Respiratory diseases and respiratory distress are common in dogs. Due to unique breed characteristics, including anatomic features, breed predilection exists for many respiratory conditions. As in all aspects of veterinary medicine, breed characteristics are remarkably useful in the initial generation of a differential diagnosis list and diagnostic plan.

This article focuses on respiratory conditions that are overrepresented in specific dog breeds. Localizing the source of disease to the respiratory system is essential for developing an appropriate diagnostic plan.

Although the following conditions are common, keep an open mind, evaluate each patient individually, and avoid tunnel vision.

**UPPER AIRWAY OBSTRUCTION**

Upper airway obstruction is a common, but occasionally under recognized, source of respiratory distress. Dogs with upper airway obstruction have noisy breathing that worsens with exercise or heat exposure.

- **Stertor** is a sound similar to snoring, while **stridor**, which is commonly associated with laryngeal disease, is a more high pitched sound.
- During upper airway obstruction, normal inspiration causes negative pressure inside the upper airways, resulting in collapse of weaker or less supported tissues.
- Upper airway obstruction, therefore, causes inspiratory dyspnea.
- Recurrent obstruction contributes to tissue swelling and edema, further magnifying obstruction.

**Specific upper airway diseases** that result in airway obstruction include:

- Brachycephalic obstructive airway syndrome (BOAS)
- Laryngeal paralysis
- Rhinitis and other nasal diseases (while dogs are preferential nasal breathers, particularly at rest, most open their mouths to breathe if they have nasal obstruction).

**Bulldog**

All bulldogs have some component of BOAS. While this article focuses on English bulldogs, many other breeds, including French bulldogs, pugs, and Pekingese, are also affected by BOAS. Table 1 lists clinical signs associated with this syndrome; Figures 1 and 2—sagittal computed tomography (CT) images of the head—compare the upper airway conformation of a brachycephalic dog with that of a mesocephalic dog with normal skull anatomy.

Management of BOAS in bulldogs includes:

1. Consideration of surgical palliation with soft palate resection (palatoplasty) and/or stenotic nares resection (rhinoplasty); an interested clinician or surgeon can successfully perform surgical palliation by using laser or hand-suturing techniques.
2. Early conversation with clients: Many owners assume that exercise intolerance and stertorous breathing are normal; however, it is important to explain that surgery often markedly improves quality of life and life span, particularly if performed before one year of age, while long-standing obstruction results in increased laryngeal and pharyngeal soft tissue weakness.

3. Bulldogs are prone to heat stress due to their brachycephalic conformation, which results in near constant airway obstruction and, subsequently, inability to effectively cool themselves. At rest, bulldogs may appear comfortable, but with exertion, they start to overheat and pant.

4. Bulldogs are also prone to gastrointestinal (GI) distress and esophageal dysfunction, which may manifest as aerophagia and intermittent hiatal hernias. Bulldogs tend to swallow a lot of air during inspiratory efforts, leading to a gas-filled stomach and abnormal GI motility. Long-term therapy with a proton-pump inhibitor, such as omeprazole (1 mg/kg or 20 mg/dog), may be beneficial. Many bulldogs also benefit from veterinary input on nutrition and diet in order to avoid obesity.

**Norwich Terrier**

Norwich terriers (Figure 3, page 30), while not a brachycephalic breed, have upper airway abnormalities, including redundant supra-arytenoid folds, laryngeal collapse, everted laryngeal saccules, and a narrowed laryngeal opening. However, some Norwich terriers with one or more of these abnormalities are asymptomatic.

Response to surgical intervention, such as arytenoid lateralization, in treated terriers has been minimal to moderate, with less improvement seen than normally appreciated in larger dogs. Additionally, laryngeal collapse may persist, and may continue to cause airway obstruction. Because some dogs are asymptomatic, anesthesia should be performed with caution in this breed, with the dog carefully intubated in case it has a smaller than normal laryngeal lumen.

While Norwich terriers are somewhat uncommon dogs, breeders are uniquely familiar with these respiratory conditions and expect the same level of knowledge from their veterinarians.

**Labrador Retriever**

As Labrador retrievers age, the syndrome of laryngeal paralysis is more commonly seen, which is also common in other large and giant breed dogs. Recent work has been transformative in recognizing this syndrome as part of the newly termed GOLPP (geriatric-onset laryngeal paralysis polyneuropathy syndrome).

Laryngeal paralysis is considered a slowly progressive condition, although some dogs may present in respiratory crisis associated with excessive heat exposure and/or exercise.

- Laryngeal paralysis is suspected in dogs based on inspiratory stridor and confirmed by visual examination of the larynx under light sedation.
- Direct visualization confirms failure of the arytenoids to abduct (open) during inspiration; be careful not to confuse paradoxical motion with normal motion. With paradoxical motion, the larynx is drawn closed during inspiration and blown open during expiration, which can lead to the false perception of motion.
- Doxapram (1 mg/kg IV) is useful as a respiratory stimulant to both improve inspiratory efforts and accuracy of the diagnosis. While some dogs may be managed adequately for several years by rest (minimizing exercise) and limiting exposure to warm temperatures, surgical palliation via unilateral arytenoid lateralization provides more definitive therapy.

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**TABLE 1. Clinical Signs Associated with Brachycephalic Obstructive Airway Syndrome**

<table>
<thead>
<tr>
<th>CLASSIC FEATURES</th>
<th>IN SOME DOGS</th>
<th>PROLONGED OBSTRUCTION</th>
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</thead>
<tbody>
<tr>
<td>Stenotic nares</td>
<td>Laryngeal collapse</td>
<td>Pharyngeal edema</td>
</tr>
<tr>
<td>Long/thick soft palate</td>
<td>Nasopharyngeal turbinates</td>
<td>Pharyngeal collapse</td>
</tr>
<tr>
<td>Everted laryngeal saccules</td>
<td>Tracheal hypoplasia</td>
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</table>

**FIGURE 1. Sagittal CT image of the head of a brachycephalic dog; note the extremely shortened facial bones and subsequently obstructed airway.**

**FIGURE 2. Sagittal CT image of the head of a mesocephalic dog; note that the dog is intubated. Compare this dog to the dog in Figure 1 and note the longer nose and lack of intrinsic airway obstruction.**

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BREED-SPECIFIC RESPIRATORY DISEASE IN DOGS

TRACHEAL DISEASE

Yorkshire Terrier

Tracheal collapse is frequently seen in Yorkshire terriers and other small breed dogs, such as Maltese, toy poodles, and Pomeranians. Tracheal collapse often involves the lower airways, with chronic bronchitis and bronchomalacia with main stem bronchial collapse common.

Historically, tracheal collapse has been divided into cervical and intrathoracic collapse.

• Most dogs suffer collapse affecting both segments, but, in some dogs, one segment seems to have more clinical relevance.

  • Cervical collapse causes more signs upon inspiration, while intrathoracic collapse results in more expiratory distress and cough.

  • Affected dogs may also have laryngeal paralysis or collapse, which needs to be identified and therapeutically managed.

In practice, clinical suspicion is typically adequate to initiate treatment in affected patients; however, if a patient does not respond to medical therapy, further testing is advisable. Clinical evaluation includes neck and chest radiography, which is useful but relatively insensitive. To confirm collapse and/or assess disease severity, fluoroscopy or tracheobronchoscopy (gold standard for diagnosis) is recommended.

Treatment of tracheal collapse is outlined in Table 2. As an overview:

• The initial focus is almost invariably on medical therapy; however, my opinion is that surgery is more beneficial in dogs with airway obstruction.

• Tracheal rings and stents are considered palliative, meaning that the disease continues to progress, and the choice between a tracheal stent and tracheal rings is often clinician dependent.

• Tracheal stents are preferred in dogs with significant intrathoracic collapse. Complications of intraluminal stenting include persistent cough, granulation tissue, stent migration, and fracture. Overwhelmingly, owners are pleased.

Table 2. Treatment of Tracheal Collapse

<table>
<thead>
<tr>
<th>LIFESTYLE</th>
<th>MEDICAL</th>
<th>SURGICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight loss for overweight dogs</td>
<td>Cough suppressants</td>
<td>Severe cases with airway obstruction may benefit from surgical intervention with:</td>
</tr>
<tr>
<td>Avoidance of tracheal stimulation (eg, use of a harness versus neck lead)</td>
<td>Intermittent therapy with anti-inflammatory agents (ie, prednisone), as needed</td>
<td>• Tracheal stent</td>
</tr>
<tr>
<td></td>
<td>Periodic antibiotics to address secondary bacterial colonization</td>
<td>• Extraluminal tracheal rings</td>
</tr>
<tr>
<td></td>
<td>Dogs with concurrent lower airway disease may benefit from theophylline or terbutaline</td>
<td>• Laryngeal lateralization in dogs with concurrent laryngeal paralysis or collapse</td>
</tr>
</tbody>
</table>

To Swim or Not to Swim

Clinicians are divided with regard to whether dogs should be allowed to swim after arytenoid lateralization surgery (for laryngeal paralysis) due to the increased risk of aspiration after surgery. However, swimming is a passion for many retrievers, often making this an individual owner decision.

Tracheal diameter is more dynamic than initially believed; a recent report documented an up to 24% change in diameter of the normal trachea between inspiration and expiration.
with outcomes from stenting, but it is very important to discuss possible risks associated with the stent and potential long-term complications.

- If cough is the major sign, more efforts should be directed toward treating lower airway disease. Dogs with concurrent lower airway disease and main stem bronchial collapse are particularly hard to manage as persistent cough is very common.
- Cough can lead to stent fracture and micromovement, which may predispose to granulation tissue.
- Tracheal rings require a patient surgeon and are only effective in cervical and thoracic inlet collapse; laryngeal paralysis from damage to the recurrent laryngeal nerve is not uncommon.

LOWER AIRWAY & LUNG DISEASE

Lower airway and pulmonary parenchymal diseases are also common in dogs. Clinical signs include cough, shortness of breath, and exercise intolerance. In chronic conditions, exercise intolerance may go unnoticed until signs are severe.

Siberian Husky

Siberian huskies are overrepresented with allergic (eosinophilic) airway disease, also known as eosinophilic bronchopneumopathy (EBP), which is characterized by cough and exercise intolerance. Circulating eosinophilia is observed in more than 50% of dogs with EBP, and radiographs document a bronchial pattern and air trapping/hyperinflation.

Diagnosis should be based on thoracic radiographic findings (Figure 4) and confirmed by collection and interpretation of airway cytologic samples. Cytologically, the majority of nucleated cells are eosinophils, often in the range of 75% to 80%. Although EBP is usually idiopathic in origin, it may be triggered by parasitic diseases (eg, lungworm, heartworm); thus, careful evaluation for parasitic triggers is advised, especially in areas endemic for specific pathogens. Serum allergy testing has been minimally explored in dogs, but could be considered for those refractory to treatment.

Prednisone is used for treatment of EBP, tapered to the lowest possible dose. Oral prednisone is typically dosed at 1 to 2 mg/kg Q 24 H to start, and many dogs are well controlled on 0.25 mg/kg Q 24 H or even every other day. In some dogs, inhaled glucocorticoids may be useful. If a trigger is found, and can be avoided, prednisone can be discontinued in some dogs.

Northern Breeds

Northern breeds, such as Siberian huskies and Alaskan malamutes, are overrepresented with spontaneous pneumothorax, which develops from a pulmonary bulla or bleb. It is not clear if this is related to airway eosinophilia, although most biopsies do not show evidence of tissue infiltration with eosinophils.

Spontaneous pneumothorax is recognized clinically by tachypnea and restlessness, with radiographic evidence of a pneumothorax and no history of trauma. It is considered a surgical disease, and after surgery to remove the affected lung lobe, most dogs recover completely. However, spontaneous pneumothorax caused by EBP (similar to secondary spontaneous pneumothorax in asthmatic cats) is not considered a surgical disease. In dogs:

- With suspected spontaneous pneumothorax accompanied by clinical signs of tachypnea and a radiographically large volume of pneumothorax, surgical exploration is strongly recommended.
- With cough, eosinophilia, and suspected EBP, accompanied by a small volume pneumothorax, treatment directed at ameliorating the eosinophilic reaction should result in resolution of the pneumothorax.

In all cases, carefully assess an individual dog’s history and physical and radiographic examinations to help guide decision making.

West Highland White Terrier

West Highland white terriers can develop a condition similar to human pulmonary fibrosis. Pulmonary fibrosis is a type of interstitial lung disease in which scar tissue slowly replaces normal lung tissue, leaving very little lung capacity for daily activities.

The underlying cause of pulmonary fibrosis is unclear, although it is thought to potentially represent inappropriate healing following lung injury. In a small number of horses, pulmonary fibrosis has been associated...
Diagnosis of pulmonary fibrosis in dogs requires a degree of suspicion.

- Clinical signs are often subtle at disease onset, and may be attributed to normal aging rather than appreciated as abnormal. In one study, owners had noticed abnormalities for up to a year before their pets were diagnosed.
- Affected dogs may be initially misdiagnosed with congestive heart failure or pneumonia, and detection of pulmonary fibrosis only occurs after the patient fails to respond to therapy for either of these more common conditions.
- Auscultation of crackles and the heavy interstitial pattern seen on chest radiographs of dogs with pulmonary fibrosis are also seen in some dogs with chronic bronchitis; however, dogs with chronic bronchitis usually have a pronounced cough.

In humans, pulmonary fibrosis runs in families. A genetic component is suspected in dogs as well. The following diagnostic findings are associated with pulmonary fibrosis in dogs:

- Clinical signs include exercise intolerance, rapid respiratory rate and, ultimately, respiratory distress and oxygen dependence.
- Physical examination findings classically include the presence of very loud crackles upon auscultation of the chest and increased respiratory rate and effort; some dogs may also have heart murmurs, but they are typically low grade (eg, II/VI) and accompanied by sinus arrhythmia.
- Chest radiographs usually show a heavy interstitial pattern without signs of infection or heart failure (eg, alveolar disease, pulmonary edema, pleural effusion). Some dogs have right-sided cardiomegaly, consistent with cor pulmonale.

Further diagnostic testing may include lower airway cytology, bronchoscopy, and thoracic CT:

- Bronchoscopy is particularly useful in order to exclude chronic bronchitis.
- Echocardiography is warranted in dogs with suspected idiopathic pulmonary fibrosis to evaluate for pulmonary hypertension, which is treatable with sildenafil. Treatment of affected dogs may improve exercise tolerance.
- Thoracic CT is considered the gold standard diagnostic modality in humans; ongoing work is evaluating the utility of this imaging modality in dogs.
- Characteristic CT findings include subpleural blebs, traction bronchiectasis, a diffuse interstitial pattern and, rarely, honey-combing in advanced cases.
- CT is also useful to exclude other potential causes of respiratory distress, such as chronic bronchitis or neoplasia.
- While lung biopsy is definitive, it is less commonly performed due to cost, potential risks, and current lack of therapeutic options for this disease.

Unfortunately, no pharmacologic therapy is beneficial in pulmonary fibrosis. Therapeutic management includes:

- Oxygen therapy, which is extremely helpful and can be administered on an outpatient basis if clients build an oxygen cage at home.
- Sildenafil for dogs that develop pulmonary hypertension (1–3 mg/kg Q 8–12 H, titrate up, and avoid concurrent nitrates).
- Prednisone (0.5–1 mg/kg Q 12 H for 14 days; then reassess and taper to lowest dose that controls signs or, after tapering, stop if no benefit is observed); a short course may be considered but is rarely beneficial unless initial diagnosis is inaccurate or a component of chronic bronchitis is present.
- N-Acetylcysteine, which has a weak effect in humans but may be tried in dogs as an antioxidant and mucolytic.

IN SUMMARY

Selective breeding of dogs for unique traits has led to an increased frequency of specific diseases in certain breeds. Some conditions are directly related to conformation, such as those in bulldogs, while others are more likely reflective of genetic susceptibility and possibly a smaller gene pool. While all dogs should be individually evaluated, it is helpful to be aware of breed characteristics that may predispose a patient to particular diseases.

BOAS = brachycephalic obstructive airway syndrome; CT = computed tomography; EBPP = eosinophilic bronchopneumopathy; GI = gastrointestinal; GOLPP = geriatric-onset laryngeal paralysis polyneuropathy syndrome

References
1. History and physical examination: In all dogs presenting with respiratory signs, perform a complete medical history and physical examination; the location of disease within the respiratory system should be established.

2. Thoracic radiography: Most helpful diagnostic tool for dogs with lower airway disease (eosinophilic bronchitis), pneumonia, and pulmonary fibrosis. Also useful for:
   - Excluding pulmonary disease in Norwich terriers
   - Identifying concurrent pneumonia or megaesophagus in laryngeal paralysis
   - Diagnosing pneumonia or hiatal hernia in bulldogs.

3. Thoracic CT: Primarily used to identify pulmonary fibrosis.

4. Oral/laryngeal examination: Most useful for identifying upper airway disease in dogs; doxapram (1–2 mg/kg IV) may be useful to identify dynamic collapse.

5. Tracheobronchoscopy: Useful for identifying tracheal collapse and differentiating between chronic bronchitis and idiopathic pulmonary fibrosis in West Highland white terriers.

6. Airway cytology and culture: Useful for identifying eosinophilic disease, and excluding or establishing the location of disease within the respiratory system.

Summary of Diagnostic Approach to Respiratory Disease

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