



CAUSE

Tracheal collapse (dorsoventral flattening) is most commonly attributed to tracheomalacia associated with a lengthened/hypotonic dorsal tracheal ligament. On histopathology of affected dogs, tracheal cartilage has fewer chondrocytes, hyaline cartilage is replaced by fibrous cartilage, and cartilage contains reduced amounts of chondroitin, glycosaminoglycans and calcium. (I could find no reports of prevention or successful treatment of tracheal collapse with chondroitin and glucosamine supplements, though). Rarer causes include intra- and extraluminal masses and trauma.

SIGNALMENT

- Middle-aged (small proportion of puppies)
- Small breed with domed head, pointy nose, well-muscled neck and narrow thoracic inlet – most commonly Toy Pom, Chihuahua, Yorkshire Terrier and small poodles^{1,12,18}
- Often obese

Tracheal collapse in cats is very rare – I only could find one case report of primary tracheal collapse¹³. The cat was presented for dyspnoea, not because it was coughing. The other rare cases of feline tracheal collapse have occurred in association with an intra- or extra-tracheal mass or trauma¹³.

HISTORY

- Chronic goose honk, paroxysmal cough which may be productive. Usually slowly progressive. Worsens with excitement, exercise, tracheal compression (e.g. collar), eating/drinking.
- Stridor, tracheal snap noted by owner.
- In-/expiratory dyspnoea – mild to cyanosis at rest
- Exacerbated by weight gain, tracheal intubation

CONCURRENT CONDITIONS AND/OR DIFFERENTIAL DIAGNOSES:

- laryngeal paralysis – present in up to 30% of cases¹² (in- and expiratory stridor, voice change, coughing on eating/drinking)
- chronic bronchitis (expiratory heave)
- mitral valve disease (murmur, loss of respiratory sinus arrhythmia, other arrhythmia, signs of congestive heart failure)

Other clinical signs listed in brackets can increase one's level of suspicion for one/several of these. As several conditions may be present concurrently, further tests are needed to confirm the diagnosis/diagnoses.

DIAGNOSIS

Radiography

- o Good screening test – will identify 60–84% of cases^{8,12}
- o Often don't need general anaesthesia – but remember to include the neck
- o Need inspiratory (cervical collapse) and expiratory (intrathoracic collapse) views
- o May under-estimate the extent of trachea involved¹⁰

- o False positive: superimposed fat, oesophagus / longus colli muscles
- o Concurrent bronchiectasis reported in 18/60 cases in one series¹¹. Radiographic evidence of bronchiectasis should increase your determination to perform a complete examination of the respiratory tract to identify concurrent chronic bronchitis/infections

Endoscopy

- o Allows you to see the dorsal tracheal ligament and watch dynamic changes in tracheal diameter
- o Can't easily watch what happens while coughing – false negatives ARE possible with this technique!⁸
- o Allows you to check the WHOLE respiratory tract for concurrent problems: a recent study reported concurrent bronchial collapse in 20/24 dogs with tracheal collapse⁸. This is relevant if you're considering placing a stent. Dogs with concurrent bronchial collapse are more likely to continue coughing after a procedure is performed to widen the trachea (surgery/stenting) and therapeutic choices and prognostication could be adjusted accordingly⁸. Persistent coughing increases the risk of stent migration and persistent coughing is likely to decrease owner and patient satisfaction with the intervention.
- o General anaesthetic needs care as there may be increased vagal tone and the potential for bronchospasm is increased. Pre-medication with opiate antitussives, bronchodilators, anticholinergics and/or short-acting corticosteroids should be considered. Close post-procedure monitoring is essential. Halothane, enflurane and sevoflurane all have similar bronchodilator effects, so may be preferred over isoflurane in these cases⁵.
- o Collect cytology at the same time (trachea and bronchi) to identify concurrent conditions. Consider culture if indicated by cytology.

Grading of tracheal collapse according to endoscopic findings:

- Grade 1: up to 25% loss of tracheal diameter, but cartilage shape is maintained
- Grade 2: up to 50% to tracheal diameter, tracheal rings start flattening
- Grade 3: up to 75% loss of tracheal diameter, flattening of rings palpable
- Grade 4: total tracheal collapse at times, cartilage rings may even invert

NB: Recently a small CT study of 10 dogs without respiratory disease showed that asymptomatic dogs of breeds not traditionally affected with tracheal collapse had an up to 19% difference in inspiratory and expiratory tracheal height. Thus for a diagnosis of Grade 1 tracheal collapse, endoscopic/fluoroscopic findings must be associated with consistent clinical signs and other DDs must be excluded⁹

Fluoroscopy

- o More sensitive than radiographs as you can view the

- o whole respiratory cycle
- o Can make patient cough
- o Not readily accessible

Ultrasound

There are 2 reports using this technique^{4,15}. Because ultrasound is limited to assessing the lateral and ventral wall of the cervical trachea, the technique relies on indirect measurement (i.e. of tracheal width) to indicate tracheal collapse – rather than demonstrating a decreased dorsoventral height or pendulous dorsal tracheal ligament.

Computed Tomography (CT)⁹

It is easy to exclude overlying muscle or fat with this technique. Other than that, CT is much more expensive than radiography, requires access to medical facilities, requires at least sedation and is more difficult to time in relation to the respiratory cycle because exposures are longer.

Watch out: Liver enzymes (12/26 dogs) and bile acids (24/26 dogs) are often elevated in dogs with severe tracheal collapse¹ and hepatomegaly is commonly observed¹². Possible causes include: chronic hypoxia, steroid hepatopathy and hepatic lipidosis associated with obesity¹ or even right heart failure¹². In the group of 26 dogs studied, those that *had* been treated with steroids were no more likely than those that *hadn't* been treated to have high liver enzymes and/or bile acids¹. As bile acids decreased following stent implantation, the authors thought the hepatic changes were probably caused by hypoxia¹.

NEW: NT-proBNP is a new blood test that can help you determine whether a patient's dyspnoea is caused by respiratory disease (NT-proBNP normal) or cardiac disease (NT-proBNP markedly elevated). The test is run by Idexx. Sample handling is important (the samples need to be analysed promptly, so call ahead to the lab and arrange it with them) and you need special tubes.

MANAGEMENT

Medical: always try first

- o **Weight loss**
- o Environmental management:
 - Avoid triggers for cough (e.g. smoke, dust, perfumes), walk on harness
 - Manage other causes for cough: concurrent cardiac disease, chronic bronchitis
 - Manage other causes for obesity: hypothyroidism, Cushing's
 - Remember that tracheal intubation may result in a marked exacerbation of signs
- o Antitussives: Use to suppress a **dry** cough. If cough is moist, consider that there may be something that needs to get out (mucus, secondary infection). Efficacy of butorphanol (get V-tech to make up a paste) > Codeine cough syrup (try putting syrup into empty capsules if the dog finds the taste offensive). Alternatively, try Lomotil at 1 tablet per 5 kg b.i.d.¹⁸.
- o Bronchodilators: Trial therapy indicated where small airway diseases suspected or proven. They dilate bronchi but not the trachea, enhance mucociliary clearance, increase the force of contraction of respiratory muscles and may even have anti-inflammatory effects. The pharmacokinetics of different theophylline sustained-release products

varies in dogs, so try a few. **NB: Do NOT give with a fluorquinolone (e.g. Baytril, Zeniquin)**

- o Corticosteroids: Anti-inflammatory doses (around 0.5 mg/kg b.i.d) are usually very good at resolving clinical signs. Long-term use can lead to weight gain and predispose to bacterial infections of the upper or lower respiratory tract
- o Inhaled corticosteroids/bronchodilators: These have been used for years to try and decrease systemic side effects – but there are no clinical trials in ill dogs proving efficacy. Recently it has been shown that inhaled fluticasone has fewer effects on the pituitary and adrenals than oral prednisolone treatment³.
- o Sedatives: These are used in hyperactive animals whose signs are exacerbated by excitement. The narcotic antitussives, especially butorphanol, work well. Alternatively try alprazolam.
- o Antibiotics: Don't use these based on airway culture alone, i.e. without supporting evidence from clinical signs, radiographs and cytology. In one study bacteria were isolated from the distal trachea in 36% of normal dogs¹². Although bacteria were commonly cultured from dogs with tracheal collapse, few had other signs consistent with an active infection⁷. In another study 2/24 dogs with tracheal collapse had septic cytology at the time of diagnosis⁸. Sterile airway inflammation is much more common – 17/24 cases in the same study.

Surgical

In general, you need to do something about the misshapen cartilage as well as about the redundant dorsal tracheal ligament. Surgical correction is most easily performed on the extra-thoracic trachea. Post-operation complications include laryngeal paralysis and the need for a permanent tracheostomy.

- o Seven of 9 dogs on which plication of the dorsal tracheal membrane was performed improved markedly¹².
- o Ring prostheses prepared from old (3 ml) syringe cases and sown onto cartilage rings with 10–15 mm gaps was the next technique reported. This stretches the trachea open so the dorsal tracheal ligament is taut and tracheal diameter is increased². This technique decreases the risk of damage to blood vessels and nerves compared with spiral ring prostheses. It has been used on intrathoracic parts of the trachea as well.
- o Spiral ring prostheses prepared from the same syringe cases but this time cut at 15 degrees was tried next. This technique provides more uniform support to the trachea (avoiding kinking between supported rings), is quicker and less fiddly to apply. The downsides are that you can get focal necrosis in area where the trachea is trying to bend against a spiral, and that the trachea has to be stripped from the connective tissue for the whole length of the prosthesis, which results in greater disruption of the vascular and nerve supply to the trachea. This disruption increases the risk of tracheal necrosis and laryngeal paralysis¹².
- o The response to these problems was to do a prophylactic unilateral arytenoid lateralisation at the same time¹⁹ and to try and place the spiral prostheses by tunneling them around the trachea and preserving as much of the connective tissue as possible.

Stenting

Here a (self) expanding stent is placed within the tracheal lumen. Advantages over surgery include speed of application and quicker post-op recovery, especially if the intrathoracic

trachea is collapsing. Many complications have been described: stent fracture¹⁴, stent migration, narrowing of the tracheal lumen due to granulation tissue formation, increased susceptibility to infection, stent trapping secretions, stent shortening/extension of tracheal collapse beyond stent¹⁷. Some of these complications may be decreased by modifications of stent design¹⁶. Stent sizing is absolutely critical. 75–90% of cases improve after correct stent placement. Cost of stent: US\$ 800–1000 for the implant. (Of course, you'd ideally want to keep a range of sizes in stock so you only need to anaesthetise the patient once). *NB: the patient will STILL need medical management.* Tracheal stenting is considered a salvage procedure, not a cure and should only be performed if medical management has failed.

Other experimental stuff

- o Laser-assisted reshaping of laryngeal cartilages¹²
- o Goretex mesh tube in a submuscular oesophageal tunnel to replace damaged trachea⁶

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QUESTIONS

1. Which of the following is NOT involved in the pathogenesis of tracheal collapse?

- a. Lengthened dorsal tracheal ligament
- b. Tracheomalacia associated with reduced chondrocyte numbers
- c. Tracheomalacia associated with altered tracheal glycosaminoglycans
- d. Extraluminal mass
- e. Fibrous cartilage is replaced by hyaline cartilage

2. Which small animal patients are NOT commonly affected?

- a. Middle-aged dogs
- b. Obese dogs
- c. Small-breed dogs with domed heads and pointy noses, e.g. Yorkies, Toy Poms
- d. Persian cats
- e. Toy and Miniature Poodles

3. The cough is typically (mark the INCORRECT statement)

- a. Paroxysmal
- b. Slowly progressive
- c. Worse at night
- d. Triggered by tracheal compression eg by collar
- e. Associated with a tracheal snap

4. The following techniques can be used to guard against a misdiagnosis of tracheal collapse on radiography. Indicate which one is FALSE

- a. In 16–40% of cases with tracheal collapse, the lesion is not obvious on radiography but can be seen with endoscopy or fluoroscopy.
- b. CT can be used to determine whether an apparent collapsing trachea evident on radiography is real or just an artefact caused by overlying fat or muscle.
- c. Fluoroscopy can be used to detect dynamic lesions that occur only during coughing and are thus not obvious on the static radiographs.
- d. Endoscopy allows you to see the dorsal tracheal ligament and determine whether it is stretched or not.
- e. In cases with Grade 1 collapse, CT is the most suitable diagnostic technique as it allows you to clearly separate normal and affected patients.

5. Which of the following is only RARELY found as a co-existing problem?

- a. Obesity
- b. Thymic lymphoma
- c. Laryngeal paralysis
- d. Chronic bronchitis
- e. Mitral valve disease

6. Which of the following statements about the diagnosis of tracheal collapse is FALSE?

- a. Both in- and expiratory radiographs of the thorax and neck are needed

- b. Radiography will detect up to 84% of cases, but may underestimate the extent of the lesion
- c. Ultrasound may be used to detect cervical tracheal collapse
- d. Endoscopy is the most sensitive technique
- e. Endoscopy should be performed in all cases where a stent is being considered to identify concurrent bronchial collapse

7. Blood tests may help detect concurrent conditions in patients with tracheal collapse. Which of the following is FALSE?

- a. Most dogs with severe tracheal collapse are hyperlipidaemic.
- b. Most dogs with severe tracheal collapse have elevated bile acids.
- c. Elevated bile acids appear to be a direct consequence of severe tracheal collapse and levels decrease after tracheal stenting.
- d. Elevated liver enzymes occurred in animals that had NOT been treated with corticosteroids
- e. NT-proBNP may help identify dogs in which cardiac disease contributes to their dyspnoea.

8. Medical management of tracheal collapse does NOT include:

- a. Weight loss
- b. Sedatives, e.g. alprazolam, butorphanol
- c. Avoid known triggers for the particular patient's cough eg smoke, dusts, tracheal pressure, excitement
- d. Anti-tussives, e.g. codeine, lomotil
- e. Theophyllin given concurrently with enrofloxacin

9. Which of the following statements about surgical correction of tracheal collapse is FALSE?

- a. Collapse of the cervical trachea is more easily corrected surgically than intrathoracic collapse
- b. Complications of surgery include laryngeal paralysis, tracheal necrosis and tracheal kinking between prostheses leading to continued tracheal collapse
- c. Surgical ring prostheses are very expensive and difficult to obtain
- d. Individual ring prostheses take longer to apply but are less likely to damage the nerves and blood vessels running next to the trachea.
- e. Spiral prostheses are quicker to apply and decrease the risk of the trachea kinking, but should be tunneled around the trachea to maintain vascular supply to the tracheal mucosa.

10. Which statement about tracheal stenting is FALSE?

- a. Tracheal should be recommended as a solution for clients unable to medicate their pet
- b. Tracheal stenting is the treatment of choice for unstable patients who have failed medical treatment because it avoids a lengthy anaesthesia
- c. Tracheal stenting is indicated in patients whose intra-thoracic trachea is collapsing.
- d. Many complications of stenting can be avoided by choosing the correct size stent.
- e. 75–90% of dogs improve after correct stent placement.



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