

ESCCAP



EUROPEAN SCIENTIFIC COUNSEL COMPANION ANIMAL PARASITES

Ringworm Control in Dogs and Cats

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Background

ESCCAP (European Scientific Counsel Companion Animal Parasites) is an independent, non-profit making organization whose aim is to develop guidelines for the control and treatment of parasites (including pathogenic fungi) in pet animals. The guidelines are developed to protect the health of pets, enhance the safety of the public and preserve the bond between pets and people. The long term goal for ESCCAP is that parasites are no longer an issue for pets or humans across Europe.

There is great diversity in the parasites and their importance across Europe. ESCCAP guidelines summarise the different situations within Europe, highlighting important differences between parasites and between different parts of Europe where necessary, and recommending specific control measures.

ESCCAP believes that:

- Veterinarians and pet owners must take measures to protect pets from parasitic and fungal infections.
- Pet travel has the potential to change epidemiological situations with export or import of non-zoonotic parasite species, therefore veterinarians and pet owners must protect the pet population from risks associated with travel and its consequences.
- Veterinarians, pet owners and physicians should work together to reduce the risks associated with zoonotic transmission of parasitic or fungal diseases.
- Veterinarians can and should give guidance to the pet owner regarding infection risk and risk of disease caused by different parasites and measurements against them.
- Veterinarians should inform the pet owner about parasites and enable them to act responsibly for their pet's life and the pets and other animals and people in their communities.
- Wherever appropriate, veterinarians should undertake appropriate diagnostic tests to establish parasite infection status.

To assist in this process, ESCCAP produces each guideline in two formats: 1) Full: detailed for veterinary surgeons and veterinary parasitologists and mycologists; 2) Summarised: for veterinarians and pet owners. Both versions of the guideline can be found at www.ESCCAP.org.

Various guidelines for treatment and control of parasitic or fungal infections in companion animals have been implemented in other countries such as USA by organizations such as the CAPC. However, to date no single comprehensive guideline for Europe with its diverse parasite spectrum has been developed.

Ringworm Control in Dogs and Cats

Introduction

Dermatophytes are filamentous fungi which are able to use keratin as a source of carbon. Some of these organisms are true parasites; they develop in skin and hair and cause cutaneous lesions. The corresponding disease is called ringworm or dermatophytosis and is recognized as one of the most common infectious dermatosis in dogs and cats. More than 20 different dermatophyte species have been isolated from pet carnivores. Some of these dermatophytes are more important than others due to their prevalence and their zoonotic potential. In Europe, the most commonly isolated pathogens are *Microsporum canis* (especially in cats), *Microsporum gypseum*, *Microsporum persicolor* and *Trichophyton mentagrophytes* (Table 1). This guideline aims to give an overview of these keratinophilic fungi, their significance and, importantly, suggests rational control measures in order to treat pet carnivores and prevent animal and/or human infection.

The guideline is divided into five sections

- I. Consideration of pet health and lifestyle factors**
- II. Control of ringworm in animals**
- III. Environmental control of dermatophyte transmission**
- IV. Owner considerations in preventing zoonotic disease**
- V. Staff, pet owner and community education**

I. Consideration of pet health and lifestyle factors

The presence or absence of dermatophytosis is influenced by a vast number of factors relating to the animals themselves, environmental issues and crowding of animals. Some factors may dictate more intensive monitoring and/or treatment, while others may suggest a less aggressive approach. When recommending a management program for ringworm, veterinarians should consider the following elements:

Animal

- Kittens, puppies and geriatric animals are at greater risk than other animals. Pregnant and lactating bitches and queens are frequently infected by dermatophytes and may transmit the infection to the offspring. In pregnant animals, the number of available antifungal drugs is limited.
- Any breed is susceptible to the infection. However, both Yorkshire Terriers and Persian cats have a recognized predisposition to ringworm.
- Familial predispositions have been suggested in cats.
- Any debilitating disease may play a role by making dogs and cats more susceptible to dermatophyte infection. This kind of diseases should be systematically identified and, if possible, treated before the onset of specific antifungal treatments. In cats, the association between retroviral (FIV or FeLV) and ringworm is still a matter of controversy. In one study, ringworm was three times more common in FIV-infected cats whereas in another, no association was evidenced between FIV or FeLV and dermatophyte infection.
- Ectoparasites (such as fleas, ticks or *Cheyletiella* mites) or pruritus from secondary infections may be sources of cutaneous micro trauma that can predispose dogs and cats to ringworm.

Environment

- Increased warmth and humidity are predisposing factors to ringworm.
- Cats living in catteries or shelters, stray or feral cats and cats living with other cats or dogs may be at greater risk of acquiring dermatophytes and may require special consideration.

- Dogs in kennels, living outdoors, stray or hunting dogs may be at greater risk of acquiring dermatophytes and may require special consideration.

Travel

- Cats and dogs, which regularly attend shows or field trials are predisposed to ringworm.
- Common dermatophyte species (*M. canis*, *M. gypseum*, *M. persicolor* and *Trichophyton mentagrophytes*) have a very wide distribution in all European countries. Ringworm is probably more prevalent in underdeveloped countries or in areas in which there are large populations of free-roaming dogs and cats.

II. Control of ringworm in animals

II. 1. Diagnosis

Dermatophytes invade hair shafts and cornified epithelium. As a consequence, ringworm usually presents as patchy areas of alopecia on the face, ears or forelegs. The condition is typically considered as nonpruritic but some animals (especially adult cats) may be moderately to intensely pruritic. Uncommon clinical manifestations include folliculitis, feline miliary dermatitis, feline acne, pemphigus-like syndromes and pseudomycetoma. Ringworm should be considered in the differential diagnosis of many skin diseases and diagnostic aids are systematically required. Examination of the haircoat with an ultraviolet lamp (Wood's lamp) is a good screening method for ringworm in dogs and cats. When exposed to the light, hairs invaded by *M. canis* glow yellow green. Hairs infected by other dermatophyte species (*T. mentagrophytes*, *M. persicolor* or *M. gypseum*) never fluoresce and some topical medications may destroy fluorescence. Thus a negative Wood's lamp examination does not rule out ringworm. Microscopic examination of hairs is a very useful diagnostic method. Hairs should be collected through skin scrapings or during Wood's lamp examination. After digestion with a clearing solution (such as KOH or chlorolactophenol), infected hairs present as enlarged and swollen structures with a rough and irregular surface. The hair surface typically demonstrates clusters or chains of fungal spores (2-4 μm for *M. canis*). Mycological culture remains the most reliable technique for confirming ringworm in dogs and cats. Sample collection may be obtained by scraping the cutaneous lesions, plucking hairs (under Wood's light) or brushing the haircoat with a sterile toothbrush or a little piece of carpet. Several media are suitable for mycological cultures. Since the development of a specific culture medium proposed by Taplin et al. in 1969, Dermatophyte Test media (DTM) became very popular among small laboratories and are regularly used in veterinary medicine. However, only a very few attempts have been made to evaluate the performance of such media with material obtained from animals. A recent investigation demonstrated that the rapidity of color change was related to the incubation temperature and to the number of infected hairs deposited on DTM (Guillot *et al.* 2001). The risk of false positive results was identified as another problem associated with the use of DTM. For these reasons, the use of DTM is not recommended for the diagnosis of animal ringworm. The material collected from the animals should be sent to a laboratory with an expertise in veterinary Mycology. In the laboratory, specific identification is made by microscopic examination of the fungal colonies.

II. 2. Treatment procedures

In most cases, immune response is sufficient to control the spread of the cutaneous lesions and ringworm is considered to be a self-limiting disease. However, antifungal treatment should be systematically recommended for two main reasons: to shorten the course of the infection and to reduce dissemination of infective material into the environment. Infective material is composed of small pieces of hair covered by microscopic fungal spores (called arthroconidia). Infective material is easily spread and can remain viable in the environment for up to 18 months under optimal conditions of temperature and humidity. Infected animals (with or without clinical signs) and contaminated environments represent a longterm exposure to other animals and owners. Systemic antifungals are supposed to contribute to speed the resolution of the infection whereas topical antifungals are required to reduce the risk of transmission and the environmental contamination. Current treatment recommendations stem from both *in vivo* and *in vitro* studies.

Important therapeutic measures include:

- The combination of systemic and topical treatment. Conventional systemic treatment relies on oral antifungal drugs, principally griseofulvin. The micronized formulation of griseofulvin should be administered orally at 25 mg/kg twice daily and with fatty meals. In some circumstances newer antifungal drugs may be valuable (Table 2). Careful attention must be paid to the potential adverse effects of most systemic antifungal drugs. For adjuvant topical treatment, many products have been proposed (Table 3). The decision to use topical therapy should be based upon the owner's ability and willingness to pour or sponge the product over the entire hair coat of the infected animal. Spot treatment of lesions is not recommended. The frequency of topical treatment should be at least twice a week.
- The appropriate length of treatment. The general recommendation is to culture the animal once a month during treatment and to stop antifungal administration after two negative cultures. Three negative results are preferred when multiple cats are involved. When mycological follow up is not possible, combined systemic and topical treatment should be continued for at least 10 weeks. If lesions persist after 8 weeks of treatment, veterinarians should suspect (i) that the treatment is not correctly administered by the owner (ii), that an underlying disorder is interfering with the normal action of the immune system, (iii) that the animal has a genetic background that makes it more sensible to dermatophyte infection. The presence of resistant strains is regularly suspected but resistance of dermatophytes to antifungal drugs has been proved in only a very few instances and this hypothesis should not be considered as the most likely in cases of treatment failure.
- The clipping of the hair coat, especially in severely infected animals, long-haired cats or in multi-animal households. Clipping makes topical therapy application easier and allows for better penetration of the drug. In households with one or two pets, spot clipping of lesions may be enough. Clipping must be performed carefully and in an area that can be easily disinfected (see later). In cats, clipping the coat may require sedating.
- The complete separation of infected animals from non-infected ones.
- Hygiene measures especially environmental decontamination (see section III).

All dermatophyte species have a similar sensitivity to antifungal drugs currently available. As a consequence, the specific identification of the dermatophyte is not required for the choice of the drugs. Identification of the dermatophyte may be useful for a better understanding of the epidemiology of the infection and for preventing a new contamination.

In catteries and animal shelters, dermatophyte infection is very difficult to eradicate and creates a significant health hazard for people in contact with the animals. The cost of antifungal drugs and the reluctance of the breeders to admit that their colony is infected usually account for the noncompliance with treatment recommendations. Most recommendations for the control of ringworm in catteries are based on the concept of a total treatment program, which associates the use of reliable diagnostic tools, both topical and systemic treatment of all the cats and strong environmental decontamination procedures. Interruption of breeding programs and show campaigns may also be recommended.

II. 3. Prevention

Although the risk of dermatophyte infection is greatest for puppies, kittens, old or debilitated animals, the infection is not strictly age- or health status-related, and so the risk continues throughout life. Therefore consideration should be given to provide all dogs and cats with appropriate dermatophyte control throughout their lives.

The contact with infected animal or contaminated environments represent the major risk of infection. As a consequence, the best way to avoid infection is to prevent this contact. This prophylactic strategy is very simple but not always feasible because infected animals do not systematically express obvious clinical signs. Asymptomatic carriers are frequently observed in feline populations. These animals may correspond to mechanical carriers or truly infected cats that will develop clinical signs in a few days or weeks.

To protect animals, the use of antifungal drugs has been proposed:

- Oral antifungal drugs were not proved to be appropriate. Carefully controlled studies in humans demonstrated that oral griseofulvin has no prophylactic action. Recent investigations showed that oral lufenuron may delay the initial establishment or progression of ringworm in cats reflecting some inhibitory effect, but lufenuron did not prevent infection.
- Topical treatments are probably more valuable. The general recommendation is to apply an antifungal shampoo or rinse on the entire body of any dog and cat, which has been in contact with an infected animal or a contaminated area. Under optimum conditions, infective fungal spores germinate within 6 hours on the skin of pet carnivores, so the preventive application of antifungal drug should be performed in the day following the presumptive contamination.

Efforts in developing fungal vaccines to prevent ringworm in dogs and cats continue. Few products are currently commercialized in some European countries. These are live vaccines that may contain different dermatophyte species (*Microsporum canis* and *Trichophyton mentagrophytes* for example). Investigations proving that these vaccines are protective against challenge exposure are still lacking. As a consequence, the use of these vaccines should not be recommended for a longterm prevention of ringworm in dogs and cats.

In dog and cat breeding units as well as in animal shelters, the main risk is represented by the introduction of an infected animal. Newbury et al. (2007) recently described a management plan that should be recommended for the longterm prevention of ringworm in any dog and cat colony. This plan includes screening, monitoring and treatment procedures. At the point of entry, animals should be carefully examined, vaccinated, treated for ectoparasites and intestinal worms (see Guideline 1). The animals are also screened for ringworm via Wood's lamp examination and fungal culture. Animals should then be transferred to a quarantine ward until the results of the tests. The presence of an annex building for the treatment of animals with ringworm is preferable. The most interesting information provided by Newbury et al. is that treatment decision should be made according to fungal culture results. Colony-forming unit count combined with clinical examination can help to differentiate mechanical carriers from infected animals. Mechanical carriers should be treated with one topical application of antifungal drug before introduction within the colony. Infected animals are kept in quarantine and treated by a combination of systemic and topical antifungal drugs. These animals are not introduced in the colony before two negative fungal cultures are obtained.

III. Environmental control of dermatophyte transmission

Dermatophytes are transmitted through microscopic spores, which are formed via fragmentation of fungal hyphae on the skin or infected hair. The presence of these spores in the environment increases the risk of exposure, reinfection and prolonged treatment of animals. Decontaminating the environment involves thorough cleaning and regular disinfectant application.

Spores and fragment of infected hairs may be mechanically eliminated by a regular vacuum cleaning of the surfaces where animals lie on.

Recent studies demonstrated that undiluted bleach and 1% formalin were able to kill all dermatophyte spores in the environment (however, because of its caustic properties, undiluted bleach is not recommended for use in households). Sodium hypochloride solution at 1:10 dilution and enilconazole solution were also proven to be active. All other disinfectants demonstrated poor efficacy.

An enilconazole smoke fumigant formulation is available in most European countries.

Brushes, combs rugs and cages should be carefully washed and if possible, treated with a solution of enilconazole or 1:10 dilution of household bleach.

Vehicles used for transporting the animals should also be treated.

In animal shelters or breeding, contact plates can be used to sample environmental surfaces and check that disinfection has been correctly performed.

IV. Owner considerations in preventing zoonotic diseases

Important preventive measures for pet owners include:

- practicing good personal hygiene (dermatophytes are zoonotic),
- controlling dermatophyte infection through regular diagnostic testing and/or repeated proper treatments (see under II, 2),
- preventing infection by reducing wherever possible the pet from acquiring infection,
- minimizing exposure of children in particular to potentially contaminated environments or infected animals.

People in contact with infected animals should be advised of the risks and made aware that there are specific risk groups in the society.

This information should be made available through physicians and veterinarians at anybody's request without obtaining a medical history of the client and his/her family.

In this respect special care should be taken in case of:

- immunocompromised individuals such as: pregnant women, elderly people, HIV-infection patients, people undergoing chemotherapy, organ transplantation, or treatment for autoimmune diseases,
- other susceptible groups: babies and toddlers, mentally disabled persons, people with specific occupational risks.

V. Staff, pet owner and community education

Protocols for the control of dermatophyte infection should be communicated to veterinary and para-veterinary staff and consistently applied. Awareness of dermatophyte infection, including clinical manifestations in people and particularly children should be created in the medical profession through information brochures. Cooperation between the medical and veterinary profession ought to be institutionalised and its benefits underlined in case of zoonosis.

Pet owners should be informed about the potential health risks of dermatophyte infection, not only to themselves but also to family members and all people living regularly in contact with their pets. Brochures in veterinary practices, pet shops, posters or specific websites are useful tools to achieve this. Responsible dog and cat ownership can remove public health concerns.

Additional information and resource materials can be obtained at www.esccap.org

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Table 1: Characteristics of major dermatophyte species infecting dogs and cats in Europe

Dermatophyte species	Major hosts	Source of contamination	Zoonotic agent	Distribution in Europe
<i>Microsporum</i> genus				
<i>Microsporum canis</i>	Cats, dogs and many other mammals (including humans)	Cats most frequently	Yes	Everywhere
<i>Microsporum gypseum</i>	Dogs, horses	Soil (geophilic dermatophyte)	Yes (but very rare)	Everywhere
<i>Microsporum persicolor</i>	Small rodents (moles and voles), dogs and cats	Small rodents	Yes (but very rare)	Everywhere (rural areas)
<i>Trichophyton</i> genus				
<i>Trichophyton mentagrophytes</i>	Small rodents (guinea pigs, rats), rabbits, dogs	Small rodents (guinea pigs, rats), rabbits, dogs	Yes	Everywhere
<i>Trichophyton rubrum</i>	Man, dogs (very rare)	Man (pet owner)	The dog is contaminated by its owner (and not the opposite)	Everywhere

Table 2: Systemic antifungal drugs for the treatment of ringworm in dogs and cats

Antifungal drugs	Antifungal groups	Dosage and frequency of administration	Comments on use	Adverse effects
Griseofulvin	polyene	<ul style="list-style-type: none"> • 25 mg/kg administered every 12h (micronised form) • 5 mg/kg administered every 12h (ultramicrosised form) 	<ul style="list-style-type: none"> • griseofulvin is still considered as a gold standard for the treatment of dermatophytosis • the drug is labelled to use in dogs and cats • the drug should be administered with a fatty meal (the fat enhances absorption) 	<ul style="list-style-type: none"> • the drug is highly teratogenic and must not be administered to pregnant dogs and cats • gastrointestinal disorders are sometimes observed • myelosuppression has been documented in FIV-infected cats
Ketoconazole	imidazole	<ul style="list-style-type: none"> • 5 mg/kg administered every 12h 	<ul style="list-style-type: none"> • the drug is registered for use in dogs but not in cats • the absorption is improved when the drug is given with food 	<ul style="list-style-type: none"> • the drug is teratogenic and must not be administered to pregnant dogs and cats • anorexia, vomiting and diarrhoea are sometimes observed • ketoconazole has hepatotoxic effects, including elevated serum alanine transaminase activity
Itraconazole	imidazole	<ul style="list-style-type: none"> • 5 mg/kg administered every 24h 	<ul style="list-style-type: none"> • the drug is registered for use in cats but not in dogs • because of its high lipophily, the drug has been proved to be effective in an alternate week regimen (one week off and one week on) 	<ul style="list-style-type: none"> • itraconazole has a lower toxicity than ketoconazole and at regular dosages, adverse effects are very seldomly observed • the drug should not administered to pregnant dogs and cats (even if teratogenic effects have been reported only in rodents and at very high doses)
Terbinafine	allylamine	<ul style="list-style-type: none"> • 20-40 mg/kg administered every 24h 	<ul style="list-style-type: none"> • the drug is commonly used for the treatment of dermatophytosis (especially onychomycosis) in humans but it is not registered for use in cats and dogs 	<ul style="list-style-type: none"> • no teratogenicity has been reported in rodents or rabbits. The drug is not contraindicated in pregnant women • vomiting may sometimes be observed in cats

Lufenuron is a chitin synthesis inhibitor commonly used for the prevention of flea infestations in dogs and cats. Chitin is a component of fungal cell wall and several investigations recently aimed at demonstrating the antifungal activity of lufenuron. A first retrospective study was conducted in Israel and suggested that lufenuron treatment was strongly associated with recovery in many dogs and cats with a number of fungal infections, including ringworm. However, the results of other investigations were contradictory and increasing scepticism about efficacy of lufenuron rapidly occurred. To date, the use of lufenuron should not be recommended for the treatment of ringworm in dogs and cats.

Table 3: Topical antifungal drugs for the treatment of ringworm in dogs and cats

Antifungal drugs	Antifungal groups	Dosage and frequency of administration	Comments on use	Adverse effects
Shampoos				
Miconazole and chlorhexidine	imidazole	<ul style="list-style-type: none"> 2% miconazole and 2% chlorhexidine twice weekly 	<ul style="list-style-type: none"> this combination is not available in all European countries lathering or rubbing process may macerate fragile hairs and increase the release and dispersal of spores 	<ul style="list-style-type: none"> no adverse effect has been documented
Rinses				
Enilconazole	Imidazole	<ul style="list-style-type: none"> 0.2% solution twice weekly 	<ul style="list-style-type: none"> enilconazole is registered for use in dogs in all European countries (and also in cats in some countries) the entire body must be treated and the antifungal agent left to dry on the skin careful application (using sponges and by patting rather than rubbing) is recommended After application, the coat and skin can be dried with a hairdryer 	<ul style="list-style-type: none"> topical application of enilconazole is well tolerated (including in cats)
Lime sulfur	imidazole	<ul style="list-style-type: none"> 1:32 or 1:16 twice weekly 	<ul style="list-style-type: none"> lime sulfur is commonly used in the USA but is not available in all European countries the entire body must be treated and the antifungal agent left to dry on the skin careful application (using sponges and by patting rather than rubbing) is recommended 	<ul style="list-style-type: none"> lime sulfur has an offensive odour and may stain light-coloured hair oral ulceration has been sometimes observed in cats. As a consequence, cats should be collared to prevent them from licking the solution
Creams, gels and ointments				
Several compounds available	Several groups		<ul style="list-style-type: none"> the efficacy of these products has not been demonstrated in dogs and cats with dermatophytosis the products may be messy or easily groomed off by the animals 	

Captan, povidone-iodine, and chlorhexidine (alone and at a concentration lower than 3%) have been found to be ineffective against dermatophytes in *in vitro* and *in vivo* studies.

Sodium hypochloride solution has been used as topical treatment of ringworm in cats. However, it dries and irritates the skin and bleaches the haircoat. The use of this product is not recommended.

ESCCAP



EUROPEAN SCIENTIFIC COUNSEL COMPANION ANIMAL PARASITES

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