Endoparasites: innovations and advice to give owners

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ABSTRACT

Endoparasites (worms and protozoa) have been always considered as a potential threat to the health and welfare of companion animals. Even though antiparasitic drug resistance has not yet evolved to become a serious threat in companion animal medicine, and despite the availability of effective anthelmintic drugs, management of parasitic worms is still fraught with challenges. This is mainly due to the increasing prevalence, the complexity of parasites' life cycles and the multiple opportunities for the maintenance of these parasites in reservoir animals and in invertebrate vectors, as well as the ability of some worm species to cross the species barrier and infect humans. In the face of these challenges, it is important to develop and implement effective and efficient worm control interventions that respond to pet owners' needs, and consider the animal health and welfare as a core priority. This article presents the state of the art on advances in the diagnosis and management of worm infections in dogs and cats.

Pet ownership and animal assistance have become increasingly common means of help and support to people with various clinical, psychosocial and psychophysiological problems (Beetz et al, 2012).

Figure 1. Adult *Toxocara canis*, the most common intestinal roundworm of dogs.

An overwhelming number of studies have reported many positive effects of human-animal interaction on human health. In the interim, the occurrence and undesirable impact of endoparasitic infections on animal health and welfare have been well recognised in the literature.

Scientific evidence indicates the occurrence of worm infections – or even multiple parasite infections – in dogs and cats continues to escalate.

Also, the potential zoonotic implications that can be anticipated with certain infections cannot be underestimated. For instance, serious cases of ocular and visceral larva migrans, caused by infection of the dog roundworm *Toxocara canis*, have been reported in humans worldwide. These risks necessitate implementation of effective diagnostic, therapeutic and preventive interventions to mitigate any potential health threats to pets and their owners. Successful implementation of these interventions cannot be accomplished without the engagement of pet owners.

In the following sections, the author will provide a summary of the range of endoparasitic helminth infections, their clinical impact and methods of their detection in companion animals, and provide some advice on what pet owners should know regarding variables that put the health of their pets at risk.

The article concludes with strategies used to control worm infection in dogs and cats, and the key roles veterinary staff can play to ensure worm control interventions are efficiently implemented.

Spectrum of endoparasites in canine and feline patients

Dogs and cats can be infected with a wide range of endoparasites, which live inside various body systems of the animal.

Figure 2. Tapeworm of dogs. Note the segmented appearance of the worms.

Endoparasites are divided into two main groups – protozoa and helminths (worms). Protozoa are single-celled parasites and comprise several species that cause important diseases in dogs and cats, such as babesiosis, giardiasis, isosporiasis, leishmaniasis and toxoplasmosis, but these are out of the scope of this article.

Dog and cat roundworms, such as whipworm (*Trichuris vulpis*), hookworm (*Ancylostoma caninum*) and roundworm (*Toxocara canis*; **Figure 1**), live in the intestines. Others, such as *Angiostrongylus vasorum* (canine lungworm), *Aelurostrongylus abstrusus* (feline lungworm) and *Dirofilaria immitis*, are extraintestinal and live in the cardiorespiratory system.

The most common tapeworm found in dogs are *Dipylidium caninum* and *Taenia pisiformis.* However, dogs may also serve as hosts to other Taenia species (such as *Taenia hydatigena* and *Taenia ovis*) and to the hydatid tapeworms *Echinococcus granulosus* and *Echinococcus multilocularis* (which does not exist in the UK).

In the UK, the two most common types of worms in dogs and cats are roundworm (**Figure 1**) and tapeworm (**Figure 2**).

Some parasites, such as *Toxocara* species, are commonly known to be present and can potentially infect dogs and cats in the UK. Although the prevalence of *Toxocara* is not increasing, the genus still provides a high zoonotic risk.

On the other hand, other parasites are on the increase, in terms of numbers and geographical expansion, such as *A vasorum*.

Interestingly, an interactive UK lungworm distribution map can be used to check for cases of A vasorum infection in any geographic locality in the UK. The UK and Ireland division of the European Scientific Counsel Companion Animal Parasites provides up-to-date practical advice to veterinary professionals and pet owners on protecting pets from these and other parasitic diseases of dogs and cats.

Clinical manifestations

Dogs or cats infected with intestinal or extraintestinal (cardiopulmonary) parasites exhibit clinical signs suggestive of the body system affected, providing the owner and the vet with some clues to localise the source of the clinical problem.

General signs of worm infection include scooting the bottom on the ground, vomiting, diarrhoea, weight loss, anaemia, distended abdomen and even death.

In general, these signs are not specific and can be mistaken with other conditions. Also, dogs infected with some parasites, such as lungworm, can present with varied and confusing clinical signs.

Often, a combination of signalment, history and physical findings is used to develop a list of differential diagnoses, ranking the most likely parasite agents involved. Finding out the parasite causing the disease is necessary for a definitive diagnosis to be made.

How does worm infection occur?

Pet owners should know transmission of worms to dogs and cats, whether indoors or outdoors, requires three main elements:

- a source of infecting parasites
- a means of transmission for the parasite to the animal
- a vulnerable animal

Source and means of transmission of worms

Pets can be exposed to a variety of worms from other pets, the environment or even from bitches to pups via transplacental or transmammary transmission.

Worm infection can occur via many routes, such as animal faeces, contaminated soil (*T canis*), accidental ingestion of fleas (*Dipylidium caninum*), accidental ingestion of snails and other gastropods (*A vasorum* and *A abstrusus*), scavenging and hunting (*Echinococcus* and *Taenia pisiformis*), or via placental transmission from the bitch to fetus or the mother's milk to newborn puppies (*T canis* and *A caninum*; **Figure 3**).

Figure 3. Eggs of the hookworm *Ancylostoma caninum*. The eggs are oval in shape and thin-shelled, measuring 52?m to 79?m by 28?m to 58?m.

Some worms have complex life cycles and may infect more than one species of animal (vertebrate and invertebrate) to complete their development – for example, common tapeworm *D caninum*, where the flea's juvenile stage eats the eggs produced by this tapeworm. The egg hatches within the flea and develops in a dog or cat's intestine when the infected flea is ingested during grooming. It is also possible children can catch this tapeworm if accidentally ingesting fleas originating on a pet.

Pet susceptibility

Pets, like any other vertebrate animals, have variable susceptibility to develop an infection after exposure to a pathogenic agent.

Some animals have innate protective mechanisms and will not develop clinical illness (remain as an asymptomatic carrier), because they can resist increasing parasite growth or have immunity to parasite virulence factors. Other pets exposed to the same parasite may develop an active disease process. Therefore, it is important to inform pet owners to take extra care of younger pets, because they are at a higher risk due to their exploratory behaviour and immature immune system, which makes them more likely to come into contact with slugs/snails and succumb to infection with lungworm than older animals.

Likewise, susceptibility applies to pet owners and their household members. Some individuals are more likely to be infected. These vulnerable individuals are either immunocompromised because of age (neonate or elderly), they have underlying diseases or they are undergoing immunosuppressive medical treatments.

Available diagnostics

Routine methods used to diagnose worm infections are generally based on microscopic investigation of faecal samples. The most popular method used to detect and count worm eggs is the McMaster technique, which is suitable for the detection of roundworm infections (for example, Toxocara species in dogs and cats).

For worms that deposit larvae instead of eggs, such as lungworms, the Baermann method is preferred. It requires faecal samples to be collected from the same animal over three consecutive days, because the results can be influenced by the irregular excretion of larvae. However, it remains popular and has an acceptable level of sensitivity (Elsheikha et al, 2014).

Antibody detection (ELISA) assays have been developed and can aid in the diagnosis of some worm infections. However, antibody detection methods have some limitations – for example, antibodies can persist after a parasite agent has been eliminated. Results of antibody assays can be negative in the pre-patent period if antibody immune responses have not been developed yet and some immunocompromised animals may not be able to mount a detectable antibody immune response.

Interestingly, the need to detect *Dirofilaria immitis* infections in dogs with an occult infection (that is, do not exhibit circulating microfilariae) has spawned a new generation of point-of-care diagnostics. Subsequently, a number of point-of-care tests for other parasite agents have also been developed for the lungworm A vasorum (Elsheikha et al, 2014; Schnyder et al, 2014), detecting antigen of A vasorum in the dog’s blood in about 15 minutes. Point-of-care testing is a rapidly growing area in

companion animal medicine and it is anticipated it will open a new era of in-house diagnostic systems in veterinary clinics (Bowman and Little, 2015).

Prevention strategies

Protection can be provided with a product containing a macrocyclic lactone (moxidectin or milbemycin).

Some dogs eat raw food or are allowed to hunt. These dogs might be at risk of tapeworm infection. To prevent tapeworm, praziquantel is usually recommended.

In general, dogs and cats require routine cover for roundworms and fleas. Also, they might need cover for ticks, tapeworm, and/or lungworm, depending on whether the animal is at risk of these infections. For those animals travelling overseas, a more comprehensive parasite cover is needed.

To achieve good worm protection, a parasite risk assessment should be considered. Indeed, prior to prescribing any preventive antiparasitic therapy, a full parasite risk assessment should be performed.

In the context of *A vasorum*, this involves considering aspects of the dog's lifestyle that might bring it into contact with slugs, snails and paratenic hosts. For example, time spent outdoors, hunting, consumption of slugs or snails (or grass that might contain these) and travel to known endemic areas.

The main challenge is caused by the mixed opinions on how often the animal should be dewormed. The quest for optimal deworming frequency is ongoing, due to the diversity and complex nature of parasites, and because a solution that can fit all scenarios simply does not exist.

Due to the lack of a robust scientific evidence, veterinary professionals use clinical judgement to figure out what works best for each pet. Therefore, when it is important to minimise the risk of clinical disease – especially in high-risk cases – treatment at a frequency close to the pre-patent period (monthly for convenience) will help achieve this.

In this context, and considering the possibility of intermediate and paratenic hosts of lungworm A vasorum to be present throughout the year – and their widespread and growing distribution – the possibility of all-year-round control should be taken into consideration. However, monthly treatment has been questioned by some clinicians who consider monthly lungworm preventives unnecessary – especially when the evidence for risk of infection is minimal.

Some guidelines, developed by professional organisations, recommend the use of antiparasitics at a certain frequency based on "expert opinion", but without substantial evidence to support such recommendations.

Large, prospective, randomised, controlled trials are really needed to investigate the efficacy of anthelmintic prophylaxis on the prevention of lungworm.

Evidence-based practices

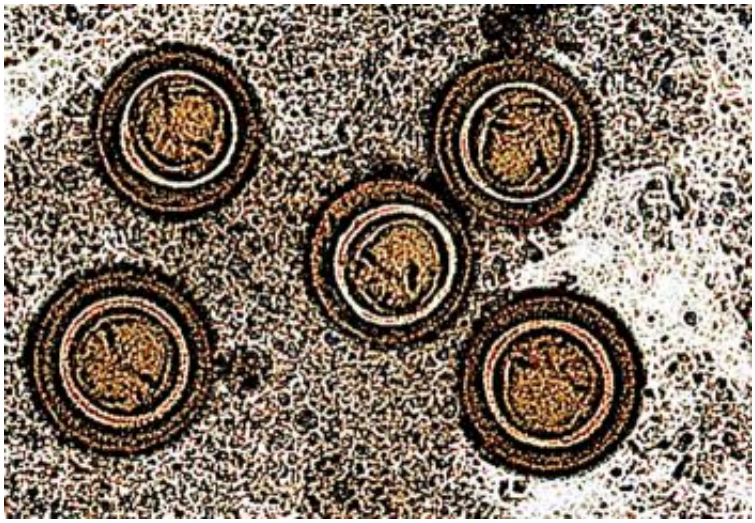

Figure 4. Typical taenid's eggs, which are morphologically similar between tapeworms of the genus *Taenia* and genus *Echinococcus*.

Effective treatment and management of parasitic infections rely on a rationally, timely and correct diagnosis. Hence, it is important to detect and quantify the type and level of parasite infection involved to guide treatment decisions. However, certain parasite detection methods have low sensitivity, are expensive, are invasive or require specialised equipment.

Diagnosis of some worms, such as tapeworm, can be challenging. Detection of tapeworm is usually made by finding proglottids/segments on the animal's perineum, or in its faeces or bedding. But different *Taenia* species (**Figure 2**) cannot be easily distinguished based on the shape of their proglottids. Also, *Echinococcus proglottids* are only a few millimetres and can be easily missed. In addition, their eggs (**Figure 4**) cannot be differentiated from those of *Taenia* species, complicating the assessment of their zoonotic potential.

In some situations, the use of both parasite microscopic detection techniques and antibody or antigen assays concurrently (that is, lungworm in dogs) may provide more useful information than using a single method. Veterinary staff should be familiar with the laboratory they submit clinical samples to and make sure this laboratory follows good laboratory practice and has a good reputation of providing reliable results. The parasitology laboratory can provide significant support – especially when the results are needed to guide treatment or decide on how often the animal should be dewormed.

Anthelmintic resistance

No definite evidence exists that resistance to commonly used anthelmintics in dogs and cats is an emerging problem, either through new mutations or by the selection of innately tolerant strains.

However, experiences with worm species – particularly those with the quick spread of anthelmintic resistance (AR) in livestock – should warn small animal clinicians against the extensive use of anthelmintics for the control of helminth infection in dogs and cats.

The conditions required for anthelmintic-based helminth control in pets are different from those in livestock, as the transmission dynamics are more complex (particularly for lungworm and heartworm); treatments may be less frequent and spectrum may be lower. Thus, different strategies can be proposed to reduce the appearance or selection of resistant helminth strains. However, these are just hypothetical assumptions, which may delay – but probably will not prevent – the appearance of AR.

In livestock, the problem is economic, which is bad enough. In pets, widespread AR would have a serious impact on pet health and welfare, as well as to public health.

Owner compliance

The renewed interest in drug compliance/adherence is an exciting frontier, but also one fraught with challenges. No doubt, the majority of pet owners look after their pets, but even attentive pet owners can still miss doses, do not complete course of treatment or forget to deworm their pets.

Non-adherence can have many undesirable consequences, such as reduction in the quality of life of pets, increased chances of illness or even mortality, increased treatment costs, and possibly a compromised vet-client relationship. Also, sub-optimal adherence means sub-therapeutic drug levels, which may lead to incomplete parasite suppression and generation of resistant parasite strains by selection for mutant parasites. Indeed, the link between poor adherence and drug resistance is well established.

Barriers to pet owner’s adherence are many, and might be related to social and economic factors, parasite-specific factors, treatment-related factors, client-related factors, or even related to veterinary staff and the standard of veterinary care provided. It is important to find out which of these factors are the main barrier for your client’s adherence.

Several strategies can be used to improve pet owners’ compliance (Elsheikha, 2016a,b).

Veterinary staff responsibilities

Identify the roles and responsibilities of the practice team to deliver improved animal-centred health care.

Ensure robust processes are in place for communication among practice staff involved in an animal's care. Also, remember, drug sales representatives understand specific indications and differences between the products they sell, so they can help guide veterinary staff in providing the right product for owners.

Inform owners pets should be dewormed and failure to deworm adequately can lead to poor weight gain, diarrhoea and even death. The owner should also be informed the risk of infection with certain parasites and the need for antiparasitic treatment depends on certain factors, such as the age of the animal (young dogs are more susceptible to infection), lifestyle (whether it eats offal or molluscs), location (living in endemic area) and whether the animal lives with vulnerable humans (young children, elderly or people with immunosuppression).

Advise owners to remember to dispose of dog faeces safely, cover sandpits when not in use (to prevent cats using them as litter trays), and control their dogs in the countryside.

Conclusions

The burden of worm infection can be considerable, due to its adverse effects on animal health and welfare, and the associated economic implications.

Additionally, some worms can cause significant public health risks. Hence, the lack of, or inadequate, worm control can result in poor clinical outcomes and may also increase the risk of human infections. It is essential to ensure owners understand how worms cause disease in pets and humans, and to realise the need to control these worms with effective anthelmintic products.

Worm control is fraught with challenges, and the development of solutions to tackle these challenges is essential to improving the quality and efficiency of pet health care.

While small animal vets play key roles in implementing worm control programmes, clinical parasitologists can make significant contributions to the formulation and success of these programmes.

- 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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