of sustained-release theophylline in cats is 20 to 25 mg/kg PO Q 24 H in the evening (ie, one 100-mg tablet/cat/day). Published recommendations for cats suggest 4 mg/kg Q 8 to 12 H for nonsustained-release theophylline.³

It is important to note that the pharmacokinetics of theophylline in humans (and likely small animals) vary widely among similar patients and cannot be predicted by age, sex, body weight, or other demographic characteristics.

- It is recommended that serum theophylline concentration be monitored every 6 to 12 months in patients receiving long-term theophylline therapy.
- Therapeutic serum levels should be 5 to 20 mcg/mL.
- Unacceptable side effects routinely occur in humans with serum concentrations > 20 mcg/mL (and may even occur with concentrations of 10 to 20 mcg/mL).
Adverse Effects

Adverse effects of beta2-receptor agonist bronchodilators include tachycardia, central nervous system (CNS) stimulation, tremors, and hypokalemia. These drugs should be used cautiously in cats with pre-existing diabetes mellitus, hypertrophic cardiomyopathy, hypertension, hyperthyroidism, or seizure disorders.¹

Adverse effects of methylxanthines include tachyarhythmias, restlessness, CNS stimulation, increased gastric acid secretion, and gastrointestinal upset.

Drug Interactions

Theophylline should not be used concurrently with other drugs that require cytochrome p450 metabolism, such as enrofloxacin, clindamycin, erythromycin, cimetidine, and others, as these increase theophylline drug concentration, increasing risk for side effects.

In my opinion, 2 different bronchodilators should not be used concurrently, as adverse effects may be compounded.

MONITORING

The ideal method for monitoring response to chronic therapy for cats with LAD is unknown, but can include:

• Evaluation of owner-reported clinical signs
• Repeated evaluation of BAL fluid and/or respiratory mechanics.

Thoracic radiographs are generally not recommended, since severity of radiographic abnormalities does not correlate with clinical signs. In addition, it has been reported that cats may continue to have marked lower airway inflammation despite resolution of clinical signs.

Because airway inflammation predisposes to airway remodeling and chronic exacerbation of clinical signs, documentation of improvement in airway inflammation (ie, a reduction in the extent of inflammation in bronchoalveolar lavage fluid) throughout treatment is ideal.

PROGNOSIS

The long-term prognosis for feline allergic asthma and chronic bronchitis has not been well assessed. Individual cats with LAD vary widely in clinical manifestation and response to various therapies. However, prognosis is usually good, although some cats have persistent clinical signs and recurrent bouts of dyspnea, requiring aggressive medical management.

CNS = central nervous system; LAD = lower airway disease; MDI = metered-dose inhaler; PDE = phosphodiesterase

References

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