

DIAGNOSIS AND TREATMENT OF SUPERFICIAL AND DEEP BACTERIAL PYODERMA

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Superficial pyodermas (impetigo, superficial bacterial folliculitis) are bacterial infections that involve the epidermis and/or follicular epithelium. Impetigo is characterized by nonfollicular subcorneal pustules that affect sparsely haired areas of the skin. The primary feature of folliculitis is a tiny, inflammatory pustule with a hair shaft protruding from the center. Typical pustules may be difficult to find as pustular lesions are very transient in dogs and cats, especially when the animal is pruritic. More common lesions are follicular papules, which may or may not be crusted, epidermal collarettes, erythema, hyperpigmentation, and alopecia. In most cases, coagulase-positive *Staphylococcus* organisms are involved, with the overwhelming majority of canine skin infections caused by *S. pseudintermedius* bacteria.

Successful treatment of bacterial skin infections requires systemic antimicrobial therapy aimed at the specific etiologic agent. The clinician should prescribe systemic antibiotics that are bactericidal and beta-lactamase resistant for a minimum of 3-4 weeks. The rule of thumb is to continue systemic antibiotic for 7-10 days beyond complete clinical resolution. Historically, routine bacterial culture and sensitivity was not indicated in most cases of superficial pyoderma as *S. pseudintermedius* resistance was low. However, with the increasing frequency of methicillin-resistant and multi-drug resistant Staph. organisms, bacterial culture and sensitivity testing would be recommended for those patients who had received systemic antibiotics within the past 6 months. As always, if a patient is not responding to appropriate antibiotic therapy, the first step the clinician should take is to confirm that the cause of the dermatitis is actually bacterial pyoderma (rule out Malassezia dermatitis, dermatophytosis, etc.). Cytology should be performed in the case of a patient that has non-responsive pyoderma. If rods are seen on cytology in addition to cocci, then the staphylococcal pyoderma may be complicated by a gram-negative infection. In any event, culture and sensitivity should be performed to aid in antibiotic selection. In the case of recurrent skin infections, the clinician must look for and address the primary problems that are predisposing to the animal to repeated infections.

Antibiotic choices for skin infections include the cephalosporins, clindamycin, clavulanic-acid-potentiated amoxicillin, and the fluoroquinolones. Cephalosporins are broad-spectrum, bactericidal antibiotics with low incidence of staphylococcal resistance. Cefadroxil (22 to 30 mg/kg every 12 hours for dogs; 22mg/kg every 12 hours for cats), cephalexin (22 to 35 mg/kg every 12 hours), and cefpodoxime (5 to 10 mg/kg every 24 hours) are the most commonly used cephalosporins. Cefadroxil, cefpodoxime and cefovacin are labeled for veterinary use. Cefovacin is an injectable cephalosporin dosed at 8mg/kg every 14 days.² All of these drugs are effective and can be used long-term with a low incidence of side effects. Gastrointestinal signs (inappetence, vomiting, loose stool/diarrhea) are the most common side effects.

Clindamycin (11 mg/kg every 12 hours or 22 mg/kg every 24 hours for dogs; 5.5 mg/kg every 12 hours or 11 mg/kg every 24 hours in cats) is bacteriostatic, with a spectrum of activity primarily against gram-positive bacteria, including *Staphylococcus*, *Streptococcus*, *Corynebacterium*, as well as most pathogenic anaerobes. Clindamycin is generally well tolerated, although high doses have caused vomiting and diarrhea in cats. Diarrhea may be seen due to altered bacterial population in the intestine.

Amoxicillin + clavulanic acid (13.75 to 22.0 mg/kg every 12 hours) is a broad spectrum antibiotic, which is usually well tolerated. Diarrhea and vomiting are noted side effects. Clavulanate has no antibacterial effects alone, but it is a strong inhibitor of the beta-lactamase enzyme that causes resistance among gram-positive and gram-negative bacteria. Some clinicians find the label dose (13.75 mg/kg twice daily) to be less effective than a higher dose (22 mg/kg twice daily).

Fluoroquinolones are broad-spectrum bactericidal antibiotics. They include enrofloxacin, ciprofloxacin, marbofloxacin, orbifloxacin, and premafloxacin. Although they are effective in the treatment of staphylococcal infections, their use should be reserved for the treatment of resistant infections, that is, infections with gram-negative bacteria (*Escherichia coli*, *Pseudomonas* spp, *Salmonella* spp) and for deep granulomatous infections with *Staphylococcus* sp. The fluoroquinolones achieve good penetration into granulation tissue. The minimum inhibitory concentration (MIC) requirement and dosage requirement for staphylococcal infections and for *Pseudomonas* spp is considerably higher than for *Escherichia coli* and *Salmonella* spp. When dealing with *Pseudomonas*, enrofloxacin (20 mg/kg daily), ciprofloxacin (20 mg/kg daily), and marbofloxacin (5.5 mg/kg daily) are the best choices. Marbofloxacin has a lower MIC for *Pseudomonas* sp than the other veterinary approved drugs. The effectiveness of the fluoroquinolone class of medications is dose dependent; therefore, a higher dose once daily is recommended over the same dose split twice daily. Potential side effects of fluoroquinolones in dogs include gastrointestinal upset and cartilaginous defects in growing dogs.

Deep bacterial pyodermas involve tissues deeper than the hair follicle and are generally a continuation of a superficial infection or superficial folliculitis. The infection goes deeper into the follicles and breaks through the follicular wall to produce furunculosis and infection of the dermis and often the subcutaneous tissue. Clinical features will vary but generally dogs will present with erythematous, edematous skin with crusting and draining tracts.

Antibiotics used for deep pyoderma are similar to those used for superficial infections of the skin. Many dogs with deep pyoderma, however, particularly with chronic infections or those associated with demodicosis, may have gram-negative bacteria associated with the infection in addition to *Staphylococcus* sp. For that reason, in the case of deep pyoderma, a sample is often collected for culture and sensitivity testing. Culture samples may be collected in one of two ways: If intact lesions are present and are not ulcerated or draining, they may be cultured with a culturette. A lesion, such as a pyohemorrhagic bulla, is cleaned lightly with alcohol; and then the lesion is punctured using a 25-gauge needle. The culturette is touched to the lesion surface to collect the expressed material and then placed into the sterile tube containing the culture medium. In many cases of deep pyoderma, there are areas of swelling, erythema, and draining tracts. In such cases, finding an intact primary lesion is difficult, therefore a biopsy sample is obtained from an area of inflammation in which the surface is not ulcerated. The surface of the skin is cleaned lightly with alcohol, and a small area of affected skin is removed either using a punch biopsy or by resection with a scalpel blade. This piece of skin is then wrapped in sterile gauze that is lightly moistened with sterile saline and placed into a sterile container. The sample is then submitted to the laboratory for a macerated tissue culture. Alternatively, a transport media may be used.

As with superficial pyodermas, deep pyodermas do not occur spontaneously in normal dogs and cats. Successful treatment mandates the identification of the predisposing problem(s).

WHAT ABOUT METHICILLIN-RESISTANT STAPHYLOCOCCAL ORGANISMS?

Methicillin-resistant *Staph. pseudintermedius* (MRSP) is not a “super bug”. As with the methicillin-sensitive *Staph.* organisms, successful treatment requires the use of an antimicrobial agent to which the bacteria are sensitive. The treatment period is the same and depends upon the depth of the infection (superficial or deep). Oral antibiotic choices include doxycycline/minocycline, trimethoprim/sulfas, chloramphenicol, rifampin and linezolid. An antibiotic available by intravenous administration is vancomycin. These antibiotics may all be successful at treating a MRSP if the sensitivity results indicate an appropriate minimum inhibitory concentration (MIC), however each carries its own set of risk factors and/or cost factors.

Doxycycline (5mg/kg every 12 hours) is bacteriostatic with a broad spectrum of activity including bacteria, protozoa, *Rickettsia*, and *Ehrlichia*. It is usually the drug of choice for treating tick-borne diseases in animals. Doxycycline administered orally to cats has caused esophageal irritation, tissue injury, and esophageal stricture. This may be caused by more solid-dose formations (primarily doxycycline hyclate rather than doxycycline monohydrate) becoming entrapped in the esophagus.

Chloramphenicol (40-50mg/kg every 8 hours for dogs; 12.5-20mg/kg every 12 hours for cats) is a bacteriostatic drug and it is important to maintain drug concentrations above the MIC for as long as possible during the dosing period. It is a broad spectrum antibiotic used to treat infections caused by gram-positive cocci, gram-negative bacilli, anaerobic bacteria and *Rickettsia*. Of concern is possible bone marrow suppression with high doses or prolonged treatment. This effect is possible in any species with prolonged use, but cats appear particularly susceptible. **NOTE: exposure to small doses has caused aplastic anemia in people.

Rifampin (5mg/kg every 12 hours or 10mg/kg every 24 hours) has a high activity against gram-positive bacteria but more limited activity against gram-negative bacteria. Rifampin is highly lipid soluble enters cells easily to concentrate in leukocytes and inhibit intracellular bacteria. Resistance among bacteria (e.g. *Staphylococcus* sp.) has been reported to develop rapidly, but this has not been well documented among veterinary isolates. Hepatotoxicity is seen more commonly in dogs when high doses are administered (10mg/kg and higher). Elevation in hepatic enzymes may be seen. Urine, saliva, tears, feces, sclera and mucous membranes may become colored with a reddish-orange color.

Linezolid (10mg/kg every 12 hours) is bacteriostatic and active against streptococci and staphylococci. It is indicated for treatment of infections that have become resistant to other drugs, particularly when there is resistance to the beta-lactam antibiotics. It is not indicated for gram-negative organisms. Because of the high cost of linezolid, it is not used for routine infections. Side effects may include diarrhea and nausea in people, but because of the limited use in animals, adverse effects have not been reported.