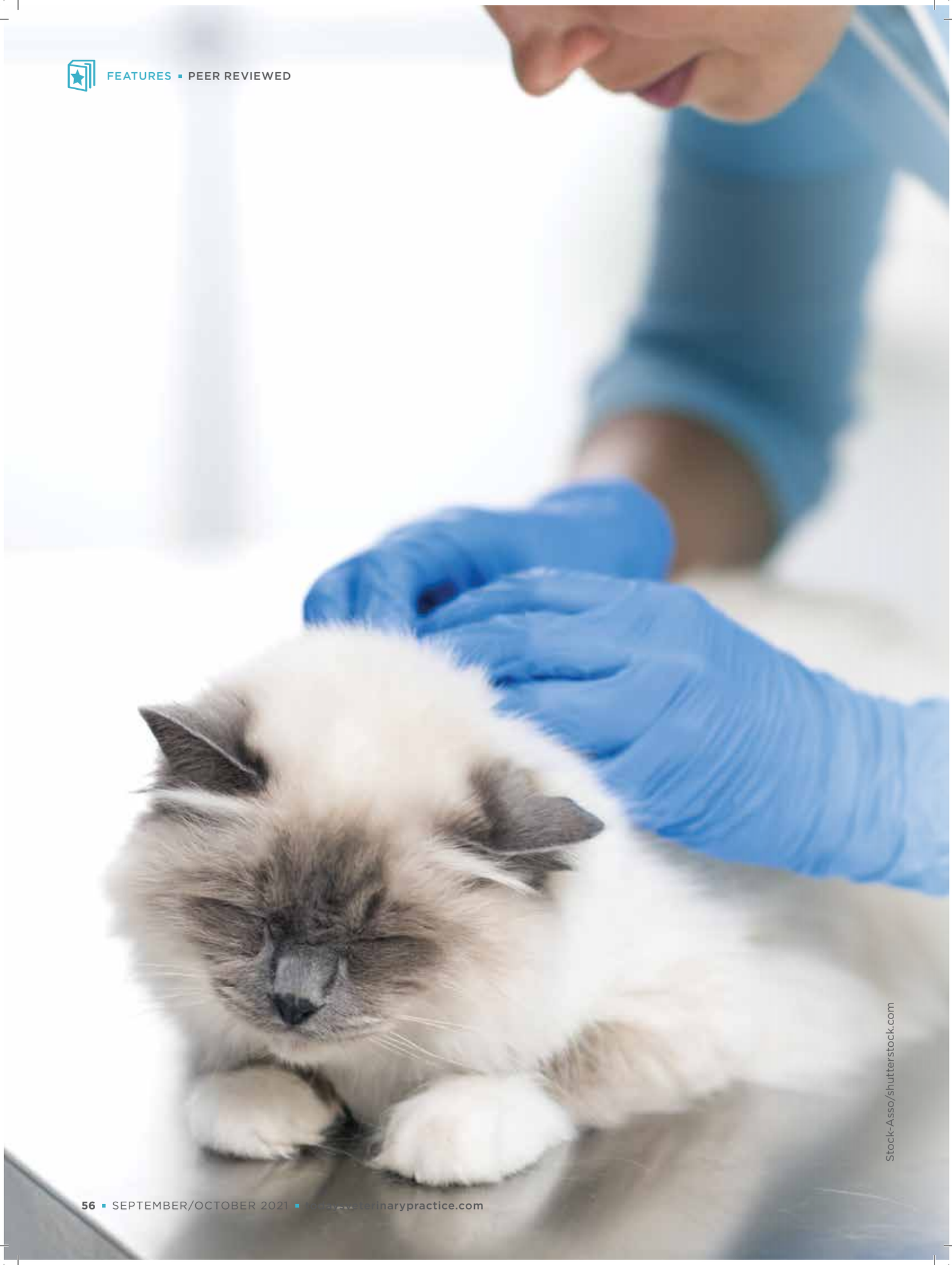

Stock-Asso/shutterstock.com

ISSUES IN DERMATOLOGY

Dermatophytoses in Dogs and Cats

***Rosanna Marsella**, DVM, DACVD*
University of Florida College of Veterinary Medicine

Dermatophytes are pathogenic fungi that cause skin disease in small animals and humans; they can represent a significant problem for shelter animals and household pets allowed extensive exposure to an outdoor environment. The most common dermatophyte infections diagnosed in small animals are caused by *Microsporum canis*, *Microsporum gypseum*, and *Trichophyton mentagrophytes*, and the most common sources are cats (*M canis*), infected soil (*M gypseum*), and rodents (*T mentagrophytes*).[1]

Although dermatophytes are transmitted by contact with arthrospores, exposure to arthrospores does not always lead to establishment of an infection. Resistance to infection is associated with a strong cell-mediated response.[2] Infection is more likely to develop in very young, geriatric, or stressed animals.[3] In shelter cats, infections with dermatophytes other than *M canis* are rare and do not seem to represent a treatment challenge; most cats reach mycological cure within 3 weeks of treatment.[4]

IDENTIFY THE PROBLEM
Dermatophytoses have a variety of clinical presentations, and a step-by-step logical approach is crucial for proper diagnosis.

CLINICAL SIGNS AND DIAGNOSES

Dermatophytoses have a variety of clinical presentations. Because dermatophytes are keratinophilic, their targets are hairs and nails.

Folliculitis

When dermatophytes affect the hairs, they lead to folliculitis (**FIGURE 1**). Infections appear as papules and pustules (**FIGURE 2**), which rapidly rupture, leaving epidermal collarettes, circular areas of alopecia (**FIGURE 3**), and crusts. Differential diagnoses for folliculitis include staphylococcal infection (**FIGURE 4**) and, particularly in dogs, demodicosis (**FIGURE 5**). Thus, when assessing a dog with signs of folliculitis, perform cytologic examination to look for intracellular bacteria and deep skin scrapings to rule out demodicosis.

In the author's experience, bacterial folliculitis is typically more common than dermatophyte infection in dogs; however, do not make assumptions and skip diagnostic steps.

Dermatophytosis can represent a significant challenge in dogs of certain breeds, such as Yorkshire terriers. It is very important to go through the list of differential diagnoses and work up each case in a step-by-step logical manner. Other causes of pustular disease (e.g., pemphigus foliaceus) that are not oriented to follicles should also be considered when working up patients presented for hair loss and crusting. A good initial approach is ruling out causes of folliculitis first by doing cytology, deep skin scrapings, and fungal culture.

Nodular Lesions

Sometimes dermatophytes are accidentally inoculated into the dermis (e.g., during injury), which leads to a severe inflammatory response and development of a nodular lesion called a kerion.[5] This nodular lesion is typically found on the bridge of the nose of dogs that like to dig. Even after the dermatophytes die, the severe inflammatory response can persist. Another manifestation of nodular disease caused by dermatophytes is the dermatophytic mycetoma, also called pseudomycetoma. This uncommon dermal/subcutaneous infection is primarily found on Persian cats and appears as nodules with draining tracts,

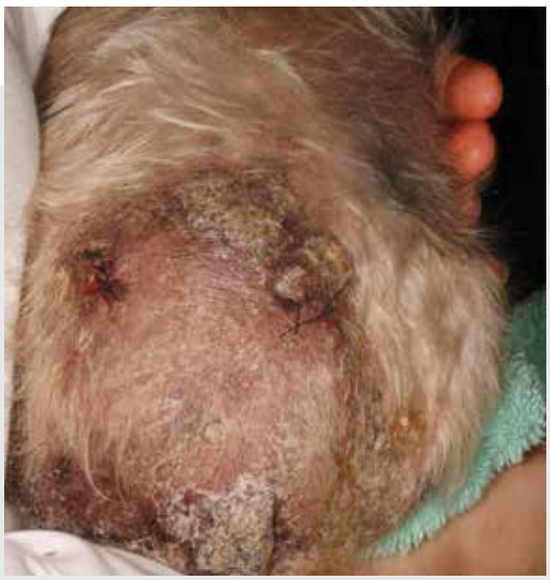

FIGURE 1. Folliculitis in a dog diagnosed with *Trichophyton* species. Note the alopecia and the crusting.

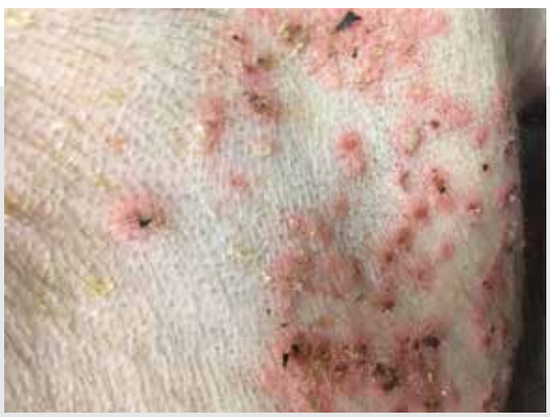

FIGURE 2. Note the papules and pustules of this patient diagnosed with *Trichophyton* species.

FIGURE 3. *Microsporum canis* lesions in a cat. Note the circular areas of alopecia.

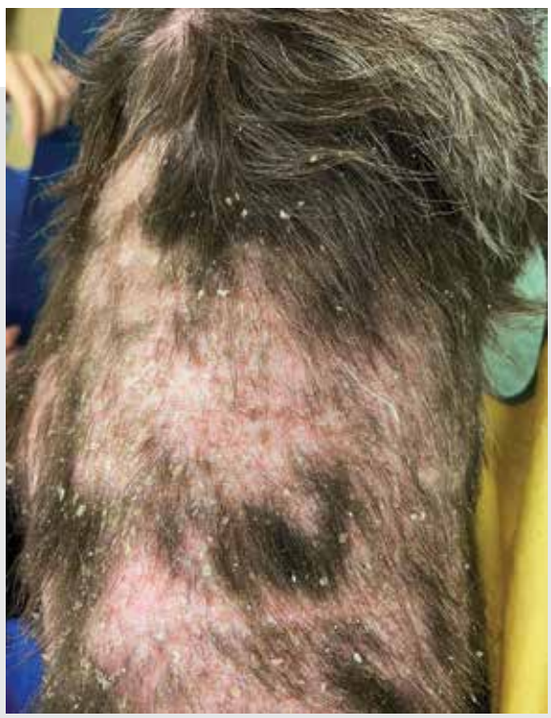

FIGURE 4. Dog diagnosed with bacterial folliculitis. Papules, hair loss, and scaling are evident.

Lower left and upper right: courtesy Dr. Diane Lewis. Opposite counterclockwise from lower left: courtesy Dr. Diane Lewis (3).

typically on the back. These cats are usually presented because they do not respond to antibiotic therapy.

For patients with nodular lesions, it is important to determine whether they result from infectious agents. Biopsy for histopathology and culture is frequently required, but cytology should also be performed since impression smears can be diagnostic.[5]

FIGURE 5. Dog diagnosed with demodicosis. Note the circular alopecia and peripheral crusting that could be mistaken for a dermatophytosis. Importantly, also note the gray discoloration of the skin due to comedone formation due to the plugging of the hair follicles filled with mites.

FIGURE 6. Footpad of a dog diagnosed with *Trichophyton* species. Note the crusting resulting from dry pustules on the pads.

Nail Lesions

Dermatophytes can affect the footpads (**FIGURE 6**) and nails (**FIGURE 7 AND 8**). Dermatophyte-infected nails become brittle and appear deformed, especially in dogs with *M gypseum* infection.[6]

Differential diagnoses for deformed and brittle nails can include systemic lupoid onychodystrophy or genetically inherited dystrophies that are not immune mediated. When working up these cases, before considering biopsies or other invasive diagnostic tests, collect samples of the affected nails (e.g., nail clippings) and submit them for fungal culture.

DIAGNOSTIC TECHNIQUES

A recently published clinical consensus paper on

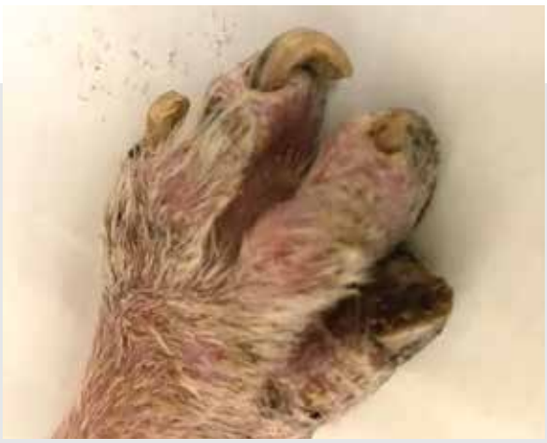

FIGURE 7. Deformed and broken nails in a dog diagnosed with dermatophytes.

FIGURE 8. Infection of skin and nails caused by *Microsporum gypseum*. Note the deformed nails and the brittle appearance.

dermatophytosis in small animals concluded, after review of the current literature, that no single diagnostic test can be identified as the gold standard for the diagnosis of dermatophytosis.[1] The authors state that diagnosis is made by using complementary methods to indicate an active infection, such as direct examination of the arthrospores on infected hairs and fungal culture of hairs collected with a sterile toothbrush.

Wood's Lamp

Use of a Wood's lamp is still recommended as a screening tool, and it is now accepted that most *M canis* infections will fluoresce apple green under a Wood's lamp. Depending on the study, positivity ranges from 91% to 100%; the higher percentages were found in studies of experimentally induced infection.[1] The ability to fluoresce develops after the first week of infection and can persist at the tip of the hairs after resolution of the infection.[1] The authors of the consensus paper concluded that the Wood's lamp is a better tool for initial screening than for monitoring the success of treatment.[1] Clinicians need to be familiar with how to properly use a Wood's lamp. Examination should start at the patient's head, moving slowly back while holding the lamp close to the skin (2 to 4 cm), distinguishing the apple green fluorescence of hairs with dermatophytosis from the false blue fluorescence that can be seen with scaling and some topical products.[1]

Fungal Culture

For decades, the gold standard of dermatophyte diagnosis has been fungal culture. However, the reality is that this approach simply indicates the presence or absence of spores on the hairs. The success of this approach depends partly on the sampling technique and the area that was selected for culture. A technique widely reported in the literature is the toothbrush approach, which may detect asymptomatic carrier animals. In 2017, Di Mattia et al. reported the importance of properly inoculating the samples onto the fungal culture media. Pressing the toothbrush onto the plate is the optimum way to maximize *M canis* growth and minimize contaminant growth.[7]

The ability to fluoresce develops after the first week of infection and can persist at the tip of the hairs after resolution of the infection.[1]

Direct Examination

Plucking hairs from the margins of an existing lesion is considered useful for specifically addressing the question of whether the lesion may be caused by a dermatophyte, although hair plucks can still lead to negative results.[1] Slides with 10 to 20 plucked hairs in mineral oil can be microscopically examined for arthrospores.

Polymerase Chain Reaction

In recent years, use of polymerase chain reaction (PCR) to diagnose dermatophytosis has drawn attention, and results of studies differ, depending on the PCR used. In 2018, Moriello et al. found that quantitative PCR (qPCR) testing of toothbrush fungal culture samples of lesions on shelter cats was a reliable test for confirming disease.[8] qPCR and fungal culture results matched in 94% of cases. qPCR also correctly identified 2 cats as not infected. Mycological cure was correctly identified for 65.2% of cats by *Microsporum* species qPCR assays and 84.8% by *M canis* assays.

Cafarchia et al. reported high accuracy of one step-PCR for dogs (area under the curve [AUC] >90) but only moderate accuracy for cats (AUC = 78.6).[9] In the same study, a nested PCR was accurate (AUC = 93.6) for samples from cats and achieved higher specificity (94.1% and 94.4%) and sensitivity (100% and 94.9%) for samples from dogs and cats, respectively. Another study that compared the performance of nested PCR with direct microscopy and culture found the degree of agreement to be higher for nested PCR and direct microscopy (94.4%) than for culture (83.3%).[10] Similar to fungal cultures, a positive PCR does not confirm active infection, and results need to be interpreted in the context of the clinical signs. A recent study also reported that PCR is less sensitive than previously reported but that it is more specific, thus increasing the risk for false-negative results.[11]

TREATMENTS

Successful treatment of dermatophytosis in dogs and cats requires the combination of topical treatment, systemic treatment, and environmental disinfection.

Topical Treatments

Because dermatophytosis is transmitted by contact with arthrospores, topical therapy is an essential component of treatment. Topical treatment helps speed the resolution of infection and decrease the shedding of arthrospores into the environment.

Clipping

For decades, clipping has been a necessary part of dermatophytosis treatment; however, clipping is currently being reconsidered because whole-body clipping is stressful and the common microtrauma of the skin can worsen the infection. Thus, whether to clip should be decided on a case-by-case basis; clipping is not necessary for short-coated animals.[1]

Dips, Shampoos, and Rinses

In the United States, lime sulfur dips are still recommended. Several studies have documented the efficacy of lime sulfur dips, and twice weekly application is more effective than once weekly.[1,12-14] The dip has residual activity on the coat, whereas that of shampoos is shorter.[13] In the author's experience, common side effects of lime sulfur are dryness and yellow discoloration. Although older studies reported on the potential risk for oral ulcers in cats that lick their coat while still wet, newer studies have not confirmed these findings, raising the possibility that the older studies used more concentrated solutions.[1] Most current lime sulfur formulations for veterinary use are 97.8% saturated lime sulfur, which is applied at a dilution of 8 oz/gallon of water.

When clients object to the smell of the sulfur dip, other options available in the United States include shampoos and rinses. Among the shampoos, neither chlorhexidine nor miconazole alone is considered an effective treatment. The most effective topical treatment is the combination of miconazole and chlorhexidine used twice weekly.[15,16] Although clinicians commonly believe that chlorhexidine has antifungal properties, the efficacy of chlorhexidine for dermatophytosis has been shown to be poor.[17]

Several studies have documented the efficacy of lime sulfur dips, and twice weekly application is more effective than once weekly.[1,12-14]

Topical enilconazole is also effective for treating dermatophytosis in small animals[18] but is currently not available in the United States. In countries where enilconazole rinse is available, it is considered a very effective topical option against dermatophytosis.[19] Although enilconazole is generally well tolerated, it has been reported to cause hypersalivation, muscle weakness, and slightly elevated serum alanine aminotransferase (ALT) concentrations in Persian cats.[16]

The efficacy of shampoos containing ketoconazole for animals has not been assessed by in vivo studies. In vitro studies support effectiveness of ketoconazole, but no clinical trial on ketoconazole shampoo for dermatophytosis in small animals has been published.[19,20]

Similarly, no in vivo studies support the use of topical climbazole for dermatophytosis in small animals. In vitro studies showed good residual activity of 0.5% climbazole with chlorhexidine.[19]

Only 1 study on topical terbinafine has been published, and it reported a good response.[20]

Systemic Treatments

The ideal choices for systemic therapy are drugs that are keratinophilic and lipophilic and accumulate in the skin and keratin. Currently, the most effective systemic treatments for both dogs and cats are oral itraconazole or oral terbinafine.[1]

Itraconazole has a long half-life in cats[21] and a great propensity to accumulate in hairs and skin. This property enables use of pulse therapy, which decreases the cost of therapy; daily administration for 1 week followed by 1 week on and 1 week off has shown clinical success.[22] Others have started the pulse regimen

only after giving the drug daily for 4 weeks.[23] The most commonly used dose for itraconazole in dogs and cats is 5 mg/kg once daily. Because itraconazole affects cytochrome P450, it is important to consider drug interactions and decrease doses of other medications if their metabolism is affected by this interaction (e.g., cyclosporine).

Compounded formulations of itraconazole should be avoided; several studies showed that compounded formulations had subtherapeutic values in treated animals.[24,25] Generic itraconazole seems to be better, although therapeutic monitoring is helpful because concentration can be very variable.[23] If treatment failure is noted, switch to the product formulated for humans, Sporanox (Janssen Pharmaceuticals, janssen.com). Note also that when used at higher doses, itraconazole has been reported to trigger vasculitis in dogs.[26] Clinicians should consider the possibility of this adverse effect when using this medication, although the high doses are typically reserved for systemic mycosis and are not recommended for dermatophytosis. A liquid formulation (Itrafungol; Elanco, elanco.com) is available for use in cats. Reported adverse effects of itraconazole include elevated liver enzymes and anorexia in dogs and decreased food consumption, depression, and elevated serum ALT concentrations in cats.[1]

Terbinafine is very keratinophilic and accumulates in hairs,[27] making it possible to do pulse therapy, which decreases cost and adverse effects. Terbinafine has excellent activity against dermatophytes, and one study has shown that it is efficacious and can represent a suitable and cheaper alternative for shelter cats.[14] The commonly used dose range for terbinafine is 20 mg/kg[14] to 40 mg/kg;[28] efficacy is increased at higher doses. Although terbinafine does not have the same effect on cytochrome P450 as the azoles, its metabolism largely involves the liver; monitoring of liver values may be necessary when treatments are prolonged.

Ketoconazole is effective against dermatophytes, although it is not as good a treatment choice as itraconazole or terbinafine. Ketoconazole has been used in cats;[29] however, because it is not typically well tolerated and frequently causes nausea and anorexia, it is best to reserve this medication for dogs. Ketoconazole is typically prescribed for dogs at 5 mg/kg PO q12h and is best administered with food to minimize adverse effects and increase absorption.

Fluconazole has poor activity against dermatophytes in vitro[30] and is no longer recommended for treatment of dermatophytosis. Fluconazole is also water soluble and does not have the same ability as itraconazole and ketoconazole to accumulate in the skin and keratin.

Griseofulvin has historically been used to treat dermatophytosis but safer and more effective choices are now available. Thus, griseofulvin is rarely selected as a treatment.

Lufenuron was previously considered as a possible treatment, but studies have shown no efficacy.[31,32] Therefore, lufenuron should not be considered as a treatment option.

Vaccines do not prevent development of dermatophytosis[33] and thus should not be used for that purpose.

Environmental Decontamination

Environmental decontamination is a major part of dermatophytosis treatment. It also minimizes false-positive fungal culture results. Although separating animals for the purpose of minimizing contamination[34] has been advocated for decades, confinement needs to be done with care because it can be very stressful, particularly for young animals.[1] Thus, the duration of isolation should be minimized to what is needed to decontaminate the environment. The need for extended isolation can be decreased by weekly cleaning and use of topical therapy.

Studies have shown that weekly cleaning is very effective for removing infective arthrospores.[35,36] The most important part of the decontamination process is the actual hard cleaning, which involves removal of

The most important part of the decontamination process is the actual hard cleaning, which involves removal of debris and hairs.

debris and hairs. Cleaning can be accomplished with over-the-counter household detergents.[37] Hard surfaces can be disinfected with 1:100 concentration household bleach or accelerated hydrogen peroxide.[37,38] Machine washing of soft fabrics should be done by using the longest cycle, to maximize spore removal.

MONITORING TREATMENT SUCCESS

Clinical cure does not always equate to mycological cure. Thus, hair regrowth and the clinical appearance of the patient may not be sufficient criteria for decisions about duration of treatment. It is currently recommended that monitoring therapy and establishing whether a patient is completely cured should be based on a combination of resolution of clinical signs and a negative fungal culture.[1] Extent of infection can be monitored by performing weekly cultures.[1]

Dead fungal organisms can still be detected by PCR. Thus, a positive PCR result along with resolution of signs may indicate that the patient still has some spores on the coat rather than an actual infection. Patients may, for example, pick up spores from a contaminated environment although they have developed immunity and are no longer actively infected. These animals may represent a source of infection for other individuals around them, and further environmental decontamination may be warranted. Fungal cultures are easily available in practice and can help with treatment monitoring. When in doubt, fungal culture can be repeated to ensure that the results are truly negative.

Long-haired cats have a propensity for subclinical dermatophytosis[39] and therefore are potential carriers. When dealing with an outbreak of dermatophytosis in a multicat household, every cat should be cultured to determine which are truly negative and which are clinically normal but carrying arthrospores on their coats and potentially acting as a source of infection for others.[40]

SUMMARY

Dermatophytosis is a zoonotic but curable disease. When examining patients with folliculitis, a step-by-step logical approach is crucial for proper diagnosis. Diagnosis can be obtained by a combination of clinical signs and positive fungal culture results. In the absence of clinical signs, positive PCR or culture results may simply indicate presence of arthrospores on the coat without active infection. Because dermatophytes are not part of the regular flora, the source of the arthrospores should be identified. Wood's lamp examination is still recommended for fast screening of *M canis* infection. Most affected patients require a combination of topical and systemic therapies. The most effective oral medications are itraconazole and terbinafine, which can be combined with twice weekly topical lime sulfur dips and/or shampoos containing both miconazole and chlorhexidine. Establishing whether a patient is completely cured should be supported by a combination of resolution of clinical signs and negative culture. TVP

Rosanna Marsella

Dr. Marsella is a board-certified veterinary dermatologist and full professor at the University of Florida. She has authored more than 150 peer-reviewed articles and has written several books (*Manual of Equine Dermatology* and *Clinical Approach to Feline Dermatologic Diseases*) and contributed to many others as either author or author and editor (e.g., *BSAVA Manual of Canine and Feline Dermatology*). She has served as president of the American College of Veterinary Dermatology and co-editor of *Veterinary Dermatology*.

References

1. Moriello KA, Coyner K, Paterson S, Mignon B. Diagnosis and treatment of dermatophytosis in dogs and cats: Clinical Consensus Guidelines of the World Association for Veterinary Dermatology. *Vet Dermatol*. 2017;28(3):266–e68.
2. DeBoer DJ, Moriello KA. Humoral and cellular immune responses to *Microsporum canis* in naturally occurring feline dermatophytosis. *J Med Vet Mycol*. 1993;31(2):121–132.
3. DeTar LG, Dubrovsky V, Scarlett JM. Descriptive epidemiology and test characteristics of cats diagnosed with *Microsporum canis* dermatophytosis in a northwestern US animal shelter. *J Feline Med Surg*. 2019;21(12):1198–1205.
4. Moriello KA, Stuntebeck R, Mullen L. *Trichophyton* species and *Microsporum gypseum* infection and fomite carriage in cats from three animal shelters: a retrospective case series. *J Feline Med Surg*. 2020;22(4):391–394.
5. Cornegliani L, Persico P, Colombo S. Canine nodular dermatophytosis (kerion): 23 cases. *Vet Dermatol*. 2009;20(3):185–190.
6. Moretti A, Agnetti F, Mancianti F, et al. Dermatophytosis in animals: epidemiological, clinical and zoonotic aspects. *G Ital Dermatol Venereol.* 2013;148:563–572.
7 Di Mattia D, Fondati A, Monaco M, et al. Comparison of two inoculation methods for *Microsporum canis* culture using the toothbrush sampling technique. *Vet Dermatol*. 2019;30(1):60–e17.
8. Moriello KA, Leutenegger CM. Use of a commercial qPCR assay in 52 high risk shelter cats for disease identification of dermatophytosis and mycological cure. *Vet Dermatol.* 2018;29(1):66–e26.
9. Cafarchia C, Gasser RB, Figueredo LA, et al. An improved molecular diagnostic assay for canine and feline dermatophytosis. *Med Mycol.* 2013;51(2):136–143.

Osurnia®

(florfenicol, terbinafine, betamethasone acetate)

Otic gel

For Otic Use in Dogs Only

Do not use in cats

CAUTION: Federal (USA) law restricts this drug to use by or on the order of a licensed veterinarian.

BRIEF SUMMARY (for full prescribing information, see package insert)

DESCRIPTION: OSURNIA contains 10 mg florfenicol, 10 mg terbinafine and 1 mg betamethasone acetate per mL and the inactive ingredients propylene carbonate, glycerol formal, hypromellose, phospholipid, oleic acid and BHT in an off-white to slightly yellow translucent gel.

INDICATION: OSURNIA is indicated for the treatment of otitis externa in dogs associated with susceptible strains of bacteria (***Staphylococcus pseudintermedius***) and yeast (***Malassezia pachydermatis***).

DOSAGE AND ADMINISTRATION: OSURNIA should be administered in the clinic. Clean and dry the external ear canal before administering the initial dose of the product. Administer one dose (1 tube) per affected ear(s) and repeat administration in 7 days. Do not clean the ear canal for 45 days after the initial administration to allow contact of the gel with the ear canal. Cleaning the ear may affect product effectiveness (see **Effectiveness** in the product insert). If alternative otic therapies are required it is recommended to clean the ear(s) before application. Open tube by twisting the soft tip. Insert the flexible tip into the affected external ear canal(s) and squeeze entire tube contents into the external ear canal(s). After application, gently massage the base of the ear to allow the gel to penetrate to the lower part of the ear canal.

CONTRAINDICATIONS: Do not use in dogs with known tympanic perforation (see **Precautions** in the product insert). Do not use in dogs with a hypersensitivity to florfenicol, terbinafine, or corticosteroids.

WARNINGS:

Human Safety Warning:

OSURNIA may cause eye injury and irritation

Not for use in humans. Keep this and all medications out of reach of children. Consult a physician in case of accidental ingestion by humans. In case of accidental skin contact, wash area thoroughly with water. Avoid contact to the eyes. **In case of accidental eye contact, flush thoroughly with water for at least 15 minutes. If symptoms develop, seek medical advice.**

PRECAUTIONS: Wear eye protection when administering OSURNIA and restrain the dog to minimize post-application head shaking. Reducing the potential for splatter of product will help prevent accidental eye exposure in people and dogs and help to prevent ocular injury. Do not administer orally. The use of OSURNIA in dogs with perforated tympanic membranes has not been evaluated. The integrity of the tympanic membrane should be confirmed before administering this product. Reevaluate the dog if hearing loss or signs of vestibular dysfunction are observed during treatment. Use of topical otic corticosteroids has been associated with adrenocortical suppression and iatrogenic hyperadrenocorticism in dogs (see **Animal Safety** in the product insert). Use with caution in dogs with impaired hepatic function (see **Animal Safety** and **Adverse Reactions** in the product insert). The safe use of OSURNIA in dogs used for breeding purposes, during pregnancy, or in lactating bitches, has not been evaluated.

ADVERSE REACTIONS: The following adverse reactions were reported during the course of a US field study for treatment of otitis externa in dogs treated with OSURNIA in decreasing order: elevated liver enzymes, vomiting, weight loss (>10% body weight) and hearing loss. To report suspected adverse events, for technical assistance or to obtain a copy of the SDS, contact Dechra Veterinary Products at (866) 933-2472. For additional information about adverse drug experience reporting for animal drugs, contact FDA at 1-888-FDA-VETS or online at http://www.fda.gov/AnimalVeterinary/SafetyHealth.

POST-APPROVAL EXPERIENCE (2020): The following adverse events are based on post-approval adverse drug experience reporting for OSURNIA. Not all adverse events are reported to FDA/CVM. It is not always possible to reliably estimate the adverse event frequency or establish a causal relationship to product exposure using this data.

In humans, accidental exposure leading to corneal ulcers and other ocular injuries such as eye irritation, burning, stinging, and itchiness have been reported to occur when the dog shook its head after application of OSURNIA.

In dogs, the adverse events reported for OSURNIA are presented below in decreasing order of reporting frequency: Deafness, ear discharge, ear irritation and pain, vomiting, head shaking, head tilt, ataxia, vocalization, corneal ulcer, keratoconjunctivitis sicca, nystagmus, tympanic rupture, and facial paralysis.

INFORMATION FOR DOG OWNERS: Owners should be aware that adverse reactions may occur following administration of OSURNIA and should observe dog for signs such as deafness, ear pain and irritation, vomiting, head shaking, head tilt, incoordination, eye pain and ocular discharge (see **Animal Safety** and **Post-Approval Experience** in the product insert). Owners should be advised to contact their veterinarian if any of the above signs are observed.

Owners should also be informed that splatter may occur if the dog shakes its head following administration of OSURNIA which may lead to ocular exposure. As a result, eye injuries in humans and dogs have been reported including corneal ulcers.

EFFECTIVENESS: Effectiveness was evaluated in 235 dogs with otitis externa. The study was a double-masked field study with a placebo control (vehicle without the active ingredients). One hundred and fifty-nine dogs were treated with OSURNIA and seventy-six dogs were treated with the placebo control. All dogs were evaluated for safety. Treatment (1 mL) was administered to the affected ear(s) and repeated 7 days later. Prior to the first administration, the ear(s) were cleaned with saline but not prior to the Day 7 administration. Six clinical signs associated with otitis externa were evaluated: pain, erythema, exudate, swelling, odor and ulceration. Total clinical scores were assigned for a dog based on the severity of each clinical sign on Days 0, 7, 14, 30 and 45. Success was determined by clinical improvement at Day 45. The success rates of the two groups were significantly different (p=0.0094); 64.78% of dogs administered OSURNIA were successfully treated, compared to 43.42% of the dogs in the placebo control group.

STORAGE CONDITIONS: OSURNIA should be stored under refrigerated conditions between 36° - 46° F (2° - 8° C). To facilitate comfort during administration, OSURNIA may be brought to room temperature and stored for up to three months.

MANUFACTURED FOR:
Dechra Veterinary Products
7015 College Boulevard, Suite 525
Overland Park, KS 66211 USA

Product of Great Britain

Approved by FDA under NADA # 141-437

R 03 2021

Dechra
Veterinary Products

FEATURES ▪ PEER REVIEWED

10. Piri F, Mahmoudabadi AZ, Ronagh A, et al. Assessment of a pan-dermatophyte nested-PCR compared with conventional methods for direct detection and identification of dermatophytosis agents in animals. *Mycoses.* 2018;61(11):837–844.
11. Frost K, Schick A, Mount B. A retrospective analysis of the concordance of in-house dermatophyte culture and a commercial qPCR from 16 dermatology referral practices across the USA, 2018–2019. Abstract presented at the virtual North American Veterinary Dermatology Forum; 2021 April 21–24.
12. Moriello K, Coyner K, Trimmer A, et al. Treatment of shelter cats with oral terbinafine and concurrent lime sulphur rinses. *Vet Dermatol*. 2013;24(6):618–620.
13. Newbury S, Moriello K, Verbrugge M, Thomas C. Use of lime sulphur and itraconazole to treat shelter cats naturally infected with *Microsporum canis* in an annex facility: an open field trial. *Vet Dermatol*. 2007;18(5):324–331.
14. Moriello K, Coyner K, Trimmer A, et al. Treatment of shelter cats with oral terbinafine and concurrent lime sulphur rinses. *Vet Dermatol.* 2013;24(6):618–620.
15. Moriello KA. In vitro efficacy of shampoos containing miconazole, ketoconazole, climbazole or accelerated hydrogen peroxide against *Microsporum canis* and *Trichophyton* species. *J Feline Med Surg*. 2017;19(4):370–374.
16. Moriello KA. Immediate and residual antifungal activity of compounds used for whole body and adjuvant topical therapy against *Microsporum canis*: an in vitro study. *Vet Dermatol.* 2020;31(4):272–e64.
17. DeBoer DJ, Moriello KA. Inability of two topical treatments to influence the course of experimentally induced dermatophytosis in cats. *JAVMA*. 1995;207(1):52–57.
18. Hnilica KA, Medleau L. Evaluation of topically applied enilconazole for the treatment of dermatophytosis in a Persian cattery. *Vet Dermatol*. 2002;13(1):23–28.
19. Moriello KA. Treatment of dermatophytosis in dogs and cats: review of published studies. *Vet Dermatol*. 2004;15(2):99–107.
20. Hyo-Seung N, Tae-Young K, Suk-Hee H, Changbaig H. Evaluation of therapeutic efficacy of medical shampoo containing terbinafine hydrochloride and chlorhexidine in dogs with dermatophytosis complicated with bacterial infection. *J Biomed Res*. 2013;14(3):154–159.
21. Liang C, Shan Q, Zhong J, et al. Pharmacokinetics and bioavailability of itraconazole oral solution in cats. *J Feline Med Surg*. 2016;18(4):310–314.
22. Puls C, Johnson A, Young K, et al. Efficacy of itraconazole oral solution using an alternating-week pulse therapy regimen for treatment of cats with experimental *Microsporum canis* infection. *J Feline Med Surg*. 2018;20(10):869–874.
23. Colombo S, Cornegliani L, Vercelli A. Efficacy of itraconazole as a combined continuous/pulse therapy in feline dermatophytosis: preliminary results in nine cases. *Vet Dermatol.* 2001;12(6):347–350.
24. Mawby DI, Whittemore JC, Fowler LE, Papich MG. Comparison of absorption characteristics of oral reference and compounded itraconazole formulations in healthy cats. *JAVMA.* 2018;252(2):195–200.
25. Renschler J, Albers A, Sinclair-Mackling H, Wheat LJ. Comparison of compounded, generic, and innovator-formulated itraconazole in dogs and cats. *JAAHA.* 2018;54(4):195–200.
26. Nichols PR, Morris DO, Beale KM. A retrospective study of canine and feline cutaneous vasculitis. *Vet Dermatol*. 2001;12(5):255–264.
27. Foust AL, Marsella R, Akucewich LH, et al. Evaluation of persistence of terbinafine in the hair of normal cats after 14 days of daily therapy. *Vet Dermatol*. 2007;18(4):246–251.
28. Kotnik T, Kozuh Erzen N, Kuzner J, Drobnic-Kosorok M. Terbinafine hydrochloride treatment of *Microsporum canis* experimentally-induced ringworm in cats. *Vet Microbiol.* 2001;83(2):161–168.
29. Medleau L, Chalmers SA. Ketoconazole for treatment of dermatophytosis in cats. *JAVMA*. 1992;200(1):77–8.
30. Begum J, Kumar R. Prevalence of dermatophytosis in animals and antifungal susceptibility testing of isolated *Trichophyton* and *Microsporum* species. *Trop Anim Health Prod*. 2020;53(1):3.
31. DeBoer DJ, Moriello KA, Blum JL, Volk LM. Effects of lufenuron treatment in cats on the establishment and course of *Microsporum canis* infection following exposure to infected cats. *JAVMA.* 2003;222(9):1216–1220.
32. Moriello KA, Deboer DJ, Schenker R, et al. Efficacy of pre-treatment with lufenuron for the prevention of *Microsporum canis* infection in a feline direct topical challenge model. *Vet Dermatol.* 2004;15(6):357–362.
33. DeBoer DJ, Moriello KA, Blum JL, et al. Safety and immunologic effects after inoculation of inactivated and combined live-inactivated dermatophytosis vaccines in cats. *Am J Vet Res.* 2002;63(11):1532–1537.
34. Newbury S, Moriello K, Coyner K, et al. Management of endemic *Microsporum canis* dermatophytosis in an open admission shelter: a field study. *J Feline Med Surg.* 2015;17(4):342–347.
35. Moriello KA, Kunder D, Hondzo H. Efficacy of eight commercial disinfectants against *Microsporum canis* and *Trichophyton* spp. infective spores on an experimentally contaminated textile surface*. Vet Dermatol*. 2013;24(6):621–623, e151–152.
36. Moriello KA. Mechanical washing of pet food bowls is effective for *Microsporum canis* decontamination. *Vet Dermatol*. 2019;30(5):428–e130.
37. Moriello KA. Decontamination of 70 foster family homes exposed to *Microsporum canis* infected cats: a retrospective study. *Vet Dermatol.* 2019;30(2):178–e55.
38. Moriello KA. Kennel disinfectants for *Microsporum canis* and *Trichophyton* sp. *Vet Med Int*. 2015;2015:853–937.
39. Sattasathuchana P, Bumrungpun C, Thengchaisri N. Comparison of subclinical dermatophyte infection in short- and long-haired cats. *Vet World*. 2020;13(12):2798–2805.
40. Moriello K. Feline dermatophytosis: aspects pertinent to disease management in single and multiple cat situations. *J Feline Med Surg*. 2014;16(5):419–431.