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“Chronic Feline Lower Respiratory Disease”

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Lower Respiratory Tract (LRT) Disease in Cats
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CAUSES OF LRT DISEASE

In cats, the most common cause of chronic coughing is chronic bronchopulmonary disease. Because of this, it may, on occasion, be tempting to make a presumptive diagnosis, rather than undertaking a full investigation. However, this is not to be recommended as many of the other differential diagnoses carry very different treatment options and/or prognoses. In addition, different types of chronic bronchopulmonary disease may respond better to slightly differing treatment approaches and are frequently complicated by secondary infections.

1. Chronic bronchopulmonary disease:
   This describes a commonly occurring yet poorly understood group of conditions that affect the airways and alveolar space. It includes ‘feline asthma’, chronic bronchitis, chronic broncho-pneumonia, chronic obstructive pulmonary disease (COPD), emphysema and idiopathic pulmonary fibrosis. By definition, asthma is characterized by airway hyper-responsiveness and reversible bronchoconstriction, while chronic bronchitis (or COPD) is characterized by airway inflammation and excessive mucus production, and leads to irreversible narrowing of the airways. However, given current diagnostic facilities the distinction between the two disease entities is at best difficult, and often completely arbitrary. Somewhat incorrectly, the term ‘feline asthma’ tends to be used for those cases that are found to have a strong component of airway hypersensitivity, combined with an increased number of eosinophils on bronchoalveolar lavage. In most cases, the exact aetiopathogenesis of the different conditions remains unclear.

   The main clinical signs are coughing, wheezing, dyspnoea and respiratory distress. Clinical signs may be episodic, intermittent or persistent, and arise because of:
   - Tracheobronchial inflammation and irritation
   - Excessive airway secretion
   - Bronchoconstriction

   Disease is seen most frequently in young to middle aged cats (2-8 years of age), with Siamese, Burmese and other Oriental breeds being over-represented. Historically, the cats may have previously experienced cat ‘flu’, have initially shown a degree of seasonality to their disease, or had their clinical signs exacerbated by airway irritants (smoke, temperature changes, aerosols, dusty cat-litter, or sleeping on their owners bed – sometimes defined as being ‘worse at night’). Coughing may conclude with a terminal retch to clear mucus from the pharynx.

   In cats with episodic signs clinical examination is often unrewarding. However, while many asthmatic cats appear normal, thoracic auscultation frequently reveals that the respiratory pattern has a prolonged expiratory phase. During an episode of coughing or in cats with more protracted disease, increased lung sounds may be heard on auscultation (typically wheezes and, in more severe cases, crackles). In severe cases the chest may be barrel-shaped, and a ‘heave line’ may be evident. Percussion may reveal hyperinflation of the chest (with resonance extending to the 12th rib), and air-trapping can result in reduced thoracic compressibility. Palpation of the cervical trachea may trigger a severe bout of coughing, and coughing can be sufficiently severe to cause spontaneous fractures of the caudal ribs (dorso-caudally).

2. Pneumonia:
   This can be caused by various infectious agents (viruses [feline herpes virus FHV-1, feline Calicivirus FCV, cow pox virus – from voles, rarely Influenza A virus – either from infected humans or eating infected birds], bacteria [Pasteurella multocida, Bordetella bronchiseptica, Mycoplasma spp., extra-intestinal pathogenic Escherichia coli (ExPEC), beta haemolytic Streptococcus spp. {a common cause of pneumonia in US and Swiss studies – being seen most commonly in
kittens of <12 weeks of age), Neisseria spp. (EF4), Salmonella spp., Mycobacterium bovis, Mycobacterium microti, rarely Streptococcus equi subspecies zoopneumonia – from horses), parasites [Toxoplasma gondii, lungworm e.g. Aelurostrongylus abstrusus, heart worm e.g. Dirofilaria immitis], or inhaled or circulating toxins or irritants (lipid or food aspiration, smoke inhalation, uraemia, pancreatitis, sepsis, or potassium bromide administration for seizures [which can lead to eosinophilic peri-bronchial infiltrates).

Bacterial pneumonia is seen most frequently in immunocompromised individuals, or in individuals with compromised lung function. Bacterial bronchopneumonia usually presents with a cough, tachypnoea, dyspnoea, nasal discharge, fever and depression. Auscultation may reveal increased lung sounds, crackles, wheezes, and silent areas (due to pulmonary consolidation, infiltration, neoplasia or bullus formation). Primary bacterial pneumonia, with mixed and pure cultures of B. bronchiseptica may be found in kittens of 5-10 weeks of age that have come from environments where husbandry is poor. The latter infection can also be spread from dogs. Pneumonia due to ExPEC or Streptococcus spp. can result in systemic spread, meningitis, joint and/or kidney infection, endocarditis and disseminated intravascular dissemination.

Primary bronchopneumonia may also result from infection with members of the tubercle group (typically M. microti and M. bovis, both believed to be most commonly caught from infected voles and mice). These infections are seen quite regularly in the UK and Ireland. Clinical signs are rather insidious in onset, dyspnoea is usually more obvious than coughing, and cutaneous lesions are usually present.

Bacterial pneumonia can also arise secondary to other disorders. These include chronic bronchopulmonary disease, the long-term presence of a foreign body, or previous damage from inhalation or aspiration. With chronic bronchopulmonary disease secondary infection occurs most typically with Mycoplasma spp., P. multocida, or B. bronchiseptica, and in these cats the signs of pneumonia are often quite subtle, usually presenting as an exacerbation of an already chronic condition.

Parasitic pneumonia: Aelurostrongylus abstrusus is probably the most common lungworm of cats, although Eucoleus aerophilus (previously Capillaria aerophila) infection may also occur. While A. abstrusus may be present in up to 20% of free-roaming cats, it rarely causes clinical signs of disease. Clinical signs are more prevalent in immunosuppressed cats. Cats are infected by eating infected slugs or snails (the intermediate host), or infected rodents, lizards or birds (the transport hosts). Affected cats may present with a chronic cough, with associated crackles and wheezes. Perhaps the most important consideration of A. abstrusus infection is its differentiation from chronic bronchopulmonary disease, particularly ‘feline asthma’. Since both conditions can result in an eosinophil-rich bronchoalveolar lavage fluid it is advisable to treat all coughing cats with a therapeutic course of fenbendazole, prior to undertaking further investigations.

Heart worm (e.g. Dirofilaria immitis) is endemic in warm and tropical regions, including Southern Europe, the USA and Canada. Affected cats may present with clinical signs typical of chronic bronchial disease, or may present with acute, often fatal, severe dyspnoea associated with pulmonary thromboembolism.

3. Neoplasia:

Pulmonary neoplasia may be primary or metastatic. While primary neoplasia is rare in cats it can include adenoma, bronchoalveolar adenocarcinoma, and bronchial gland carcinoma. Affected cats are usually older (average age 10-14 years), with clinical signs consisting of coughing, wheezing and/or dyspnoea, depending on the location and extent of the tumour. Interestingly, lameness may be seen in ~25% of cats with malignant lung tumours because some of these tumours may metastasise to the digits. Since metastatic lung tumours are seen more typically within the lung parenchyma, rather than the bronchial tree, they rarely result in coughing.
4. **Foreign bodies:**
Foreign bodies within the trachea or bronchial tree will initially cause acute coughing. However, if the foreign body is not removed chronic coughing and dyspnoea can result. This is often accompanied by halitosis as secondary infection develops.

5. **Pulmonary oedema:**
In cats, most cases of pulmonary oedema result from congestive heart failure. Occasional cases of non-cardiogenic pulmonary oedema may result from severe uraemia, pancreatitis, shock, sepsis, near-strangling, near-drowning, electrocution, smoke-inhalation, or cranial trauma. The history and other clinical findings are likely to indicate the cause of the disease. Uncomplicated pulmonary oedema, because it is located within the lung parenchyma, rarely causes coughing.

6. **Pulmonary contusion (trauma):**
Blunt trauma to the chest (road traffic accidents, ‘high-rise’ falls) can result in pulmonary contusion, haemorrhage, oedema, atelectasis, and gas-filled cyst formation. Other injuries may include fractures of ribs, sternebrae, mandible or fore-limbs, pneumothorax or pneumomediastinum. Pulmonary contusions rarely cause coughing unless the trauma results in tracheal damage or significant haemorrhage within the bronchi.

7. **Pulmonary thromboembolus**
This is not seen commonly in cats, although it may be under-recognised. It should be considered in any cat with significant acute-onset dyspnoea with minimal radiographic changes.

8. **Pulmonary hypertension**
This may occur secondary to a number of different diseases, including cardiac and chronic respiratory tract diseases (e.g. idiopathic pulmonary fibrosis), and may results in dyspnoea and eventually, cyanosis. Echocardiography is the most practical way of making this diagnosis.

**DIAGNOSIS OF LRT DISEASE**

In practice, the differentiation of LRT disease and thoracic cavity disease is not always obvious. However, it is essential to determine which is present since the investigation and treatment are very different.

**Signalment and history**
Cats with respiratory compromise are often difficult to handle. Stressful handling can result in respiratory decompensation, hysteria and death. This is because while normal cats use less than 5% of their oxygen intake to supply their muscles of respiration, dyspnoic cats can be using over 50% of their inhaled oxygen for the same function, leaving no room for further compensation. Severely affected cats often benefit from being placed in an oxygen-enriched environment (oxygen box or tent) prior to being handed for the physical examination. In all cases, it is important to collect as much background detail as possible, prior to undertaking the physical examination, as this may give an indication of most likely differential diagnoses. Interestingly, ~40% of cats with ultimately fatal infectious pneumonia lack clinical signs referable to the respiratory tract, particularly a cough. Clinical signs more typically consist on lethargy and anorexia.

The signalment of the patient can be of help: While cats of any age, breed or sex may develop a chronic cough; kittens from an unhygienic and crowded environment are more likely to develop bacterial pneumonia; cats with clinically significant lung worm infections are typically young adult males that hunt and eat their prey; Siamese and Burmese middle-aged cats are over-represented in cats with chronic bronchopulmonary disease; and primary lung tumours are seen mainly in older cats.
From the history it is important to determine:

- what type of environment the cat lives in (or has previously lived in)
- whether or not it is allowed outside, and whether or not it hunts
- whether or not there is any history of previous illness, or trauma
- at what age did the clinical signs begin
- what was the pattern of onset of the clinical signs
- how have the clinical signs progressed
- have the clinical signs ever responded to previous treatments
- what other animals it lives with
- have any other animals from the same household been affected

This will help to determine what potential pathogens and/or irritants the cat may have been exposed to. It is very helpful to know whether or not the disease was acute in onset, or slowly progressive. Foreign bodies initially cause acute disease. A cough that starts seasonally may be suggestive of ‘feline asthma’ or lungworm infection. ‘Asthmatic’ cats may cough more at night when sleeping on their owner’s bed, or at the end of a bout of play, and their clinical signs may be exacerbated by their owner’s smoking. Cats that go outside, hunt, or eat snails are more likely to become infected with *A. abstrusus* (lungworm).

**Physical examination**

The physical examination should always be carried out gently and thoroughly. However, in very dyspnoeic cats it may need to be interspersed with periods of time in an oxygen chamber. Particular points to look for include:

- **The character of the breathing:** Generally, LRT disease is associated with expiratory dyspnoea. Severely ‘asthmatic’ cats may have a much exaggerated expiratory effort. Disease affecting the URT, alveoli or pleural cavity usually results in inspiratory dyspnoea. An increased abdominal effort is seen in many dyspnoeic cats. Orthopnoea (dyspnoea when recumbent), tachypnoea (rapid breathing), or open-mouthed breathing are generally associated marked respiratory compromise, as is paradoxical abdominal movement (where the thorax and abdomen move in opposite directions). However, it is important to remember that dyspnoea may result from non-respiratory as well as respiratory causes (e.g. cardiovascular disease [anaemia, congestive heart failure, hypotension or polycythaemia], abdominal enlargement [ascites, organomegaly, pregnancy], hyperthermia, metabolic acidosis [e.g. diabetic ketoacidosis], fear, anxiety, severe pain, or respiratory muscle weakness.

  - The **respiratory rate and pattern:** Diseases which give rise to restrictive respiratory patterns prevent the lungs from expanding properly, and therefore lead to rapid, short, shallow breaths, e.g. pulmonary parenchymal diseases and diseases of the pleural space. **Obstructive respiratory patterns** arise from narrowing of the airways, leading to slower, deeper respiration, e.g. chronic bronchopulmonary diseases, such as feline asthma, or with laryngeal paralysis.

- **The presence and character of a cough:** A cough may be seen in LRT disease when the larger airways are affected. A dry harsh cough is found most commonly associated with tracheal or bronchial irritation, while a productive moist cough is usually associated with bronchopneumonia. The nature of a cough in a cat with obvious URT disease may help to determine the underlying cause. If the cough is dry and harsh it is most likely to result from ‘post-nasal drip’, where muco-pus from the caudal nasopharynx drips down and irritates the larynx and trachea. When the cough is productive and moist it is more likely to be associated with a secondary bronchopneumonia.

- **The presence of tracheal sensitivity** confirms inflammation of the upper airways.

- Assessment of the **mucous membranes** can help to assess the level of general peripheral perfusion, determine whether or not the animal is cyanotic (an indication of severe respiratory dysfunction*), assess the patient’s level
of hydration, and see whether or not the patient is septic (injected dirty-red membranes). The presence of petechial haemorrhage may suggest a clotting disorder.

*Unfortunately, since >5g/dl of deoxyhaemoglobin is needed in the blood before it can be detected by the human eye as cyanosis, many ‘cyanotic’ anaemic cats (PCV <15%) will simply appear as pale.

- **Thoracic palpation** should be used to check for the presence of trauma (bruises, pain, fractured ribs), or congenital defects (kittens with sternal deformities). Thoracic palpation will also help to localise the position of the apex beat of the heart, and detect whether or not a cardiac thrill is present. In severely ‘asthmatic’ cats the exaggerated expiratory effort may lead to a barrel-chested appearance, and enhanced musculature (a ‘heave line’).

- **Thoracic compression** will be reduced in cases of extensive pleural fluid accumulation or when an intrathoracic mass is present. It may also be reduced in COPD (or severe ‘asthma’) as a result of air trapping within the pulmonary parenchyma. Reduced anteriour thoracic compression is seen most commonly in cases of thymic lymphoma. However, it is important to recognize what is normal, e.g. young kittens have very compressible chests, while old cats have reduced compressibility because of mineralization of their costo-chondral cartilages.

- **Thoracic percussion** can help to detect the presence of fluid or soft tissue masses within the chest (a reduction in resonance, typically ventrally), or unusual gas accumulations (an increase in resonance, typically dorsally). It can also be used to determine the extent of the thoracic cavity, and this is often increased in cats with COPD because of air trapping. Thoracic percussion is a particularly useful procedure in cats, since so many of them purr which makes auscultation less useful. However, it does require some practice to perfect and care should be taken when performing percussion on cats with severe respiratory compromise as it can exacerbate clinical signs and/or cause pain.

- **Thoracic auscultation** can be used to detect the presence of wheezes and crackles, harsh or dull lung sounds, an increase or decrease in respiratory noise, to detect the extent of the respiratory field, and as part of the cardiac examination. Wheezes are high pitched musical sounds or squeaks which result from air moving through narrowed airways, and are most commonly heard in cats with broncho-constriction as is common in asthma. Crackles are most commonly heard at the end of inspiration and usually represent air bubbling through fluid, therefore signifying the presence of fluid within the alveoli. Harsh crackles can result from the opening and closing of small airways in cats with bronchial disease. Harsh lung sounds are pronounced bronchovesicular sounds that can signify turbulent flow within the airways. Respiratory noise may be increased in LRT disease, referred for the upper respiratory tract (URT), or amplified due to the presence of air in the pleural space. To determine which the case is it is necessary to auscultate over the trachea to determine how much of the sound is referred. Percussion may help to differentiate LRT disease from a pneumothorax. A decrease in respiratory noise may be associated with fluid or soft tissue within the pleural space. It is worth noting that hearing apparently normal lung sounds in a dyspneic or tachypnoeic cat is not normal; it indicates that something is masking the sound.

- **Physical examination of cardiac function;** this includes an assessment of the heart rate and rhythm and intensity of beat, capillary refill time, mucous membrane colour, quality of peripheral pulses, position of the apex beat, presence of a cardiac thrill, presence of jugular distension, a jugular pulse and/or positive hepatojugular reflex, or presence of pulse deficits, and cardiac auscultation. The presence of a cardiac thrill, jugular distension, a jugular pulse, a positive hepatojugular reflex, or abnormalities detected on cardiac auscultation warrants a more detailed cardiac examination. It is worth noting that while cardiac disease in cats can lead to either LRT disease (pulmonary oedema), or thoracic cavity disease (pleural fluid), unlike the situation in dogs, it very rarely causes coughing.

*Examination of the Cardiovascular System: Meticulous examination of the cardiovascular system is necessary to aid in the differentiation between respiratory and cardiac causes of dyspnoea. However, it should be emphasized that...*
there can be severe cardiac disease without abnormalities on cardiac auscultation; furthermore, primary respiratory disease can be accompanied by cardiac abnormalities.

The heart rate and rhythm should be evaluated. The position of the heart may be shifted if there is collapse of lung lobes, or if there is fluid or soft tissue within the thoracic cavity. It can therefore be useful to note whether or not the heart is in its usual position, or if the apex beat is shifted. The intensity of the heart sounds should be assessed. The heart sounds may be diminished in obese animals, but can also be decreased with emphysema, pleural or pericardial disease, or when left ventricular contractility and cardiac output are decreased. In contrast the heart sounds are increased in thin or fit animals, or in hyperdynamic states (such as anaemia, pyrexia or hyperthyroidism). Bradycardia is a very worrying finding as it typically results from either primary or secondary myocardial failure (the latter may be seen with sepsis, pancreatitis, etc.). Extra heart sounds may be auditable (gallop sounds). These occur due to intensification of either the third or fourth heart sound (or both). Gallop sounds often indicate advanced myocardial disease or heart failure.

The presence and character of any murmurs should be noted. Thorough auscultation of the heart should include auscultation along the sternum because in many cats murmurs are often heard best at this site. Localising the point of maximum intensity is rarely of use in the cat as the valves are so close together. The timing (systolic, diastolic, or both) and intensity of the murmur should be ascertained and a note made as to whether or not the murmur is dynamic (altering with alterations in heart rate) or static. Diastolic murmurs are rare in the cat and are most commonly associated with congenital defects (stenosis of the atrioventricular valves). Continuous murmurs are also rare in the cat; again these are typically associated with congenital abnormalities (PDA or multiple congenital abnormalities). Systolic murmurs are frequently identified. When a dynamic systolic murmur is auscultated this is frequently the result of ventricular outflow obstruction (which may be of either the left or right atrium). Unfortunately, in such cases the grade of the murmur will vary with heart rate and is therefore, not a good representation of the extent of disease.

The rhythm of the heart should be assessed. Sinus arrhythmia is not a normal finding in the cat (at least not in the clinical consultation). The presence of sinus arrhythmia is suggestive of increased vagal tone, and is most common with URT obstruction, although it can also be identified with cervical disease or trauma, and is not uncommon in abdominal diseases such as gastritis or pancreatic pathology. In addition the character and nature of the peripheral pulses should be noted. If a cardiac arrhythmia is evident, the presence or absence of any pulse deficits can help to determine the cause of the arrhythmia (for example there are often multiple pulse deficits in a cat with atrial fibrillation due to the variation in ventricular filling). If the peripheral pulses are small and weak, it is likely that the cat has a reduced stroke volume, increased peripheral resistance and narrow pulse pressure (the difference between the systolic and diastolic components). Common causes of this type of pulse include left ventricular failure and hypovolaemic shock.

- **Regurgitation** may be present when disease within the thoracic cavity impedes the transit of food through the oesophagus (e.g. with mediastinal lymphoma). When regurgitation and coughing are seen together mixed disease is usually present, e.g. megaoesophagus resulting from mediastinal disease, with secondary aspiration pneumonia and coughing. Mediastinal disease on its own rarely causes coughing.

- **General body condition and body weight.** Severely dyspnoeic cats often have a poor appetite and so experience a degree of weight loss. Marked weight loss is more suggestive of neoplasia, or severe systemic disease, such as congestive heart failure.

- **General physical examination:** Many intrathoracic diseases have systemic involvement. **Ocular examination** may suggest the presence of uveitis or retinitis in cases of FIP, or signs of hypertension associated with myocardial hypertrophy. **Detection of goiter** may be helpful as hyperthyroid cats may develop myocardial hypertrophy.
Examination of the abdomen may reveal a lack of contents in cases of diaphragmatic rupture or pericardioperitoneal hernia. Ascites may be present in cases of FIP, congestive heart failure, hypoproteinaemia or generalised neoplasia. Generalised or regional lymphadenopathy is seen most frequently in cases of neoplasia or mycobacterial infection.

FURTHER INVESTIGATIONS

Prior to undertaking further investigations, or even completing a full physical examination, it may be necessary to stabilize the patient. This can be done most simply by placing the cat in an oxygen-enriched environment (oxygen box, tent, or mask).

While assessment of serum biochemistry, haematology, and FeLV/FIV status will help to gain an overall picture of the cat’s health, they rarely lead to a definitive diagnosis. For this, radiography, and the collection of samples for cytological, histopathological, and microbiological examination are usually required.

Serum biochemistry may on occasion be of help, suggesting a diagnosis of FIP (raised globulins and bilirubin). Haematology may support a diagnosis of pyothorax or pneumonia (a raised neutrophil count with a left shift, and possibly the presence of toxic changes within the neutrophils). Lymphopaenia may be associated with FeLV or FIV infections, or with FIP, or indicate severe disease. Eosinophilia may be associated with ‘feline asthma’ or lungworm infection, or be unrelated to the thoracic disease (e.g. concomitant flea infestation). Any cat found to have HCM should have its serum total T4 assessed.

Lungworm larvae (A. abstrusus) can be detected by faecal examination using Biermann floatation. Or, where available, PCR on Biermann sediment, faeces, pharyngeal swabs or BAL fluid. Alternatively, it may be more convenient to perform a therapeutic trial, using Fenbendazole @ 50mg/kg/day PO for ~10 days.

Where there is a suggestion of cardiac dysfunction a more detailed cardiac examination should be performed. This may include ECG, thoracic radiographs, assessment of blood pressure, and echocardiography.

Radiographic investigations:
Ideally, the investigation should include good quality dorsoventral (DV – good for cardiac detail), ventrodorsal (VD – good for pulmonary detail), and lateral views. A general anaesthetic may be helpful as it allows control of respiration, enabling radiographs to be taken at the end of inspiration. It also allows the patient to have an increased oxygen supply.

Radiographs should be assessed for the integrity of the thoracic skeleton, presence of pleural or mediastinal fluid, masses or gas shadows, lung density and position, heart size and position, the presence of masses within the lung-fields, and the integrity of the diaphragm. Abdominal radiographs may be needed to assess the position of the abdominal organs, the size of the liver, and the presence of ascitic fluid.

Care should be taken when assessing thoracic radiographs since on some occasions they may show no changes, despite the presence of severe disease. This is often true of chronic bronchopulmonary disease, or pulmonary thrombosis. To assess these cases further radiography may need to be repeated at a later date. Where fluid is present radiography should be repeated after thoracocentesis.

Radiography of cats with chronic bronchopulmonary disease usually reveals a prominent bronchial pattern, with or without interstitial changes, and/or patchy alveolar infiltrates. The right middle lobe may occasionally be collapsed, presumably due to occlusion of the bronchi with mucus and debris. The lungs may appear over-inflated due to air-
trapping, with flattening of the diaphragm and peripheral emphysema. In very severe cases rib fractures may be
evident (typically caudal ribs, close to the spine).

**Ultrasound examinations:**
Ultrasound examination can be useful at detecting masses located within the thoracic fluid. It can also be used to
provide guidance for fine needle aspiration (FNA) or True-Cut needle biopsy of thoracic masses, and in the assessment
of cardiac function (echocardiography).

**Bronchoscopy:**
Where available, a bronchoscope may enable the clinician to view the trachea and main-stem bronchi. It can be used to
look for the presence of tracheal inflammation, narrowing, oedema, collapse, foreign bodies, granuloma, neoplasia, or
helminths. Where the correct tools are also available foreign bodies can be removed and broncho-alveolar lavage can
be directed to particular lung lobes. Cases of chronic bronchopulmonary disease may reveal erythema of the tracheal
and bronchial mucosa, and/or the presence of excessive mucus/mucopurulent material within the airway.

**Collection of samples:**
By this stage of the investigation it should be obvious whether samples need to be collected from the LRT or the pleural
space. For LRT disease samples can be collected using one of a number of different methods:

- **Tracheal wash**
- **Broncho-alveolar lavage (BAL)**
- **Bronchial mucosal biopsy**
- **Transthoracic FNA of a soft tissue mass**
- **Ultrasound guided True-Cut needle biopsy of a soft tissue mass**

- **Tracheal washes** can rarely be performed in conscious cats, and the technique can only sample the upper
respiratory tree. The author finds this procedure stressful and unrewarding.

- **Broncho-alveolar lavage (BAL).** This technique is much more rewarding than a tracheal wash. The cat is lightly
anaesthetised, and placed in sternal or lateral recumbency. Lateral recumbency may be used when disease is
predominantly one-sided, and the diseased side placed is ventrally. Where a human paediatric bronchoscope is
available an endoscopically-guided BAL can be collected. When performing the technique without endoscopic
guidance a narrow sterile catheter is measured against the cat’s chest and marked at a level ~2/3 of the way down
the chest. A canine urinary catheter or an endoscopic catheter may be used. (Note: the narrower the catheter the
further down the respiratory tree it is likely to be able to reach, and the more successful the BAL is likely to be). The
catheter is then introduced through the sterile endotracheal tube and advanced gently until it can be advanced no
further (approximately to the level at which it was pre-marked) (catheters can sometimes get ‘caught’ at the
tracheal bifurcation, in which case gentle repositioning may be required). Warmed sterile saline is then flushed
down the catheter (~3-10ml/cat). Very little of this first flush can usually be re-aspirated. A second and third
flush/aspiration cycle are then performed. The cat’s chest can be coupáged (clapped) between each flush as this
helps to release cells into the saline. The second flush is generally used for microbiological culture, while the third
flush is assessed cytologically. The third flush usually has the best harvest of alveolar cells. Fluid that is aspirated
back should be slightly cloudy (cellular) and frothy (denoting the presence of surfactant). After performing a BAL
the cat should be given oxygen enrichment for a few minutes prior to being allowed to recover from the
anaesthetic. Since BAL can occasionally stimulate bronchoconstriction it is sensible to pre-medicate with a
bronchodilator (e.g. terbutaline 0.01 mg/kg SQ) and in severe cases have a second emergency dose ready for use
(0.01 mg/kg IV). In severe cases it may be sensible to pre-treat with terbutaline for up to 24h (0.01 mg/kg SQ q4-
12h).
There is considerable debate as to what constitutes a BAL as opposed to a tracheo-bronchial lavage. Some authors state that much higher volumes of saline are required to perform a BAL (up to 50 ml/cat!). However, this author finds this unnecessary. It is relatively easy to determine whether or not the samples contain material from the alveoli: fluid recovered from the alveoli contains mostly alveolar macrophages, while fluid from the bronchial tree tends to contain mostly epithelial cells.

From cats, normal BAL fluid contains: 150-450 nucleated cells/µl

- 60-90% macrophages
- 2-30% eosinophils*

Cats with bacterial bronchopneumonia usually have elevated numbers of neutrophils (which may be seen to contain engulfed bacteria), while chronic bronchopulmonary disease usually results in increased neutrophils, macrophages, hyperplastic epithelial cells, and/or excessive amounts of mucus. Cats with allergic lung disease (‘feline asthma’) may have raised numbers of eosinophils, mast cells, neutrophils and macrophages.

*Occasionally, normal healthy cats can have up to 85% eosinophils in BAL fluid.

- **Bronchial mucosal biopsy** can be performed with or without endoscopic guidance. It is usually achieved using endoscopic biopsy grabs. The procedure should not be undertaken without prior training as the generation of a full-thickness perforation may lead to pneumothorax and/or pyothorax. The collection of bronchial cells using an endoscopic brush is considerably less traumatic.

- **Transthoracic FNA of a soft tissue mass** can be performed with or without ultrasound guidance. When collecting FNA samples from masses in close association with the heart or major vessels, or collecting samples by True-Cut needle biopsy, ultrasound guidance is recommended. In both cases it is strongly advised that the patient be anaesthetized. The skin overlying the area of interest must be aseptically prepared.

**TREATMENT of LRT DIEASE**

With LRT disease the treatment will generally depend on the specific diagnosis.

1. **Management of bronchopulmonary disease:**
   The treatment of chronic bronchopulmonary disease aims at the control clinical signs rather than to achieve a cure. Therapy should be tailored to each individual case. The aims are to:
   - Alter life-style
   - Reverse bronchoconstriction: (β-adrenergic agonists, theophylline)
   - Reduce inflammation: (corticosteroids, antibiotics, anti-serotonergic, and perhaps leukotriene receptor antagonists)

   **Alter life-style:**
   A marked improvement in the cat’s well being can often be achieved by reducing its exposure to airway irritants (smoke, cat-litter, aerosol, dusty environments, sudden changes in temperature), preventing its access to drugs that can cause bronchoconstriction (β-blockers, aspirin), avoiding stressful events and, for obese cats, instigating a weight loss program.

   **Medical therapy:**
   In all cases altering the life-style is usually beneficial. The first line of medical therapy is to treat any infection and give a bronchodilator. It is only if this does not work, or when the disease is more severe, that corticosteroids are added. While oral medication has previously been the main-stay of treatment, inhaled medications are now being used more
widely, particularly in more complicated cases. Their major advantage is their general lack of systemic side effects. That said, it is important to remember that few medications (oral or inhaled) have been scientifically trialed in cats, and even fewer have undergone long-term studies.

**Inhaled medication (approximate prices):**

While the successful use of an inhaler, drug-chamber and small face mask does take a little practice by the owner and the patient, many cats do very well on inhaled medications. It is best to have the owner introduce the mask to the cat at home, rather than in the clinic, as this leads to more rapid acceptance. Introducing the mask and chamber in a non-threatening, stepwise manner is best, and the application of a small amount of the cat’s favorite food to the inside of the mask may help in its acceptance. Only once the mask has been accepted should the drug be added. The AeroKat Chamber (~£75; see later for details) has been specifically designed for cats and is the preferred choice. While the Babyhaler or Paediatric Volumatic chambers from Allen & Hanburys can also be considered, they usually require higher doses of medication. (These chambers are cheaper; ~£20, but the higher drug dosages of drugs that are needed with these chambers soon accumulate extra costs).

**Suggested treatment regimens:**

**Mild cases:** *Salbutamol* (100 micrograms (µg) metered dose inhaler [MDI] ~£9), give one dose (one puff), as needed. Bronchodilators should not be used on their own (i.e. without corticosteroids) other than in very mild cases which only require occasional medication.

**Moderate cases:** i.e. clinical signs are occurring on a daily basis. *Salbutamol*, 1-2 doses, 2-4 times daily. As an alternative to many repeated doses of salbutamol, *Salmeterol* may provide more prolonged bronchodilation; 25 µg MDI (£40): 1-2 doses, twice daily. When using salmeterol the cat may occasionally need additional doses of salbutamol, in which case it should be given on an ‘as needed’ basis – up to 4 times daily.

**Inhaled corticosteroids:**

- *Fluticasone* has been used most frequently in cats. It is expensive, 50-250 µg MDI (~£30-120): 1-2 doses, twice daily. Many cases may be controlled with 50 µg MDI 1-2 doses, twice daily.
- *Budesonide*, like fluticasone is minimally absorbed from the lungs. Dose as for fluticasone.
- *Beclomethasone* may be considered as an alternative. 100 or 200 µg MDI (~£15): 1-2 doses, twice daily.
- *Qvar* is a form of *beclomethasone* that is currently under investigation as its smaller particle size may allow for using lower doses. 50 µg MDI (£12): 2 doses, 2-3 times daily.

It can be beneficial to use a combined inhaler as this reduces the overall number of ‘puffs’ the cat receives, e.g. ‘Seretide’ which contains 25 µg of salmeterol, plus either 50, 125 or 250 µg of fluticasone (depending on the formulation: give 1-2 puffs twice daily; most cats need only 50-125 µg of fluticasone) (~£60-120). **This provides optimal treatment for most cases, typically using Seretide 125 which contains 25 µg of salmeterol, plus 125 µg of fluticasone: give 1-2 puffs twice daily.**

The doses listed are only suggestions, and it is best to try to use as low a dose as is effective. Where more than one dose is required put one dose into the Chamber then place the mask on the cat’s face for 5-10 seconds. Then repeat this for the second dose. When not using a combined inhaler, give bronchodilators before corticosteroids so that the airways are as open as possible to absorb the drugs.

**Severe cases:** Treat as for moderate cases (i.e. *Salbutamol* [1-2 doses, 2-4 times daily] or *Salmeterol* [25 µg MDI: 1-2 doses, twice daily] + inhaled steroids [1-2 doses, twice daily]). However, since inhaled steroids may take 1-2 weeks to achieve maximal effect oral steroids are also required. These can usually be reduced or discontinued once the disease is under better control, typically over 2-4 weeks. (i.e. 5mg prednisolone twice daily for 1 week, then 5mg prednisolone once daily for 1 week, then 5mg prednisolone every other day for 1 week, then stop).
Oral medication:
Where oral medication is to be used the author usually starts with a two-week trial of long-acting theophylline. If this fails to achieve sufficient control of the clinical signs, prednisolone is usually added. Where one bronchodilator (e.g. long-acting theophylline) fails to give a positive response, a different class of bronchodilator (e.g. salbutamol, or terbutaline) may be used instead. (Some authors prefer to use salbutamol or terbutaline as their first choice of treatment). Where prednisolone cannot be given (recurrent infections, intolerance, diabetes mellitus), and inhaled medication will not be tolerated, the author then tries an anti-serotonergic agent, or occasionally a leukotriene receptor antagonist. Over-weight cats that prove hard to diet may benefit from a reduced corticosteroid dose, which may be compensated for by the inclusion of inhaled medication.

Reverse bronchoconstriction:
- **Beta \_2 adrenergic agonists:**
  - **Salbutamol** (Albuterol, ‘Ventolin’), single dose MDI, give as required, effective within 5-10 minutes. (i.e. it is more rapidly acting when given by inhalation than PO, SQ or IM) (see above for treatment regimens). Use of high doses can result in tachycardia and muscle twitching.
  - **Salmeterol** (‘Serevent’, or combined with fluticasone [see above] in ‘Seretide’), is a long-term bronchodilator that takes up to 1-2 hours to take effect but lasts ~8-12 hours (see above for treatment regimens). Use of high doses can result in tachycardia and muscle twitching.
  - **Terbutaline** (‘Bricanyl’) 0.625-1.25 mg PO q12h
    As with all of these drugs, this drug is not licensed for use in cats. However, it has been used frequently with few problems reported. Side effects include GI upset, weakness, tachycardia and hypotension. Care should be taken when used concurrently with corticosteroids. It is perhaps less useful than Salbutamol when either are given orally.

- **Theophylline:** *Slow release theophylline* (‘Corvental-D’) 20-25mg/kg PO q24h.
  Theophylline is a weak bronchodilator that also improves mucociliary transport, stabilizes mast cells, and increases the strength of respiratory muscle contractions. It has a narrow therapeutic window, with toxicity resulting in GI upset, hyperactivity, seizures, and cardiac arrhythmia. Efficacy is very dependent on formulation; Corvental-D and Theo-Dur are recommended.

- **Propentofylline** (Vivotin) 5mg/kg PO q12h.
  This is another methylxanthine derivative, with bronchodilation effects comparable to theophylline, but a better therapeutic index. Also has anti-inflammatory effects (adenosine-potentiation), and is an antioxidant.

Reduce inflammation:
- **Corticosteroids:**
  - **Fluticasone propionate** (‘Flixitide’), **Beclomethasone bipropionate** (‘Becotide’, ‘Qvar’) and **Budesonide** (‘Pulmicort’) are available as inhaled medications. They have virtually no systemic effects (especially fluticasone and budesonide). In cats they can occasionally cause airway irritation. (See above for treatment regimens).

  - **Prednisolone** 1-2 mg/kg PO q12h, then taper off slowly.
    Corticosteroids are very effective at reducing airway inflammation, and in prolonged dosing may reduce airway hyper-responsiveness. Short-term high-dose therapy should be avoided as a rebound hyper-responsiveness may result.
• **Anti-serotonergics: Cyproheptadine ('Periactin') 0.1-1.0mg/kg PO q8-24h**
  Given that feline mast cells release high concentrations of serotonin, a number of clinicians have been using anti-serotonergic drugs to treat refractory cases of 'feline asthma'. While cyproheptadine has been used successfully to control a number of difficult cases, it has a considerable appetite stimulatory effect that can be unhelpful. It can also cause drowsiness and inco-ordination. This drug is not licensed for veterinary use.

• **Leukotriene receptor antagonists: Zafirlukast ('Accolate') 0.5-1.0 mg/kg PO q12-24h; Montelukast ('Singulair') 0.25-0.5 mg/kg PO q24h.** In humans, a number of other anti-inflammatory drugs have come into use, including these leukotriene receptor antagonists. However, although the author has found Zafirlukast to be useful in occasional cases of feline asthma, experimental data suggests these drugs are unlikely to give major benefits in cats. In addition, the unexplained sudden death of one of the research cats may suggest this group of drugs should be avoided. They often need to be given for four weeks before their full effect is seen. These drugs are not licensed for veterinary use.

• **Antibiotics: Cats with chronic bronchopulmonary disease are very susceptible to opportunistic airway infections.** Whenever infection is found it should be treated. Ideally, selection of antibiotics should be made on culture and sensitivity. However, empirical choices include doxycycline, penicillins, and fluoroquinolones. Treatment for 4-6 weeks is often required. Recommended treatment for mycoplasmosis is doxycycline 5mg/kg PO q12h.

• **Mucolytics: Bromhexine ('Bisolvon') 3mg/cat IM/day, or 1mg/kg PO/day.**
  While the author has rarely found mucolytics to be beneficial, some authors recommend them to help ease respiratory tract congestion.

**Acute decompensation:**
This requires very prompt intervention. It is important to keep restraint to a minimum, and increase the oxygen concentration of the air the cat is breathing (oxygen tent or box).
Rapidly acting drugs include:
- Methylprednisolone Na succinate@ 50-100mg/cat SQ, IM, IV
- Dexamethasone @ 0.2-2.2 mg/kg SQ, IM, IV
- Terbutaline @ 0.01 mg/kg SC, IM, IV q4h (is also absorbed very rapidly PO). Unfortunately, supply has recently become unreliable.
- Aminophylline @ 5 mg/kg IV q8-12 hours (is also absorbed very rapidly PO). This is painful when given IM or SC.

Some drugs can be administered via an inhaler or in nebulised air. Unfortunately, administration via nebulised air can result in their therapeutic concentrations taking a longer time to be reached. However, some drugs are more effective than others when given by this route e.g. Salbutamol (two doses every 30 minutes for up to 2-4 hours) and/or Fluticasone (see above) can have beneficial effects, particularly in cats that have previously been diagnosed as asthmatic.

**In severe respiratory distress;**
- Adrenalin @ 0.1ml of a 1:1000 solution SC, IM, IV or via ET tube
- Atropine @ 0.015 mg/kg IV, 0.04 mg/kg SC – will block vagal bronchoconstriction and reduced bronchial secretions, but increases heart rate and can cause cardiac arrhythmia.

Unfortunately, very severe cases may be too unstable to allow a physical examination to be conducted. In these cases, it may be impossible to tell whether the cat is asthmatic, broncho-constricted or in congestive heart failure - it is therefore not inappropriate to give a single IM injection of short-acting steroid (e.g. dexamethasone), a bronchodilator (e.g. terbutaline) and frusemide [i.e. "lasi-dexa-butaline!"].
2. **Bacterial bronchopneumonia:**

Treatment of bacterial bronchopneumonia usually includes a protracted course of antibiotics. Ideally, antibiotics should be selected by culture and sensitivity. Long-term treatment is often necessary, 1-4 weeks beyond clinical and radiographic resolution e.g. 4-8 weeks. Useful broad-spectrum antibiotics include amoxycillin, cephalosporins, doxycycline, trimethoprim-sulpha, and aminoglycosides. Combinations of drugs may be required to give 4-quadrent cover against unknown infectious agents; e.g. amoxicillin/clavulanate (10 mg/kg IV q8-12h; 12-25 mg/kg PO q8-12h) and marbofloxacin (2 mg/kg PO [slow IV] q24h). Although this combination is unlicensed, it can be given IV in critical patients. Where consolidation is severe consider marbofloxacin plus clindamycin or azithromycin as these all have good penetration into congested lung. Where B. bronchiseptica or Mycoplasma spp. have been detected give doxycycline, a fluoroquinolones or azithromycin (this is concentrated in the lungs 200x that of the plasma so is a good choice for suitable respiratory infections). B. bronchiseptica and Mycoplasma spp. are surface dwelling infections so they may respond to nebulised gentamicin (25mg in 3-5ml saline/nebulisation). B. bronchiseptica from cats is generally not very sensitive to amoxicillin-clavulanate. If Toxoplasmosis is a possible differential give clindamycin (10 mg/kg IV, PO q12h) or azithromycin. Oxygen enriched environment, fluid therapy, airway humidification, bronchodilators, and daily coupéage may also be helpful. N-Acetyl cysteine (NAC – 200-500mg PO or IV q12h) may help in severely inflamed lungs to remove excessive mucous and cellular debris.

3. **Lungworm infection:**

In mild cases supportive therapy may be sufficient. In more severe cases intervention may be needed. The first choice of treatment is Fenbendazole @ 20-50mg/kg/day PO for 10-21 days as this has minimal toxicity. In addition to this it is advisable to give bronchodilators (see above), antibiotic cover to prevent secondary infection of the damaged lung tissue, and an anti-inflammatory dose of glucocorticoid to reduce the inflammation that tends to arise as the cat’s immune system removes the dead and dying worms. Potential alternatives to fenbendazole are Advocate (moxidectin/imidacloprid spot-on; Bayer) which has a registered claim for treatment of *A. abstrusus* at least in Australia. Other potential treatments include ivermectin (0.4 mg/kg SQ), abamectin (0.3 mg/kg SQ, repeated 2 weeks later), or topical emodopside/praziquental or selamectin (6mg/kg). Levamisole (25-30 mg/kg divided into 8 hourly doses and given on alternate days for 5 treatments) should be given with care as it can be toxic to cats (and tastes very bitter).

*AeroKat Spacers can be obtained from:*

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www.aerokat.com

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Tel: +44 845 680 8975  
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E-Mail: JSlattery@Breatheazy.co.uk  
Web: www.breatheazy.co.uk

AeroKat is stocked by VSS Co Ltd, NVS, Centaur and Dunlops
Other helpful sites for owners and vets are:
www.felineasthma.co.uk
www.fritzthebrave.com
http://www.felineasthma.org
http://groups.yahoo.com/groups/felineasthma/

Further reading

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