A Comparison of Canine and Human Demodicosis – Epidemiology, Prevalence, Clinical Manifestations and Treatment Options

Harita Neervannan, Department of Animal and Veterinary Science

Mentor: Dr. Melody L. Wallace, DVM

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ABSTRACT

Demodicosis is caused by an excess of demodex mites in dogs and humans. However, the species of demodex mites and the manifestation of demodicosis is different between humans and dogs. In dogs, the demodex species are Demodex canis, Demodex injai, and Demodex cornei. Canine demodicosis causes inflammation of the skin and manifests symptoms including alopecia and crusts on the skin. There are different types of demodicosis in dogs – localized demodicosis which is mostly seen in younger puppies and is limited to a couple hairless spots usually on the face, and generalized demodicosis which is usually seen in older dogs and affects the whole body. In humans, the demodex species commonly found are Demodex folliculorum and Demodex brevis. D. folliculorum is more common and causes inflammation in the face (eyelashes) while D. brevis causes inflammation of the neck and chest. Treatment of demodicosis in dogs includes antibiotics and antimiticidal treatments. The treatment for generalized demodicosis differs from that of localized demodicosis. The treatment of generalized demodicosis includes amitraz, ivermectin and moxidectin to get rid of the mites, while the treatment for localized demodicosis includes benozyl peroxide and ethyl lactate shampoos to soothe the irritation and avoid additional bacterial infections. The treatment of human demodicosis includes permethrin, lindane and sulfur. There is now a new class of drugs, isoxazolines, are now being introduced as a treatment for demodicosis. This paper goes deep into the many factors of demodex infestation in canines and humans, and explores the different treatments that are currently available.

INTRODUCTION

- Demodex mites are a parasite that are harmless in normal numbers and harmful in excess.
- Demodex mites are classified as arthropods. Their bodies are separated into sections and they have eight legs [1].
- *Demodex canis* most common cause in dogs, *D. injai, D. cornei* more recently discovered and acknowledged
- *D. folliculorum* most common cause in humans but *D. brevis* also specific to humans
- A demodex mite's life cycle consists of four stages – the egg, the larvae, the nymph, and the adult
- The mites only are transmitted by direct contact, so it does not spread very easily amongst animals, but can be difficult to treat.
- Demodicosis is an inflammatory condition caused by demodex mites. In dogs, demodicosis appears as the inflammation of the skin while in humans, it appears as the inflammation of hair follicles.
- Localized demodicosis goes away on its own so it doesn't need to be treated with medications.
- The objective of this research paper is to understand the differences of demodicosis in humans and dogs. We will be looking at the prevalence of demodicosis and the factors affecting it. We will also look into how demodicosis is diagnosed and the different treatment options

DEMODICOSIS IN CANINES

- Canine demodicosis is a well known and common non-contagious dermatological condition, often also known as Red Mange, Demodectic Mange and Follicular Mange
- There are three different species of Demodex are prevalent on the canine skin, the most common actor is Demodex canis which live in the hair follicles, sebaceous glands and sebaceous gland ducts. However, recently other species such as D.injai and D.cornei have also been associated with clinical manisfestations (Figure 1).
- Mostly caused by *D. canis* which is in hair follicles, sebaceous glands, and sebaceous gland ducts
- Also can be caused by *D. injai* (in the sebaceous glands of adults with Cushing's syndrome or hypothyroidism) or *D. cornei* (in the keratinized layer of the epidermis) [1].
- The cases of canine demodicosis are prevalent in most parts of the world, but most often in areas with less-than-ideal hygienic living conditions for the animals.
- Not contagious but mites transmitted from mom to puppy while nursing during first 3 days.
- Demodicosis is more common in dogs with a weak immune system. The juvenile onset of demodicosis is often caused by an inherited weak immune system while older dogs have weak immune systems due to medications [2].
- Localized demodicosis – mostly in younger puppies with localized alopecia on the face (Figure 2)
    - Goes away on its own and often needs no treatment
    - Treatment directed towards itchiness and dry skin
- Generalized demodicosis – usually in older puppies and adults and affects whole body (Figure 3)
    - Usually starts of as localized demodicosis
- Chronic demodectic pododermatitis – form of generalized demodicosis that manifests as persistent lesions on the feet
- Diagnosis of the demodicosis is done by looking for mites with multiple deep skin scrapings from affected areas of skin (alopecic, seborrhea sicca/oleosa pustules and furuncles). The collected material is then microscopically examined at low magnification [3].
- In dogs with localized demodicosis, topical antibacterial therapy combined with good miticidal agents will be sufficient, Most Demodex mites in dogs respond very well to antimiticidal treatment.
- Because these treatments are highly effective, use of concomitant glucocorticoids or unsafe organophosphates should be avoided

Figure 1: Various species of Canine Demodex.. Demodex canis (150 – 285 mm) is most common; Demodex injai (330-370 mm) is longest; Demodex cornei (90-140 mm) is shortest

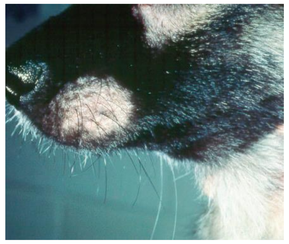

Figure 2: Canine Localized Demodicosis**:** A focal area of alopecia on the muzzle of a young dog.

Figure 3: Canine Generalized Demodicosis showing grey hyperpigmented skin and alopecia

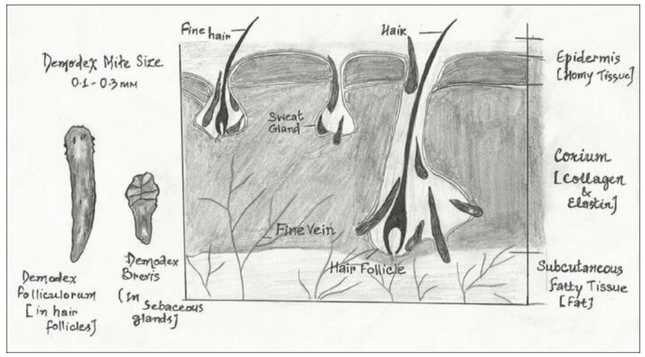

Figure 4. Demodex mites' presence in pilosebaceous unit in humans

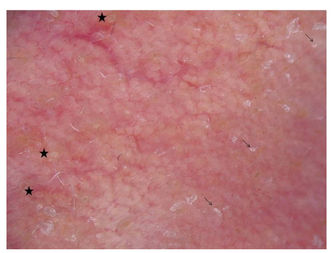

Figure 5. Dermoscopic picture: Demodex "tails" (arrow), Demodex "follicular openings" (star) and non-specific scales [5]

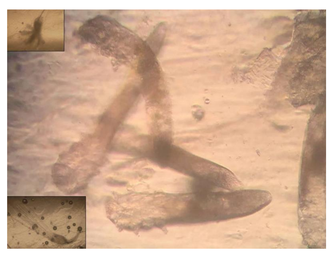

Figure 6. Standardized skin surface biopsy. Microscopic visualization of *Demodex folliculorum* [5]

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DEMODICOSIS IN HUMANS

- Demodex mite is a common human ectoparasite, and it is present in or near the pilosebaceous units. About 65 species of Demodex are known. Two species D. folliculorum and Demodex brevis, collectively referred to as Demodex, are typically found on humans (Figure 4). [4].
- Primary demodicosis – inflammation of sebaceous glands, inflammation around lips, nostrils and eyes
- Vs Secondary demidicosis – mainly caused by the use of immunosuppressants
- Human demodicosis may manifest as a type of rosacea, termed rosacea-like demodicidosis. Demodex type rosacea is characterized by dryness, follicular scaling, superficial vesicles, and pustules, while common rosacea is characterized by oily skin, absent follicular scaling, and being more deeply seated.
- Facial dermatitis – facial pruritis, etc. (form of primary demodicosis)
- Madarosis/Blepharitis – demodicosis that affects the eyelash follicles (form of primary demodicosis). Demodex mite causes follicular inflammation that produces edema and subsequent easier epilation of eyelashes
- A skin surface biopsy (SSB) technique with cyanoacrylic adhesion is a commonly used method to measure the density of Demodex [Figure 6). Other techniques use simpler methods such as dermoscopy, which can show the classic demodex tails (Figure 5) [5].
- There is a high prevalence of Demodex mites in patients with rosacea compared to healthy controls (70.4% vs. 31.8%, respectively)
- Common interventions used for Demodex infestation include metronidazole-based therapies, permethrin, benzoyl benzoate, crotamiton, lindane, and sulfur. Short courses of metronidazole taken orally have shown efficacy in reducing Demodex density.
- Home treatment and prevention strategies include, using mild shampoo on hair and eyelashes every day, cleansing the face twice daily with a non-soap cleanser.
- Many treatments for periorbital demodicosis involve spreading an ointment at the base of the eyelashes at night to trap mites as they emerge from their burrow and move from one hair follicle to another. One treatment is to scrub the lashes and lash roots with baby shampoo, and then treat the area with tea tree oil or macadamia nut oil to try and kill any eggs.

NEW TREATMENT OPTIONS - ISOXAZOLINES

- Isoxazolines are a group of drugs that have been used as flea and tick preventatives. They are a class of five-membered heterocyclic chemical molecules, containing one atom each of oxygen and nitrogen which are located adjacent to one another.
- These include drugs such as Afoxolaner, Sarolaner, Lotilaner, and Fluralaner.
- They have unique properties with very long in vivo half-lives that provide weeks to months of protection after a single oral administration.
- Even though these compounds have neuronal targets, they have been generally shown to be safe in mammals, as they show limited brain penetration and significant selectivity for insect over mammalian receptors
- Isoxazolines kill parasites by negatively affecting their nervous systems. They inhibit the glutamate- and gamma-aminobutyric acid (GABA) – gated chloride channels.
- While isoxazolines are approved to prevent and treat fleas and tick infestation, they are now also being tested on mites and treat demodicosis. They have been especially used in the treatment of generalized demodicosis. Some are topical treatments, and some are oral treatments.
- Isoxazolines have been proven to have a high efficacy against Demodicosis. It takes a few weeks for them to fully get rid of the mites and the scabs, the efficacy has been over 90%
- Some of them (Afoxolaner, Fluralaner and sarolaner) have been evaluated against weekly topical application of moxidectin plus imidacloprid, with demonstrated 99% reduction of demodex in 4 weeks. Lotilaner also eliminated demodex 99.9% with monthly applications.
- While none of these drugs are approved for use against demodicosis yet, they demonstrate remarkable improvement in the ongoing treatment of these conditions [6]. More importantly, they show none of the side effects of the older drugs and can be a very safe alternative that can eliminate this awful condition from the animal population.

CONCLUSIONS

- Although Demodex mites appear as if they can reside without any potential benefit or harm (commensals), there does seem to have some association to skin and ocular inflammatory conditions, when they infest beyond a certain point.
- Symptoms and clinical impact are different in humans and dogs, probably related to variation in the sebaceous follicles in which the mites live and the propensity for bacterial superinfection of affected skin in dogs.
- For both hosts, the mechanism by which the immune system controls the mite population, maintaining Demodex as a commensal, as well as the elements that trigger a transition of the resident mite population to an infestation causing a pathological burden of mites, is not clear
- The complex relationship between mites and their human and animal hosts and how treatments are effective is only now becoming somewhat clear, with new drugs coming on board with some specific mechanisms (such as isoxazolines).
- Further research to clarify how mites interact with each host, human and canine, can also contribute to clarify their role in the other species, as well as informing our approaches to therapeutic interventions.