

Ectoparasites: preventive plans and innovations in treatment

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Categories : [Companion animal](#), [Vets](#)

Date : May 19, 2017

ABSTRACT

Ectoparasites are a complex group of parasites that cause pets and their owners a lot of concerns worldwide. Ectoparasites, such as ticks, mites and fleas, live on the skin, deep inside the dermis or even within the hair follicles – causing a wide range of dermatological problems. Control of these ectoparasites in dogs and cats is essential, not only to maintain the health and welfare of the animal, but also to protect people from flea and tick infestations with their known vectorial capacity of transmission of serious zoonotic infections. A large number of safe and effective ectoparasiticides are already available; however, effective management of ectoparasites is still challenging. Knowledge of the indications, safety and side effects of different available ectoparasiticide drugs for the common ectoparasitic infestations is crucial when choosing the appropriate treatment for the individual patient.

Effective counselling, innovative strategies and interventions targeting pet owner compliance, and individualised ectoparasiticide regimens, are needed and may be crucial if we are to achieve effective ectoparasite control. Here, the clinical impact of key ectoparasites are summarised and information regarding the most effective therapeutic approaches to control ticks, mites and fleas is provided.

Companion animals have always suffered from ectoparasite infestations. Ticks, mites and fleas act as ectoparasites by living on the skin (ticks and mites) or transiently feeding through the skin (fleas).



Figure 1. Adult female common tick species that infest dogs and cats in the UK. **1a.** *Ixodes ricinus* (sheep tick, wood tick, deer tick or castor bean tick). **1b.** *Ixodes hexagonus* (hedgehog tick). **1c.** *Ixodes canisuga* (British dog tick). **1d.** *Dermacentor reticulatus* (ornate cow tick or marsh tick). Source: <http://bristoltickid.blogs.ibr.org> with kind permission of Richard Wall. IMAGE: University of Bristol.

Irritation and allergic reactions frequently occur in the infested animal. These pests can also vector other infectious diseases of animals and humans. In the following sections, the clinical impact caused by ticks, mites and fleas are discussed, along with approaches for treatment and prevention.

Ticks of dogs and cats

Tick infestation can seriously compromise the health of the affected animal through multiple mechanisms. For example, severe anaemia or immunosuppression can result from blood-feeding and engorgement of dozens of adult female ticks (**Figure 1**). Secondary bacterial infection of bite sites can lead to dermal pathologies or pyogenic lesions. Also, toxins secreted in the saliva of certain ticks can cause tick paralysis.

Importantly, as ticks are haematophagous (ingest blood from dogs and cats), they can transmit many pathogens, which can cause diseases even more serious than the damage caused by ticks themselves (Elsheikha, 2016). For example, canine ehrlichiosis, due to *Ehrlichia canis*, and canine babesiosis, due to *Babesia gibsoni* and *Babesia canis*, can significantly cause ill health of dogs. Infections may progress to a chronic disease resulting in immunosuppression and pancytopenia (in case of ehrlichiosis), or haemolysis and shock due to multi-organ ischaemia (in case of babesiosis).

Fortunately, babesiosis is rare in British dogs; most cases are acquired abroad. However, the detection of a cluster of dogs with babesiosis in Harlow in 2016, and that some of the affected dogs had not travelled abroad, has raised concerns babesiosis might become endemic in the UK. Ticks are also responsible for the spread of zoonotic diseases to humans, such as Lyme disease, human babesiosis, human granulocytic ehrlichiosis, tularaemia and rickettsial diseases.

For more information on Seresto Collars: <https://www.vettimes.co.uk/sources/seresto/>

To control ticks, some protective measures should be adopted, such as avoidance of tick habitat, avoiding heavily wooded and grassy areas, using repellents, and frequent tick checks (at least one check per day) to pick up and remove ticks, with a tick removal device or fine-pointed tweezers, before they can transmit disease. Even though the transmission time for *Borrelia* (agent of Lyme disease) and *Babesia* is one to two days, transmission can occur in less than 16 hours and the minimum attachment time for transmission of infection is still unclear.

Also, it is possible *Rickettsia* and *Ehrlichia* can be transmitted quickly (within three to four hours). In general, transmission is correlated to duration of tick attachment; hence it is advisable to use a product that kills or repels ticks as quickly as possible to reduce the risk of disease transmission. A number of anti-tick products can be used to reduce the risk of exposure of pets to ticks. The choice of product must be based on lifestyle factors, geographical location, previous tick exposure, travel to endemic region/country, owner affordability and preference (tablet, collar or spot-on), and other drug needs of the pet. Some products contain pyrethroids, which have a tick-repellent (prevent tick from taking a blood meal), as well as insecticide and acaricide effects.

Table 1. Products available for effective parasite control (correct at time of print, to the author’s knowledge).

A wide range of anti-flea products are available for effective flea control, and some can also protect against ticks and other parasites – even worms (**Table 1**). Several factors need to be considered when choosing which available ectoparasiticide is the best choice for the patient, including:

- mode of action
- mode of application
- onset of action
- residual effect
- spectrum of activity
- frequency of reapplication (that is, effect of wetting/bathing)
- potential resistance
- ease of application
- target species
- withdrawal period
- age restrictions
- contraindications/drug interactions
- cost
- ecotoxicity to non-target species

For more information on ectoparasiticides, *Veterinary Prescriber* has created the parasiticides database to guide practitioners on available products (<http://bit.ly/2nE7DPZ>). A tutorial also exists on how to use the parasiticides guide (<http://bit.ly/2nWvcUQ>).

Tick treatment of pets entering the UK, although not obligatory, is still needed to protect travelling and resident pets. Also, a Lyme disease vaccine is available and can be discussed with pet owners based on the individual risk of the animal.

Mites of dogs and cats

Demodicosis



Figure 2. *Demodex canis* mite taken from skin scraping from a dog.

Demodex mites live in hair follicles and sebaceous glands of dogs, cats and humans. *Demodex*

infestation is frequently associated with immunosuppression (for example, application of topical immunomodulatory drugs) or concomitant illness (Bizikova, 2014). Diagnosis is based on clinical signs and deep skin scrapings, especially taken from the edge of the lesions to detect the mites (**Figure 2**). Feline demodicosis is caused by *Demodex cati* or *Demodex gatoi*.

Demodicosis in cats is rare and can be resolved spontaneously in mild cases. However, generalised feline demodicosis should be treated with weekly lime-sulfur dips (2%); amitraz (0.025% to 0.05%) has been used, but is not recommended for use in cats and poisoning cases have been reported in animals and humans (del Pino et al, 2015). Toxicity may occur through oral or dermal routes, or via inhalation. The use of antiparasitic macrocyclic lactones has been reported, but their efficacy is uncertain.

Most dogs carry a small number of *Demodex canis* without displaying clinical signs, but, under certain immunosuppressive conditions, the mites can cause demodectic mange. Two types of demodicosis are recognised – localised and generalised. Dog-localised demodicosis usually resolves spontaneously within six to eight weeks, with or without use of an acaricidal treatment. Treatment of generalised demodicosis is difficult and frequently requires extended, intensive therapy.

Amitraz is a topical agent for treating demodectic and sarcoptic mange in dogs, but is not recommended on Chihuahuas. Amitraz can interact with insulin – used to treat diabetes mellitus (insulin deficiency) in dogs and cats.

A number of macrocyclic lactones have been used. For example, spot-on 10% imidacloprid plus 2.5% moxidectin is effective when administered topically at monthly or, in severe cases, weekly intervals. Milbemycin oxime administered orally with dosages ranging from 0.5mg/kg/d to 2.2mg/kg/d and treatment durations ranging from 9 to 26 weeks have been reported to be effective. The extra label use of avermectins or milbemycins for treating canine demodicosis should be approached with caution, especially for breeds with known sensitivity to these compounds, such as collies and collie crosses.

Treatment must be continued not only until clinical signs abate, but also until at least two consecutive negative skin scrapings are obtained at one-month intervals. Single oral administration of fluralaner chewable tablets was found highly effective against generalised demodicosis. A study reported oral dose of 2mg/kg of sarolaner was effective against *Demodex* infestation in dogs with generalised demodicosis and against *Otodectes cynotis* (otodectic mange) in dogs with induced infestations (Six et al, 2016).

Chewable tablets containing afoxolaner, given orally at 2.5mg/kg to eight dogs diagnosed with generalised demodicosis, significantly reduced the number of mites and cured the dogs in two months (Beugnet et al, 2016). Secondary bacterial infections are treated with an appropriate antibiotic. Local and systemic immune-suppressive drugs, such as corticosteroids, are

contraindicated in any animal diagnosed with demodicosis. In adult-onset demodicosis, always look for and treat the underpinning condition that perpetuated the disease.

Sarcoptic mange



Figure 3. Adult *Sarcoptes scabiei* var *canis* mite taken from a skin scraping. The mite is roughly circular in shape, measures 0.3mm to 0.5mm long and is creamy white with brown sclerotised legs and mouthparts. The entire life cycle (two to three weeks) is spent on the dog. Females burrow tunnels in the stratum corneum to lay eggs.

Sarcoptic mange (canine scabies) – caused by *Sarcoptes scabiei* var *canis* (**Figure 3**) – is readily transmitted between dogs by direct contact; infestation by indirect contact is less frequent, but occurs. Pruritus, papular eruption, crusts start on the ventral abdomen, chest, ears, elbows, and legs and, if left untreated, become generalised. Diagnosis is based on the history of severe pruritus of sudden onset and involvement of other animals and/or humans.

A commercial ELISA for detecting specific antibodies is available. However, false-negative and false-positive results can occur due to lack of specific antibodies in early infestation or cross-reactivity with other mites, respectively. If mites are not found, but the history and clinical presentation are suggestive of sarcoptic mange, trial therapy is warranted. Treatment can be either topical (amitraz) or systemic, and should include all dogs in contact. For topical treatment, hair can be clipped, the crusts and dirt removed by soaking with a good antiseborrhoeic shampoo, and an acaricidal dip applied. Fipronil spray was reported to be effective, but should be considered an aid in control, rather than a primary therapy.

Systemic treatments of scabies are based on the administration of macrocyclic lactones. Among these, selamectin is approved for this use and given as a spot-on at 6mg/kg twice at a one-month interval. This drug appears to be safe, even in ivermectin-sensitive collies. Another endectocide,

moxidectin, is registered for the treatment of sarcoptic mange in dogs, and has been reported to be effective – depending on the dosage and route of administration. Sarolaner chewable tablets can be used for treatment of infested dogs (Becskei et al, 2016). *Notoedres cati*, the agent of the feline scabies (notoedric mange), is the cause of face or head mange in cats. This mite may also infest dogs and can cause a transient dermatitis in humans. Imidacloprid/moxidectin have been indicated for treatment of infestation with this mite; however, infestation is very rare in the UK.

Ear mite(otodectic mange)

Otodectes cynotis mites are a common cause of otitis externa in cats and dogs, and are prevalent in shelters and breeding settings. These mites are usually found deep in the external ear canal, but occasionally are seen on the head and body. Clinical signs include head shaking, ear scratching, aural pruritus and ear droop.

Mites are detected by direct examination of the ear canal using an otoscope or by swabbing the ear canal with a cotton applicator to remove the dark cerumen and observing the mites or eggs in the exudate under the microscope. The ear canal of infested animals should be flushed and cleansed with a mild ceruminolytic agent. Ear drop suspension (diethanolamine fusidate, framycetin sulphate, nystatin, prednisolone) can be used for treatment of *O cynotis* infestation in the dog and cat. Also, miconazole nitrate, prednisolone acetate and polymyxin B sulfate ear drops, and cutaneous suspension is used as topical treatment of otitis externa caused by this ear mite.

Ear drops should not be applied in animals with a perforated eardrum. Topically applied imidacloprid plus moxidectin spot-on solution is efficacious in dogs, cats and ferrets, and topically applied selamectin solution is efficacious in cats and dogs. All dogs and cats in the household having direct contact should be treated. In addition, grooming equipment and bedding should be disinfected because mites are able to survive for a period of time off the host.

***Cheyletiella* species**

Three *Cheyletiella* species are of importance to small animal practitioners – *Cheyletiella yasguri* in dogs, *Cheyletiella blakei* in cats and *Cheyletiella parasitivorax* in rabbits. Adult mites move rapidly and induce bran-like exfoliative debris on the rump and backs of animals, resulting in a “walking dandruff” appearance. Heavily infested dogs may have excessive hair shedding, inflammation and hyperaesthesia of the dorsal skin. Cats are primarily affected around the head and trunk. The mites are readily transferred to humans, causing papular lesions. No products are labelled for the treatment of cheyletiellosis in either cats or dogs. Spray, shampoo, or spot-on formulations containing pyrethrins or pyrethroids are effective for treating cheyletiellosis in dogs. Pyrethroids should not be applied to cats.

Fipronil spot-on or spray formulations have been used for treating cheyletiellosis in dogs and cats. Spot-on treatment with 10% imidacloprid plus 2.5% moxidectin solution has been shown to be

effective for treating canine cheyletiellosis, whereas spot-on selamectin solution provided efficacy for the treatment of feline cheyletiellosis. The bedding and grooming equipment of infested animals should be disinfected.

Neotrombicula autumnalis

Neotrombicula autumnalis, commonly known as “chiggers” or “harvest mites”, can be recognised by the naked eye as bright orange dots. Infested dogs or cats generally have a history of roaming through woods or fields. Infestation seems to be regional and linked to certain seasons where mites are active. Mites in larval stages develop on the ground then climb on vegetation and wait for passing hosts. They are found on ears, eyes, the nose or other areas of thin skin, including the abdomen and regions between the toes. Lesions include erythema, papules, excoriations, hair loss and crusts. Topically applied fipronil and selamectin have been used successfully to treat trombiculosis in cats and dogs, and topical pyrethroid plus pyriproxyfen products have been used to control infestations on dogs. When feasible, keep pets away from areas known to harbour large numbers of mites to prevent reinfestation, especially during high-risk periods.

Fleas of dogs and cats

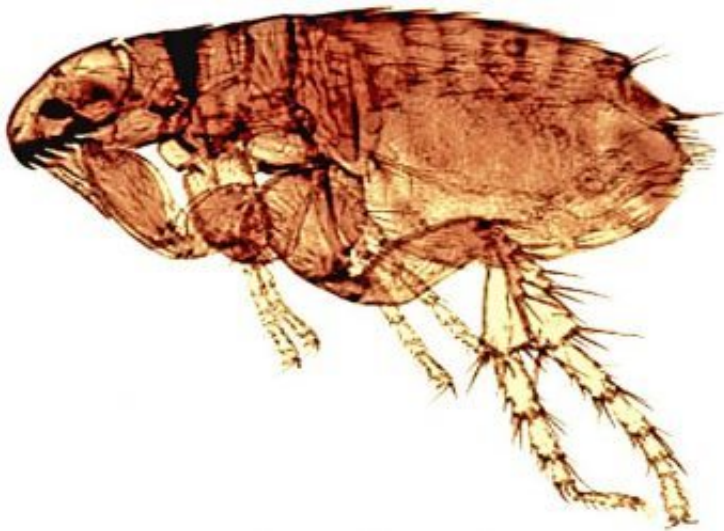


Figure 4. The cat flea (*Ctenocephalides felis*).

Ctenocephalides felis is known as the cat flea (**Figure 4**), but can also infest other animals, such as dogs, rabbits and hedgehogs. The dog flea *Ctenocephalides canis* is found on dogs and rarely on cats – especially in more temperate climates. The human flea *Pulex irritans* can also attack pets. Even indoor pets can be affected by fleas carried into homes on clothing or other material, or on stray cats.

Fleas are a common cause of pruritus and irritation, and can cause anaemia due to feeding on the

pet's blood. Some pets develop flea allergy dermatitis (Elsheikha, 2012) evoked by sensitivity to the flea dirt and/or flea salivary proteins during feeding. Also, fleas are intermediate host for the tapeworm *Dipylidium caninum* of dogs and cats. So, controlling fleas will also prevent tapeworm infection. This tapeworm can also affect humans – particularly children.

Fleas may carry blood-borne infections, some of which may affect humans, such as *Bartonella henselae*, which can cause flu-like symptoms in people. Other blood-borne pathogens isolated from fleas include *Rickettsia felis* and *Haemoplasma* species (causing anaemia in cats) and *Yersinia pestis* (causing bubonic plague).

Anti-flea products are divided into adulticides (kill adult fleas) and insect growth regulators (IGRs; prevent the development of eggs and larvae). The need for using host-targeted and environmental insecticides for eliminating flea stages in the pet's environment has led to the development of products combining adulticides with IGRs (such as methoprene and pyriproxyfen) or insect development inhibitors (such as lufenuron), which, along with environmental measures, can achieve an integrated flea control (**Figure 5**).

IGRs mimic insect growth hormone, preventing immature stages from developing to the next life stage. Lufenuron prevents the egg tooth from hardening, so the larva cannot hatch from the egg. IGRs may be used directly in the environment in the form of spray, foggers, and so on, which are used for existing infestations. Otherwise, IGR can be used in combination with an adulticide on the animal to prevent infestation from occurring by disrupting the flea's reproductive cycle. Although most adulticides will kill fleas within a day before egg laying begins, owner compliance is generally poor. Some fleas may, therefore, survive for long enough to lay eggs at the end of the treatment interval. Hence, the presence of an IGR on the pet will render the eggs that have been laid unable to cause infestation.

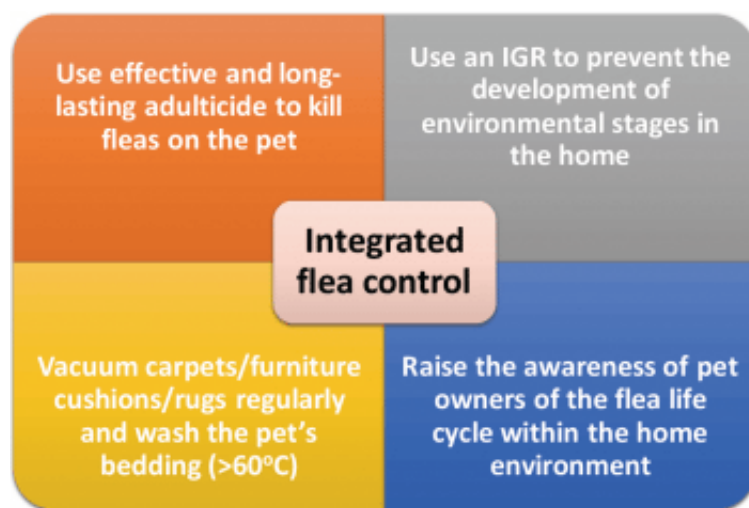


Figure 5. An integrated approach for flea control.

Flea persistence in the environment and on the pet after treatment has raised concern of resistance. However, even when resistance genes are known to exist in laboratory strains of flea, some flea products (such as fipronil, selamectin and spinosad) have been shown to be efficacious (Bass et al, 2004; Dryden et al, 2013). The perceived flea treatment failures can be due to certain factors, including:

- Not treating all animals – if all susceptible animals are not treated at the same time then the opportunity may arise for fleas to breed and then flea control fails.
- Not treating the environment – adult fleas are 5% of the flea population, so without treatment of the environmental stages, some flea infestations may take months to eliminate.
- Lack of management of expectation – heavy flea infestation may take at least three months to eradicate, even when environmental treatment is used (Dryden et al, 2000).
- Not treating pets frequently enough – probably due to advice being inaccurate, misinterpreted or not followed.

Conclusion

External body surfaces of dogs and cats are common targets for infestation with ticks, mites and fleas. Ectoparasiticides are the main stay to achieve effective control of these ectoparasites. Most flea and tick products contain one or more ingredients that have insecticide and/or acaricide effects. These products act by disrupting the neurotransmission in the parasite, leading to its death.

Ectoparasiticides can be used to kill parasites already on the animal's body and can kill newly acquired parasites to prevent reinfestation. Some anti-flea products contain an IGR alone or together with an insecticide. When used alone, IGRs only have a preventive effect. Several combination products are also available that cover fleas and roundworms.

Rapid transmission times of rickettsial diseases and presence of the protozoan *Leishmania infantum* in southern Europe makes it sensible to use tick and sandfly repellents when travelling to countries where the pathogens are commonly present. The author imagines the future of ectoparasite control as one that continues to rely heavily on ectoparasiticides, providing clinicians with more and effective tools to tackle ectoparasitic infestations.

Acknowledgements

The author is grateful to Jenny Stavisky and Kathryn Griffith for providing constructive comments on the manuscript and helping generate **Table 1**.

- The author declares the article was written in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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