Tracheal collapse is common in small breed dogs and often associated with respiratory distress and/or cough. The severity of collapse may be largely affected by genetics. Severely affected dogs are usually recognized at a young age; less severely affected dogs may not demonstrate signs until middle or older age.

The canine trachea is made of C-shaped cartilaginous rings; the dorsal aspect is composed of the trachealis muscle and connective tissue. The lack of complete rings, although beneficial for movement, can lead to loss of support and the potential for intermittent tracheal narrowing or collapse, particularly when stressed with cough or respiratory distress.

Tracheal collapse may affect the cervical, thoracic inlet, or intrathoracic trachea, and the disease may progress over time, resulting in additional areas of collapse. Cervical disease is associated with inspiratory collapse/distress, and intrathoracic disease is associated with expiratory collapse/distress.

Dynamic tracheal collapse results from differential pressures inside and outside the trachea during the respiratory cycle. Intrathoracic airways are opened during inspiration but are unable to hold their shape during expiration. Conversely, the tracheomalacic cervical airway collapses during inspiration but is opened by expiration.

There is also a growing appreciation for fixed tracheal abnormality, referred to as a tracheal malformation, in which the trachea is permanently fixed in an abnormal/obstructive position (FIGURE 1). A fixed obstruction associated with tracheal malformation, usually near the thoracic inlet, will affect both inspiration and expiration; signs worsen with excitement or exertion.

**FIGURE 1.** Lateral radiograph of a tracheal malformation resulting in obstruction (arrow) in a dog with severe clinical signs of tracheal collapse.
Tracheal collapse is graded I (mild) through IV (most severe) based on the percentage of the lumen that is obstructed. Although grading is typically performed by using tracheoscopy, this method limits the ability to determine the degree of dynamic collapse.

Given the large number of dogs affected, research into tracheal disease is surprisingly limited. There is evidence that the glycosaminoglycan content of affected tracheas is lower, but whether that is a cause or effect is unclear.

**SIGNALMENT**

Tracheal collapse is most common in small breed dogs; prevalence is highest among Yorkshire terriers and Pomeranians. In the author’s experience, collapse in Yorkshire terriers is commonly associated with tracheal malformation and cervical collapse; in Pomeranians, it is often seen with intrathoracic collapse. Pugs are also commonly affected with lower airway disease as well as intrathoracic collapse, magnified by other concerns associated with brachycephalic dogs. However, any breed of dog may be affected, as may cats, albeit rarely.

**CLINICAL SIGNS**

Suspicion of tracheal disease is commonly based on signs of cough or difficulty breathing. Cough is a response to either real or perceived airway irritants. Cough can be intermittent or persistent and productive or dry. Most airway coughs are more productive due to increased mucus, as opposed to more dry coughs that are associated with pulmonary fibrosis. Coughing may result from intermittent aspiration (e.g., with laryngeal or pharyngeal dysfunction) or from megaesophagus. Coughing may also reflect lower airway disease (e.g., chronic bronchitis) or mainstem airway collapse. Isolated tracheal collapse without lower airway disease is an uncommon cause of cough, but in dogs with tracheal collapse, multiple sites are commonly affected (e.g., tracheal collapse combined with mainstem collapse and chronic bronchitis). There is debate as to whether a “goose honk” cough is a true cough attempting to rid the airway of debris or more of a honk associated with obstruction.

Grade IV tracheal collapse, particularly that caused by tracheal malformation, will produce intermittent respiratory distress and may cause the honking sound. Other clinical signs are uncommon. Dogs with grade IV collapse are typically affected daily, and signs are worse with stress or exertion.

During examination, affected dogs are typically bright and alert, unless they are experiencing severe distress. Dogs with severe cervical collapse may feel “square” on palpation due to compression of the costochondral junction during inspiration efforts against an obstructed airway; dogs with more severe lower airway disease will have pronounced abdominal musculature, similar to a “heave line” on a horse with equine asthma, resulting from expiratory pushing against the bronchomalacic airway with its expiratory collapse. For some dogs, a lung herniates through the thoracic inlet when they cough; for others, palpation of the neck documents abnormalities with the trachea itself. Some clinicians advocate gentle pressure on the trachea to induce a cough, which may or may not help confirm a diagnosis. If signs are intermittent, clients should be instructed to bring a video/recording of the sounds their dog is making, if possible. Common concurrent conditions include mitral valve heart murmur, obesity, and dental disease.

**DIAGNOSTIC TESTING**

Diagnosis of mild tracheal collapse usually involves history taking, physical examination, and minimal diagnostic testing. Moderate to severely affected patients may require additional diagnostics.

**Initial Findings**

Laboratory test results, including complete blood count and biochemical profile, are usually within normal limits, although some dogs with tracheal collapse will have elevated liver enzyme and bile acid concentrations. If a murmur is detected, NT-proBNP (N-terminal pro–B-type natriuretic peptide) testing or echocardiography may be indicated. The number of dogs that have both cardiac and respiratory disease is unknown, and it can be challenging to determine which is primarily at fault. In general, cough-associated mainstem compression from left atrial enlargement or pulmonary edema is associated with a louder murmur, tachycardia, and often weight loss; cough associated with respiratory disease is commonly associated with an absent or coincidental murmur, sinus arrhythmia, and no recent weight loss. Pulmonary hypertension may be appreciated in dogs that undergo echocardiography as part of diagnostic evaluation for cough and a murmur.

**Imaging**

Thoracic radiographs, both inspiratory and expiratory
and including the neck, are ideal for evaluating tracheal collapse; however, these images can be hard to obtain for some small breed dogs, and radiographs alone can miss some cases of tracheal collapse. In addition, the overlying esophagus may make evaluation of the tracheal margins more challenging. Nonetheless, because of their widespread availability, radiographs are commonly the first line of imaging.

Fluoroscopy can be used to dynamically evaluate tracheal collapse; this technique documents location and severity of collapse. Disadvantages of fluoroscopy include radiation exposure and lack of widespread availability.

Computed tomography (CT) can also document lower airway collapse, although it requires both inspiratory and expiratory studies. Use of CT enables comparison of positive end-expiratory pressure and zero or negative end-expiratory pressure. CT is, however, expensive compared with other imaging modalities. The procedure typically requires general anesthesia and intubation, although it can be performed on some awake dogs.

Ultrasonography has also been used to diagnose tracheal collapse. It may be useful in experienced hands and in conjunction with other forms of imaging.

The imaging technique that is perhaps the most useful in dogs with known or suspected tracheal disease is tracheoscopy, or evaluation of the airway with endoscopy. In the author’s opinion, this is one of the most helpful techniques to better evaluate not only the trachea but also the upper and lower airways. In addition, samples can be collected for cytology and bacterial culture and/or polymerase chain reaction (PCR). Dogs with tracheal disease may also have laryngeal dysfunction or epiglottic retroversion, and dogs with tracheal collapse may also have mainstem airway collapse or lower airway/bronchiolar collapse, all of which may influence the management of the suspected tracheal disease.

**TREATMENT**

Tracheal collapse with persistent and/or severe cough can be challenging to treat. Clients should be advised that the goals are to limit the progression of the disease and to control clinical signs to improve the patient’s quality of life.

**Medical Management**

Most cases of tracheal collapse can be treated successfully with medication and management techniques.

For management, it is unclear whether clients or veterinarians can help prevent progression, with the exception that weight loss will decrease cough in overweight dogs. Attempts to keep the dog calm may help as overexcitement can worsen respiratory distress and may lead to further progression. Using harnesses instead of collars is not clearly beneficial in preventing progression of collapse, although not putting additional pressure on the dog’s neck seems like common sense.

For medical management, think of the triad of cough causing collapse, which causes inflammation/mucus production, which causes further airway collapse and cough. Thus, trying to prevent cough may help limit further inflammation, which may cause less cough and reduce some of the bronchomalacia. It is not clear whether coughing directly leads to bronchomalacia or whether the bronchomalacia results in cough.

For medical therapy, the mainstays include cough suppressants, anti-inflammatory agents, and intermittent use of antibiotics (TABLE 1). For intermittent cough, suppressants may be given as needed, with the dose tapered to the lowest amount needed to control cough. Good therapies for cough are limited; the best available are opioids. Hydrocodone has been the most widely used and is very effective, although availability can be limited. Butorphanol is also effective and may be available with a veterinary label. Other opioids such as codeine or guaifenesin/codeine syrup may also be used. Diphenoxylate/atropine is also used with some success for treatment of cough. Oral steroids may decrease inflammation and help decrease associated cough, particularly in dogs.

Clients should be advised that the goals are to limit the progression of the disease and to control clinical signs to improve the patient’s quality of life.
with tracheal collapse as well as lower airway disease/chronic bronchitis. Glucocorticoids tend to promote weight gain and should be tapered to the lowest effective dose. Periodic administration of antibiotics may help if secondary infection develops. Ideally, antibiotic therapy should be based on bacterial culture and sensitivity testing or PCR (e.g., *Mycoplasma*). Maropitant, a neurokinin-1 receptor antagonist, has reportedly been successful for treating tracheal collapse, and a small clinical trial in chronic bronchitis suggested minor improvement of cough.\(^1\) Other medications that may be considered include gabapentin and amitriptyline, although no controlled trials with either drug in dogs have been conducted. The proposed mechanism of gabapentin is to decrease neural triggers of cough.\(^1\) The proposed mechanism for amitriptyline is similar neuromodulation.\(^1\)

One small study explored the use of stanozolol in dogs with tracheal collapse and identified a benefit.\(^1\) However, stanozolol is challenging to obtain in the United States. Bronchodilators are most likely

### TABLE 1 Medications to Consider for Dogs With Tracheal Collapse

<table>
<thead>
<tr>
<th>MEDICATION</th>
<th>DESCRIPTION</th>
<th>GOAL</th>
<th>DOSE</th>
<th>ROUTE</th>
<th>FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrocodone(^a)</td>
<td>Opioid agonist</td>
<td>Cough suppression</td>
<td>0.25 mg/kg</td>
<td>Oral</td>
<td>q6–12h</td>
</tr>
<tr>
<td>Butorphanol</td>
<td>Opioid agonist-antagonist</td>
<td>Cough suppression</td>
<td>0.1–1 mg/kg</td>
<td>Oral</td>
<td>q6–12h</td>
</tr>
<tr>
<td>Diphenoxylate</td>
<td>Opioid agonist</td>
<td>Cough suppression</td>
<td>0.25–0.5 mg/kg</td>
<td>Oral</td>
<td>q8–12h</td>
</tr>
<tr>
<td>Cough tablets</td>
<td>Several</td>
<td>Cough suppression/expectorant</td>
<td>(\frac{1}{2}) tablet, 1 tablet for larger dogs</td>
<td>Oral</td>
<td>q4h</td>
</tr>
<tr>
<td>Prednisone</td>
<td>Glucocorticoid</td>
<td>Decreased inflammation</td>
<td>0.2–1 mg/kg</td>
<td>Oral</td>
<td>q12–48h</td>
</tr>
<tr>
<td>Fluticasone</td>
<td>Inhaled glucocorticoid</td>
<td>Decreased inflammation</td>
<td>110–220 μg/puff</td>
<td>Inhaled</td>
<td>q12h</td>
</tr>
<tr>
<td>Doxycycline</td>
<td>Antibiotic</td>
<td>Decreased infection</td>
<td>5–10 mg/kg</td>
<td>Oral</td>
<td>q24h</td>
</tr>
<tr>
<td>Fluoroquinolone (enrofloxacin)</td>
<td>Antibiotic</td>
<td>Decreased infection</td>
<td>10–20 mg/kg</td>
<td>Oral</td>
<td>q24h</td>
</tr>
</tbody>
</table>

\(^a\)Note the lack of recommendation for bronchodilators for tracheal collapse.

\(^b\)Opioids such as hydrocodone are increasingly hard to source in the United States.

### TABLE 2 Pros and Cons of Surgical Interventions for Tracheal Collapse (Rings and Stents)

<table>
<thead>
<tr>
<th>INTERVENTION</th>
<th>PROS</th>
<th>CONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both</td>
<td>Both surgical options will resolve honking associated with airway obstruction. Surgery may be palliative for dogs with obstruction evidenced by loud breathing and respiratory distress.</td>
<td>Surgery will not markedly improve cough associated primarily with lower airway disease and mainstem collapse.</td>
</tr>
<tr>
<td>Tracheal Rings</td>
<td>Tracheal rings do not cause irritation because they are not in the lumen of the trachea and they are permanent. Rings, in the hands of an experienced surgeon, are a good choice for dogs with primarily cervical disease. They may also be a better choice for young dogs.</td>
<td>Tracheal rings can help only the extrathoracic trachea and thoracic inlet and can potentially be associated with secondary development of laryngeal paralysis resulting from damage to the recurrent laryngeal nerve.</td>
</tr>
<tr>
<td>Tracheal Stents</td>
<td>Stents are good for dogs with tracheal collapse that extends the length of the trachea. Tracheal stents have the advantage of being relatively easy to place, most commonly by using fluoroscopy. Stents come in a variety of sizes.</td>
<td>Stent may not fit firmly, and if there are gaps, granulation tissue may develop around the stent (FIGURE 2). Stents may fracture or lead to infection. With the foreign object (stent) in the lumen, it may be hard to clear secretions. Stents may make cough worse if granulation tissue or stent fracture occur. Tracheal stents are expensive (the stent alone costs $1200–$1800), which, when coupled with imaging and hospitalization, typically adds up to several thousand dollars.</td>
</tr>
</tbody>
</table>
ineffective for treating tracheal collapse because dogs do not experience naturally occurring bronchospasm; however, a recent study supported benefits of theophylline, so it may be useful for some dogs. Other benefits of theophylline may include promoting diaphragmatic contractility and mucus clearance.

**Surgical Management**

Clients often ask about surgery; a Google search brings up over 5 million hits concerning trachea surgery in dogs, and multiple groups on Facebook widely discuss surgical intervention for dogs with tracheal collapse. For dogs that primarily cough, imaging may demonstrate evidence of tracheal collapse; however, in the author’s opinion, surgical therapy will not necessarily decrease the cough and clients will almost invariably be disappointed by surgical outcomes if productive cough is their primary complaint. For dogs with severe clinical signs, trachea surgery may be considered palliative. The key to determining whether surgical palliation should be attempted is determining the primary location of the collapsed region or if multiple segments are affected.

Some clinicians prefer that surgery be performed early, but it is wise to educate clients that no current option returns the trachea to normal. For a moderately to severely affected patient, it is prudent to offer referral for discussion of surgical therapy early rather than late. The 2 options for surgical management are placement of tracheal rings or an intraluminal tracheal stent (TABLE 2).

**Tracheal Rings**

Tracheal rings are small plastic rings that are placed through an incision on the outside of the trachea for external support. The surgery can be challenging, and a good outcome is more likely to occur when performed by an experienced surgeon. Tracheal rings are not visible on radiographs, although the shape of the trachea may appear altered. For a small percentage (<10%) of dogs with tracheal rings, signs may progress over the years, necessitating placement of an intraluminal tracheal stent.

**Intraluminal Tracheal Stents**

Congiusta et al. reported that although medical management was often sufficient for mild to moderately affected dogs, severely affected dogs benefited from placement of a tracheal stent (FIGURE 3). Intraluminal tracheal stents are typically made of the metal nitinol. These self-expanding stents are placed without need for surgery via a special device. Until deployed fully, they are reconstrainable (can be repositioned). The likelihood of stent fracture or granulation tissue is higher for younger dogs, although these events may be mitigated by experienced interventionists and careful stent placement. Despite resolution of the airway obstruction, some dogs continue to cough after stent placement, which may be frustrating for clients who had hoped the procedure would be curative.

**TAKE-HOME POINTS**

- Tracheal collapse is most common in small breed dogs.
- Tracheal collapse can be dynamic (varying with respiration) or fixed (resulting from malformation).
- Diagnosis is typically based on history, physical examination, and imaging.

**FIGURE 2.** Computed tomography reconstruction showing a dog with a tracheal stent in place and granulation tissue at the level of the carina.

**FIGURE 3.** Lateral thoracic radiograph showing a tracheal stent in place.
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Otic Solution for use in dogs only
Do Not Use in Cats.
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DESCRIPTION: CLARO® contains 16 mg/ml florfenicol, 16 mg/ml terbinafine, and 2 mg/ml mometasone furoate. Terbinafine ingredients include water, propylene glycol, peanut oil, propylene glycol, ethyl alcohol, and polysorbate 80.
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DOG AND ADMINISTRATION: CLARO® should be administered by veterinary personnel.
USE IN ORAL, PARENTERAL, TOPICAL FORM.
Do not use in cats.
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- Medical treatments include cough suppressants, anti-inflammatory, and antibiotics.
- Surgical treatments are tracheal rings or intraluminal tracheal stents.
- Surgery may be palliative but does not return the trachea to normal and does not always decrease or resolve cough. TVP

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