Guidelines for

the Prudent Use of Antimicrobials in Companion Animals for Hong Kong Veterinarians: Volume I (First Edition)

Table of Contents

The Hong Kong Veterinary Association

Antimicrobial resistance (AMR) is a pressing global challenge that threatens human, animal, and environmental health. As antimicrobials are essential for treating a wide range of infections in people and maintaining the health and welfare of animals, their diminishing effectiveness poses serious risks. The inappropriate or excessive use of these critical medications accelerates the development of resistant microorganisms, leading to treatment failures, complications, and increased healthcare costs.

Veterinarians play a pivotal role in combating AMR as part of the One Health initiative. Their responsibilities extend beyond clinical care to include promoting responsible antimicrobial use among pet owners, farmers, and animal caregivers. Through collaboration with industry and government, the veterinary profession is instrumental in advancing antimicrobial stewardship efforts and facilitating One Health.

The Hong Kong Veterinary Association has developed the following Guidelines for the Prudent Usage of Antimicrobials in Companion Animals in consultation with the local veterinary community. These guidelines address the critical need for evidence-based antimicrobial prescribing practices, which calls for coordinated prescribing guidelines to assist veterinary professionals.

The guidelines provide practical recommendations for the responsible use of antimicrobials in companion animals, focusing on when to prescribe and how to manage treatments effectively, and will be updated on a regular basis to ensure the latest information is incorporated. By encouraging veterinarians to avoid unnecessary antimicrobial use and choose appropriate treatments when needed, these guidelines help reduce the risk of resistance while safeguarding the health and welfare of animals.

The Hong Kong Veterinary Association would like to thank and commend the dedication of all who contributed to the development of these guidelines. We urge every veterinarian to integrate this advice into their daily practice, ensuring the continued efficacy of antimicrobials while promoting the well-being of the animals in their care.

With sincere appreciation and regards,

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Dermatology Conditions

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Objective:

Bacterial skin infection is commonly diagnosed and treated in dogs and cats. Due to the concerning emergence of antimicrobial resistance in Hong Kong pets, these guidelines aim to provide clinicians practical ways to treat this common disease. And reduce inappropriate use of antimicrobials.

Key points:

1. Topical antimicrobial therapy alone is the treatment-of-choice for surface and superficial pyodermas.

2. If systemic antibiotics are necessary, skin cytology and culture and sensitivity testing should be conducted before the prescription of antibiotics.
   a. Cytology results can confirm a bacterial infection
   b. Culture and sensitivity can determine the bacterial species and antibiotic options

3. Please prioritize narrow-spectrum and first-generation antibiotics for empirical antibiotic use.
   a. Systemic antimicrobials should be reserved for deep pyoderma and for superficial pyoderma when topical therapy is not effective
   b. Example of narrow-spectrum and first-generation antibiotics for dermatology conditions
   c. The tabulation of dermatology conditions, microbial etiology and antimicrobial use are illustrated in Table 1

4. Further reading and reference is listed as additional information.

Systemic therapy, with adjunctive topical treatment, is initially provided for 2 weeks in superficial and 3 weeks in deep pyoderma, followed by re-examination to assess progress and manage primary causes. First-choice drugs have expected efficacy against the majority of meticillin-susceptible *Staphylococcus pseudintermedius*; for all other drugs, laboratory testing should confirm susceptibility and exclude suitability of safer alternatives.

Table 1. A simplified and tabulated illustration of common dermatology conditions, common etiology and recommended antimicrobial use

Dept	Disease	Etiology / common microbe	Antimicrobial
Surface	Pyotraumatic acute moist dermatitis ('hot spot')	*Staphylococcus pseudintermedius, S. schleiferi*	Topical therapy Anti-pruritic/anti-infammatory treatment If systemic antibiotics are indicated: Cefalexin, 22-25 mg/kg PO twice daily Clindamycin 11 mg/kg PO twice daily Amoxicillin-clavulanate 12.5 mg/kg PO twice daily Or based on culture and sensitivity
	Intertrigo (Skin fold dermatitis)	*Staphylococcus pseudintermedius,* streptococci	Topical therapy Cefalexin, cefadroxil 22-25 mg/kg PO twice daily Clindamycin 11 mg/kg PO twice daily Amoxicillin-clavulanate 12.5 mg/kg PO twice daily Or based on culture and sensitivity

Superficial	Bacterial folliculitis	Dog: *Staphylococcus pseudintermedius, S. schleiferi* Cat: *Staphylococcus felis, S. pseudintermedius, Pasteurella,* streptococci	Topical therapy Cefalexin, cefadroxil, 22-25 mg/kg PO twice daily Clindamycin 11 mg/kg PO twice daily Amoxicillin-clavulanate 12.5 mg/kg PO twice daily Or based on culture and sensitivity Feline Acne: The primary cause is often allergies with secondary infection.
	Impetigo, "puppy pyoderma"	*Staphylococcus pseudintermedius*	Topical therapy, though may self-resolve
Deep	Bacterial pododermatitis, interdigital furunculosis	*Staphylococcus pseudintermedius, S. schleiferi ,* streptococci, *E. coli, Pseudomonas, Enterococcus, Corynebacterium*	Topical therapy Culture and sensitivity—superficial 2 weeks, deep 3 weeks
	Bacterial furunculosis	Dog: *Staphylococcus pseudintermedius, S. schleiferi*	Topical therapy Cefalexin, 15-30mg/kg PO twice daily Clindamycin 11 mg/kg PO twice daily Amoxicillin-clavulanate 12.5-25 mg/kg PO twice daily Or based on culture and sensitivity
	Abscess Cat, Dog	*Pasteurella spp, Fusobacterium spp,* streptococci, *Prevotella spp.*	Clindamycin 11 mg/kg PO twice daily Amoxicillin-clavulanate 12.5-25 mg/kg PO twice daily

Additional Information

Notes: topical therapies to control infections: chlorhexidine 2-4%, benzoyl peroxide, ethyl lactate, povidone iodine

Topical antimicrobial gels, ointments, wipes, creams: benzoyl peroxide, chlorhexidine, bacitracin, fusidic, acid, mupirocin. *Mupirocin and fusidic acid are necessary for human methicillin-resistance treatment and should only be used focally when culture and sensitivity indicated.

Reference

Loeffler A, Cain CL, Ferrer L et al. Antimicrobial use guidelines for canine pyoderma by the International Society for Companion Animal Infectious Diseases (ISCAID). Vet Dermatol. 2025;36(3):234-282.

Conclusion

Bacterial skin infections always occurs secondary to an underlying cause. Clinicians are advised to identify and address the primary disease in order to avoid recurrence.

Gastroenterology and Hepatology Conditions

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This chapter includes antimicrobial guidelines for the following conditions in both dogs and cats:

1. Acute gastroenteritis
   a. Canine acute diarrhoea
   b. Feline acute diarrhoea
   c. Specific bacterial and protozoal enteropathogens in dogs and cats
2. Chronic enteropathies in dogs and cats
3. Pancreatitis, including pancreatic fluid accumulations
4. Peritonitis
5. Hepatology: Bacterial cholangiohepatitis, gall bladder sludge/mucoceles and hepatic encephalopathy

Before reviewing the current guidelines, it is important to recognize and understand that antimicrobials should only be used when there is genuine concern for an infectious aetiology. Routine use of antimicrobials is not appropriate and should be discouraged for the following reasons:

1. *Adverse effects of the medication themselves:* it is wrongly considered that commonly used antimicrobials have a low adverse effect profile. The most common adverse effects of many antimicrobials are associated with the gastrointestinal system and includes vomiting, diarrhoea and inappetence. Therefore, when using these medications in patients already presenting with gastrointestinal signs, caution should be exercised when assessing failure to respond to therapy.

2. *Dysbiosis:* the importance of the intestinal microbiome cannot be underestimated. Only now are we starting to understand its fundamental importance, and the potential consequences and sequalae, associated with altering it. Antimicrobial therapy will alter the intestinal microbiota as well as its metabolites; however, the significance of the effect depends on the type, dose and duration of the antibiotic used. These derangements in the microbiome can persist for months to years.

3. *Antimicrobial resistance:* antimicrobials impose a selection pressure which will inhibit susceptible organisms and select for resistant bacteria. As an example of this, the prevalence of amoxicillin-resistant *Escherichia coli* increased in the intestinal microbiota of dogs prescribed amoxicillin-clavulanic acid. Prior to antimicrobial therapy, the prevalence of amoxicillin-resistant *Escherichia coli* was ~0.2% which increased to 100% during treatment and remained ~10% following treatment discontinuation.

1. Acute gastroenteritis

Causes of acute gastroenteritis in dogs and cats:

Acute gastroenteritis is a term describing cases presenting with acute signs of inappetence/anorexia, vomiting and/or diarrhoea. There are numerous aetiologies however not every case presenting for acute gastrointestinal signs requires further diagnostics. Potential aetiologies include: dietary indiscretion, dietary sensitivity, sudden food change, food poisoning or scavenging, enteric infections (see below), intestinal parasitism (e.g., hookworm, whipworm), intestinal obstructions (partial versus complete; e.g., intussusceptions, foreign bodies), metabolic (hypoadrenocorticism), toxic (food, drugs or other sources) and systemic disease (uraemia, liver disease, pancreatitis). The following list is not exhaustive however some of the common enteric pathogens includes:

- Viruses: Adenovirus, coronavirus, norovirus, rotavirus, parvovirus or distemper
- Bacteria: *Salmonella sp., Campylobacter sp., Clostridium sp., Escherichia coli*
- Protozoa: *Coccidia sp., Giardia sp., Tritrichomonas sp.*

a. Canine acute gastroenteritis

Acute diarrheoa in dogs is a common presenting compliant in veterinary medicine. The vast majority of these animals have self-limiting disease which do not require diagnostic investigations or treatment; however, a proportion of them require hospitalization and intravenous fluid support. Most cases will resolve within one week.

The European Network for Optimization of Veterinary Antimicrobial Therapy (ENOVAT) have summarized and scrutinized the literature surrounding antimicrobial use in canine acute diarrhoea. Recommendations on antimicrobial use in canine acute diarrhoea have been devised which are based on a severity grading system. This grading system and their recommendations have been summarized below.

Disease severity	Definition
Mild disease	Bright, alert and responsive. No clinical signs of dehydration or hypovolemia and absence of fever. Typically managed as out-patients. Diagnostic investigations are not warranted.
Moderate disease	Mildly-moderately depressed mental status, dehydrated and/or hypovolemic. Systemic signs due to dehydration/ hypovolemia resolve rapidly with adequate fluid replacement. There is absence of fever, overwhelming inflammation (such as severe neutrophilia ($>25\times10^9$/L), neutropenia and/or degenerative left-shift and organ dysfunction. Moderate disease warrants fluid therapy and supportive care, and are often hospitalized.
Severe disease	Moderately-severely depressed mental status and signs of systemic disease. Dogs may be febrile and often have overwhelming inflammation (e.g., severe neutrophilia ($>25\times10^9$/L), neutropenia and/or degenerative left-shift). Dehydration or hypovolemia is present and dogs warrant hospitalization, fluid therapy and supportive. Dogs in this category may present in different ways: 1) dogs with critical illness and signs of organ dysfunction and sepsis; or 2) dogs with non-critical illness (e.g., dogs presenting with moderate disease) but systemic signs do not resolve, or they progress or relapse despite adequate fluid replacement.

Potential options for diagnostic work up:

- Complete blood count, biochemistry and urinalysis: indicated in dogs with moderate to severe disease to evaluate for overwhelming inflammation, bacterial sepsis (hypoglycaemia, hyperbilirubinaemia) and/or electrolyte derangements.
- C-reactive protein: may be considered in dogs with moderate to severe disease to guide/monitor response to therapy. C-reactive protein should not be used as substitute for clinical monitoring or to determine the need for antimicrobials.
- Testing for hypoadrenocorticism: should be considered in cases of recurrent diarrhoea or electrolyte derangements consistent with mineralocorticoid deficiency (beware of pseudo-addison's disease).
- Testing for parvovirus: can be considered in patients with an unclear or absent vaccination history and young patients (<12 months). Due to the low sensitivity of available point-of-care tests, false negatives are common. Therefore, depending on the clinical suspicion, confirmatory faecal PCR should be performed. An important note: if parvovirus is even a consideration, animal isolation and barrier nursing practices should be strictly adhered to until confirmatory tests have returned.
- Testing for Giardia: unclear cause of diarrhoea on its own however testing should be considered in young dogs or dogs with relapsing diarrhoea.
- Testing for bacterial enteropathogens: not routinely recommended however could be considered in cases of severe disease or under certain circumstances (e.g., feeding raw food, outbreaks of pathogens or when more than one individual is affected). In these cases, testing for *Salmonella sp.*, *Campylobacter sp.* and *Clostridium difficile* is recommended (see later guidelines on diagnosis and treatment).
- Diagnostic imaging: not typically necessary in dogs with acute diarrhoea however could be considered in patients with abdominal pain or concurrent vomiting.

Antibiotic recommendations:

Antibiotic therapy is NOT recommended in the following situations:

- Acute diarrhoea and mild disease (non-hemorrhagic or haemorrhagic)
- Acute diarrhoea and moderate disease (non-hemorrhagic or haemorrhagic)
  - Dogs failing to respond to supportive care or in cases where there is severe or overwhelming inflammation may represent an exception.

Antibiotic therapy could be considered in the following situations:

- Severe disease (hemorrhagic or non-hemorrhagic)
  - Antimicrobials that are expected to be effective for treatment of bacterial translocation, bacteraemia and/or sepsis.
- Drug choice depends on the patient's clinical status and the most likely pathogen. Dogs with non-critical illness, ampicillin or trimethoprim-sulfonamides are recommended first line drugs.
- In situations of critical illness and/or where antimicrobial resistance is likely (e.g. based on local antibiograms and/or patient's previous antimicrobial exposure), administration of a four-quadrant protocol providing gram-positive, gram-negative, aerobic and anaerobic coverage can be considered. This protocol may also be necessary in dogs unresponsive to first line antimicrobials and supportive care.
- Antimicrobial drug combinations with four-quadrant spectrum include aminopenicillins (ampicillin/amoxicillin) or clindamycin combined with fluoroquinolones or aminoglycosides (i.e., aminoglycosides should not be used in dehydrated or hypovolemic patients).
- The duration of antimicrobial treatment is dependent on the treatment response however antimicrobial therapy should not extend beyond clinical resolution. Treatment for 3–7 days is likely adequate.

Specific canine enteric pathogens

Infectious agent	Clinical signs	Diagnostics	Treatment
Escherichia coli associated granulomatous colitis	Boxer (predominate breed), French Bulldog and Border Collies; severe large bowel diarrhoea, weight loss	Colonic biopsy (histopathology and culture +/- FISH)	Enrofloxacin 10 mg/kg q 24 hours x 8 weeks Trimethoprim-sulphonamides can be considered in resistant cases (culture is extremely important) Consultation with an Internal Medicine Specialist is highly encouraged prior to therapy

b. Feline acute gastroenteritis

Domestic cats are reportedly less frequently affected by acute gastroenteritis as compared to dogs with fewer studies evaluating the use of antimicrobials in cats with acute gastroenteritis. Dogs and cats share similar aetiologies for acute gastroenteritis and therefore until guidelines are available in cats, the canine guidelines should be extrapolated into feline practice. Some of the common infectious causes for feline diarrhoea are presented herein.
Please note: organisms affecting both canines and felines are summarized in a separate table.

Infectious agent	Clinical signs	Diagnostics	Treatment
Viral			
Viral diarrhoea is most commonly seen in kitten and multi-cat households			
Feline parvovirus	Fever, vomiting +/- diarrhoea	Leukopenia, faecal ELISA for canine parvoviral antigens, serology (virus neutralizing antibodies), faecal PC	Supportive care +/- broad spectrum antibiotics against gram negative and anaerobic bacteria (ampicillin + fluroquinolone). If using aminoglycosides instead of fluroquinolones, ensure adequate hydration status prior to use
Feline coronavirus	Mild diarrhoea +/- vomiting; occasional severe diarrhoea and vomiting in young kittens	Serology, faecal PCR	Commonly self-limiting and no specific therapy warranted Antimicrobials are not recommended unless there are signs of sepsis **Antiviral medication (i.e., GS-441524, remdesivir or similar) is NOT recommended and is strongly discouraged**

Protozoal			
Tritrichomonas foetus/ *blagburni*	Waxing and waning large bowel diarrhoea; more common in young cats	Direct faecal wet mount (very insensitive), faecal PCR (most sensitive but false negative test results are common)[a]	Ronidazole 30 mg/kg PO q 24 hours x 14 days (watch for neurotoxicity)

[a] *Tritrichomonas sp.* can be very challenging to diagnose and manage. Clinicians are strongly encouraged to read the following article which reviews the "tips and tricks" to collect the 'best' faecal sample and how to treat and manage these cats: the more we learn the trickier it gets.

Reference

1. Gookin JL, Hanrahan K, Levy MG. The conundrum of feline trichomonosis. J Fel Med Surg. 2017:19(3): 261-274.

c. Specific bacterial and protozoal enteropathogens in dogs and cats

Enteric bacterial infections are challenging to diagnose because isolations rates of bacterial enteropathogens can be similar between animals with and without diarrhoea. Faecal cultures have low diagnostic yield limiting their usefulness. Faecal PCR is more sensitive for the detection of toxin genes and organisms however a positive result is not necessarily causative. Interpretation of these panels is challenging because essentially all bacterial organisms have been isolated from clinically healthy dogs and cats. There is currently no consensus on the how best to use faecal culture or faecal PCR panels; however, it is in the author's opinion that these PCR panels do have a place in companion animal medicine in certain scenarios. Possible scenarios in which faecal PCRs should be considered includes: situation of disease outbreaks or when looking for potential zoonotic pathogens, confirmatory tests for commonly used faecal antigen tests, animals with acute onset diarrhoea with clinical signs of sepsis and acute diarrhoea associated with crowded environments.

Infectious agent	Clinical signs	Diagnostics	Treatment
Campylobacter sp.	*C. jejuni* most commonly associated with clinical disease; mucoid diarrhoea and fresh blood in young animals Occasional severe disease including anorexia, vomiting and fever	Faecal cytology, culture of fresh faeces (anaerobic swab), faecal PCR	Antibiotics not usually required; reserved for patients with severe diarrhoea or prolonged diarrhoea (>10 days) Erythromycin 20 mg/kg (dogs) OR 10 mg/kg (cats) PO q 8 hours x 5 days **Zoonotic pathogen**

Salmonella sp.	Most animals are asymptomatic Fever, malaise, anorexia, diarrhoea (watery or mucoid, occasionally bloody) and vomiting Access to raw food	Faecal culture (anaerobic) and PCR of the stools Isolation does not prove causation	Antimicrobials not usually indicated; reserved for cases of systemic infection or when bacterial translocation risk is considered high If sepsis is present, ampicillin 22-30 mg/kg IV q 8 hours + amikacin 10-15 mg/kg IV q 24 hours (fluroquinolone instead of amikacin can be used) Antimicrobial duration 7-10 days however de-escalation should be considered based on culture and susceptibility results and patient response **Zoonotic pathogen**
Clostridium perfringens	Small intestinal, large intestinal or mixed/diffuse diarrhoea	netF toxin may play a role in acute haemorrhagic diarrhoea syndrome; *Clostridium perfringens* enterotoxin in faeces or detection of the gene (PCR) Faecal culture is not recommended	No evidence supporting the use of antimicrobial therapy in uncomplicated *C. perfrigens* infections When needed, ampicillin 22 mg/kg q 8 hours x 5 days or metronidazole 10-15 mg/kg q 12 hours x 5 days could be considered Reports of clinical improvement with increasing fermentable fibre in diet have been documented

Clostridium difficile	Diarrhoea (small and large intestinal) Rare in cats	Faecal culture (positive result does not support causation); ELISA for toxins (TcdA and TcdB) have limited sensitivity; faecal PCR (should not be used alone to confirm infection) Diagnosis requires concurrent toxin and organism detection	Can be associated with antimicrobial use and if so, stop the antimicrobial Parenteral antimicrobial rarely indicated unless the animal is systemically ill Metronidazole 10 mg/kg q 12 hours x 5 days **Potentially zoonotic pathogen**
Protozoal			
Giardia sp.	Small intestinal diarrhoea most common	Direct smear of diarrhoeic stools; cytology of duodenal aspirates (dog only); faecal flotation (zinc sulphate); ELISA and PCR of stools	Presence does not indicate causation Fenbendazole is the first-line treatment Metronidazole resistance is increasing and some studies support poor efficacy Other drugs are available however studies are limited Environmental decontamination is crucial for successful eradication *Giardia duodenalis* is **potentially zoonotic**

Reference

Many of the guidelines regarding antibiotic stewardship for canine acute gastroenteritis have been summarized from the European Network for Optimization of Veterinary Antimicrobial Therapy (ENOVAT) guidelines for antimicrobial use in canine acute diarrhoea. These recommendations are open-access and it is the belief of this author that all practicing veterinarians read them. The reference is as follows:

1. Jessen LR, Werner M, Singleton D et al. European Network for Optimization of Veterinary Antimicrobial Therapy (ENOVAT) guidelines for antimicrobial use in canine acute diarrhoea. Vet J. 2024;307.

2. Chronic enteropathies in dogs and cats

Chronic enteropathies (CE) are common causes for recurrent or persistent (>3 weeks) gastrointestinal signs in dogs and cats. Chronic diarrhoea is the hallmark clinical sign in dogs however vomiting may be more common in cats. Other clinical signs such as weight loss, inappetence/anorexia and polyphagia are reported. The pathogenesis of CEs is incompletely understood. Different forms of chronic enteropathies exist including food-responsive enteropathy (FRE), antimicrobial-responsive diarrhoea (ARD) and corticosteroid-responsive inflammatory bowel disease (IBD) (steroid-responsive disease, SRD). Distinguishing these CEs are clinically challenging given the overlap in clinical signs and absence of available diagnostics which can differentiate them. It is unclear if these different phenotypes represent a single disease entity with a spectrum of manifestations.

Food-responsive disease is more common than SRD, with ARD rarely reported. Estimates vary however FRE accounts for approximately 60% of dogs with chronic enteropathies. An estimate of the different subtypes of CE in cats is challenging however numerous studies report that FRE are more common than SRD or ARD. Antimicrobial trials are routinely considered in the sequential work-up for dogs and cats with CE. This is despite a scarcity of evidence for their use. The prescription of antimicrobials has been justified based on the thought that it may counter the effects of microbial dysbiosis which could drive the host inflammatory responses. Many dogs which initially respond to an antibiotic trial relapse after discontinuation of the antimicrobial; thus, the true existence of the ARD subtype has been debated. Tylosin and metronidazole have both been associated with disturbances in the microbiome and there is the implication that antimicrobial use is a risk factor for the development of IBD later in life.

A narrative review evaluating the evidence for different therapies in dogs and cats with chronic enteropathy concluded that although numerous trials report remission with the use of metronidazole in dogs and cats, the antimicrobial often was combined with diet and other drugs (e.g., glucocorticoids) confounding interpretation as to what portion of the clinical response was attributable to the antimicrobial alone. They also concluded there is no strong evidence to support the use of metronidazole in the treatment of dogs with IBD.

Four scenarios exist which support the use of antimicrobials in chronic enteropathies:

1. Enrofloxacin in dogs with granulomatous colitis.
2. Diarrhoea which is only tylosin-responsive has been reported (although it is uncommon).
3. The use of tylosin (20 mg/kg PO q 8-12 hours) or metronidazole (10-15 mg/kg PO q 12 hours) in young large breed dogs, especially German Shepherd Dog), for which no underlying cause for the chronic enteropathy can be found. These dogs may require prolonged antimicrobial use and, in some dogs, indefinite therapy is indicated. As some dogs can mature out of the condition, periodically stopping antimicrobials is encouraged to see if they

are still needed. Whilst metronidazole and tylosin are commonly considered, oxytetracycline 10-20 mg/kg PO q 8 hours could also be considered (but can only be started after permanent tooth eruption).

4. The use of antimicrobials in patients with exocrine pancreatic insufficiency (EPI). An increase in small intestinal bacterial numbers has been reported in patients with EPI and whilst this typically normalizes after pancreatic enzyme supplementation, occasionally, antimicrobials are necessary if the response to enzyme supplementation is suboptimal.

There is also some evidence that a small majority of cats with mild IBD may improve with metronidazole however the evidence for this is weak and routine use is not recommended.

References

1. Makielski K, Cullen J, O'Connor A et al. Narrative review of therapies for chronic enteropathies in dogs and cats. J Vet Int Med. 2019;33(1): 11-22.
2. Jergens AE, Heilmann RM. Canine chronic enteropathy – Current state-of-the-art and emerging concepts. Front Vet Sci. 2022; 9.

3. Pancreatitis

Canine

Pancreatitis in dogs can be characterized as either acute or chronic, with acute on chronic pancreatitis also reported. Acute pancreatitis is typically reversible whereas chronic pancreatitis is associated with irreversible changes such as atrophy and fibrosis. Distinguishing between acute and chronic pancreatitis is challenging without histopathology and if the reader is interested, there are a number of articles available which review the pathogenesis of pancreatitis, the diagnostic challenges and the management strategies. This is beyond the scope of these guidelines which will focus on the evidence for antimicrobials in pancreatitis.

Whilst most episodes of acute pancreatitis are considered idiopathic, several risk factors have been identified including dietary factors, drugs (e.g., potassium bromide, L-asparginase, azathioprine), toxins, endocrinopathies (e.g., hypercortisolism), lipid disorders (i.e., hypertriglyceridaemia and hypercholesterolaemia) and breed predispositions. Importantly, infectious causes of acute pancreatitis are rare. Local bacterial infections are not considered a cause of acute pancreatitis. If pancreatitis is secondary to an infection, the infection is typically systemic and not localized to the pancreas. Examples of systemic infections associated with acute pancreatitis includes *Leishmania* or *Heterobilharzia americana*. Severe acute pancreatitis could theoretically alter intestinal barrier function and lead to bacterial translocation (as seen in human patients). Antimicrobials may therefore have a role in acute pancreatitis when complications develop such as gastrointestinal bacterial translocation or aspiration pneumonia. Antimicrobial choice should be based on culture and susceptibility testing (i.e., culture results of a bronchoalveolar lavage +/- lung aspiration or blood culture for bacterial translocation). Empirical antibiotic choice for bacterial translocation has been outlined in the acute diarrhoea section of these guidelines.

An important side note regarding the use of antimicrobials for aspiration pneumonia. It is currently unclear how many dogs with aspiration pneumonia actually require antimicrobials. In a 2021 study, 14 dogs with aspiration pneumopathy were successfully managed without antimicrobials[1]. As such, it is in the author's opinion that when aspiration pneumonia is documented, further investigations should be performed to try and determine whether antimicrobials are indicated. Additionally, repeat thoracic imaging does not appear to be a reliable marker to guide antimicrobial therapy in canine bacterial pneumonia as radiographic lesions may lag behind or persist despite clinical cure. A recent study has shown that dogs with aspiration pneumonia can be safely and effectively treated with short-term antimicrobial regimens and discontinued after clinical improvement and serum CRP normalization[2]. The author is aware that CRP interpretation may be challenging in dogs with concurrent pancreatitis. Another study has recommended that a 10-day course of antimicrobials is sufficient to treat uncomplicated bacterial pneumonia[3].

References

1. Cook S, Greensmith T, Humm K. Successful management of aspiration pneumopathy without antimicrobial agents: 14 days (2014-2021). J Small Anim Pract. 2021;62(12): 1108-1113.
2. Fernandes Rodrigues N, Giraud L, Bolen G et al. Antimicrobial discontinuation in dogs with acute aspiration pneumonia based on clinical improvement and normalization of C-reactive protein concentration. J Vet Int Med. 2022;36(3): 1082-1088.
3. Vientos-Plotts A, Masseau I, Reinero CR. Comparison of short- versus long-course antimicrobial therapy of uncomplicated bacterial pneumonia in dogs: A double blinded, placebo-controlled pilot study. Animals. 2021;11(11):3096.

Antibiotics guidelines for canine acute pancreatitis have been drawn from the following article. This article is free-access and the reader is encouraged to review the article for a review of the up-to-date management of acute canine pancreatitis.

4. Lim SY, Cride H, Twedt DC et al. Management of acute-onset pancreatitis in dogs: a narrative review. J Am Vet Med Assoc. 2024;262(9): 1231-1240.

Feline

Pancreatitis was once considered uncommon in cats however current evidence suggests it is more common than originally thought. Similar to dogs, there are clinical challenges in differentiating acute and chronic pancreatitis without histopathology. Pancreatitis is predominately idiopathic in cats. Pancreatitis has however been associated with numerous concurrent diseases such as diabetes mellitus, chronic enteropathies, cholangitis and hepatic lipidosis. The reader is referred to the ACVIM consensus statement on pancreatitis in cats.

Antimicrobials are not recommended in acute pancreatitis in cats. In veterinary medicine, pancreatitis is considered a sterile process. Whilst bacteria have been identified in the pancreas of 35% of feline cases with acute pancreatitis, there clinical relevance is uncertain and currently, antimicrobials in cats with acute pancreatitis should not be used. There are potential scenarios in which antimicrobials may be considered which includes aspiration pneumonia, concurrent bacterial cholangitis, sepsis or pancreatic abscesses (see below). There is a greater risk of bacterial colonization in cats with acute necrotizing pancreatitis however whether antimicrobials are necessary is debatable as they are not used in humans with acute necrotizing pancreatitis. Antimicrobial choice should be based on bacterial culture and susceptibility. Antibiotic choices for sepsis secondary to bacterial translocation has been outlined in the acute gastroenteritis section of this chapter.

Antimicrobial treatment is not recommended in chronic pancreatitis unless an infectious component has been documented.

References

This information has been summarised from the ACVIM Consensus Statement on pancreatitis in cats. The reader is encouraged to read this article for an up-to-date review on the aetiology, pathogenesis, diagnostic investigations and management of feline pancreatitis.

1. Forman MA, Steiner JM, Armstrong PJ et al. ACVIM Consensus Statement on pancreatitis in cats. J Vet Intern Med. 2021;35(2): 703-723.

Pancreatic complications:

Pancreatitis in dogs and cats can range from mild self-limiting disease to severe life-threatening illness with numerous complications. These complications include: pancreatic necrosis, extrahepatic bile duct obstruction (EHBDO), pancreatic fluid accumulations/abscessation, thromboembolic disease (regional and distant), gastrointestinal dysmotility, aspiration pneumonitis/ pneumonia, acute kidney injury, disseminated intravascular coagulation (DIC),

systemic inflammatory response syndrome or multi-organ dysfunction. Many of these complications are not indications to start antimicrobial therapy and this section will briefly discuss the conundrum of pancreatic fluid accumulations.

Pancreatic fluid accumulations are infrequently reported in veterinary medicine. Descriptions of these accumulations vary between studies which complicates recommendations. They are expected to develop as a sequela to the acute local inflammatory response. Pancreatic abscessation is a misnomer, as many of these pancreatic fluid accumulations are sterile. A diagnosis of pancreatic abscessation should never be made without cytological evaluation of the pancreatic fluid as well as culture and susceptibility testing. The presence of necrosis within the pancreatic fluid accumulation which is negative for bacteria cytologically and negative for growth on culture and susceptibility does not warrant antibiotic prescription.

Importantly, pancreatic abscessation does not necessarily warrant surgical correction and percutaneous drainage and appropriate antibiotic use (based on culture and susceptibility) can resolve some abscesses. Percutaneous drainage is best performed by an experienced sonographer or specialist radiologist as leakage of the fluid into the peritoneal space could be associated with peritonitis. Percutaneous drainage may need to be repeated numerous times before resolution is apparent. In some cases, surgical intervention is necessary however this should only be performed by a specialist surgeon as complications rates are very high.

4. Peritonitis

Peritonitis can be associated with both non-infectious and infectious aetiologies. Differentiating between the different types of peritonitis is beyond the scope of these guidelines and the reader is directed to medical textbooks or journal articles. The below section will only discuss antibiotic stewardship for septic peritonitis as there is a clear need for antimicrobial therapy. Non-infectious causes of peritonitis do not typically require antimicrobials.

Septic peritonitis is often polymicrobial, however the most frequent micro-organism cultured is *Escherichia coli*. Fluid analysis of the abdominal effusion is considered the gold standard in determining whether a patient has septic peritonitis or not. Ideally, fluid collection should precede antimicrobial administration to not influence the results. Briefly, criteria for the diagnosis of septic peritonitis are as follows:

- Detection of an exudate effusion with the presence of intra-cytoplasmic bacteria.
- Nucleated cell count (predominately neutrophils) within peritoneal effusion > 13,000 cells/mcL was 86% sensitive and 100% specific in dogs, and 100% sensitive and 100% specific in cats[1].
- A difference between blood and peritoneal effusion of >20 mg/dL (>1.1 mmol/L) was 100% sensitive and 100% specific for the diagnosis of septic peritonitis in dogs, and 86% sensitive and 100% specific in cats[1].
- Lactate difference between blood and peritoneal effusion <2 mmol/L was predictive of septic peritonitis in dogs (63% sensitivity, 100% specificity)[1].
- In one study, all dogs with septic effusions had a peritoneal fluid lactate >2.5 mmol/L[2].

Culture and susceptibility should always be performed on the peritoneal effusion to guide antibiotic therapy. Whilst awaiting culture results, commencing ampicillin (~30 mg/kg IV q 6-8 hours) or clindamycin (10-20 mg/kg IV q 12 hours) in addition to enrofloxacin (10 mg/kg IV q 24 hours, do not use in cats) or amikacin (15 mg/kg IV q 24 hours, be careful with renal insufficiency) is recommended. In cases of renal insufficiency or when enrofloxacin is not available, cefotaxime (30-50 mg/kg IV q 8 h), is recommended in place of amikacin. Metronidazole may be necessary in addition to other medication. Source control is critical to success and all efforts should be placed towards source control within 6 hours.

Once culture and susceptibility has returned, the antibiotic regimen should be reviewed. Antibiotic choices should be reduced to the fewest number of drugs (antibiotic de-escalation). Provided source control is effective and established, antibiotics for 4-7 days is recommended.

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5. Hepatology

Owing to its central position between enteric and systemic circulation, the liver plays a crucial role in guarding against infection. However, due to this position, it is susceptible to acute injury by non-infectious aetiologies (e.g., toxins and drugs). It is important to recognise that infectious causes of cholangitis and/or cholangiohepatitis is only one differential diagnoses for hepatocellular injury. Unfortunately, infectious and non-infectious hepatopathies can present with similar histories, clinical signs and clinicopathological changes. It is therefore important that a diagnosis of infectious cholangiohepatitis is made with caution when considering these changes alone. Typically, ancillary diagnostics are necessary. Diagnosis of bacterial cholangitis +/- cholangiohepatitis can be challenging however can be made with minimally invasive techniques such as cytology and culture (aerobic and anaerobic) of both liver and bile aspirates. It is recommended that a combination of liver and gall bladder samples be performed as this may increase the likelihood of identifying the offending organism(s). Surgical or laparoscopic biopsies may be necessary to achieve a diagnosis.

Please note: bacteria can occasionally be detected in the bile of healthy animals and therefore results should be interpreted with caution.

Acute bacterial cholangitis/cholangiohepatitis

In dogs and cats with hepatitis and/or cholangiohepatitis, the most common organisms cultured from bile include *Escherichia coli*, *Enterococcus spp*., *Bacteroides spp.*, *Streptococcus spp*., and *Clostridium spp*. The use of antimicrobials can be justified following a positive bacterial culture or with cytology results consistent with significant suppurative inflammation. Antimicrobials may also be justified in a febrile animal with a complete blood count suggestive of a left shift or toxic change however it should be noted that these changes alone do not definitively diagnose an infectious aetiology and efforts should be placed in trying to achieve a diagnosis.

When waiting for the bacterial culture, the choice of antimicrobial should cover a broad spectrum of possible organisms. Amoxicillin-clavulanic acid 15-25 mg/kg IV/PO q 8-12 hours is a good initial antimicrobial to commence prior return of the culture results. If there is suspicion for anaerobes or a failure to respond to amoxicillin-clavulanic acid, metronidazole 10-15 mg/kg IV/PO q 12 hours should also be commenced. Antibiotic therapy should be changed or de-escalated depending on the results of the culture. For acute cholangitis, 10-14 days of antimicrobial therapy is likely reasonable.

Please note: the importance of bacterial culture and susceptibility cannot be understated as there is growing evidence for increasing antimicrobial resistance in common pathogens involved in bacterial cholangitis/cholangiohepatitis.

Leptospirosis is one of the most commonly recognized infectious causes of acute hepatitis in dogs. Dogs often present with inappetence, lethargy, pyrexia, azotaemia, hepatocellular damage, hyperbilirubinaemia, inflammatory leukogram and thrombocytopenia. Urinalysis results can be variable and include proteinuria, glucosuria, isos/hyposthenuria with and without an active sediment. Treatment involves doxycycline 5 mg/kg PO q 12 hours x 14 days. Ampicillin may need to be considered in patients unable to take oral medication due to gastrointestinal signs. It is important to note that penicillin derivatives only suppress bacteriaemia and doxycycline is necessary to eradicate intra-renal persistence. The reader is encouraged to review the Updated ACVIM Consensus Statement on Leptospirosis in Dogs.

Gall bladder sludge and mucocele

Gall bladder sludge is not synonymous with a gall bladder mucocele however they could represent a continuum of disease. Hyperechoic sludge in the gallbladder or extrahepatic biliary tree is particularly concerning in cats and is often indicative of cholecystitis. In contrast, biliary sludge is common in older dogs and is often insignificant however can be associated with cholecystitis. It has been estimated that approximately 10% of dogs with gall bladder sludge can harbour a bacterial infection. Despite this, the routine use of antibiotics with gall bladder sludge is not recommended. Severe biliary sludge which completely fills the gall bladder might require cholecystectomy. Gall bladder sludge is typically managed medically whereas gall bladder mucoceles are an indication for surgery.

Depending on the study, gall bladder mucoceles are reported to contain a bacterial infection in approximately 14% of cases and therefore perioperative antibiotics should be considered. It is important to recognise however that pre-operatively antibiotic use may affect culture results from gall bladder mucoceles and therefore this percentage may be an underestimation. Commencing broad spectrum antimicrobials (amoxicillin-clavulanic acid 20-30 mg/kg IV q 8-12 hours) immediately following gall bladder removal is recommended whilst awaiting culture and susceptibility results. Whilst 4-6 weeks of antibiotics has been recommended, there is no evidence to support this practice. If the gall bladder mucocele is infected and has been removed, source control has been achieved and therefore antimicrobial therapy may not be necessary for 4-6 weeks. Duration of antimicrobial therapy should be based on the clinical status of the patient and should be discontinued when there is no clinical need for them.

A consensus on the treatment of subclinical or early gall bladder mucoceles has not been reached. Animals undergoing elective cholecystectomy have a reduced mortality rate and this alone may be an indication for cholecystectomy early in the disease course. However, there is no data supporting that subclinical gall bladder mucoceles will ever cause the animal acute disease and require emergency surgery. Similarly, there is a lack of evidence that medical therapy is effective for subclinical gall bladder mucoceles. Medical

therapy includes feeding a low-fat diet, administering ursodeoxycholic acid as well as screening for potential causes of the gall bladder mucocele including assessment of serum triglycerides and endocrinopathies (hypothyroidism and hypercortisolism). If there is progression of the gall bladder mucocele despite medical therapy, cholecystectomy should be considered. Antibiotics do not currently play a role in the medical management of gall bladder mucoceles.

Hepatic encephalopathy

The goal of antimicrobial therapy in patients with hepatic encephalopathy or portosystemic shunt is to impact the microbiome of the gastrointestinal tract to decrease the production of ammonia. Metronidazole 7.5 mg/kg PO q 12 hours and neomycin 22 mg/kg PO q 8 hours (avoid if any evidence of intestinal bleeding, ulcerations or kidney disease) are typically recommended. In dogs, there is evidence to support that antibiotics are not necessary for pre-surgical extrahepatic portosystemic shunt stabilization. This author typically does not use antibiotics for hepatic encephalopathy unless there is an inadequate response to hepatic diet and lactulose.

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Ophthalmology Conditions

By Dr. Derek Chow *BVSc (Hons), DACVO, DAiCVO, MANZCVS, MRCVS*

Primary infections in the eyes of dogs and cats do occur. However, not all ocular conditions have a bacterial component. Therefore, in many ocular conditions, antibiotics are not required.

Conjunctivitis in dogs

Conjunctivitis due mainly to bacterial infection is quite rare. It is important to investigate a possible cause of conjunctivitis, such as poor tear production, poor tear quality, entropion, ectropion, distichia, trichiasis, ectopic cilia, foreign body, external irritation, allergies, uveitis from causes apart from infectious disease-related, glaucoma, especially the cause is primarily related. Periocular diseases can also lead to hyperemia of the conjunctiva.

Cytology or histopathology of the conjunctiva can be considered to help determine the cause of the conjunctivitis. Histopathology is a poor diagnostic test to detect bacterial involvement. It is not unusual to detect bacteria in healthy conjunctiva. Gram-positive bacteria, especially staphylococci and streptococci, can be cultured in healthy conjunctiva. It is, therefore, not unusual to have these bacteria cultured from eyes with conjunctivitis. Gram-negative bacteria are not commonly detected, and anaerobic bacteria are rarely detected.

When sampling the conjunctiva for bacteria culture, avoid touching the eyelid margin, eyelid skin, periocular hair, and ocular discharge. The culture should be collected from the fornix of the conjunctiva.

There are lymphoid tissues within the conjunctiva. When the conjunctiva is irritated, these follicular tissues will become hyperplastic. Detection of lymphoid follicles in the conjunctiva does not indicate bacterial infection. Conjunctivitis with lymphoid hyperplasia may need topical corticosteroids to help alleviate

the symptoms. Most common bacteria isolated in normal conjunctiva or involved in conjunctivitis (after eliminating all possible causes of conjunctivitis) are Gram-positive; picking a Gram-positive antibiotic will be sufficient, such as triple antibiotics (neomycin, polymyxin B, gramicidin), fusidic acid (only good for staphylococci), chloramphenicol or tetracycline.

Conjunctivitis in cats

In cats, bacteria involvement in conjunctivitis is more common than in dogs. *Chlamydophila felis* and *Mycoplasma spp*. are common organisms involved. Feline herpes virus Type -1 can also lead to conjunctivitis apart from ulcerative keratitis.

A positive culture or detection of *Chlamydophila felis*, *Mycoplasma spp*, or Feline Herpes Virus Type 1 can be difficult. PCR tests for *Chlamydophila felis*, *Mycoplasma spp*, and Herpes Feline Virus Type 1 can be considered. However, a negative result does not mean these organisms are not involved in conjunctivitis. On the other hand, more than 85% of the feline population in the world are carriers of Feline Herpes Virus Type 1. Therefore, detection of Feline Herpes Virus Type 1 without other ocular clinical signs is not a definitive diagnosis for the cause of conjunctivitis in a particular case.

Topical tetracycline and systemic doxycycline are effective therapy to eliminate both *Chlamydophila felis* infections. The treatment period should be at least 4 weeks. Therefore, topical therapy should be safer and easier for the patient and owner. *Mycoplasma spp* infection is generally self-limiting and should be resolved in 2- to 4-week, even without topical therapy. However, treatment for *Mycoplasma spp* can be the same as *Chlamydophila felis*.

Oral doxycycline can damage the enamel of the teeth. Therefore, should not be used in developing kittens. Systemic fluoroquinolones have the potential to lead to permanent retina damage in cats. The newer fluoroquinolones reduce the potential for permanent retinal damage. Therefore, the careful systemic dosage of this class of medication is imperative.

There are vaccinations for *Chlamydophila felis*. However, even with vaccination, the patient can still be infected with an organism, but the ocular clinical signs will be reduced.

Blepharitis

Blepharitis is an infection with inflammation of the eyelid. The reaction can affect a portion of the eyelid, one or all. Organisms involved include *Staphylococcus spp*, *Streptococcus spp*, Demodex, Sarcoptes, and, if in the Mediterranean region, Leishmania. In most cases, an immunological component can be involved.

It is important that skin scraping be considered to eliminate possible parasitic involvement. The culture of the eyelid skin or even the discharge can be sent in for further diagnosis. Still, it will not contribute to your decision-making in selecting the most appropriate antibiotic for blepharitis.

Most common bacteria isolated in normal eyelid skin or blepharitis are Gram-positive; picking a Gram-positive antibiotic will be sufficient, such as triple antibiotics (neomycin, polymyxin B, gramicidin), fusidic acid (only good for staphylococci), chloramphenicol or tetracycline. Systemic cephalexin should also be considered, as some topical antibiotics may not penetrate the dermis. Adding topical or systemic anti-inflammatories, such as corticosteroids or nonsteroids, may help reduce the irritation from blepharitis and dampen any immune component in this disease.

Keratitis

There are two forms of keratitis: nonulcerative and ulcerative.

Nonulcerative keratitis is rarely bacterial-related and can be due to mechanical such as eyelid or lubrication or immunological issues. In these cases, the cornea will be mildly opaque with vasculature within the cornea. The eye can be uncomfortable but not severe compared to stromal abscessation with keratitis. It is important to determine a possible cause of nonulcerative keratitis and resolve it to allow it to attenuate and slowly restore clarity to the cornea.
There is no ulceration at the cornea in stromal abscessation, but the infection or reaction is within the cornea's stroma. The eye will be in severe pain, and a focal area of opacity within the cornea and vasculature is directed into the abscess.

If sampling cannot be performed, fluoroquinolone topical antibiotics should be considered for stromal abscessation. Fluoroquinolones have better stromal penetration compared to other classes of antibiotics.

On the other hand, ulcerative keratitis may not have a bacterial component. Even in deep corneal ulceration, the imminent issue of the cornea is perforation due to tectonic support rather than bacterial infection. Cornea that has a nonhealing ulceration with keratitis, the cause generally is not due to a bacterial infection. Nonhealing ulceration, indolent corneal ulceration, or Superficial Chronic Corneal Epithelial Defect (SCCED) is an anatomical issue rather than bacterial-related. In SCCED, an abnormal membrane has been laid at the epithelial basement membrane. This membrane prevents normal epithelium from attaching to the anterior stroma of the cornea. Therefore, if this membrane is not removed, this form of corneal ulceration will not be resolved. Prophylactic antibiotics should be considered. The normal bacteria on the corneal surface area are mostly Gram-positive, such as *Staphylococcus spp*. Chloramphenicol, triple antibiotics, tetracycline, and fusidic acid can be considered. Topical tetracycline can also stimulate corneal epithelial cell migration.

Deep corneal ulceration or perforation should be treated by surgery rather than further topical medication. If the cornea is perforated, ointment should be avoided. If deposited into the eye, the paraffin in the ointment can become a serious irritant. Systemic antibiotics, especially those eyes with perforation, should be considered. Cefazoline or Amoxycillin clavulanic acid should be sufficient.

Melting corneal ulceration (keratomalacia) has a bacterial component and can be due to beta-hemolytic Streptococcus, Pseudomonas, or fungal infection (rare in Hong Kong). Samples should be collected directly from the cornea's melted area and not the eye's discharge. Cytological samples can be collected from the melted portion of the cornea by either cytobrush or the blunt end of a scalpel blade. Diff Quik Stain can easily identify inflammatory cells and types of organisms (cocci or rods).

Treatment for keratomalacia requires frequent application of topical antibiotics, especially after cytological examination, and matches the result from culture and sensitivity. If cocci are detected in cytology, I prefer a combination of cefazolin and tobramycin drops. If rods are detected in cytology, I prefer fluoroquinolone drops. Cefazoline and tobramycin have synergistic action. Topical antibiotics will be used hourly. Serum or plasma will also be added and applied at hourly intervals.

If the melting corneal ulceration depth is deep, surgical intervention will be considered when the melting process is better controlled or resolved.

Uveitis

Uveitis is inflammation within the eye. The cause of the inflammation varies, and local infection causing uveitis is rare.

Systemic diseases, lens protein leakage, trauma, coagulation issues, immunological issues, neoplasia, or idiopathic issues can cause uveitis. Infection-causing uveitis include Borrelia, Anaplasma, Babesia, Ehrlichia, Toxoplasma, Leishmania, Toxocara, Histoplasma, Coccidiomyces, Blastomyces, Prototheca, Cryptococci, to name a few. In cat, uveitis can be due to Feline Infectious Peritonitis, Feline Immunodeficiency Virus, Feline Leukemia Virus, etc.

A careful ocular examination with systemic examination is required. In some cases, further diagnostic workup is required to determine a possible cause of the uveitis. The anterior chamber sampling or vitreal sampling for further diagnostic testing can be considered; however, both procedures are delicate and may require specialist involvement to collect the most representative samples and prevent further damage to the eye.

Topical antibiotics are not particularly useful in uveitis as the antibiotics may not be able to penetrate deep into the eye. Therefore, systemic therapy is required. However, a specific organism should be identified before any antibiotics are provided.

Glaucoma

Glaucoma is not a disease. It is a clinical sign of the eye. It means the eye has high intraocular pressure, leading to irreversible damage to the optic nerve and retina, resulting in permanent blindness.

Glaucoma can be due to a primary-related cause or a secondary-related cause. If the cause is primary, meaning there is an anatomical abnormality, topical or systemic antibiotic is not indicated and not useful in managing the condition. On the other hand, if the cause of the glaucoma is secondarily related, further workup is required, just like uveitis. Uncontrolled uveitis will lead to secondary glaucoma.

General consideration

We need to adhere to several methods to reduce organism resistance to antibiotics or antiviral medication.

1. A definitive indication that a bacterial or virus is involved
2. Correct dosage means do not underdose
3. Correct frequency of application of the medication

Surgery Conditions

By Dr. Owen Swan *BVSc*

Prescribing Guidelines for Surgery

In surgical practice, antimicrobials may be used for treating pre-existing infections or preventing infections resulting from the procedure, known as antimicrobial prophylaxis.

For pre-existing infections, culture and sensitivity (C&S) testing should be performed before administering any antimicrobial.

In the event of a potential break in sterile technique, the surgeon must balance the risk of infection against the risk of developing antimicrobial resistance.

Regardless of infection timing, surgical site infections pose significant challenges, including increased costs, morbidity, and even mortality in veterinary medicine. The chance of infections depends on the type of surgery but may be reduced by adhering to surgical asepsis principles and techniques.

Surgery is commonly classified as:

- Clean: No infection present, and contamination is unlikely.
- Clean-contaminated: Involves the respiratory, gastrointestinal, or genitourinary tracts without significant contamination.
- Contaminated/dirty: Infection already present at the surgical site or contamination likely during the procedure.

Reported surgical infections rates are approximately 5% for clean surgeries, 12% for clean-contaminated surgeries, and 10% for contaminated/dirty surgeries.

Antimicrobial prophylaxis is not a substitute for aseptic preparation of the patient, staff, facilities, or equipment. Selection of prophylactic antimicrobials should be based on the procedure, potential pathogens, and risk factors associated with the animal and surgical environment.

Clean surgical procedures (for example, routine desexing or neurological procedures of short duration) do not require antimicrobial prophylaxis in animals without risk factors; antisepsis and aseptic technique reduces the risk of infection to negligible levels.

Postoperative Antimicrobial Use Beyond 24 Hours May Be Required If:

- There is a dirty surgical site.
- The patient is severely underweight or obese.
- There is an extended ICU stay, extreme age, or significant hair removal (>4 hours preoperatively).
- The patient experiences hypothermia or hypotension.

Risk factors indicating postoperative use of antimicrobials beyond 24 hours postoperatively include a dirty surgical site, increasing body weight (dogs >50 kg), duration of postoperative intensive care unit stay, extremes of age, morbid obesity, removal of hair greater than 4 hours preoperatively, hypothermia, and hypotension.

Risk factors for developing surgical infections with multiple drug resistance include the type of bacteria present, feeding a homemade diet, or feeding raw food to the animal.

Prescribing Guidelines for General Surgery: Antimicrobial Use Guidelines

Clean surgical procedures:

No antimicrobial is required.

Examples of clean surgical procedures for which antimicrobial use is unnecessary:

1. Ovariohysterectomy.
2. No antibiotics for elective procedures without entry into hollow organs (e.g hernia repair).
3. Castration.
4. Removal of skin masses (lipomas for example).
5. Clean surgical procedures without implant placement and procedures <70 minutes duration such as some neurological surgeries.

Clean - Contaminated Surgeries (or with Comorbidities):

Use Cefazolin 20-30mg/kg iv or Amoxycillin 20mg/kg. In all cases antibiotics are administered 30-60 minutes prior to surgery and repeated at 1-2 elimination half-lives during the procedure.

Examples:

- Gastric, urogenital, and small intestinal surgery: Cefazolin (30 mg/kg IV)
- Large intestinal surgery: Cefazolin (30 mg/kg IV) Cefoxitin (30 mg/kg IV)
- Pyometra (contained, no leakage): Cefazolin (30 mg/kg IV) Amoxicillin (20 mg/kg IV)
- Abdominal surgery: Cefazolin (30 mg/kg IV) Amoxicillin (20 mg/kg IV)

For upper gastrointestinal surgery, anticipated pathogens are Gram-positive cocci and Gram-negative bacilli.

For lower gastrointestinal surgery, anticipated pathogens are Gram-negative bacilli, enterococci and anaerobes.

Contaminated/Dirty Surgeries:

Contaminated surgery where infection is already apparent or likely to be present:
Abscesses, hepatobiliary surgery, removal of organs, marsupialisation and drain insertions.

Initial therapy:

First line: Cefazolin (30 mg/kg IV) or Amoxicillin (20 mg/kg IV) and Gentamicin (6 mg/kg SC)
Second line: Cefoxitin (30 mg/kg IV)

Ongoing therapy:

Based on C&S. Narrow spectrum if possible.

Usage Recommendations

In hepatobiliary, urogenital, or lower GI surgery, gentamicin is added and given prior to surgery if enteric or Gram-negative bacteria possibly involved. Cefoxitin is suggested if anaerobic infection likely and possibly resistant to amoxicillin or cefazolin

For head and neck surgery, clindamycin or cefazolin are appropriate choices, and anticipated pathogens are *Staphylococcus spp.*, *Streptococcus spp.*, anaerobes.

For hepatobiliary, anticipated pathogens are *Clostridium spp.*, Gram-negative bacilli, anaerobes.

Key Points

- Administer prophylactic antibiotics 30-60 minutes before surgery and every 90 minutes during surgery for a maximum of 3 doses.
- Discontinue prophylactic antibiotics within 24 hours unless an infection persists.
- Avoid prolonged postoperative antibiotic use to prevent resistance.

Cat Abscesses

First line:

- Amoxicillin (22 mg/kg q12h PO; 7.5 mg/kg q24h SC or IM) Amoxicillin-clavulanate (20 mg/kg q12h PO)
- Cephalexin (30 mg/kg q12h PO)
- Metronidazole (10 mg/kg q12h PO)

Second line:

- Cases that fail to respond to standard therapy should be sampled appropriately (usually via fine needle aspiration from deep within the lesion) to permit cytology (Diff-Quik®), Gram staining, and C&S. 29

Third line:

- Cefovecin (8 mg/kg SC) is suitable for cases where there are concerns of compliance, or there are difficulties with oral dosing.

Usage Recommendations

- There is no evidence-base regarding treatment duration. The panel recommends that 4-5days of therapy is probably adequate in simple uncomplicated cases. In more complicated cases 7-10 days may be required.
- Currently registered veterinary fluoroquinolones are INAPPROPRIATE in this setting as most fluoroquinolones have no activity against anaerobes.

Prescribing Guidelines for Orthopaedic Surgery

In all cases antibiotics are administered 30-60 minutes prior to surgery and repeated at 1-2 elimination half-lives during the procedure.

Elective Orthopaedic surgery:

Cefazolin (30 mg/kg IV given every 90 minutes until wound closure)

For elective orthopaedic surgery (total hip replacement, cruciate ligament surgery TPLO, TTA, others that involve cutting bone, or use of surgical implants), the anticipated pathogen is *Staphylococcus spp*. First generation cephalosporins can be continued parenterally every 8 hours for up to 24 hours postoperatively.

Specific Orthopaedic Conditions:

Osteomyelitis:

Diagnosis: Based on clinical signs (lameness, bone imaging) and confirmed by culture and sensitivity (C&S).

Key Issues:
- Common pathogen: *Staphylococcus spp*.
- Mixed infections may include anaerobes like *Bacteroides spp*.
- Implant removal is often necessary for infection resolution.

Antibiotics:
- Gram-Negative Bacteria (e.g., *E. coli*):
  - Amoxicillin + Clavulanate: 12.5-25 mg/kg every 8-12 hours PO 30
  - Cefazolin: 20-30 mg/kg every 12 hours PO
  - Cefadroxil: 10-20 mg/kg every 12 hours PO
- Gram-Positive Bacteria (e.g., *Staphylococcus, Streptococcus*):
  - Amoxicillin + Clavulanate (as above)
  - Cefazolin or Cefadroxil (as above)
  - Clindamycin: 11 mg/kg every 12 hours PO

Treatment Duration:

- IV antibiotics for 2-3 days, followed by oral antibiotics for 6-8 weeks or at least 2 weeks beyond clinical and radiographic resolution.

Septic Arthritis:

Diagnosis: Joint effusion with neutrophils in synovial fluid (via arthrocentesis, imaging).

Treatment:

- Empirical therapy while awaiting C&S results:
  - Amoxicillin-Clavulanate
  - Cefazolin
  - Clindamycin

Antibiotics: Same as for osteomyelitis

Treatment Duration:

- Minimum of 4 weeks, continuing 2 weeks beyond normalization of synovial fluid.

Discospondylitis:

Diagnosis: Confirmed via imaging and exclusion of fungal infections (e.g., *Aspergillus spp.*) based on cultures(blood)

Key Issues: Consider IV therapy for severe neurological signs.

Antibiotics:

- Gram-Negative Bacteria:
  - Amoxicillin-Clavulanate or Cefazolin

Based on Culture:

Second line therapy: Gentamicin 6mg/kg.

Treatment Duration:

- Minimum of 8 weeks, adjusted based on clinical response.

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