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Demodicosis - A Frequent Problem in the Dog
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Introduction
Demodex canis is an obligate parasite of the dog and low numbers of mites are part of the normal cutaneous fauna. Within the first days after birth, the mites are transmitted from the bitch to the nursing puppies. Transmission of clinical disease from dogs with generalized demodicosis to normal dogs is not typically seen and the disease is not considered contagious. Fusiform eggs of Demodex mites hatch into six-legged larvae, molting into eight-legged nymphs and finally maturing into adults. In the dog, Demodex canis is the most commonly recognized mite. However, a short-bodied and hitherto unnamed mite seems to inhabit the stratum corneum. A long-bodied mite was first reported to cause oily skin and subsequently named D. injai. It resides in the pilosebaceous unit.

When considering the pathogenesis of demodicosis in dogs, it is important to distinguish between juvenile onset and adult onset disease, as well as between localized and generalized forms. The differentiation between localized and generalized disease is sometimes difficult. Generally it is accepted that up to four focal lesions indicate localized disease, whilst more than a dozen lesions, a large lesion or paw involvement suggest generalized disease. Dogs exhibiting lesions fitting into neither category need to be decided upon individually. Localised demodicosis usually heals spontaneously1. Generalised disease may also spontaneously resolve2, but studies to evaluate the rate of self-cure are lacking. With juvenile onset, certain breeds are at risk; cessation of breeding with affected animals reduces, if not eliminates, juvenile generalized demodicosis from breeding kennels. Other predisposing factors mentioned in the literature include short hair, poor nutrition, stress, oestrus, endoparasites, and debilitating disease.

Drugs or diseases altering the immune response may trigger for adult-onset demodicosis. Hypothyroidism, hyperadrenocorticism, leishmaniasis, glucocorticoid therapy, neoplasias or chemotherapy have all been reported.3,4 Idiopathic adult-onset demodicosis also exists. In cats, demodicosis is typically due to an underlying systemic disease.

Clinical signs
Clinically, canine demodicosis is characterized initially by erythema, papules and comedones, as mites accumulate in the hair follicles. Alopecia and scaling may also be seen. Later, influx of inflammatory cells may lead to pustule formation. With severe disease, follicles rupture and furunculosis with deep lesions and crusting develops. Lesions can occur anywhere on the body, although the face and feet are most commonly affected.

Diagnosis
Diagnosis is made by deep skin scrapings or trichogram. A deep skin scraping is one of the most common diagnostic procedures performed in veterinary dermatology. A small area of affected skin (1-2 cm²) is scraped in the direction of hair growth until capillary bleeding is observed, using a blade covered with mineral oil. Follicular papules or pustules are good sites for scraping. Because Demodex mites live in the hair follicles, it is useful to squeeze the skin prior to and during the scraping in an attempt to push the mites out from the depths of the follicles. Paws and faces are difficult to scrape and skin biopsies may be needed in some of these patients to confirm the diagnosis. Some breeds, such as Shar Peis, with demodicosis are anecdotally reported to be negative on scrapings and may have to be biopsied for diagnosis. Although Demodex canis is a normal part of cutaneous fauna and thus an occasional mite can be found in skin scrapings from normal dogs, it is extremely rare to see more than one Demodex mite on a dog not affected by demodicosis. If only one mite is found, further scrapings or a biopsy are recommended. When evaluating deep skin scrapings, it is important to assess and to note in the record the site of scraping and the relative numbers of adults, larvae, nymphs and eggs per microscopic field. In subsequent visits, assessment of response to therapy relies on the comparison of such numbers. Scrapings should be repeated at the same sites monthly when monitoring patients with demodicosis.

Treatment
Localised demodicosis resolves spontaneously in most patients.5 Treatment may be initiated against possible concurrent bacterial infections with benzoyl peroxide or oral antibiotics, but miticidal therapy is usually not necessary and should not be initiated in intact dogs; thus the few patients where the generalised form may subsequently develop can be identified. These dogs should be neutered to prevent passing on the predisposition to offspring. Lime sulfur rinses (2%) weekly for 4-8 weeks are recommended for the treatment of feline demodicosis. Treatment for generalized demodicosis may include a number of medications, many of which are not registered.
for this indication anywhere in the world:

**Amitraz**

Amitraz is a miticidal rinse. Adverse reactions associated with amitraz application resemble those induced by alpha 2-adrenergic agonists such as xylazine. These are sedation, bradycardia, hypothermia, hypotension, bloating, polyuria, vomiting and hyperglycemia. Yohimbine (0.1mg/kg IV), antagonizes the CNS-depressant and bradycardic effects of amitraz. Amitraz is one of the few drugs registered for the treatment of canine demodicosis in many countries.

Clipping the entire dog is essential to allow better contact of amitraz with the skin. All crusts should be removed (preferably by shampooing with an antibacterial follicular flushing agent such as benzoyl peroxide). The dog must be dry completely (2-8 hours), before being sponged down with amitraz. The treating person should wear protective gloves and work in a well-ventilated area. Owners with asthma are advised to find somebody else for the rinses. The dog should stand in a tub with its feet in the amitraz solution to allow soaking of the often extensively affected feet. Amitraz causes a transitory sedative effect for 12 to 24 hours. Concentration of the drug and frequency of application influences the response rate. The author uses a concentration of 600 ppm once- to twice-weekly. In patients with demodicosis, the procedure should be repeated until four weeks after two successive skin scrapings (2-4 weeks apart) fail to reveal live demodectic mites. For pododermatitis and otitis externa, a mixture of 1 ml amitraz with 30 ml mineral oil can be used topically on a daily basis. Treated dogs should not get wet or be washed.

**Ivermectin**

Ivermectin, orally at a dose of 300 - 500 mcg/kg daily, is used in the treatment of demodicosis with good success. It must not be used in collies and Old English sheep dogs, as it commonly causes adverse reactions in these breeds. Ivermectin paralyzes nematodes and arthropods by potentiating gamma-aminobutyric acid (GABA) binding to its receptor and stimulating GABA release. In mammals, GABA is only found in the CNS and ivermectin does not readily cross the blood brain barrier. However, the adverse reactions seen commonly in some breeds include ataxia, mydriasis, tremors, stupor, salivation, bradycardia and respiratory arrest. These side effects are seen in collies at a dose between 100 and 200 mcg/kg. Other breeds may be affected as well, showing ataxia and tremors at lower doses. Thus, the routine protocol for a dog that did not receive ivermectin before, is a slow increase from 50 to 100 to 150 to 300 mcg/kg on subsequent doses every day. The owner must monitor the animal carefully during that time for side effects. If any signs of ataxia or tremors occur, administration of the drug must be discontinued immediately. Once the maintenance dose is reached, patients receive that dose once daily until four weeks after the second consecutive negative monthly skin scraping. Note: with daily dosing, the serum level increases for weeks due to the long half-life of ivermectin, thus patients need to be monitored for side effects for the first eight weeks.

**Milbemycin**

Milbemycin oxime is a macroolide antibiotic made from the fermentation of Streptomyces hygroscopicus and registered as a monthly heartworm preventative. It may be used daily at 2 mg/kg for the treatment of demodicosis. The advantages of this drug versus conventional treatment with amitraz include the rare occurrence of side effects and the ease of administration. The treatment is very expensive for larger dogs. Response is comparable to amitraz. Milbemycin is used until four weeks after the second negative skin scraping.

**Moxidectin**

This is another milbemycin that was evaluated for the therapy of canine generalized demodicosis. Studies have evaluated moxidectin at 200-400 mcg/kg/day orally, two of which employed the initial gradual dose increase advocated for ivermectin. Reported side effects were ataxia, lethargy, inappetence and vomition. As moxidectin is a macrocyclic lactone and has a similar mode of action to the other drugs in this group, the success rate and rare adverse effects are not surprising. However, more studies with longer follow-up period are needed to identify potential benefits and disadvantages. Moxidectin has recently been approved as a spot-on formulation for the treatment of canine demodicosis and it will be interesting to see the efficacy of that formulation in future studies.

**Doramectin**

This is the final macrocyclic lactone successfully used for therapy of generalized demodicosis. In one study, 23 dogs were injected weekly with 600 mcg/kg subcutaneously. Ten of the dogs were cured, seven relapsed after 1-24 months (two of which responded to repeat doramectin treatment) and six were lost to follow-up. None of the animals in this study showed any adverse effects with therapy. Further investigations are needed to evaluate doramectin for the treatment of generalized demodicosis.

**Other considerations**

A number of other drugs such as levamisole, muramyl dipeptide, vitamin E, lufenuron, homeopathic and herbal preparations, deltamethrin and closantel have been evaluated for the use of generalized demodicosis, but at this point they cannot be recommended based on published reports. Treatment of the primary disease may result in resolution of the demodicosis. This emphasizes the need for pursuing and treating concurrent diseases in patients...
with adult-onset demodicosis. When dogs do not respond to a given treatment, changing the therapeutic agent leads to remission in two out of three dogs. Similarly, if a relapse occurs after initial remission, a second treatment attempt (either with the same or a different drug) will lead to resolution in approximately two out of three dogs.

References