Dermatophytosis is one of the most common cutaneous fungal infections we see in cats, and we diagnose it in dogs as well. Most dermatophytes in cats and dogs are caused by one of three fungi: Microsporum canis, Microsporum gypseum, and Trichophyton mentagrophytes. M. canis is a fungus well adapted to cat skin and is the most likely to cause inapparent or very mild infections. This fungus is the one most likely to be transmitted to other cats, to dogs, and to humans. The likelihood of transmission may be related to the virulence of particular strains of the fungus. M. canis infection results from association with other cats, from fomites, or from environmental contamination. These spores remain viable in the environment for many years, making endemic infections in catteries and shelters common and difficult to eradicate. Clinical signs are often most severe in kittens, becoming less severe as the animals age, whether the cats are treated or not. In catteries, it is not unusual for normal appearing queens to have repetitive litters with severely affected kittens. Lesions can range from very mild alopecia to erythematous patches and plaques with crusting. Milia dermatitis is one manifestation, as is the development of pseudomycetomas. Infections with M. canis require the most aggressive treatment to prevent chronic inapparent infections, to prevent spread from animal to animal and from animal to humans.

Microsporum gypseum can affect dogs and cats, and infections seem to be more common in geographic areas of high temperature and high humidity, such as that found in the southeastern United States. Infections are often quite inflammatory with erythema and crusts. In dogs, infection with this fungus is often manifested as a kerion reaction. These dermatophyte infections often spontaneously resolve fairly quickly without treatment, and spread to other animals or humans is rare. Topical therapy may be all that is needed for these infections, and treatment of the environment is not required.

Trichophyton mentagrophytes is most often associated with rodents and these animals are the likely source for infection in dogs and cats; Trichophyton infections can also be contracted from soil. Trichophyton infections can present with alopecia and crusting, and it is not unusual for these infections to mimic diseases such as pemphigus foliaceus. Dermatophyte fungi have proteases that cleave the intercellular adhesion molecules between keratinocytes, leading to acantholysis. Treatment of Trichophyton infections often requires the combination of systemic and topical therapy, and contagion to other animals and to humans is possible.

Diagnostic tools
Dermatophytosis can be on the list of differential diagnoses for any feline skin disease characterized by alopecia and crusting. An excellent screening tool is the Wood’s lamp. A positive test is an apple green fluorescence of the hairs themselves; fluorescence of scale or crust is not significant. The brightness of the fluorescence will increase the longer the lamp is on, so it has been recommended to turn the light on a few minutes prior to use. The lights should be turned off. The results of the test should be confirmed by culture, so that no misinterpretation of fluorescence occurs. While a negative test does not rule out dermatophytosis, a positive test allows you to select hairs for culture with a high yield of success, AND it allows you to institute therapy immediately. It is important to note that the only dermatophyte found on cats to fluoresce is M. canis but not all cats with M. canis will show positive fluorescence. Infections with M. gypseum and Trichophyton spp will not cause fluorescence of the hairs. Every clinic that treats cats should have a Wood’s lamp.

Microscopy of infected hairs following KOH/DMSO digestion is a very useful tool although somewhat time consuming. It does require some expertise, but a positive result allows for the immediate start of treatment, rather than waiting 1-2 weeks for a fungal culture to grow. Fungal culture is still performed in order to determine the species of fungus involved.

Fungal culture remains the test of choice for confirmation of the species involved. Knowing the species of fungus involved is very important as it will determine how aggressively the infection needs to be treated. To date, the standard Dermatophyte Test Medium (DTM) remains the most reliable way to culture dermatophytes. This medium contains antibiotics to inhibit contaminant bacteria, and antimitabolites to inhibit saprophytic growth. Suppression of these microbes is not 100% effective. The color indicator is phenol red. Because dermatophyte fungi utilize the proteins in the medium first, they produce alkaline metabolites which turn the medium red as the fungus grows. Most BUT NOT ALL saprophytes will utilize the carbohydrates in the medium first, producing acid metabolites which keep the color yellow. Two features, therefore, can be used to identify dermatophytes, a change of color to red as the fungus grows, and the gross morphology with white, or pale colonies. If the medium turns red, but the colony is grey or green or brown, it is not a dermatophyte. Microscopy remains important to verify the diagnosis, because there are a few saprophytes that are pale in color and can turn the medium red as they grow. It is important to observe the cultures daily so that the early color change is not missed. Most dermatophytes will grow at room temperature, meaning 25°C. During winter, temperature drops within the clinic will slow the growth and sporulation. In fact, dermatophytes grow best if the temperature is elevated to 27°C, so investing in a small incubator is a good plan. Humidity should be about 30-40%, and this can be achieved by having a pan of water in the
incubator. Unless someone in the clinic is willing to monitor these cultures, grow them properly, and do the microscopy to verify the species, it is better just to submit samples to a good microbiology laboratory.

Microscopy is easy and rapid, and there are a number of websites which show the gross and microscopic appearance of the common dermatophyte fungi. A particularly good one is Doctor Fungus (http://www.doctorfungus.org/). Images can be downloaded as Powerpoint slides and then you can generate your own “in clinic” fungal atlas. M. canis tends to produce canoe-shaped macroconidia with thick walls; usually 6 or more chambers are present; these findings can be correlated with the colony morphology which is white on the top and yellow on the bottom. M. gypseum tends to produce rowboat-shaped macroconidia with thin walls and 6 or fewer chambers; these findings are correlated with the colony morphology which is tan in color and looks like chamois. Trichophyton spp. tend to produce lots of microconidia and long macroconidia may not be seen. I think it is sufficient to identify Trichophyton spp. to the genera only! A key feature for all dermatophytes is the lack of pigment. If there is any pigment in the material seen on microscopy it is NOT a dermatophyte.

At least 2 “rapid” or “improved” assays are commercially available. The Rapid Vet-D test (DMS Laboratories, Inc) is meant to provide a diagnosis of dermatophytosis within 4 days, without requiring microscopic identification. The medium contains a proprietary mix of nutrients and antimicrobials that is suggested to promote more rapid growth of pathogens with more aggressive suppression of contaminant fungi that might turn the medium red. The problem is that there are only two publications evaluating this medium. It was shown that the speed of growth was related to the size of the inoculum; small inoculates required more time. Four days was not sufficient for all dermatophytes, and if the test was stopped at 4 days, Trichophyton spp in particular could be missed. Furthermore, identifying the fungus involved is an important factor in the choice of treatment and how aggressive treatment needs to be. Another system touted as superior to standard DTM is the In Tray DM for Dermatophytes (BioMed Diagnostics). This system is meant to allow both observation of the colony grossly and microscopically without opening the tray. Growth is listed to occur within 1-14 days. The one paper evaluating this system showed that it was effective in growing known inoculates of M. canis only 65.4% of the time, suggesting that a substantial percentage of cases could be missed. The amount of medium is very small and it has been observed to dry out prior to the growth of the fungus.

Like any test, fungal culture is not perfect. Both false negatives and false positives can occur. The success of the test is related to the quality and quantity of the material inoculated. Higher numbers of fungal spores will produce macroscopic growth more quickly. If fluorescence is observed, and a number of fluorescent hairs are inoculated, early growth can be seen in 2-3 days. If there is no fluorescence, but there are broken hairs and scale or crust, you can use a blade to scrape this material up to inoculate the medium. If there are no lesions visible, the toothbrush technique is recommended. A clean toothbrush is used to pick up hair and scale, and the tips of the bristles gently tamped into the medium. A variation on this technique is to use a Swiffer cloth! {Carlotti 2010} Small pieces can be held in a forceps and swiped over the cat; they are then trimmed and placed directly on the medium. False positive reactions can occur when dermatophyte fungi are transiently carried on the skin of dogs or cats. I have seen this most commonly with M. gypseum species and Trichophyton terrestr. False negatives can occur if the inoculum is inadequate or the growth conditions for the culture are not ideal. Another cause of false negatives is overgrowth by bacterial or saprophytic fungal contaminants. Keep in mind that a negative culture does not rule out dermatophytosis.

Often if I am strongly suspicious that dermatophyte infection is present, I will biopsy the animal. Results can be obtained fairly quickly and special stains requested. The situations in which I use biopsy would be suspected kerion reactions, the pseudomycetomas of M. canis that we see sometimes in long-haired cats, or some of the unusual asymmetric crusting disorders we can see with Trichophyton infections.

What about PCR as a diagnostic tool? Currently PCR for dermatophyte identification is offered by Research Associates Laboratories in Dallas TX USA and Healthgene in Toronto, Ontario CANADA. Unfortunately the websites contains no information about quality control, the primers used, what type of PCR is used or what to submit for a sample. For RAL, the order form simply lists “ringworm” and suggests submitting a swab. What we can gather is neither of these labs provides discrimination among the various species of ringworm for veterinary species. There are no publications to support the use of these assays at this time. What does a positive PCR test tell us? PCR tells us that the DNA of the dermatophyte is present in the sample submitted. The presence of DNA does not necessarily prove infection. PCR is very sensitive. There are many variables that need to be controlled to get a quality result. Contamination is possible at every step. In addition, the specificity of the assay will be determined by the primer design as well as the number of cycles, the controls, used and type of PCR assay used. Recently, a publication showed the utility of this tool for veterinary dermatophyte identification when a nested PCR protocol was used; this discrimination is not possible with the single step PCR assay commercially available. Other peer-reviewed articles support the notion that PCR for identification of human dermatophytes may be useful in future, but we have no evidence that the commercial products offered to veterinarians have value.
Treatment options

Treatment of dermatophytosis in cats will be determined by the species of dermatophyte identified, whether the cat is an only cat or a member of a multiple cat or pet household, whether you are dealing with a cattery or shelter situation, and whether human infection is a risk or actuality.

My protocol for single cats with M. canis or Trichophyton spp. infections is to combine the use of an oral antifungal agent with a topical antifungal shampoo twice weekly. While not the most effective topical option (lime sulfur being more effective), using a chlorhexidine/miconazole shampoo twice weekly has been shown to be helpful. In a recent poster presented by Patrick Bourdeau and his colleagues at the World Congress Veterinary Dermatology, several products were tested for their ability to reduce arthrospores in the hair of a cow infected with Trichophyton verrucosum. The most effective topical product was DOUXO chlorhexidine with climbazole shampoo, followed in order by enilconazole, lime sulfur, and chlorhexidine with miconazole. Chlorhexidine shampoo alone was ineffective. Assuming this data can be extrapolated to M. canis, using DOUXO chlorhexidine with climbazole could be a real advantage, as lime sulfur is messy, drying to the skin, and potentially irritating to some cats.

Several options exist for systemic therapy of dermatophytosis. Griseofulvin is no longer recommended for routine use in cats due to its potential for bone marrow suppression when used at the doses required to resolve dermatophytosis. The gold standard has been the use of itraconazole at 10 mg/kg/day. When used for 21 days daily, this drug was shown to be safe and effective, and after that time, it can be used on a pulse basis, giving it daily for one week, breaking for one week, then alternating weeks on with weeks off until the infection is resolved. What has become clear is that Sporanox brand must be used (in the USA); when itraconazole is compounded into liquids at compounding pharmacies, failure can occur. It is believed that these compounded itraconazole liquid products are not well absorbed. Less expensive alternatives include the use of terbinafine 30-40 mg/kg/day or fluconazole at 5-10 mg/kg/day. Ketoconazole tends to be more toxic to cats, and we have seen some failures associated with ketoconazole treatment of animals with ringworm, so it is not recommended.

Protocols for multiple cat households and any home in which humans have infection may require the systemic antifungal drug, the use of weekly or twice weekly lime sulfur dips, and environmental cleanup. Everything that can be bleached should be, and weekly vacuuming and “swiffering” can help reduce the accumulation of spores in the home. A recent study presented by Kunder and Moriello at the World Congress Veterinary Dermatology looked at the efficacy of various household products to kill dermatophyte spores. The 4 that worked best were Chlorox Cleanup (Chlorox Company), Formula 409 (Chlorox Company), Lysol (Reckitt Benckiser), and Accel (Virox Technology).

Catteries and shelters present a special situation with regard to treatment. Virulent M. canis can sweep through these facilities very rapidly, creating a major problem for control, and raising ethical issues for the placement of kittens into new homes. These facilities should be designed so that the general population of cats is kept infection free. Quarantine facilities are needed for any new cats brought into the facility. These new cats should be screened for dermatophytosis by Wood’s lamp exam and by culture before they are released into the general population of cats. When there is a break with dermatophytosis, the facility needs to shut down, accepting no new cats and placing no cats until the infection is brought under control. Ringworm epidemics are expensive to treat because a combination of systemic antifungal drugs, frequent topical therapy, and frequent environmental decontamination is required. It is recommended that at least 2 negative cultures be obtained before the individual animal is considered clear of infection. Good infection control measures including the isolation of infected cats and the use of personal protective equipment is needed. Many no-kill cat shelters operate on a limited budget, but there is no way to make treating epidemic ringworm economical. Unless these infections are treated aggressively, the infections will become endemic. There is then risk that kittens adopted out of such facilities will carry this zoonotic disease into the homes of unsuspecting adopting families.

For an extensive review of handling infections in catteries or shelters, please see the “ringworm bible” written by Dr. Karen Moriello and an excellent e-book written by Dr. Keith Hnilica (http://management.ebooks6.com/Treating-Multi-animal-Facilities-Infected-with-Dermatophytosis-pdf-e35133.pdf#)

M. gypseum infections are much less likely to cause problems and in many cases will spontaneously resolve. Certainly the use of a systemic antifungal drug is not contraindicated but it may be sufficient to utilize topical therapy alone for these infections.

References


Additional references available upon request