Assessment of the respiratory patient begins with a complete medical history and physical examination. Signalment can be important because young animals with chronic recurrent pneumonia or sinusitis could have primary ciliary dyskinesia or IgA deficiency. Parasitic migration through the lungs, pulmonary infiltrates with eosinophilia, fungal diseases, and foreign bodies also occur more commonly in young animals. Older dogs more typically present develop chronic obstructive pulmonary disease or neoplasia. Breed specific disorders are also recognized, such as cervical tracheal collapse in small breed dogs and bronchiectasis in Cocker Spaniels.

Patient examination begins with an appraisal of the respiratory pattern. Restrictive respiratory diseases (pleural and parenchymal disorders) cause rapid and sometimes shallow respiratory motions, while obstructive disorders such as bronchitis result in slow, deep breathing with augmented expiratory effort. Upper airway obstruction can lead to incessant panting, although prolonged, labored inspiration is typically expected.

Auscultation should include the larynx, trachea, and all lung fields. Over the larynx and trachea, loud, hollow sounds are heard on inspiration and expiration with a noticeable pause between the two phases. Large airway narrowing results in high pitched musical sounds on inspiration. This can be detected in dogs with laryngeal paralysis, laryngeal collapse, or cervical tracheal collapse. Normal lung sounds are termed bronchial, vesicular, or bronchovesicular. Bronchial sounds are loud sounds heard best over large airways near the hilus of the lung, and they are louder and longer during expiration than inspiration. Bronchial sounds should not be heard in the lung periphery unless disease is present, causing referral of sounds to distal regions. Vesicular lung sounds are heard best on inspiration and can be detected over most of the chest in normal individuals. The sound resembles breeze passing through trees. Bronchovesicular sounds (a mixture of bronchial and vesicular qualities) can be heard on inspiration > expiration. Adventitious (abnormal) lung sounds (crackles and wheezes) are discontinuous noises produced in diseased lungs. These can usually be enhanced by inducing a cough, a deep breath, or by exercising the patient. The timing of abnormal lung sounds in the respiratory phase is important. Wheezes are heard on expiration as air flows out of mucus-filled airways or when airways narrow or collapse. Crackles are a result of air passing through fluid or mucus-filled alveoli and can be heard at any point during inspiration or expiration.

Diagnostic testing in the animal with respiratory disease begins with a complete blood count. Polycythemia and/or the presence of nucleated red blood cells are potential indicators of hypoxia. Neutrophilia occurs with chronic bronchitis, feline bronchial disease, pneumonia, neoplasia, or pulmonary fibrosis. Neutropenia in the presence of pneumonia warrants a guarded prognosis since it is likely that the lungs are trapping all blood neutrophils. Animals with eosinophilia require heartworm testing and fecal examinations (flotation, Baermann, sedimentation) to rule out parasitic disorders.

Currently, the primary tests of pulmonary function available to practitioners are pulse oximetry and arterial blood gas analysis. Pulse oximetry is based on the principle of photometric detection of hemoglobin saturation with oxygen, where the optical density of the arterial pulse wave at different wavelengths is related to saturation. Hypotension or anemia can result in falsely lowered results. Recently developed testing units have made blood gas analyses available in private practices and emergency clinics. Samples for blood gas analysis can be obtained from the dorsal pedal or femoral artery in most dogs (and some cats) using a 23-25 gauge needle and a heparinized tuberculin syringe.
Radiographic patterns are used both to establish a list of differential diagnoses and to decide on the type of airway sampling that is most likely to result in a definitive diagnosis.

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Characteristics</th>
<th>Disease Association</th>
<th>Diagnostic technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interstitial</td>
<td>Diffuse haziness throughout lung fields; bronchi and vessels are ill-defined</td>
<td>Viral or rickettsial pneumonia, fibrosis, neoplasia, hemorrhage</td>
<td>Fine needle aspirate Bronchoscopy Lung biopsy</td>
</tr>
<tr>
<td>Bronchial</td>
<td>Calcified or thickened bronchial wall; 'donuts' or rings</td>
<td>Chronic bronchitis, eosinophilic pneumonitis, feline asthma/bronchitis</td>
<td>Tracheal wash Bronchoscopy</td>
</tr>
<tr>
<td>Alveolar</td>
<td>Fluid filling of the alveoli; outlining of the airways as air bronchograms</td>
<td>Bronchopneumonia, atelectasis, edema, hemorrhage, ARDS</td>
<td>Bronchoscopy Tracheal wash Fine needle aspirate</td>
</tr>
<tr>
<td>Consolidation</td>
<td>Marked opacification of lung fields, usually lobar in distribution; lack of air bronchograms or vessels</td>
<td>Lung lobe torsion, neoplasia, bronchial obstruction, granuloma, consolidating pneumonia</td>
<td>Fine needle aspirate Bronchoscopy</td>
</tr>
<tr>
<td>Vascular</td>
<td>Increased width or tortuosity to pulmonary arteries or veins</td>
<td>Congestive heart failure, congenital cardiac disease, heartworm disease</td>
<td>Echocardiography</td>
</tr>
<tr>
<td>Effusion</td>
<td>Blurring or elevation of the cardiac silhouette; displacement of lungs</td>
<td>Transudate/modified transudate, exudate, hemorrhage, chylolothorax</td>
<td>Thoracocentesis Minimum database</td>
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**Tracheal wash**

To perform a tracheal wash, a small volume of fluid (4-6 mls) is instilled in the vicinity of the carina for collection of inflammatory cells or bacteria from the proximal airway. Equipment needed for a tracheal wash can be found in most veterinary practices. For cats and small dogs (<7-8 kgs), dogs with probable tracheal collapse, and dogs with marked tracheal sensitivity, I prefer to use heavy sedation and oral intubation with a sterile endotracheal tube. A sterile polypropylene urinary catheter or sterile feeding tube can be used to inject fluid for collection of an airway sample. Before passing the catheter, the length of the catheter should be measured against the outside of the body to a level that approximates the carina (near the 4th intercostal space). The catheter should be passed no further than this level to avoid entering a lobar bronchus. Once the catheter is in place, 4-5 mls of nonbacteriostatic saline (followed by 1-2 mls of air to clear the catheter) are injected through the catheter and rapidly withdrawn. This can be repeated 2-4 times until enough fluid is retrieved for culture/sensitivity and cytology (approximately 0.5-1.0 mls). If no fluid is obtained, the endotracheal tube cuff should be inflated and an assistant should copague the dog's chest to encourage retrieval of airway fluid. Use of house suction and a suction trap can enhance return.

In dogs> 7-8 kgs or in animals in which excess sedation is not desired, a transtracheal wash can be performed. Minimal sedation with acepromazine or a narcotic agent may be required in overly anxious patients. A 14 gauge over the needle catheter is inserted between the tracheal rings and a 3.5 French urinary catheter is passed to the level of the carina. Firstly, the neck region is palpated to identify a region low on the neck where the rings are easily palpable and the trachea can be stabilized. The skin over this region is infiltrated with lidocaine. The skin is tented and the catheter inserted between the rings. Once the needle is firmly within the trachea, the hub is moved toward the trachea, the needle is withdrawn, and the urinary catheter is passed parallel to the airway. This generally stimulates a cough. Larger dogs can tolerate instillation of 1 to 3 applications of 4-10 mls of fluid in order to collect an adequate airway sample. Complications that might be encountered following a transtracheal wash include tracheal laceration, subcutaneous emphysema, pneumomediastinum, or chondroma formation.

Aerobic and anaerobic bacterial culture and Mycoplasma culture should be submitted for dogs with pneumonia. Cytologic examination is important in determining the etiology of respiratory disease.
Pneumonia is anticipated to be characterized by septic suppurative inflammation whereas nonseptic inflammation is typical of bronchitis.

**Non-bronchoscopic bronchoalveolar lavage**

This technique has been described to obtain a deeper sample from the lung that approximates bronchoalveolar lavage fluid. In cats and small dogs, an 8 French red rubber catheter (with the tip cut off) can be passed through a sterile endotracheal tube to obtain a lavage sample. In larger dogs, a larger red rubber or stomach tube is passed blindly into the lung until gentle resistance is obtained. Larger volumes (10-20 mls) of fluid can be instilled in the isolated segment to retrieve a distal lung sample. Caution is warranted when passing a tube blindly into the lung because diseased airways are prone to rupture.

**Fine needle aspiration**

A fine needle aspirate can provide an accurate cytologic diagnosis in animals with focal mass lesions that are near the thoracic wall or in animals with diffuse interstitial lung disease. An area on the chest wall is clipped and briefly prepped. The aspiration can be performed blindly or with ultrasound guidance. We generally use a 26 gauge, 1 or 1 1/2 inch needle on a 3 ml syringe. Usually, only a small amount of fluid is recovered for cytology, which limits the application of this technique. This technique should not be used in severely tachypneic animals, or in animals with pulmonary hypertension, bullous lung disease, or coagulopathies. Following a fine needle aspirate, the animal should be encouraged to lie quietly with the aspirated side down and monitored for tachypnea or changes in lung sounds which might indicated pneumothorax or pulmonary hemorrhage. Prior to release of the patient, ultrasound of the thorax is performed to confirm the presence of a glide sign, which means that the lung is moving in coordination with the pleura.

**Bronchoscopy**

Bronchoscopy is one of the most useful techniques for providing a diagnosis in animals with lung disease. Indications for bronchoscopy include chronic cough, an unexplained pulmonary infiltrate, foreign body aspiration, non-resolving pneumonia, hemoptysis, recurrent or refractory bronchitis, and airway collapse. The major drawbacks to bronchoscopy are the expense of the equipment and the need for special training in the procedure. Contraindications for bronchoscopy center around the risks associated with general anaesthesia such as worsening hypoxemia or exacerbation of cardiac arrhythmias. Risks are assessed on an individual basis and weighed against the potential benefits of the results obtained.

When purchasing an endoscope for use in the airway, the size of the animal to be examined must be considered. A 55 cm 2.5-3.8 mm scope can be used in cats and small dogs while a 5.0–6.0 mm bronchoscope with extended length is useful for larger dogs.

General anesthesia is used in bronchoscopy to suppress coughing and laryngospasm, to allow examination of the airways without inducing trauma, and to protect the endoscope. Pre-oxygenation with a facemask or nasal oxygen prior to bronchoscopy is highly recommended to improve the safety of the procedure since all animals being examined have some degree of respiratory embarrassment. Larger dogs can have an endotracheal tube placed with use of a special adapter to allow passage of the scope (5.0-5.5 mm outer diameter) through the tube while the endoscope is passed. Animals too small to accommodate a 7 French endotracheal tube require jet ventilation or an alternate means for administering oxygen throughout the procedure.

Bronchoscopy in veterinary patients is performed in sternal recumbency with the jaw elevated to allow easy access to the airways. Two large mouth gags are in place throughout the procedure to protect the bronchoscope. If the dog appears light, the scope should be withdrawn immediately to avoid expensive repairs.

The upper airway should be thoroughly examined prior to bronchoscopy to detect eversion of laryngeal saccules, elongated soft palate, or laryngeal paralysis. The trachea is evaluated for collapse and prolapse of the dorsal tracheal membrane. The carina is easily recognized as a bifurcation into left and right principal bronchi. Blunting of the carina is suggestive of extramural compression due to hilar lymphadenopathy or a mass lesion. The anatomy of the bronchi has been defined and is virtually identical in dogs and cats. Openings to the bronchi are generally round to oval at rest and should show minimal
collapse during respiration or coughing. The epithelium is generally pale pink, appears slightly glistening, does not obscure the underlying vascular pattern, and lacks gross mucus accumulation. Mucosal and submucosal abnormalities that can be seen include hyperemia, edema, or bronchitic nodules. Hemorrhage and purulent secretions should be investigated for underlying foreign bodies or mass lesions.

After all airways have been examined, the scope is withdrawn, the outside is wiped off with saline-soaked sponges, and the biopsy channel is flushed with sterile saline. On the second entry to the airway, care is taken to prevent the scope from touching the oral mucosa and airway epithelium in order to limit upper airway contamination when approaching the site for lavage.

To perform a BAL, the scope is gently wedged into the smallest bronchus possible. Depending on the size of the scope and the size of the dog, 10-20 mls of nonbacteriostatic saline is instilled (5-8 mls in a dog or small cat), then the fluid is slowly and gently suctioned back through the channel. A bronchoalveolar sample is generally evident by aspiration of a foamy material containing surfactant. If insufficient fluid is recovered, return to the same site and lavage a second time to improve yield. Cytology and culture/sensitivity is generally performed on BAL fluid. If desired, brush cytology can be performed after BAL fluid is collected.

Bronchoscopy can be associated with anesthetic complications during the procedure related to hypoxemia or arrhythmias. Airway collapse can worsen gas exchange during recovery and lead to complications. Recovery in an oxygen cage in a stress-free environment is beneficial.