Dermatophytosis and Clinical management

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Fungal skin disorders in dogs and cats can be roughly divided into three categories, (1) superficial mycoses of which the dermatophytes are well known representatives, (2) subcutaneous mycoses, which are rare but seen as eumycotic mycetoma and phaeohyphomycosis, and (3) systemic mycoses with cryptococcosis as the most common manifestation.

Dermatophytosis is an infection of keratinised structures, including the nails, hair, and the corneal layer of the skin, caused by Microsporum and Trichophyton complex species (especially Arthroderma vanbreuseghemii). In cats and dogs zoophilic dermatophytes such as M. canis (dogs: 70%, indoor cats: 98%) and T. mentagrophytes/A. vanbreuseghemii (dogs: 10%) and geophilic dermatophytes such as M. gypseum (dogs: 10-15%) are most common. In cats M. canis is responsible for approximately 98% of the observed dermatophyte infections in indoor cats, whereas cats carrying A. vanbreuseghemii are usually hunters, indicating that the natural source of this species is either the soil or rodent prey (1-3). Longhaired Persian cats and Himalayan cats seem to be especially predisposed to the disease. M. persicolor is rarely observed as a causative agent of skin problems in dogs (< 5%) (3).

A dermatophytosis is an extremely contagious disease not only between animals, but also from animals to man. Direct contact with arthrospores and hyphae is the mode of transmission. These may be present on the animals or in the environment (hairs and scales), but also on clippers, brushes, combs, clothing and bedding (4). Ectoparasites such as fleas or Cheyletiella sp. can act as mechanical vectors. The incubation period for experimental feline M. canis in domestic short and long hair cats is 7 to 14 days. Lesions continue to develop and expand for 6 to 8 weeks, then spontaneously gradually resolve by 12 to 14 weeks post infection. It is important to realise that dermatophytes may persist in dry conditions for up to 18 months. Apart from direct contact, important sources of infection are the so-called carriers (subclinical infection), which are animals without visible lesions but nevertheless carrying the infectious material. The reported percentage of carriers of M. canis usually ranges between 10 and 90% in cats. In general, in dogs the percentage of carriers is considered much lower.

Clinical manifestations: The clinical aspects of a dermatophyte infection vary considerably (1, 3, 5). Although pruritus may occur, in the majority of cases it is moderate or even absent. Predilection sites for a dermatophyte infection are the head and the extremities. In cats, the most common clinical manifestation of a dermatophyte infection are:

- A patchy alopecia (a moth-eaten aspect) with broken hairs, appearing as short stubble. Minimal lesions, slight powderly dandruff, and erythema may be observed concomitantly.
- A miliary dermatitis, which is observed in approximately 15 percent of feline dermatophytosis cases.
- Circular, rapidly expanding, squamous patches of alopecia with superficial scaling or collarettes. These are known as ringworm and occur only occasionally.

Additionally, a kerion is observed, which is a circumscribed area of acutely inflamed skin with folliculitis and furunculosis, caused by both bacterial and fungal elements. Such lesions or dermatophyte infection of the subcutis (pseudomycetoma; only reported in Persian cats) are very rare. This is also the case for onychomycosis, which is often caused by Tr. mentagrophytes complex, and results in dry, brittle, and deformed nails, or paronychia, or generalised involvement usually due to infections with M. gypseum or Tr. mentagrophytes complex.

In dogs clinical manifestations are usually less specific. Well-circumscribed circular lesions do occur, but non-specific reaction patterns like scaling head dermatosis or non-responsive (to antibiotics) folliculitis are commonly observed. In rare cases of generalization M. gypseum, M. persicolor or Tr. Mentagrophytes complex (A. vanbreuseghemii) are most likely involved.

Diagnosis: The diagnosis is aimed at the identification of hyphae or arthrospores. For this purpose Wood’s light, microscopy of hair and skin samples, and dermatophyte cultures are the basic tools (3, 5, 6). Wood’s light examination results in a positive yellowish-green-coloured fluorescence in 50 percent of M. canis infections and is in addition positive for some strains of M. audouini, M. distosorum, and Tr. schoenleinii. The other dermatophytes do not fluoresce. Consequently, about half of the dermatophyte infections of cats and one-third of these in dogs may be detected by Wood’s light. Therefore this examination should be performed prior to microscopy.

For microscopic examination of keratinized structures samples should be collected from non-medicated lesions at margins and adjacent areas, and stubbed, broken or misshapen hairs are advantageous. For nail samples scrapings of the concave aspect of
claws after removal of the distal portion of the nail, is recommended. In order to get appropriate microscopic preparations, hair and scrapings should be mixed with chlorphenolac, 10-15% KOH, 10% KOH-DMSO (1:1), 20% KOH-1.2% Indian ink (2:1), or a chlorphenolac-cotton blue solution. At microscopy one should aim to find fragmented pieces of hair, irregular shaped or distorted hairs first. Dermatophytes usually show echotrich involvement. However, M. persicolor hyphae are only seen in surface keratin.

A fungal culture may be required for a definitive diagnosis and is the only way to trace carriers of dermatophyte infections. For the collection of the sample the toothbrush technique is much preferred. For single lesions alternatively hairs may be collected after clipping excessive hair and local disinfection with 70% alcohol-impregnated gauze with subsequent air dry. Performing the MacKenzie method, a new toothbrush is vigorously combed over all parts of the hair coat for 2 to 3 minutes. The toothbrush bristles are very slightly embedded in the Dermatophyte Test Medium (DTM). DTM must be evaluated daily for 20 days at room temperature; white mycelial growth and a colour change to red of the medium within 10 days after inoculation is conclusive for the presence of dermatophytes. Increased incubation temperatures (24-27°C) result in more rapid sporulation of fungi (6). After 10 days saprophytic fungi can also induce a colour change to red, so then further microscopic examination of the culture is necessary.

The presence and morphology of macroconidia and microconidia (microscopy of an acetate tape preparation of the colonies growing on the medium) determines the species involved.

Clinical management: Although spontaneous recovery has been reported in cats, the unpredictable course and the potential public health risk warrants treatment. Essentially, the same approach is recommended for dogs with dermatophytosis. Therapy needs to be individualized on three principles:
1. Topical therapy to kill infective material and prevent environmental contamination.
2. Systemic therapy to shorten length of infection in the patient.
3. Environmental treatment to minimize recurrence and infection of other pets and humans.

Consequently, all or part of the following recommendations are – pending the situation – made (3, 5, 7):
- Gentle clipping of affected animals - clipping the entire cat will likely worsen that individual’s clinical disease but is key for minimizing environmental contamination. However, clipping should not be done in your veterinary clinic or a grooming facility due to the risk of contamination of those premises.
  - Appropriate isolation of affected and non-affected animals;
  - Sanitation of the living environment;
  - Tracing carriers and in-contact animals;
  - Topical treatment of affected animals;
  - Systemic administration of fungicidal or fungistatic drugs.

If an adult cat develops dermatophytosis evaluation for underlying diseases such as FeLV, FIV, diabetes or neoplasia is indicated.

First and foremost don’t get involved in trying to clear dermatophytosis in catteries or animal shelters unless the owners or managers are absolutely committed to the process and to following your instructions! The second principle that must be accepted is that decontamination of a cattery is an expensive and time-consuming process. Lastly, the cattery must have facilities to completely separate infected from non-infected cats.

Topical therapy: For topical use a 2% chlorhexidine–2% miconazole shampoo (e.g., Malaseb®), or twice weekly dips with natamycin (0.01%), enilconazole (0.2%; ImaveR®, or 2% lime-sulfur (4-8 oz per gallon; DVM LymDip®) are available; Lime-sulfur, enilconazole (0.2%) and 2% chlorhexidine-2% miconazole shampoo are likely to be most effective. Unpredictable toxicity of enilconazole has been reported in cats; therefore caution is advised. Local treatment with imidazole containing creams (spot-treatment) is not recommended.

Systemic therapy: Systemic drugs which can be used are griseofulvin (microsized form: 60 mg/kg daily in 2 divided doses; ultra-micronized form 5-10 mg/kg/day), ketoconazole (10-15 mg/kg daily), itraconazole (5-10 mg/kg daily or [only in cats!] 5 mg/kg oral suspension alternating for a period of a minimal total 5 weeks, one week on-one week off), fluconazole (10-20 mg/kg or 50mg/cat) and terbinafine (30-40 mg/kg daily).

Griseofulvin should be administered with food to avoid vomiting and the food should have a high fat content to enhance absorption. This drug should not be given during pregnancy because its teratogenicity. At higher doses than recommended bone marrow depression with resultant panleucopenia may be observed. Consequently, haematological check-ups every 2-3 weeks are then indicated. Griseofulvin is effective against dermatophytes only, acts by damaging microtubuli in fungal cells and is secreted into the skin through sweat glands. In addition, griseofulvin (50 mg/kg daily for 14 days) can be used for prophylaxis.
**Ketoconazole** (Nizoral®) should also be administered with a meal. Principal side effects include gastric irritation, hepatotoxicity, and anorexia. Ketoconazole is not routinely recommended, and in particular contra-indicated for breeding animals (both male and female pets). Ketoconazole inhibits the ergosterol synthesis of fungal cells. In order to obtain proper absorption, an acid environment is essential; therefore this drug should be given a few hours before feeding.

**Itraconazole** (Trisporal®, Itrafungol®) has basically the same action as ketoconazole, is secreted through both sweat and sebaceous glands, and has a strong affinity to keratinocytes. Apart from this, it is incorporated into the basal membrane (studies in people and laboratory animals) resulting in a continuous release to the skin surface until 3 to 4 weeks after finishing the treatment. Whether this is also true for dogs is unknown. In cats alternate administration (one week on-one week off for 5 or more weeks is effective. Itraconazole can be administered to young animals and to pregnant cats with very low risk. Reported side effects are gastric irritation and elevated plasma liver enzymes.

**Fluconazole** (Diflucan®) is an efficacious therapy for *M. canis* infections. As itraconazole it remains in skin and nails for greater than a month after treatment, thus intermittent dosing schedules (one week on one week off, one week per month etc could probably be used but has not been adequately evaluated). Toxicity is rare. Fluconazole is metabolized via the kidney.

One of the newer drugs is terbinafine (Lamisil®). This drug inhibits the ergosterol synthesis (independent of cytochrome P-450) and has a direct destructive effect on fungal cells (by inhibition of squalene-epoxidase resulting in increased amounts of squalene in fungal cells and subsequent cell membrane damage). Terbinafine binds to plasma proteins, is keratophilic and lipophilic; terbinafine concentrations are present in the corneal layers of the skin up to 3 weeks after the last administration in people. The drug is generally well tolerated by cats and dogs.

Due to potential drug interactions, the following combinations are not recommended; for griseofulvin: a combination with barbiturates; for ketoconazole and itraconazole: a combination with cyclosporine and antihistamines; and for terbinafine: a combination with cimetidine.

In general it must be realised that the use of trendy antifungal systemic agents does not routinely give better results. The use of drugs, of which there is hardly any experience in dogs and cats, should not be promoted.

Based on placebo-controlled clinical trials lufenuron (Program®) is not considered to be effective against dermatophyte infections nor is the drug recommended for prevention of dermatophytosis (5, 7).

In addition, vaccines (live or killed antigen) have not shown any clinical efficacy in dermatophytosis of dogs and cats.

**Environmental control:** Disinfection of floors, walls, cages, and grooming tables is performed every 1-2 weeks with enilconazole (0.2%), concentrated chlorine laundry bleach (1:10) solutions, or a detergent-peroxide based product (only UK; Virkon-S®); foggers with enilconazole or formaldehyde are also effective. In contrast, steam cleaning for carpets is not recommended as the steam cools down to 40°C at the carpet surface; such temperature is insufficient for killing infectious spores. As carpets cannot be effectively decontaminated, these should be removed. Special attention must be given to beddings and clothing of in-contact people. For the latter professional steam cleaning may be recommended. Persistence of contagious material in clothing and beddings are common reason for relapses after initial response. All potential fomite items: brushes, rugs, and bedding are discarded and replaced. In exceptional cases euthanasia of one or more animals with proven responsibility for recurrences within a group (or cattery) may be considered.

Antifungal therapy must be continued until fungal cultures are twice negative with 4 weeks in between cultures. Usually dermatophyte infections of the skin require 3-4 months of therapy, whereas onychomycosis requires at least 6 months.

**References**
