Battling Bugs With More Than Baytril

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- Antibiotics have significant variability
    - Mechanism of action
        - How the drug halts or kills the bacteria
        - Bacteriostatic
            - Stops the bacteria from replicating
            - Requires competent host immune response to clear the infection
        - Bactericidal
            - Kills the bacteria
            - Better choice for severe infections or immunocompromised patients
    - Spectrum of activity
        - Type of bacteria the drug targets
        - Four general categories: Gram positive, Gram negative, aerobic, anaerobic
    - Tissue distribution
        - Parts of the body the drug can physically access
        - Some regions are protected (CNS, eye) and many drugs will *not* be able reach the location, even if the organism is considered susceptible to the drug
            - Inflammation of these protected areas (e.g. meningitis) will make the normal barrier leakier which may allow drugs to access these areas when they normally would not. However, as the inflammation resolves and the barrier is restored, the drug will have less and less effect which may result in incomplete clearance of the infection. Therefore, drugs that have naturally good penetration to these sites should be selected from the start whenever possible.
        - Purulent/caseous exudate, necrotic tissue and foreign material can inhibit a drug's ability to access the infection
            - Wound management is crucial for successful control of external infections
    - Dosing regimen
        - How much, how often and how long the drug should be administered
        - Formularies are the best source for this information, though wildlife often require extrapolation from published references
    - Side effects
- Minimum inhibitory concentration (MIC) or Minimum bactericidal concentration (MBC) is the lowest concentration of drug that will effectively stop/kill the bacteria
    - Used to determine dosing

    - Drugs work by either staying very high above the MIC/MBC (concentration dependent drugs) or by prolonging the time that they stay above the MIC/MBC (time dependent drugs)
        - Any changes in a drug protocol should take this property into consideration
            - E.g. If a time-dependent drug is an appropriate choice but the results are not as expected, increasing the *frequency* of dosing (q8h instead of q12h) would be more appropriate than increased the *dosage* (increasing from 10 mg/kg to 20 mg/kg).
- Judicious use of antibiotics allows us to:
    - Effectively and efficiently eradicate or prevent infection
    - Limit side effects
    - Save time and money
    - Limit the emergence of resistance
        - Many antibiotics used in veterinary medicine are also used in human medicine
        - The One Health concept focuses on the collaborative efforts of multiple disciplines working to attain optimal health for the people, animals and our environment
        - The development of new antibiotics is rapidly dwindling while the emergence of antibiotic resistant bacteria is on the rise – this means it is *crucial* that we do everything we can to maintain the efficacy of the drugs we do have by not misusing or overusing them
- Indications for the use of antibiotics
    - Ideally ALWAYS work with a veterinarian
        - We know this is not realistic or feasible
    - When a veterinarian *cannot* weigh in on a specific animal, standard operating procedures (SOPs) for commonly encountered conditions (e.g. cat attack passerines) can be a very helpful way to improve antibiotic stewardship
    - When a veterinarian *cannot* weight in <u>and</u> an SOP is not available, care should be taken to determine if an antibiotic is indeed warranted. Ask the following questions:
        - Is there an active *bacterial* infection?
            - Rule out contamination vs infection – flush and clean the wound when possible
            - Redness, swelling, heat, discharge and odor can all be indications of an active bacterial infection
        - If not, is there a high likelihood of one developing without an antibiotic?
            - Cat attack animals
            - Open fractures
        - What part of the body is affected?
            - Guides antibiotic choice by considering tissue distribution
        - What type of bacteria is likely to be present?
            - Cytology and Gram stain (training required)

- Knowledge about type of injury
    - E.g. deep punctures more likely to be harboring *an*aerobic bacteria; respiratory infections more likely to be harboring *a*erobic bacteria
- Are there side effects or contraindications to the antibiotic use?
    - E.g. Fluoroquinolones like Baytril can cause joint damage in young animals
- Are there any laws prohibiting the use of an antibiotic?
    - Food Animal Residue Avoidance Databank (FARAD)
        - Fluoroquinolones and nitroimidazoles in food-producing animal species
            - Look to your state's regulated hunting seasons to determine what wild animals are considered "food animals"

- Immediate implementation of an appropriate antibiotic drug is warranted with the following presentations:
    - Predator attacks with significant wounds
    - Cat attacks
    - Open fractures
    - Other presentations with a known bacterial component – will vary by region
        - E.g. *Mycoplasma* conjunctivitis in finches
- Immediate implementation of an appropriate antibiotic drug is ***sometimes*** warranted with the following presentations:
    - Significant soft tissue injuries NOT from a predator
        - E.g. severe entanglement injuries
    - Severe or repeated aspiration
    - Open umbilicus in mammals
    - Primary viral/parasitic/fungal infections with likely secondary bacterial infections
        - E.g. sarcoptic mange with secondary bacterial dermatitis
    - Emaciation
        - Due to concern for bacterial translocation from the gut and compromised immune system
    - Others…
- Immediate implementation of an appropriate antibiotic drug is ***not*** warranted with the following presentations:
    - Diarrhea
        - Rule out parasites, husbandry causes, toxins, pain/stress first
    - Minor soft tissue injuries
        - E.g. road rash
    - Blunt force trauma without open fractures

                - E.g. HBV, window strike
- Amoxicillin-Clavulanic Acid (Clavamox)
    - Class: Beta lactam
        - Clavulanic acid is a penicillinase inhibitor, works to increase drug efficacy against bacteria that have developed the enzyme penicillinase
    - Mechanism of action
        - Inhibit cell wall synthesis
        - Time dependent
        - Bactericidal
    - Spectrum
        - Aerobes and anaerobes
        - Better Gram positive than negative, does have activity against *Pasteurella*
    - Distribution
        - Soft tissue, fluid, bone
        - *Poor* distribution to deep and protected tissues
    - Common indications
        - Predator (especially cat) attack
        - Soft tissue wounds
        - Respiratory or urinary infections
        - Open fractures
    - Side effects
        - GI upset
            - Consider pro and/or pre-biotic use
    - Contraindications
        - Hind gut fermenters (lagomorphs and rodents)
- Enrofloxacin (Baytril)
    - Class: Fluoroquinolone
    - Mechanism of action
        - Disrupts DNA replication
        - Concentration dependent
        - Bactericidal
    - Spectrum
        - Gram negative aerobes
    - Distribution
        - Soft tissue, fluid, bone
        - Moderate distribution to deep and protected tissues
    - Common indications
        - Susceptible Gram negative bacteria based on high index of suspicion or culture and sensitivity
        - *Veterinarians taught to *avoid* Baytril as an empiric first choice
    - Side effects

        - Joint damage in young growing animals
        - Retinal degeneration in cats
    - Contraindications
        - Young animals
        - Food animals
- Potentiated sulfonamides (SMZ-TMP, TMS, Sulfatrim)
    - Mechanism of action
        - Inhibits folic acid synthesis (crucial for DNA development)
        - Time dependent
        - Bactericidal
    - Spectrum
        - Gram positive and negative aerobes, some protozoans (e.g. coccidia)
    - Distribution
        - Soft tissue, fluid, bone *and* deep and protected tissues
    - Common indications
        - Soft tissue injuries
        - Predator attack
            - Safe for hind gut fermenters
        - Respiratory infections
        - Open fractures
    - Side effects
        - Rare
    - Contraindications
        - Pregnant animals
        - Purulent/caseous or necrotic tissue
            - Contains PABA-like components that the bacteria can use even when the natural form is blocked by the antibiotic
            - Debride/flush before implementation if needed
- Metronidazole (Flagyl)
    - Class: Nitroimidazole
    - Mechanism of action
        - Damages DNA
        - Time or concentration dependent, depending on the microbe
        - Bactericidal
    - Spectrum
        - Anaerobic bacteria
        - Gram negative more than Gram positive
        - Many protozoans (e.g. trichomonas, giardia)
    - Distribution
        - Soft tissue, fluid, bone *and* deep and protected tissues
    - Common indications

        - Bacterial infections in the GI tract (e.g. clostridial enteritis)
        - Protozoal infections in the GI tract
        - Deep wounds with anaerobic bacterial growth
    - Side effects
        - Neurotoxicity
        - Unpalatable
    - Contraindications
        - Pregnant animals
        - Food animals
- Culture and sensitivity can be helpful guides for antibiotic use
    - Lavage the site, if possible, before taking a swab for submission (this tests what's left after cleaning, rather than sampling a contaminant)
    - Whenever possible, collect *before* implementing a course of antibiotics as this will confound results
- Regional limb perfusions of injectable antibiotics
    - Possible option for distal extremity infections
    - Limits systemic effects of the drug while providing high concentrations of the drug locally
    - Work with a veterinarian if this is a feasible option
- When possible, consider non-pharmaceutical options for the prevention and treatment of infections
    - Lavage
    - 0.05% chlorhexidine, 0.1% povidone-iodine
    - Appropriate PPE to prevent contamination
    - Clean/sterile instrument use
    - Isolation of infectious individuals
    - Medicinal honey
        - Used for centuries; natural anti-bacterial properties, enhances wound debridement, reduces inflammation and edema and promotes granulation tissue through its hypertonic nature and enzymatic production of hydrogen peroxide
    - Sugar
        - Similar mechanism of action as honey but less effective at reducing inflammation and stimulating granulation tissue
    - Wound management products
        - Silver sulfadiazine, triple antibiotic ointment, aloe vera
        - Use judiciously to prevent fur/feather contamination