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The Feline Fungal Footprint: Diagnostic Insights into Dermatophytosis

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Abstract:

The most prevalent fungal infection in cats and one of the most significant infectious skin conditions in this species is dermatophytosis, which is typically brought on by *Microsporum (M.) canis*, *M. gypseum*, and *Trichophyton Mentagrophytes*. The disease merely causes hair loss and scaling in many cats, and it usually goes away on its own. The result could be a generalized or multifocal skin condition in immunocompromised people and young animals. Culture on Sabouraud agar is the gold standard for dermatophyte detection. For preliminary screening, Wood's light examination and microscopic arthrospore detection are excellent.

Key words: Woods lamp, Trichogram, Sabouraud dextrose agar

Introduction:

A superficial fungal infection of the **skin and hair**, and less frequently of the **claws and hoof**, is called dermatophytosis. Dermatophytes, or "**skin plants**," are complex fungi that grow as hyphae and form a mycelium, as opposed to single-celled yeasts. *Microsporum (M.) canis* is responsible for more than 90% of feline dermatophytosis cases globally (Moriello and DeBoer, 2012). Others are brought on by *Trichophyton (T.) mentagrophytes*, *T. quinckeanum*, *T. verrucosum*, *Nannizzia gypsea*, or other substances. After colonizing the dead, keratinized section of epidermal tissue (primarily stratum corneum and hairs, occasionally nails), all of these fungus, with the exception of *Nannizzia gypsea*, develop proteolytic and keratolytic enzymes that allow them to use keratin as their exclusive food supply.

Dermatophytes create extremely resilient arthrospores that can endure for a year or longer in a dry environment (Sparkes *et al*., 1994 b). Nevertheless, arthrospores are transient in a humid environment. They are rapidly destroyed at high temperatures (100°C). Arthrospores have a great affinity for keratin. Dermatophyte species are divided as zoophilic, sylvatic, geophilic, and anthropophilic fungus based on the reservoirs and the source of infection.

Clinical Signs:

Dermatophytes induce a minor, self-limiting infection that causes hair loss and scaling in many cats. Regular, circular alopecia, hair breaking, desquamation, and occasionally an erythematous perimeter and central healing are the characteristic symptoms of ringworm in cats (Chermette *et al*., 2008; Moriello and DeBoer, 2012). Sometimes the lesions are extremely little, and other times they may be 4–6 cm in diameter. Affected regions can be one or several, and they are primarily located on the head (Fig. 1), but they can also be found on any part of the body, including the tail and the distal portions of the legs.

Lesions in young cats, in particular, are initially restricted to the nose bridge and later spread to the temples, the outside of the pinnae, and the edges of the auricles (Fig. 2). Lesions may group together. According to Chermette *et al*. (2008) and Moriello and DeBoer (2012), pruritus varies, is typically mild to moderate, and is typically accompanied by neither fever nor appetite loss.

Fig. 1

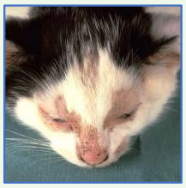

Fig. 2

Fig. 3

(Localized lesions due to Dermatophytosis)

Immunity:

Ringworm that occurs naturally is rarely recurrent, indicating a strong and durable immunity. Animals exhibit greater resistance to a future attack by the identical fungus, according to experimental research (Moriello and DeBoer, 2012). Although they need a significantly larger quantity of spores, re-infections are possible and typically resolve more quickly (Moriello and DeBoer, 2012). Since the delayed type hypersensitivity reactions were frequently less severe in cats whose infection was terminated with antifungal therapy, it has been proposed that the infection must complete its natural course in order for full immunity to develop (Moriello *et al*., 2003).

Despite being limited to superficially keratinized tissues, dermatophyte infection triggers humoral and cellular immune responses. While **Th1 cell** activation triggers a cell-mediated response marked by **interleukins 12 and 2**, as well as **interferon-γ**, and results in recovery, prominent activation of **T helper type 2 (Th2)** cells and the associated cytokine profile causes antibody formation and chronic disease (Sparkes *et al*., 1995; Moriello and DeBoer, 2012). Re-infection is prevented in these cats (Sparkes *et al*., 1993a). Although it is unknown how the humoral reaction contributes to dermatophytosis, antibodies may have a fungistatic impact by complement activation and opsonization (Sparkes *et al*., 1994a).

Even while dermatophyte infections only affect superficially keratinized tissues, they nevertheless trigger humoral and cellular immunological reactions. Strong T helper type 2 (Th2) cell activation and the associated cytokine profile cause antibody production and chronic illness, while Th1 cell activation

triggers a cell-mediated response marked by interleukins 12 and 2 and interferon-γ, which results in recovery (Sparkes *et al*., 1995; Moriello and DeBoer, 2012). These felines are shielded from re-infection (Sparkes *et al*., 1993a). Antibodies may have a fungistatic impact by **opsonization and complement activation**, but the humoral response's significance in dermatophytosis is uncertain (Sparkes *et al*., 1994a).

Diagnosis:

All cats with any cutaneous disease should be evaluated for dermatophytes since they can cause lesions that resemble those of many feline skin conditions. Before beginning any treatment, dermatophyte diagnosis should be attempted if at all possible.

1. Woods Lamp Technique:

Wood's lamp examination is a cheap and easy way to check for *M. canis* infection (Figs. 4, 5). Infected hair shafts exhibit **apple-green fluorescence** throughout this process. Since only roughly 50% of *M. canis* strains glow and other dermatophytes do not, it is widely assumed that this approach is not highly sensitive (Sparkes *et al*., 1994c). Additionally, false positive results can be caused by debris, scale, lint, and topical drugs (like tetracycline), however they hardly ever exhibit fluorescence down the hair shaft.

Therefore, it is recommended to use additional methods to confirm the results obtained from the Wood's lamp. However, Moriello's research (Moriello, 2014) indicates that some of the so-called "non-fluorescing *M. canis* strains" might have come from cats that were just carrying spores without being sick, as spores themselves do not fluoresce. In a similar way, she has demonstrated that employing the correct inspection method can significantly reduce the number of incorrect positive and negative outcomes.

She also came to the conclusion that a lamp with a central area that permits magnification of the examined site, used by a trained observer, is a very helpful first-line diagnostic test. She also hypothesized that differences in the usefulness of the Wood's lamp might have been caused in part by a different quality of model that was available. A review explains how to use a Wood's lamp correctly (Moriello, 2014).

Fig. 4

Fig.5

(Wood’s lamp exam shows distinct fluorescent hairs on a cat in the early phase of *M. canis* infection)

2. Trichogram:

A trichogram for feline dermatophytes is a microscopic examination of plucked hairs to search for signs of fungal infection, such as fuzzy or frayed hair shafts containing fungal elements like hyphae, spores, or conidia. To make a trichogram, hairs are taken from the edge of a lesion, put on a slide with a cleaning

solution like mineral oil or potassium hydroxide, and seen at low magnification. Although it is a useful diagnostic tool, it may not be as sensitive as a fungal culture for identifying the species of dermatophyte.

Performing A Trichogram:

- Collect hairs: Pluck hairs from the front margin of an alopecia or lesion. Don't use whiskers.
- Mount the hairs: Put the hairs on a glass slide and add a drop of potassium hydroxide (KOH) or mineral oil. As a cleaning agent, a KOH solution is frequently chosen for improved visualization.
- Viewed with a microscope: Use a low magnification (e.g., 10x) to view the slide.
- Determine any irregularities: Keep an eye out for infection symptoms such as-

Frayed or enlarged hair shafts: The cortex, the outermost layer, could seem "fuzzy" or damaged.

Fungal components: Examine the hair shaft for hyphae or fungal spores (also known as **ectothrix spores**)(fig.6).

Results and Interpretation:

- A sign of dermatophytosis is the presence of **fungal hyphae or spores**.
- A fungal culture is advised to confirm the diagnosis and conclusively identify the dermatophyte species if a trichogram is positive.
- The trichogram can be used to evaluate a cat's reaction to treatment or determine whether the cat is an asymptomatic carrier.

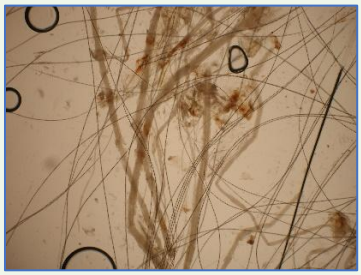

Fig. 6: Microscopic exam of plucked hairs in a drop of mineral oil using the 10X objective. Normal hairs are black and thin, while *M. canis* -infected hairs are brown and thick with cuffs of fungal spores adhered to the shafts **(ectothrix)**

Limitations:

- The precise species of fungus cannot be identified by a trichogram.
- It might overlook certain diseases since it is typically less sensitive than a fungal culture.
- A Wood's lamp may cause some hairs to glow, but this is not a good way to diagnose a condition on its own because it only works on specific species and can provide false positives.

3. Microscopic Examination:

Another quick and easy way to find dermatophytes on hairs or scales is to look at them under a microscope. Instead of removing hairs from the edge of a lesion, it is highly advised to pluck them for this reason under the illumination of a Wood's lamp (Moriello, 2014). Although a direct observation in a drop

of mineral oil is possible, the sample should be cleaned with 10–20% KOH prior to analysis (Moriello, 2014). To enhance the visibility of fungal components on the hair shafts, several methods are available (Moriello and DeBoer, 2012). For instance, hairs or hair fragments with arthrospores and hyphae have a rougher, uneven surface and are thicker.

However, if debris or keratin is mistaken for fungal components, direct microscopic examination may produce false-positive results. Additionally, this technique's sensitivity, which has been evaluated at 59%, is rather low (Sparkes *et al*., 1993b). **Calcafluor white, a unique fluorescent stain** that binds strongly to structures comprising cellulose and chitin, has been used in fluorescence microscopy to obtain higher sensitivity (76%) (Sparkes *et al*., 1994 c). An useful technique for identifying fungal hyphae and spores in cats is adhesive tape impression cytology, which is renowned for being simple to use, reasonably priced, non-invasive, and low stress (Bouza-Rapti *et al*., 2023). It performs similarly to other diagnostic methods and has been shown to be more successful in identifying dermatophytosis than trichogram, Wood's lamp, and fungal culture (Ludwig *et al*., 2024). Large, thick-walled, spindle-shaped (or fusiform) macroconidia that are multicellular (septate) and have a pointed, knob-like or "tuberculate" tip are seen. (Fig.7)

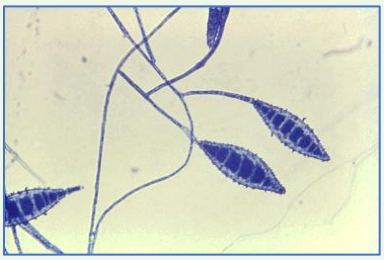

Fig.7 Microscopic examination of stained *M. canis* macroconidia

4. Cultural Examination:

The gold standard for dermatophyte detection is usually thought to be culture on Sabouraud dextrose agar or other medium. False results, however, could come from poor sample and/or inoculation methods (Moriello *et al*., 2017). This technique can identify the species and is highly sensitive. To minimize contamination, samples (hairs, scales) should be taken at the edge of newly formed lesions after being gently swabbed with alcohol. The best way to gather sample material if passive carriage or a subclinical illness is suspected is to brush for five minutes using a sterile brush. According to Moriello and DeBoer (2012), a brand-new toothbrush is mycologically sterile.

Following this process, the number of colonies on the plate indicates the infection's severity, and some shelters have implemented a "pathogen score" system for treatment monitoring (Moriello, 2014; Moriello *et al*., 2017).

Fig.8: *(M. canis* colony growth on a DTM plate after 7 day- white colony turning the growth medium red)

Vaccination:

Immunotherapy using anti-dermatophyte vaccinations for cats has shown limited effectiveness. A double-blind trial involving 55 cats with severe dermatophytosis indicated that while therapeutic vaccination led to some improvement, it was not significantly better than the placebo (Westhoff *et al*., 2010).

Moreover, a preventative vaccination did not prove effective, as immunized cats still succumbed to M. canis challenges. A commercial vaccine aimed at treatment was also found inadequate, leading to its market withdrawal. Consequently, the ABCD does not recommend vaccination for dermatophytosis in cats due to the lack of an effective and safe option (Chermette *et al*., 2008; Lund and DeBoer, 2008; Moriello *et al*., 2017).

Feline dermatophytosis is an uncommon but significant disease in cats, with implications for zoonotic transmission and multi-cat environments. It presents a variety of dermatological signs, which can lead to diagnostic challenges. Diagnosis typically involves complementary tests such as Wood's lamp examination, direct hair inspection, dermoscopy, dermatophyte culture, and PCR testing. Monitoring treatment response includes clinical assessment, Wood's lamp checks, and fungal culture; a negative culture from a lesion-free cat suggests cure. While treatable and curable, management strategies for catteries and shelters are not covered in this summary.

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