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DEMODICOSIS OR HUMAN FACE MITES: A REVIEW

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Abstract

Demodex mites are the most common ecto-parasite found mainly on facial skin of humans. These mites represent a part of the usual skin flora. Demodex folliculorum and Demodex brevis are the only species confirmed in humans. Demodex sp. can be pathogenic as a result of many risk factors. Presence of increased number of mite could cause numerous ocular and skin lesions called demodicosis. Early detection of demodicois is essential for patient health and accurate treatment.

Keywords: *Demodex*, Ecto-parasite, Demodicosis, A review.

Introduction

Demodex mites are permenant ecto-parasites of the family Demodicidae of order Acarina of the class Arachnida of phylum of Arthropoda (Lam *et al,* 2018). *Demodex* derives from the Greek expression 'Demos' for fat and 'Dex' for worm (Noreen *et al,* 2011). Demodicosis, also called *Demodex folliculitis* in humans and demodectic mange or red mange in animals, is caused by sensitivity to and overpopulation of *Demodex* spp. as the host's immune system is unable to keep the mites under control (Smith *et al,* 2022).

Review and Discussion

Each animal species hosting these mites has specific *Demodex* species (Sędzikowska *et al,* 2018). A total of 140 species of *Demodex* was detected in mammals (Litwin *et al,* 2017), two species are recognized in man, *Demodex folliculorum* inhabit hair follicles and *Demodex brevis*, inhabit the sebaceous glands (Paichitrojjana and Chalermchai, 2024). D*emodex* mites can be a pathogenic parasite (Marquardt-Feszler *et al,* 2022). Some studies reported that the *Demodex* mites have been accompanied with rosacea, dermatitis, pityriasis folliculorum, alopecia and blepharitis (Erdal and Albayrak, 2022), and otitis externa (Horváth *et al,* 2011). Nourishment of mites on bacteria that colonize the follicles may be useful for the host (a symbiotic relationship) (Zhong *et al,* 2019). Mites can produce free fatty acids from triglycerides of the sebum, as they secreate immune-reactive lipase, so it protect the skin from pathogenic bacteria, such as *Streptoccus pyogenes* and *Staphylococcus aureus* (Namazi, 2007). It may act as a vector and transmit infections, as studies showed that spores of *Microsporum canis* were reported in some many several *Demodex* mites (Rather and Hassan, 2014).

History: In 1841, Jakob Henle made the first report of *Demodex folliculorum* (Ortiz-Hidalgo, 2015), Then it was described by Simon in 1842 (Rufli and Mumcuoglu, 1981). In1843, the genus was named *Demodex* (Monsel *et al,* 2016). In 1963, the two zoonotic subspecies of *Demodex* were recognized (Meinking *et al,* 2011).

Epidemiology: *Demodex* infestation is common and the prevalence in healthy adults is 23-100% (Panopoulou *et al,* 2017). With age, number of *Demodex* mites increases. As infestation is maximum in the age group 20-30 years, since the rate of sebum excretion is at its highest (Paichitjjana, 2022b) also mites were observed in in people over 70 years old (Paichitrojjana and Chalermchai, 2024). Role of the age is not explained, especially in ocular demodicosis (Li *et al,* 2021). *Demodex* is transmitted to newborn through close physical contact with the mother's skin, but, low sebum secretion in infants decreases the number of this mite (Basta- Juzbasic *et al,* 2002). Demodex mites favor warm and humid environment (Chudzicka-Strugała *et al,* 2023). Average density of *Demodex* in skin of general population is <5 *Demodex* spp./cm2 and do not show any manifestaions. Pathology occurs when abnormal increases of *Demodex* mites population in the sebaceous unit (Nicholls *et*

al, 2017). Some studies showed a higher prevalence in females (Zhong *et al,* 2019), but gender variances in the prevalence of *Demodex* have not been clarified (Biernat *et al,* 2018). *Demodex* blepharitis were found in 57.7% of participants in a study carried out on 1,000 eye care patients (Trattler *et al,* 2022)

Mode of transmission: The mites are mainly found on the facial skin including cheeks, chin, forehead, nose, eye lashes, brows, neck, ears and the balding scalp (Zhong *et al,* 2019). Also found on naso-labial and peri-orbital areas (Zeytun, 2017). *Demodex* spp. are transmitted mainly by direct contact with an infected individuals, as skin of the face, shaking hands, kisses, sharing towels, pillows, blankets, bed linen (Chudzicka-Strugała *et al,* 2023) also sharing cosmetics (lipsticks and mascara) (Sedzikowska *et al,* 2021), glasses, contact lenses, face creams, and/or eyeliner (Vargas-Arzola *et al,* 2020). Moreover, mites' infestation could be acquired from infested pet-dog (Morsy *et al,* 1995) or infested pet cat (Beale, 2012).

Biology and morphology: The length of mature *D. folliculorum* mites is 0.3-0.4 mm while *D. brevis* is 0.15-0.2 mm with females smaller than males. These mites have a worm-like shape and the body is covered with scales. It has an elongated transparent body, made of two segments and has pin-like mouth and nourish on lipids, bacteria and sebum (Sędzikowska *et al,* 2018). The first body segment has 8 short legs that help the mites moving at a rate of 8-16 mm/h. Mites move at the night as it has sensitivity to light (Lacey and Kavanagh, 2009). After mating, eggs are laid inside the hair follicles or sebaceous glands then hatch after 3-4 days, giving larvae having six-legged, then become into adults in about a week, with 2 weeks life cycle (Rather and Hassan, 2014).

Pathogenesis: Demodicosis affects pilosebaceous units mainly in the eyelids, the nose and the naso-labial folds (Marquardt-Feszler *et al,* 2022). Invasion by *Demodex* mites causes both skin and eye lesions. Various mechanisms are involved mechanical, inflammatory and bacterial. Demodicosis can block the openings of follicles and sebaceous gland ducts causing follicular distention (Gazi *et al,* 2019). The mites' claws cause micro-abrasions that prompt epithelial hyperplasia and hyper-eratinization (Rhee *et al,* 2023). IL-17 is stimulated by *Demodex folliculorum* and this may enhance the function of the corneal epithelial barrier. Also IL-17 causes inflammation and obstruction of the glands and destruction of the surface of the eye (Kot *et al,* 2017). Mites activate the vascular endothelial growth factor, leading to a vascular reaction and occurrence of itching, pain, redness, papules, or acne (Zhang *et al,* 2018). Also mites are able to secrete bioactive molecules that activate the release of IL-8 by sebaceous cells (Lacey *et al,* 2018). *Demodex brevis* act as a foreign body and block the openings of meibomian glands, leading to formation of chalazion due to a localized granuloma (Litwin *et al,* 2017)

Predisposing Factors: The immune system can accommodate the existence of mites and preserves its normal number (Marquardt-Feszler *et al,* 2022). Apart from in immunocompetent children (Morsy *et al,* 2000), many factors permit abnormal increase of *Demodex* species population such as diabetes, obesity, and chronic renal failure (Özer *et al,* 2020), malignancies and HIV infection (Yazisiz *et al,* 2020), malnutrition (Kaya *et al,* 2013), recurrent use of topical steroids on the face and other immune-modulators (Paichitrojjana, 2022). Also change in types and quantities of skin surface lipids, skin moisture, and pH may help *Demodex* mite propagation (Demirdağ *et al,* 2016). In leukemia, demodicosis may cause severe inflammation of the eyelids and face. Mites were found in 1/3 of children with malignancy and in 1/4 of malnourished children (Kaya *et al,* 2013). Moreover, *Demodex* species were risky factor for rheumatoid arthritis patients (Aletaha *et al,* 2010).

Clinical manifestations: Most people are

symptomatic and only carriers of *Demodex* mites (Kaya *et al,* 2019). Two clinical types are known, primary demodicosis with abnormal increase of mites and accompanying pityriasis *folliculorum*, nodulocystic demodicosis, blepharitis, perioral dermatitis and auricular demodicosis not accompanied with systemic and/or local immunosuppression (Hsu *et al,* 2015). Secondary demodicosis, the presence of *Demodex* mites is associated with other systemic diseases (Chen and Plewig 2014). More severe form of demodicosis was found in immune-suppressed patients (Elston and Elston, 2014). Many ocular infestations are caused by *Demodex folliculorum* in hair follicles and *Demodex brevis* in Meibomian glands and sebaceous glands of the eyelashes (Chudzicka-Strugała *et al,* 2023). Symptoms include burning, itching along the lid margin (Murphy *et al,* 2019), redness, tearing, stickiness of eyelids, or crusting. The pathognomonic sign of ocular demodicosis is occurrence of waxy plugs at lashes base (Nicholls *et al,* 2017), also loss of eyelashes and chronic inflammation of the meibomian gland (Zhong *et al,* 2019), meibomian gland dysfunction, with decrease of lipid tear in the conjunctiva and diminished vision (Li *et al,* 2021). It can cause corneal infiltration, neovascularization, opacity and ulceration, nodular corneal scars, and permanent changes in eyelid (Putnam, 2016). In skin case, the symptoms include redness and irritation, dry, itchy, scales, pustules, acne-like eruptions, eczema, and lines on the patient's face (Rather and Hassan, 2014).

Diagnosis: Detection of *Demodex* spp. is depending on microscopic examination. The samples are collected from the skin by using cyanoacrylate adhesive glue, skin scrapings, skin biopsy, or using adhesive tape, hair epilation of eyelashes and eyebrows (Chudzicka-Strugała *et al,* 2023). Samples are placed on a glass slide in a drop of 10% KOH solution, covered with a suitable coverslip, and carefully examined under a light microscope at a low and high power magnification (Yun *et al,* 2017). Others diagnosis methods include dermoscopy and PCR (Horváth *et al,* 2011), confocal laser scanning microscopy with probability of species determination (Nazzaro *et al,* 2018). Measuring the mass of mites or their extra-follicular position is vital in diagnosis of demodicosis (Boel, 2023). Skin surface standardization biopsy method is used to determine the number of mites per 1 cm2 (Nashat *et al,* 2018).

Preventive measures for demodicosis:

Good hygiene, the use of washing and cleaning products, as shampoos, soaps, and wipes for daily care of the face and eyes can prevent demodicosis. Also education of patients and frequent washing of the linen at high temperatures can eradicate the mites (Zhao *et al,* 2009).

Treatment: *Demodex* is a portion on the normal skin flora, so the aim of treatment is to reduce the mites' overpopulation not to abolish it totally, as well as reducing the inflammation (Fromstein *et al,* 2018). Therapy of demodicosis is usually very difficult and lasting several months (Zhao *et al,* 2009). However, El Shazly *et al.* (2004) successfully treated human human *Demodex folliculorum* cases by camphor oil and metronidazole. *Demodex* mites were not treated by antiseptics like 10% iodine & 75% ethanol (Pelletier *et al,* 2017). A combination of therapies is focused against the mites, as well as the bacteria that could be associated (Carly *et al,* 2014). Treatment of demodicosis is based on the use of antibiotics: tetracycline, doxycycline, metronidazole, and ivermectin. The most common treatments for demodecosis are metronidazole, but also permethrin, benzoyl benzoate, lindane, and sulfur (Lam *et al,* 2018). Medicinal oils such as tea tree oil, bergamot oil, camphor oil, and peppermint oil, as well as sulfur ointment, and choline esterase inhibitors, mercury ointment are also used (Chudzicka-Strugała *et al,* 2023). Tea tree oil is frequently used in treatment as it is of value in decreasing Demodex density (Karakurt, 2018). Irradiation by infrared rays or specialized heating glass-

es is also used. Washing the face with warm water and sunbathing can improve the symptoms of demodicosis (Fromstein *et al,* 2018). Li *et al.* (2023) recommended using ivermectin (topical and systemic), ivermectin-metronidazole (topical), and TTO (topical) are promising anti-*Demodex* interventions.

Mueller *et al.* (2020) reported that in pregnant pet dogs and cats, underlying immunosuppressive conditions contributing to demodicosis should be explored. To avoid transmission for their off-springs, deep skin scrapings were the diagnostic gold standard for demodicosis, but trichograms and tape squeeze preparations may also be useful under certain circumstances. Amitraz, macrocyclic lactones and more recently isoxazolines have all demonstrated good efficacy in the treatment of canine demodicosis. Raman *et al.* (2021) as to pet-dog demodiosis, they reported that long-term oral ivermectin and topical amitraz, an oral antibioic, and nutritional therapy were effective against canine demodicosis. They added that keeping long-haired dogs with good body condition and indoor management was highly suggestive of preventing and controlling the disease.

Conclusion

Demodicosis have a variety of clinical symptoms, making it misdiagnosed. It can occur when there is disproportion between density of the mites and host immunity. There is developing attention in *Demodex* as a causative parasite for skin disorders and ocular diseases. Early diagnosis of a *Demodex* infestation is essential to evade misdiagnosis and proper treatments.

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