Tracheal collapse

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Abstract: The proposed aetiology, diagnosis, differential diagnoses and current diseases as well as medical and surgical treatment options of tracheal collapse will be discussed. New aspects (concurrent liver disease, concurrent bronchiectasis and / or bronchial collapse) will be highlighted.

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, YRT and small poodles
- Often obese

Tracheal collapse in cats is very rare – I could find once case report of primary tracheal collapse in this species. 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 trauma.

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

Concurrent conditions and / or DD:
- Laryngeal paralysis – present in up to 30% of cases (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 your level of suspicion for one / several of these. As you may have several conditions present concurrently, you need further tests to confirm the diagnosis / diagnoses.

Diagnosis:
- Radiography:
  - Good screening test - will ID 60-84% of cases
  - Often don’t need a GA – but remember to include the neck
  - Need inspiratory (cervical collapse) and expiratory (intrathoracic collapse) views
  - May under-estimate the extent of trachea involved
  - False positive: superimposed fat, oesophagus / longus colli muscles
  - Concurrent bronchiectasis reported in 18/60 cases in 1 series. Radiographic evidence of bronchiectasis should increase your determination to perform a complete examination of the respiratory tract to identify concurrent chronic bronchitis / infections
- Endoscopy
  - Allows you to see the dorsal tracheal ligament and watch dynamic changes in tracheal diameter
  - Can’t easily watch what happens while coughing – false negatives ARE possible with this technique.
- 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 accordingly⁹. Persistent coughing increases the risk of stent migration and persistent coughing is likely to decrease owner and patient satisfaction with the intervention.

- GA needs care as there may be increased vagal tone and the potential for bronchospasm is increased. Pre-medications with opiate anti-tussives, bronchodilators, anticholinergics and/or short active corticosteroids should be considered. Close post procedure monitoring is essential. Halothane, enflurane and sevflurane all have similar bronchodilator effects, so may be preferred over isoflurane in these cases⁵.

- 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 a for a diagnosis of Grade 1 tracheal collapse, endoscopic / fluoroscopic findings must be associated with consistent clinical signs and other DD must be excluded⁹.

- Fluoroscopy
  - More sensitive than radiographs as you can view the whole respiratory cycle
  - Can make patient cough
  - Not readily accessible

- Ultrasound: there are 2 reports using this technique⁴,¹⁵. Because ultrasound is limited to assessing the lateral and ventral wall of the cervical trachea, the technique relies on indirect measurement (ie of tracheal width) to indicate tracheal collapse – rather than demonstrating a decreased DV height or pendulous dorsal tracheal ligament.

- CT⁹: It is easy to exclude overlying muscle or fat with this technique. Other than that, the 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 lipodosis 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 with steroids 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 this first
  - Weight loss
  - Environmental management:
    § Avoid triggers for cough (eg smoke, dusts, 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 Anti-tussives: 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 Vet 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 bid.

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 fluoroquinolone (e.g. Baytril, Zeniquin)

o Corticosteroids: anti-inflammatory doses (around 0.5 mg/kg bid) 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 fluticazone has fewer effects on the pituitary and adrenals that oral prednisolone treatment.

o Sedatives: These are used in hyperactive animals whose signs are exacerbated by excitement. The narcotic anti-tussives esp butorphanol work well. Alternatively try alprazolam.

o Antibiotics: Don’t use these based on airway culture alone ie without supporting evidence from clinical signs, radiographs and cytology. 36% of normal dogs in 1 study had bacteria isolated from the distal trachea and although bacteria were commonly cultured from dogs with tracheal collapse, few had other signs consistent with an active infection. In another study 2/24 dogs with tracheal collapse had septic cytology at the time of diagnosis. 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 op complications include laryngeal paralysis and the need for a permanent tracheostomy.

o In 1973, plication of the dorsal tracheal membrane was performed on 9 dogs of which 7 improved markedly.

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 increased. 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 paralysis.

o The response to these problems was to do a prophylactic unilateral arytenoid lateralization at the same time 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 in placed within the trachea 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 fracture, stent migration, narrowing of the tracheal lumen and granulation tissue formation, increased susceptibility to infection, stent trapping secretions, stent shortening / extension of tracheal collapse beyond stent. Some of these complications may be decreased by modifications of stent design. Stent sizing is absolutely critical. 75-90% of cases improve after correct stent placement. Cost of stent: 800-1000 US$ for the implant. (Of course, you’d ideally want to keep a range of sizes in stock so you only need to GA 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 cartilages
Goretx mesh tube in a submuscular oesophageal tunnel to replace damaged trachea

References: