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medicalbrief

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★ May 2024 ★

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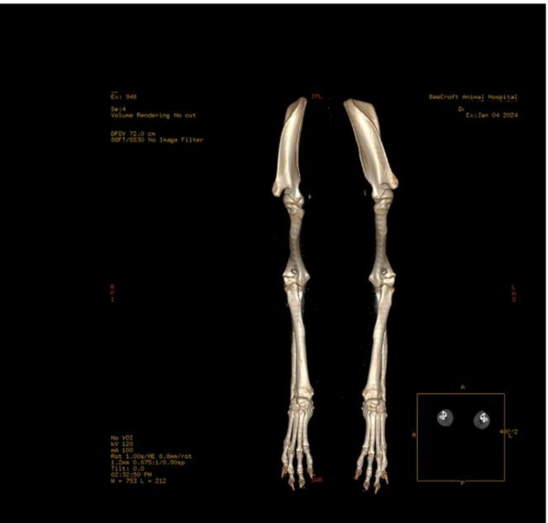

Figure 1. Dorsal plane volume rendering of the whole antebrachium with both the full elbows and carpi.

ADVANCED DIAGNOSTIC IMAGING IN SMALL ANIMALS: COMPUTED TOMOGRAPHY

By Arabel Yap, Dip VeT

INTRODUCTION

Diagnostic imaging has consistently played a crucial role in veterinary medicine since the late 1900s (Meomartino et al., 2021) with the ability to greatly enhance the efficiency of clinician diagnosis. Despite radiography and ultrasonography asserting their position as the more fundamental options, given their accessibility and economic cost-effectiveness, there is a growing trend worldwide in the increased utilisation of advanced diagnostic imaging modalities such as Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) in veterinary practice. This shift can be attributed to these two modalities' enhanced, non-invasive, diagnostic capabilities.

CT proves extremely advantageous by delivering a wealth of information with only a minimal duration of general anaesthetic. Typically, with conventional radiology, we often face the hindrance of obstructive overlying organs or tissues that superimpose internal structures. There is an element of uncertainty as the images produced only provide a two-dimensional picture and may occasionally be insufficient in achieving a diagnostic conclusion due to lack of visibility.

CT imaging attains superior bone definition and anatomical location. It provides detailed cross-sectional images of the body, allowing veterinarians to visualise internal structures more accurately and even generate three-dimensional images with the help of reconstruction algorithms. Some of the common applications of veterinary CT include:

- Musculoskeletal and joint disorders
  - Angular Limb Deformities (ALD)
  - Canine Elbow Dysplasia
- Soft tissue abnormalities and neoplasia
  - Shunts and Vascular Anomalies
- Nasal/Oral lesions

MUSCULOSKELETAL AND JOINT DISORDERS

Angular Limb Deformities (ALD)

CT is increasingly used to diagnose and assess bone angulation in patients with ALD. Axial or helical acquisition can generate three-dimensional models with volume rendering or multiplanar reconstruction (MPR) of the affected bones to improve visualisation and orientation for surgical planning. It can also help quantify the degree of angular deformity in the limbs and assist in preoperative preparation.

Canine tibial or radial torsion with valgus or varus deformities requires the measurement of angles between multiple planes. CT has been demonstrated to be more accurate than traditional radiography where two-dimensional angular measurements may vary as it depends significantly on the standardisation of positioning and alignment of the X-ray beam (Brühschwein et al., 2023).

Canine Elbow Dysplasia (CED)

Canine elbow dysplasia is one of the more common skeletal disorders. Since CED is hereditary, the sensitivity of CT imaging can provide detection in dogs as young as 14 weeks old (Lau et al., 2013). Although ununited anconeal processes and osteochondrosis can be successfully diagnosed on radiographs, multiplanar reconstructions offer sagittal and dorsal planes that are essential in accurately identifying certain pathological conditions associated with CED including joint incongruity and medial coronoid process fragmentation (Hebel et al., 2021).

Figure 2. Multiplanar reconstruction of a patient with elbow dysplasia characterised by medial coronoid fragmentation.

SOFT TISSUE ABNORMALITIES AND NEOPLASIA

Common clinical indications for CT scans encompass tasks such as tumour staging, delineation of surgical margins, and evaluation of metastatic disease, often employing CT angiography (CTA). Initial diagnostic steps typically involve ultrasound due to its accessibility and cost-effectiveness. However, the inherent drawback of ultrasound lies in its relatively restricted field of view, limiting the simultaneous assessment of larger areas or multiple structures. This limitation poses a challenge in accurately pinpointing the origin of mass lesions, often prompting subsequent CTA scans to assist in precisely determining anatomical locations and vascular associations crucial for surgical planning.

Positive iodinated contrast has a high atomic number, effectively absorbing X-ray beams. The increased blood flow in tumours often results in greater contrast agent accumulation, making tumours more conspicuous in the images. When injected into the bloodstream, the contrast agent helps to highlight specific areas and improve the differentiation between organs, lesions, and abnormalities.

In a recent case study, a CTA was conducted to aid in surgical planning for a Golden Retriever diagnosed with an expansile multilobulated granular bony calvarium mass. The CTA facilitated vascular mapping and precise localisation of the tumour, enabling the neurosurgeon to assess the feasibility of undertaking surgery of this magnitude and evaluate potential associated complications.

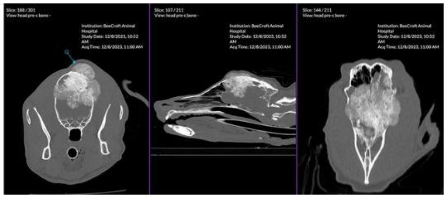

Figure 3. Multiplanar reconstruction of a multilobulated expansile mineralised mass-like lesion at the calvarium that has significantly impacted adjacent structures.

Figure 4. 3D-printed model of cranium with a multilobulated expansile mineralised mass-like lesion (left) and 3D-printed model of cranium with simulated surgical tumour removal (right).

Shunts and Vascular Anomalies

Multiphase abdominal contrast studies, comprising arterial, portal, venous, and delayed phases, serve to characterise lesions or anomalies based on contrast enhancement at distinct time intervals. Various methods are employed for acquiring contrast-enhanced CTA, each presenting its advantages and disadvantages. Notably, injection protocols utilising test bolus tracking necessitate a larger contrast medium volume and extended anaesthesia time to attain precise peak enhancement. This approach facilitates increased accuracy in results, considering the potential impact of patient variability on the corresponding timings for vascular phases. Despite being more labour and time-intensive, test bolus tracking can overcome the variations in contrast enhancement patterns affected by cardiac output and cardiovascular circulation that differ in every patient.

In comparison, bolus tracking represents a time-efficient approach whereby the contrast bolus's transit through the vasculature is monitored to ascertain the ideal moment for image acquisition. A designated region of interest (ROI) is positioned within a major artery or vein, with the CT scanner continually assessing the CT attenuation (density) within this region. Upon reaching a predetermined threshold of contrast concentration in the targeted vessels, the scan commences automatically, thus reducing the necessity for manual intervention and ensuring consistency in timing. Nonetheless, depending on the desired phase acquisition, certain scenarios may entail a delay between the arrival of the contrast bolus and the initiation of the scan, potentially resulting in suboptimal timing and compromising image quality.

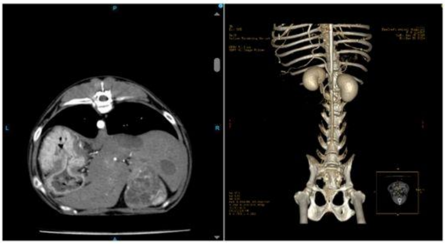

Figure 5. A transverse view of a canine abdomen during the arterial phase. Notable hyperintensity was observed exclusively within the aorta, with no corresponding hyperintensity evident in the caudal vena cava (left). Volume rending of the same arterial phase with visible hyperintense aorta and other arteries (right).

Nasal and Oral Lesions

CT offers exceptionally detailed imaging of nasal structures, facilitating a thorough examination of the nasal cavity, paranasal sinuses, and adjacent tissues. This heightened level of detail is instrumental in the identification and characterisation of diverse nasal pathologies, encompassing tumours, inflammatory processes, and developmental anomalies. Moreover, CT serves as a valuable tool for evaluating the extent of bony involvement in nasal lesions, furnishing intricate insights into bone destruction, erosion patterns, and remodelling changes. Such detailed information is indispensable for accurately gauging disease extent and strategising interventions, including rhinoscopies and surgical procedures.

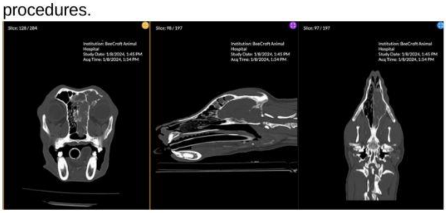

Figure 6. A multiplanar view of a large heterogenous soft tissue attenuating mass occupying a majority of the right nasal cavity, right frontal sinus and sphenoidal sinus. Extensive lysis of the nasal turbinates, medial wall of the right orbit, right frontal bone, ethmoidal bone, nasal septum, and cribriform plate has resulted from aggressive neoplastic invasion.

CONE BEAM COMPUTED TOMOGRAPHY CANNOT SUBSTITUTE CT

It is important not to confuse Cone Beam Computed Tomography (CBCT) with conventional CT imaging. CBCT utilises a cone-shaped X-ray beam and a two-dimensional detector to capture images in a single rotation around the patient. Its primary application is dental and facial imaging, providing views of teeth and in the facial area. However, there are limitations to its utility. CBCT is not recommended for routine imaging of thoracic and abdominal regions or soft tissue examinations due to its reduced soft tissue contrast resolution and increased motion artefacts. Cone beam technology is not reliable for tissue density assessment, reducing the ability to define soft tissue lesions or structures (Varshowsaz, et al., 2016).

On the other hand, conventional CT uses multiple detectors to capture images from various angles and perform multiple rotations around the animal. Conventional CT is particularly suited for comprehensive imaging of the skull, brain, and larger anatomical regions like the thorax, abdomen, or spine. As a result, CT offers greater diagnostic capabilities compared to CBCT and cannot be replaced by it.

Figure 7. Arabel Yap, head of Imaging department at Beecroft, positions a patient on the CT table to ensure the area of scan is properly aligned with the scanner's gantry.

Figure 8. Cone Beam Computed Tomography © 2021 Animal Medical Center of Seattle.

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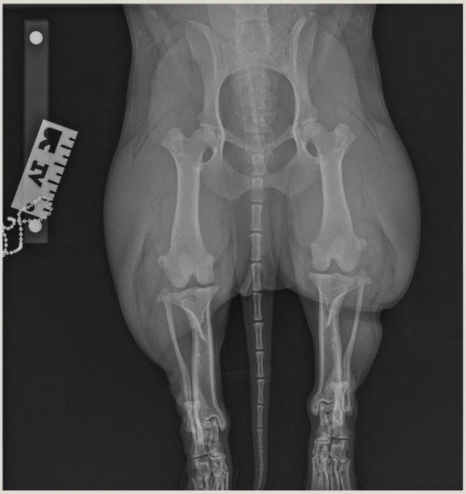
PENNHIP



SCREENING FOR HIP DYSPLASIA

Workup @ $983.22 (with GST)

- AIS PennHIP Interpretation (Standard)
- IV Catheter Placement
- IV Infusion Set Up Fee & fluid bag
- Pre-Anaesthetic Medications
- Radiograph (required radiograph views)

Referral Process

Referral bookings are available online at www.beecroft.com.sg or via the QR code.

MANAGEMENT OF OTITIS MEDIA IN GUINEA PIGS

Dr Athena Lim BSc, BVMS (Murdoch) (ECM resident)

Rina Maguire, BVSc hons 1, Dip ABVP ECM, DACEPM (ECM specialist)

Otitis media is a common disease encountered in pet guinea pigs. The most common route of infection would be an ascending or descending respiratory infection via eustachian tube. Another less likely aetiology could be due to an extension of external ear infection into the middle ear. Otitis externa infection is evidenced by the presence of purulent debris in the ear canal, erythema (redness), and edema (swelling) of the ear canal skin. In this case study, a foreign body in the ear canal caused an otitis externa and a chronic otitis media was also noticed radiographically. Signs of otitis interna may not be obvious other than unspecific signs of pain, anorexia, and gut stasis. In some cases, the disease can be asymptomatic. A clinician may notice signs such as a head tilt, facial nerve paralysis causing secondary ulcerative keratitis, and facial contracture[1,5]. Otitis interna may elicit severe vestibular signs such as torticollis, ataxia and a horizontal nystagmus[3,5]. Common etiological agents associated with otitis media include *Streptococcus pneumoniae, Streptococcus equi subsp. zooepidemicus, S. pseudointermedius and Bordertella bronchiseptica*[1,5]. Other differentials may cause neurological symptoms in the guinea pigs such as insulinoma, heavy metal toxicity, encephalitozoon cuniculi[9], cerebrovascular accident and neoplasia.

A CASE STUDY

A one-year-two-month-old female entire American Shorthair guinea pig was evaluated for a left head tilt, lethargy and hyporexia. The patient also has a history of chronic pneumonia which had been managed with several weeks' duration of oral antibiotics and nebulisation therapy. Apart from the mild left head tilt, reduced left palpebral reflex and a moderate grimace score, the pet was in good body condition and the physical exam was unremarkable. Skull and thoracic radiographs were performed under chemical restraint of midazolam 0.5mg/kg IM. There was increased soft tissue opacity with an alveolar pattern in the right cranial lung lobes. There was also increased soft tissue attenuation and thickening of bilateral tympanic bullae. (Figure 1 & 2) Cytology of the discharge in both ears revealed non-budding yeasts and some inflammatory cells. The yeasts were not likely the causative agent but a secondary infection. These results supported a diagnosis of chronic pneumonia, bilateral otitis externa and otitis interna. A bacterial infection was suspected due to the prevalence of the presence of otitis media and interna signs. Medical therapy was initiated with enrofloxacin 12mg/kg PO BID, terbinafine 5mg/kg PO BID, meloxicam 1mg/kg PO BID, nebulisation with hypertonic saline as well as supportive gut motility drugs and critical care feedings. The pet was reviewed in 10 days but there was no significant improvement. An endoscopic evaluation of the ear canals and a left-sided myringotomy was recommended.

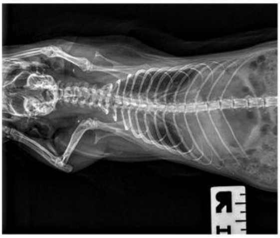


Figure 1. Ventrodorsal radiograph view showing increased soft tissue attenuation and thickening of bilateral tympanic bullae.

Figure 1. Right lateral radiograph view showing increased soft tissue opacity with an alveolar pattern in the right cranial lung lobes.

The patient was pre-medicated with 0.05mg/kg IM buprenorphine and 0.5mg/kg IM midazolam followed by 0.1mg/kg SC Atropine and 2mg/kg SC maropitant. The patient was induced and maintained on isoflurane with a face mask. A rigid Karl Storz 30-degree 2.7mm endoscope was used for the exploration of the ear canals. There was moderate to severe inflammation of bilateral ear canals, but the left canal appeared to be more affected. A strand of hay was found proximal to the left tympanic membrane. (Figure 3) The foreign material was removed from the ear canal. A small fenestration was made on the pars tensa using a 0.7mm myringotomy needle and the tympanic cavity was gently lavaged with sterile saline. Fluid was then suctioned out and collected for culture and sensitivity.

The patient was reversed with flumazenil and recovered well. It was noted that the head tilt was slightly more pronounced during recovery likely due to pain. The patient was hospitalised overnight for monitoring and managing any postoperative gastrointestinal ileus. Dilution of 6ml of injectable enrofloxacin 5% (baytril) with 2ml of injectable dexamethasone sodium phosphate (2mg/ml) and 12ml of saline was administered into both ear canals at a frequency of 0.1ml BID AU for seven days and pain management and antibiotics were continued as previously described.

The left head tilt was not present the following day and the guinea pig was discharged two days later. Topical ear medication was continued for seven days. At the one-week recheck, ear cytology was repeated and showed normal cells. No clinical relapse of the left head tilt was observed, and the pet was back to normal in terms of its appetite and energy levels.

Discussion

In this case study, the guinea pig was diagnosed with severe otitis externa secondary to a foreign body in the left ear canal. The pet showed radiographic changes to the tympanic bulla which is indicative of otitis media. Due to the signs of the left head tilt and the history of chronic respiratory infection, a left-sided myringotomy was performed after the removal of the foreign body in the ear canal. The patient's right ear was treated medically with antibiotic ear drops as no signs of otitis interna were observed.

Skull radiographs can be diagnostic for otitis media and were reported to have a 96% accuracy in affected guinea pigs[1]. Radiographic findings are characterised by the presence of radiopaque contents/soft tissue attenuation within tympanic bullae and increased tympanic wall thickness. Advanced imaging such as Computed tomography (CT) is preferred to evaluate the tympanic bullae and the extent of involvement of deeper structures especially if surgery is considered[5]. The use of IV Contrast can be used to check for any uptake in the brain to rule out central nervous system involvement.

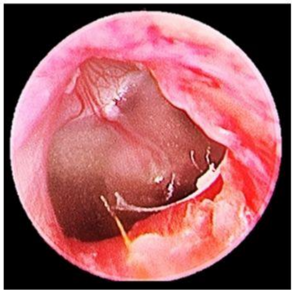


Figure 4. Videoscopic image of a guinea pig's ear canal and tympanic membrane. The pars tensa appears thin and transparent. There is evidence of inflammation, debris, and hay material in the ear canal.

Medical treatment includes analgesics, anti-inflammatories, and antibiotics therapy ideally based on culture and sensitivity. Fluoroquinolones, tetracyclines, and chloramphenicol have been used[3,5]. Prochlorperazine or meclizine, may be beneficial in patients that are exhibiting head tilt and/or rolling[10]. Medical therapy may improve clinical signs but is often not curative due to the caseous nature of the purulent discharge. Total ear canal ablation, partial ear canal ablation and lateral bulla osteotomy (TECALBO/PECALBO) have been performed in dogs, cats, and rabbits to treat middle ear disease[7,8]. There is only one report of TECALBO in guinea pigs and three out of four patients died within two weeks post-surgery[4]. With the significant mortality rate and postoperative complications (facial nerve paralysis, anorexia, persistent head tilt), this procedure is not recommended in this species[3,4].

Endoscopy-assisted myringotomy with tympanic cavity lavage has been described as a treatment which has been associated with fewer complications[2,3]. Endoscopy can be a valuable diagnostic tool as the tympanic cavity and membrane are assessed and explored during the process[2,3]. The guinea pig's ear canal diameter has been described to be narrower than the rat[2], hence a suitable endoscope diameter less than 3.5mm operating sheath is recommended for videoscopy[2].

The guinea pig's tympanic membrane lacks pars flaccida[6]. Weekly repeated lavage is recommended until no purulent discharge is seen to reduce bacteria and effusion from the tympanic cavity and tympanic membrane. The healing time of the tympanic membrane has been described as an average of 21-28 days, though inflammation due to otitis media may delay this[3].

It is important to provide supportive care and adequate analgesics for all sick and hyporexic guinea pigs including fluid therapy, anti-inflammatory, opioids, and pro-kinetics for gastrointestinal health. Guinea pigs tend to fare better with early intervention. The prognosis for otitis media and interna is usually fair to guarded but resolution has been successfully seen in many clinical cases. Guinea pigs with severe tympanic bullae osteolysis and those with severe comorbidities may not be suitable candidates for myringotomies and sole medical management can be explored.

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TOTAL HIP REPLACEMENT
IN SMALL DOGS AND CATS

INTRODUCTION

Total hip replacement (THR) is recommended for dogs and cats exhibiting clinical signs associated with hip pathology. It is important to note that lameness may not be immediately evident during the initial evaluation. Therefore, a detailed history is critical for interpreting clinical examination findings.

- Decreased mobility
- Difficulty standing up, climbing stairs, jumping
- Stiffness
- Reluctance to jump
- Depression and anorexia
- Abnormal grooming
- Changes in temperament

REFERRAL PROCESS

Please continue to use our online referral form to refer potential hip replacement cases. Pre-surgical screening for templating, implant selection, and evaluation of the skin condition will be performed with Dr Patrick Maguire.

CASE SELECTION FOR VISITING SPECIALIST

A founding fellow of joint replacement who is recognised globally for his work, surgical specialist for small animals, Dr Antonio Pozzi, Dipl. ECVS, ACVS & ACVSMR, will be available at Beecroft for referrals on the following dates:

- 8th to 12th July 2024
- 22nd to 24th July 2024

DR PATRICK MAGUIRE, BVSC HONS 1, DACVS-SA

Dr Patrick Maguire is a small animal specialist surgeon and founding partner of Beecroft Animal Specialist & Emergency Hospital. Dr Patrick's involvement in total hip programmes dates back over 15 years. He is the second full-time specialist surgeon to work in Singapore and the only Diplomate of the American College of Veterinary Surgeons.

APPROACH TO THE COUGHING PATIENT

By Gordon Yeo, BVMS (Hons)

INTRODUCTION

Coughing is a common clinical sign presented in practice and serves a vital function of protecting the airways. However, excessive coughing can become detrimental to one's quality of life, affecting ability to sleep, breathe, exercise, eat and drink. In severe cases, coughing may even cause syncope, urinary/fecal incontinence, muscular pain, and exhaustion. Approximately one in three people suffer from interrupted sleep annually due to a bout of cough (Jansen et al., 2001). Similarly, with many pet owners sleeping in the same room as their pet, a coughing pet may be particularly conspicuous, affecting the clients' sleep quality and general wellbeing. Therefore, coughing is a clinical symptom that is frequently noticed by owners and presented to veterinary practices.

The purpose of this essay is to increase our understanding of coughing. We provide a brief background information on the physiology as well as the general diagnostic and therapeutic approach to a coughing patient. This essay will also touch on two cases that were seen by the Beecroft Internal Medicine referral service. For further reading or clarification regarding specific diseases, diagnostics and treatment, please refer to the recommended reading material list and references below.

WHAT IS A COUGH?

Two types of cough can be differentiated:

1. Tracheobronchial cough

It involves three physiological phases which include:

i) Inspiratory phase: Initial deep inhaling of air which will cause lengthening of the expiratory muscles.
ii) Compressive phase: Closure of the glottis results in a buildup of intrathoracic pressure due to contraction of expiratory muscles against the closed glottis.
iii) Expiratory phase: Opening of the glottis is followed by closing of the nasopharynx and forceful expiration through the mouth. This will also result in the expulsion of airway debris and secretions rostrally. The sound of the cough is caused by vibrations of the vocal cords, laryngeal structures, and large airways.

2. Laryngeal cough

Also known as an expiration reflex.

i) Induced by stimulation of the vocal cords or trachea.
ii) Forceful expiratory effort against a closed glottis which will elicit a cough.

Being able to differentiate between a tracheobronchial from a laryngeal cough is clinically relevant as they have different physiological functions and meanings. The key differences between tracheobronchial and laryngeal cough are listed in the table below (Figure 1).

Differences	Tracheobronchial cough (or typical cough)	Laryngeal cough (or expiratory reflex)
Cough characteristics	Contains an inspiratory phase.	Lacks an inspiratory phase.
Function	Airway clearance and maintenance of mucociliary apparatus.	Protects airway from aspiration.
Localisation of issue	Lower airway stimulation.	Upper airway stimulation.

Figure 1. Key differences comparing between tracheobronchial and laryngeal cough.

Physiology of coughing (refer to Figure 2)

Coughing is an important defence mechanism designed to protect the respiratory system. The mechanism can be complex, and these are some key pointers:

- It involves stimulation of two types of cough receptors; mechanical or chemoreceptors. These receptors are located within the epithelium of the airway.
- There is an unequal distribution of these receptors with varying sensitivity (Ferasin and Linney, 2019).
  - The proximal airways (larynx, trachea, and large bronchi) are predominantly mechanosensitive. Mechanical stimulation of the larynx will trigger a laryngeal cough.
  - The distal airways (bronchi) are predominantly chemosensitive.
  - The smaller bronchi, bronchioles and alveoli do not initiate the cough reflex.
- Stimulation of sensory cough receptors is mediated by the vagus nerve.
- Following stimulation of these receptors, information through the afferent pathways will be transmitted via the vagus nerve to the medulla (Hseih and Beets, 2020).
- This is followed by the efferent pathway which will stimulate the respiratory muscle, laryngeal muscle and bronchial smooth muscle which elicits a cough. In general, coughing is under control by the autonomic system. However, there is also some degree of conscious control that can take place and it is possible for dogs to learn to cough as a conditioned behaviour to attract the owner's attention.

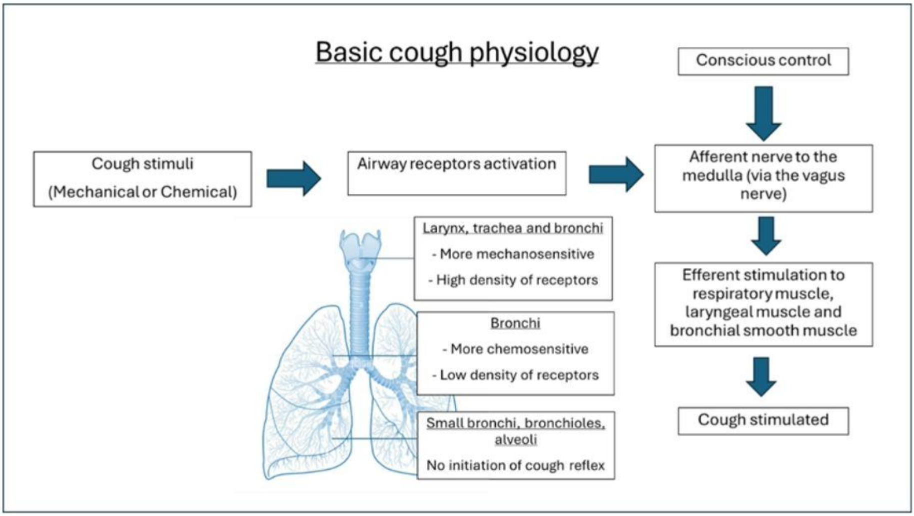


Figure 2. Basic cough physiology

Role of mucociliary apparatus

The mucociliary escalator moves airway secretions rostrally, this will trigger cough receptors which are most concentrated at the airway bifurcation (Corcoran, 2010). This will expel secretions, irritants, or foreign materials out of airways, preventing inhalation.

Pathophysiology

During clinical disease, coughing is typically triggered by either diseases that cause increased stimulation or increased sensitivity/decreased threshold of the sensory cough receptors.

- Disease processes that can result in increased stimulation of these sensory cough receptors can be classified as either endogenous or exogenous. Endogenous stimuli include inflammation and bronchial secretions, while exogenous triggers include foreign body inhalation, smoke and dust.
- Example of a disease process that can cause increased cough receptor sensitivity is *Bordetella bronchiseptica* infection in dogs, which results in increased sensitivity of rapidly adapting stretch receptors (RARs), lowering the cough reflex threshold (Dixon et al., 1979).

KEY INFORMATION AND DIAGNOSTIC APPROACH OF A COUGH WORKUP

1. Signalment:

- Breed predisposition to certain diseases causing cough: tracheal collapse, bronchitis, brachycephalic syndrome, laryngeal disease, etc.
- Patient's age

Signalment	Laryngeal cough (or expiratory reflex)
Small breed dogs (e.g. Pomeranian, Yorshire terrier)	Tracheal collapse
Brachycephalic dog breeds	Brachycephalic obstructive airway syndrome
Older large breed dogs (e.g. Labrador)	Laryngeal paralysis
Terriers (e.g. West Highland white terrier and Cairn terrier)	Idiopathic pulmonary fibrosis
Young dogs with recent history of being in a kennel	Canine Infectious respiratory disease complex
Senior dogs	Pulmonary neoplasia

Figure 3. Summary of common signalments associated with coughing.

2. History taking:

- Vaccination status
- Assessing the chronicity
- Severity of clinical signs

Questions	Possible answers	Common differentials/Interpretation
Duration/chronicity	Acute – <3 weeks Subacute – 3-8 weeks Chronic – >8 weeks	Will influence diagnostics and management.
Productive/Non-productive	Mucus/Exudate	Bacterial/aspiration pneumonia, bronchitis.
	Hemoptysis	Coagulopathy, neoplasia, pulmonary thromboembolism, heartworm disease
	Non-productive	Airway collapse, early congestive heart failure, chronic bronchitis
Environment	Possible exposure to dust mites, cigarette smoke, strong scented items/perfumes, mold, litter tray dust.	Allergic causes considered – such as feline asthma, eosinophilic bronchopneumopathy.
Exposure to other pets + Vaccination history	Yes/No	Infectious contagious causes of cough.
Travel history + Parasite preventatives	Yes/No, region of the world?	Parasitic diseases based on endemic region.
Other relevant signs	Dyspnoea, known heart murmur, nasal discharge, vomiting or regurgitation.	Cardiac disease, post-nasal drip syndrome, gastroesophageal reflux disease.

Figure 4. Non-exhaustive list of pertinent information to obtain from owners.

3. Clinical examination

Always perform a complete physical examination as it can provide useful clues to better understand systemic diseases/causes of the cough: i.e. temperature, lymph nodes, skin, etc.

More specific physician examination:

i) Oronasal cavity examination:

- Oculo-nasal discharge
- Indirect signs of swallowing or licking suggestive of post-nasal drip syndrome
- Oral examination

ii) Upper airway examination:

- Abnormal respiratory noises:
  - Stertor is a snoring sound caused by partial obstruction of the nasal passage and/or nasopharynx.
  - Stridor is a harsh shrill sound caused by an upper airway obstruction, more likely laryngeal in origin. But it can also be due to pharyngeal, tracheal, cervical or nasal in origin.
- Palpation around the cervical, laryngeal, and cranial tracheal region.
- Tracheal pinch is a commonly performed test.
  - It involves palpation and manipulation of the trachea.
  - A "positive" result is classically defined as displaying a cough during this exam. This tracheal pinch test is not a confirmation of the origin of the cough.
  - However, it is still a useful tool to ascertain with clients whether the cough elicited is similar to the cough displayed at home.

iii) Lower airway examination:

- Auscultation to identify abnormal lung sounds.
- Abnormal adventitious lung sound can help with localisation of the issue.

Abnormal airway sounds	Description	Common causes	Key points
Fine crackles	Caused by opening of small airway that has collapsed (usually secondary to cellular infiltrates/oedema) or obstruction caused by airway exudate.	Early inspiratory - consider obstructive pulmonary diseases (e.g. asthma, chronic bronchitis). Mid-to-late inspiratory - consider restrictive pulmonary disease (e.g. interstitial fibrosis, pneumonia, pulmonary oedema).	The presence of fine crackles does not confirm cardiac failure. Both pulmonary and cardiac disease can cause this change.
Coarse crackles	Caused by rupture of fluid (usually secondary to cellular infiltrates/oedema) or obstruction caused by airway exudate.	• Severe congestive heart failure (causing fluid accumulation in large airways) • Tracheobronchitis • Other large airway inflammatory disease	Difference between coarse and fine crackles is that coarse craackles are easily heard over trachea/mouth even without a stethoscope.
Wheezes	Caused by airway narrowing and vibration of small bronchial walls or between bronchial walls and another structure (e.g. mass/mucus)	• Classically small airway constriction, most commonly asthma. • Small airway narrowing (e.g. pulmonary oedema, pneumonia, bronchitis, fibrosis, neoplasia).	This is not pathognomonic for bronchial diseases.
Stridor	Caused by laryngeal/large airway obstruction.	Most common tracheal collapse. Possibly heard in patients with severe laryngeal paralysis.	Exacerbated by situations which cause increased respiratory rate and depth (e.g. when stressed).
Stertor	Caused by nasopharyngeal obstruction (e.g. elongated soft palate, excessive pharyngeal tissues or weak pharyngeal muscles).	Most commonly in Brachycephalic Obstructive Airway Syndrome (BOAS) patients. Also, in laryngeal paralysis patients.	Typically low frequency and sounds like snoring.

Figure 5. Summary of airway sound. Adapted from Keene et al. (2014).

iv) Cardiac examination:

- Abnormal murmurs, heart rate and rhythm.
- Identify a sinus rhythm which reduces the likelihood of a cardiac etiology and corresponds to enhanced vagal tone (primary respiratory disease).

4. Radiography

A three-view thoracic radiograph is the most valuable initial diagnostic test.

Identify evidence of:

- Extrathoracic abnormality (e.g. ribs, sternum)
- Trachea, mediastinum:
  - Enlargement of the mediastinum
  - Narrowing of the trachea, inconsistent diameter
- Cardiomegaly
  - Enlargement/congestion of pulmonary vessels, triggering the lower cough receptors
  - Left-sided heart enlargement typically causes coughing due to severe left atrial enlargement compressing the mainstem bronchi.
- Pulmonary lung patterns
  - Localisation (caudal versus ventral)
  - Three types of parenchymal pattern: Bronchial, interstitial, alveolar

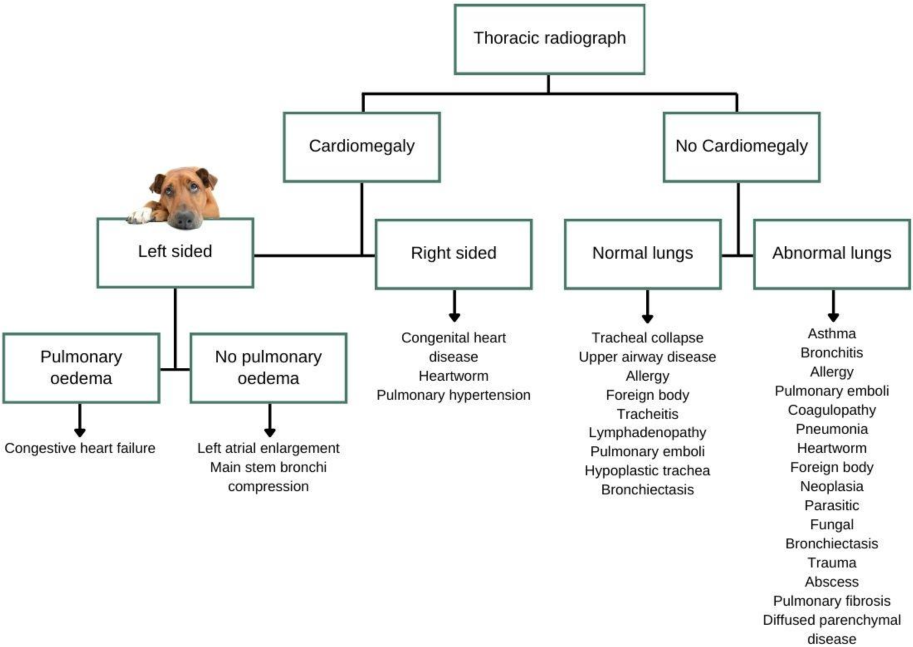


Figure 6. Algorithm for radiographic interpretation in a coughing patient. Adapted from Ettinger et al. (2024).

5. Laboratory tests

- Basic profile
  - Complete blood count to look for inflammatory leukogram, neutrophilia with or without a left shift and variable evidence of toxic changes would be suggestive of a bacterial pneumonia.
  - Biochemistry testing: Hypoalbuminemia is another common finding in patients with pneumonia which was present in around 53% of the patients in the study by Koogan et al. (2008).
- Additional testing which can be done in general practice will include testing of ProBNP.
- Heartworm testing and faecal testing.

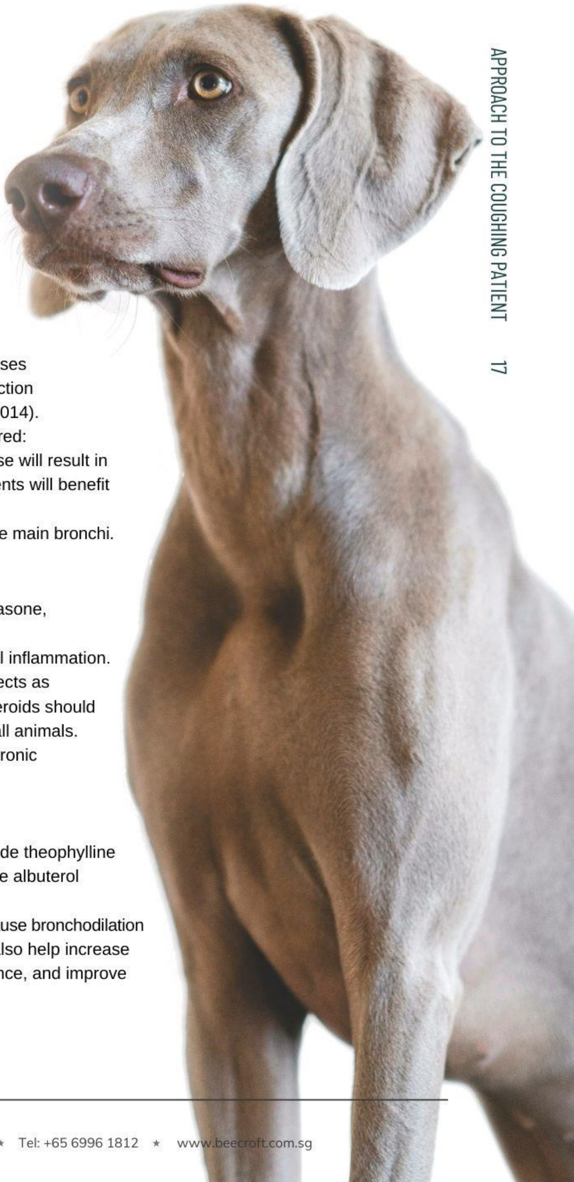
6. Advanced diagnostics

These are generally investigations that are best performed with an internist or an experienced practitioner. These diagnostics are sometimes indicative to achieve a definitive diagnosis for a more targeted therapy which is especially important in chronic cough cases.

Further investigations may entail CT scans, upper airway examination, bronchoscopy, bronchoalveolar lavage, and infectious disease screening (e.g. culture, PCR, serology).

THERAPEUTIC OPTIONS CONSIDERATIONS

- The etiology of the cough should be considered first prior to deciding the therapeutics.
- There is no fixed treatment plan for the management of cough.
- Always consider these factors prior to deciding the therapeutic plan:
    - Underlying cause
    - Treatment goal
    - Patient's quality of life
    - Chronicity and characteristics of cough.



Therapeutic options for cough management will include:

1. Cough suppressants
    - Examples include codeine, butorphanol, hydrocodone.
    - These are centrally acting antitussives which act on the medullary cough centre to inhibit the cough reflex.
    - Usage should be reserved for patients with chronic non-productive coughs that are negatively impacting their quality of life. It could mask symptoms and worsen diseases by suppressing the necessary cough reflex. Coughing is designed as a defence mechanism.
    - Antitussives are contraindicated in the management of bacterial pneumonia and other immune-mediated diseases as it will interfere with the body's ability to clear the infection and result in the retention of mucus and debris (Dear, 2014).
    - Two conditions cough suppressants should be considered:
        i) Chronic coughing conditions such as tracheal collapse will result in further airway irritation and compromise. These patients will benefit from antitussive therapy.
        ii) Patients with cardiac cough due to compression of the main bronchi.

2. Corticosteroids (inhaled/systemic)
    - Examples include prednisolone, dexamethasone, fluticasone, beclomethasone, and budesonide.
    - These act directly on the airway mucosa to reduce local inflammation.
    - Inhaled corticosteroids generally carry less adverse effects as compared to systemic administration, inhaled corticosteroids should be administered using specific masks designed for small animals.
    - Diseases which could benefit from steroids: asthma, chronic bronchitis, eosinophilic diseases.

3. Bronchodilators (inhaled/systemic)
    - Two main classes are methylxanthines (examples include theophylline and aminophylline) and beta-agonists (examples include albuterol and terbutaline).
    - Methylxanthines are phosphodiesterase inhibitors that cause bronchodilation by allowing bronchial smooth muscle relaxation. They also help increase diaphragmatic contractility, increase mucociliary clearance, and improve pulmonary perfusion.

- Beta-agonists cause adenylate cyclase activation which results in the relaxation of smooth muscle. They also inhibit cholinergic neurotransmission, stabilise mast cell membranes, inhibit the release of mast cell mediators, increase mucociliary clearance, and decrease vascular permeability.
  - Clinical usage should be carefully monitored: Efficacious in reducing bronchospasms in cats and is the treatment of choice for feline patients in status asthmaticus (Barchilon and Reinero, 2023) but not manage them chronically.
- Side effects will include hyperexcitability, tachycardia and gastrointestinal upset. Would advise cautious usage in patients with cardiac disease.

4. Antibiotics

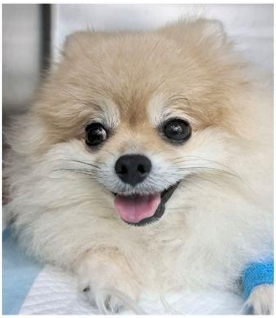
- Indicated for infectious causes of pulmonary disease.
- Ideally antibiotic choice should be based on culture and sensitivity results whenever possible.
- Conventional veterinary recommendation is to treat dogs with pneumonia for three to six weeks or one to two weeks beyond radiographic resolution. However, more recent studies were suggestive that short courses of antibiotics are sufficient in the management of uncomplicated aspiration pneumonia after normalisation of clinical signs and serum CRP (Fernandes Rodrigues et al., 2022).
- Antibiotics choice should be based on the guidelines from the latest consensus.

5. Non-pharmacological management

- Environmental control by avoiding airway irritants and pollutants.
- Weight loss
- Nebulisation and coupage

CASE EXAMPLES

We have included two coughing cases that were seen as referrals by our Internal Medicine service.
There are some useful take home pointers that will be useful even when working in primary practice.



Case 1 - The coughing Pomeranian

Short summary of history

A 7-year-old female spayed Pomeranian was referred to the Beecroft Internal Medicine Service for management of acute-on-chronic goose-honking cough, dyspnoea, and cyanosis. Prior to referral, the patient had been trialled on oral corticosteroids, bronchodilators, and cough suppressants, but the clinical signs persisted.

Physical exam

On initial physical examination, the patient was displaying intermittent goose-honking cough and tachypnoea. The patient had a body condition score of eight out of nine. The rest of the physical examination was unremarkable.

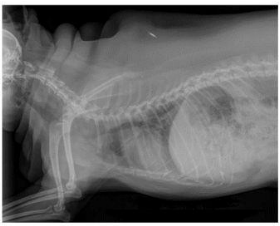


Image 1: Right lateral thoracic radiograph.

Image 2: Ventrodorsal thoracic radiograph.

Diagnostics

Thoracic radiographs (from the primary care providers) revealed severe tracheal collapse at the level of the thoracic inlet with generalised bronchointerstitial lung pattern (refer to images 1 and 2 below).

Tracheoscopy and bronchoscopy revealed grade 4 collapse of the trachea, carina and left mainstem bronchi (refer to images 3 and 4). There was a grade three collapse at the level of the right main stem bronchi. There was generalised hyperaemia and increased mucoid material.

Bronchoalveolar lavage was performed concurrently to collect samples for cytology, canine respiratory disease PCR panel and culture. The cytology revealed a mixed inflammatory response consistent with chronic airway disease. The PCR panel and culture results were negative. This allowed us to rule out concurrent infections which can result in implant infections or failure.

Diagnosis
Tracheobronchomalacia caused severe tracheal and bronchial collapse.

Treatments/Procedures
In this patient, the bronchoscopy/tracheoscopy, bronchoalveolar lavage, tracheal dimension measurements and tracheal stent placement were performed under the same general anaesthesia. The tracheal dimension measurements were obtained via the placement of a marker catheter in the oesophagus (refer to image 5.). This is a crucial step as stent diameter oversizing and natural tracheal taper were associated with an increased risk of caudodorsal stent fracture (Violette et al., 2019).

Following measurements, an intraluminal tracheal stent was placed which extended from the caudal cervical region, across the thoracic inlet to the cranial thorax (refer to image 6.). These were regions that were determined to have the greatest degree of collapse. The patient had a smooth recovery post-stent placement and was better able to ventilate itself. The patient was subsequently discharged as it showed significant clinical improvement after placement.

At the time of writing this newsletter, the patient remained clinically well with no evidence of stent-related complications.

Important take-home pointers
While we are very glad that the patient had an excellent recovery and outcome following the stent placement, it is important to understand the indications of surgical intervention especially prior to referral. Surgical intervention for tracheal collapse is commonly requested by both clients and referring primary vets as there has been increasing recognition. However, there were also many instances where clients and fellow veterinary professionals could have misconceptions regarding this procedure.

Patient selection is key, and we generally recommend stent placement in severely affected patients who are refractory to medical management. These are typically patients with severe inspiratory-expiratory stertor and obstructive dyspnoea indicative of severe dynamic tracheal obstruction. It is also imperative to understand that if coughing is the primary complaint, a stent is not indicated. Coughing is not only a sign of tracheal collapse and might warrant further diagnostics to rule out other causes of coughing.

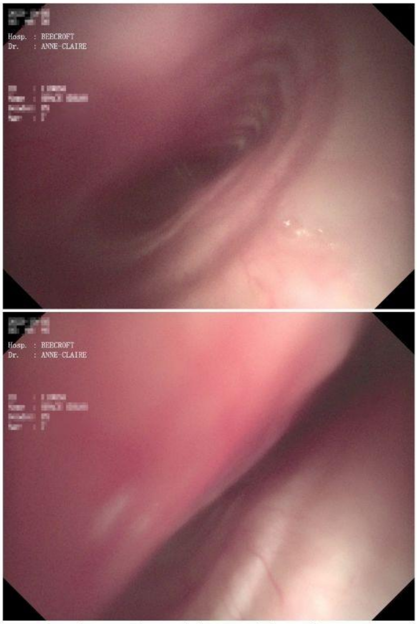


Image 3 and 4. Bronchoscopic images of the trachea.


Image 5. Tracheal dimension measurement with a marker catheter.

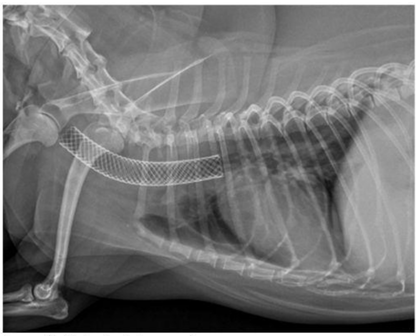


Image 6. Post-stent placement

Stent placement will result in coughing as it is a foreign material placed on the inflamed trachea and post-stent coughing management is one of the mainstays of stent management to avoid dislodgement.

A paper looked at non-goose-honking cough patients who had stents placed and there was an equal percentage of patients who had improved and worsened cough post-stent placement in the study by Weisse et al. (2019). Therefore, highlighting an important point that, with stent placement, this is not a procedure to cure coughing. Instead, our goal is to restore a good quality of life to patients who are severely affected and unresponsive to medical management.

Medical management of tracheal collapse will also need to be continued immediately post-stent placement. This is in combination with lifestyle modifications which will include weight management in obese patients, use of harnesses instead of neck collars and avoidance of airway irritants or stimulants.

Image 7 and 8. Bronchoscopic images of the mainstem bronchi.

Case 2 - The coughing puppy

Short summary of history

A 10-month-old male Cockapoo was referred to the Beecroft Internal Medicine department for an investigation of a six-month history of chronic coughing. Prior to the referral, the patient had been trialled on multiple courses of antibiotics and antitussives, but the clinical signs persisted.

Physical exam

On the initial physical exam, the patient had an unremarkable physical exam. The only finding noted was a sensitive trachea that would elicit a cough on gentle palpation.

Diagnostics

Blood tests revealed severe leukocytosis with marked neutrophilia, lymphocytosis and monocytosis. The C-reactive protein was also markedly elevated. The rest of the blood work was considered unremarkable. This finding was suggestive of a severe inflammatory disease indicative of a chronic persistent inflammation or infection. However, bloodwork abnormalities are not always present and should not rule out infectious causes.

Thoracic Computed Tomography (CT) revealed mild cranial mediastinal lymphadenopathy with no significant pulmonary or bronchial changes. These are non-specific findings indicative of an inflammatory or infectious process.

Bronchoscopy revealed mild to moderate erosion of the mucosa with no unusual discharge noted. There was no visible bronchial or tracheal collapse, there was bronchiectasis. The rest of the bronchoscopy was considered unremarkable. These findings were consistent with chronic inflammation.

Bronchoalveolar lavage was performed concurrently to collect samples for cytology, canine respiratory disease PCR panel and culture.

- Cytology of fluid analysis revealed neutrophilic inflammation with phagocytosed bacteria noted. This finding was indicative of an active infection.
- Respiratory PCR panel tested positive for both *Bordetella bronchiseptica* and *Mycoplasma cynos*.
- Fluid culture is positive for a mixed infection with a large population of *Bordetella bronchiseptica* and other secondary infections.

Diagnosis

- Chronic bordetella bronchiseptica infection.
- Despite the positive PCR for Mycoplasma cynos, we deduce that this is more likely either a co-infection, a commensal or a secondary infection for this patient.

- Mycoplasma is actually retrieved in up to 20-30% of normal dogs.
- Interestingly, there is increasing recognition of Mycoplasma cynos as there are hypotheses that this organism could be an initiating agent of Bordetella infections and exacerbate the clinical signs (Rycroft et al., 2007).

Treatment

The patient was managed medically for Bordetella bronchiseptica infection with twice daily nebulization with gentamicin, empirically doxycycline (10 mg/kg twice daily), fenbendazole (50 mg/kg once daily for five days), omeprazole (1 mg/kg at a weaning dose) and short course of prednisolone (1 mg/kg at a weaning dose for secondary inflammation). The patient had gradually reduced the frequency of coughing and tolerated well to the treatment initiated which was readjusted once the results of the different samples were obtained. After six weeks the patient made a full recovery.

Important take-home pointers

Canine infectious respiratory disease (also known as kennel cough) is not an uncommon disease faced in general practice. This is a contagious disease that is most seen as an acute infection especially in young dogs after a recent boarding. In the majority of cases, the clinical signs are typically mild and self-limiting. However, in some patients, Bordetella bronchiseptica can result in chronic infections that are refractory to typical medical management. Several aspects of the organisms' pathophysiology can contribute to the pathogen's persistence and resistance to therapy. These include adherence to the cilia, induction of ciliostasis, biofilm production and local immunosuppression (Reagen, 2021).

The initial drug of choice for the management of suspected bordetellosis is typically doxycycline. Other first-line antibiotics such as penicillins and first-generation cephalosporins typically have poor efficacy against Bordetella bronchiseptica (Morrissey et al., 2016). Therefore, culture and susceptibility testing are generally recommended whenever possible. In some instances, such as in this case where patients are refractory to treatment despite documented susceptibility to antibiotics. In a retrospective study by Canonne et al. (2020), long-term nebulisation helped to control Bordetella infection. In this patient, we did adopt the protocol described in this paper which allowed us to achieve good clinical outcomes. In human literature, aminoglycoside nebulisation is considered an important way of delivering antibiotics for the effective treatment of lower airway bacterial infections (Heyder, 2004). However, it is imperative to understand that this should not be the first-line treatment as nebulisation of gentamicin does have the potential to cause airway irritation and contribute to the selection of resistant bacterial populations.

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Recommended reading list

1. Ettinger's Textbook of Veterinary Internal Medicine Vol I & II. Stephen J. Ettinger, Edward C. Feldman and Etienne Cote (Editors), 9th Edition. Elsevier Saunders, St Louis, 2024.

2. BSAVA Manual of Canine and Feline Cardiorespiratory Medicine. Virginia Luis Fuentes, Lynelle R. Johnson and Simon Dennis (Editors), 2nd Edition. Wiley, 2010.

3. Small Animal Internal Medicine. Nelson RW & Couto CG (Editors), 6th Edition. Elsevier, 2019.

4. Journal of Veterinary Internal Medicine Consensus Statements

SVA LOCAL CONFERENCE

12 & 13 APRIL 2024

Beecroft saw presentations from

1. Small Animal Surgical Specialist Dr Patrick Maguire,
2. Exotic Companion Mammal Specialist Dr Rina Maguire,
3. Small Animal Internal Medicine Specialist Dr Anne-Claire Duchaussoy,
4. Clinical Resident American College of Veterinary Behaviorist, Dr Daphne Ang,
5. Head of Anaesthesia Joel Martorillas,
6. Senior Surgical Nurse Dexter Presto, and
7. Ultrasonographer Keong Pei En.

We extend our heartfelt gratitude to all the speakers for taking the time to share their insights, experiences, and innovative approaches in their practice. Kudos to the SVA team for bringing us together once again, and for your dedication in advancing veterinary professional development.

UPDATES & announcements

VETERINARY CE LUNCHEON

Beecroft's upcoming Vets' Continuing Education Luncheon is scheduled for brunch on 17 November 2024. More details will be sent to you via an email invitation and shared on our website and social media. We look forward to sharing knowledge and fostering collaboration with you.

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BEECROFT'S HOSPITAL COORDINATORS

Introducing our hospital coordinators, Hospital Manager Dr Ng Weng Yan (BSc, BVMS, MVetSci) (*wengyan.ng@beecroft.com.sg*) and Deputy Hospital Manager Dr Timothy Chua (BVM&S) (*timothy.chua@beecroft.com.sg*) who will provide support for all your primary care practitioner (PCP) referral needs.

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