GLOBAL WORMING

Abi Chase, a veterinarian at Boehringer Ingelheim with a PhD in parasitology, suggests we take a closer look at *Toxocara* and public health.

I HAVE A snow globe on my desk filled with ticks. That may sound disgusting, but it's pretty fascinating to stare at. In fact parasites in general are fascinating when you consider their complex lifecycles and characteristics that include an ability to modify the behaviour of their hosts.

That said, my admiration for parasites was recently called into question when I reviewed an article on *Toxocara* species. It made me go home, worm all the animals in my house, research medication for my children (not advised – this was done in panic) and start picking up poo left by other people's dogs. Here's why.

ONE HEALTH – THE VETERINARIAN'S ROLE IN PUBLIC HEALTH

Research in the past few years has investigated the associations between human toxocariasis, caused by the dog and cat parasites *Toxocara canis/cati*, and a variety of human diseases – and leading parasitologists are now recommending more regular deworming to protect public health (Pennelegion et al., 2020). As veterinarians and veterinary nurses can have a significant influence on preventing this disease by advising appropriate deworming and

reducing environmental contamination, it's extremely important that we're aware of emerging research and recommendations in this field.

HUMAN TOXOCARIASIS

Human toxocariasis (HT) is a significantly underdiagnosed public health issue around the world (Rostami et al., 2019). It can cause a wide range of diseases, from childhood asthma (Momen et al., 2018), urticaria (Vinas et al., 2020) and neuropsychiatric disorders (Fan, 2020) to decreased cognitive function in children and young adults (Walsh and Haseeb, 2012; Erickson et al., 2015). However, HT is rarely on a differential list, particularly when clinical signs in children are as nondescript as fever, abdominal pain, nausea and wheezing, and therefore it's rarely diagnosed (Ma et al., 2018).

As a clinical veterinarian, I have to admit I only gave *Toxocara* a thought in pregnant bitches and puppies. I knew about larval migrans in the eyes of children, but understood this was so rare that it warranted limited concern. But as I've now discovered, research shows a wide range of syndromes are caused by *Toxocara* larvae.

Humans become infected by ingesting eggs or infective larvae, for example through eating raw meat or children eating soil. Larvae penetrate the intestinal wall and are transported to different tissues through the bloodstream (Strube et al., 2013). The persistence of larvae in the brain, eye, liver and muscle can cause a broad range of clinical symptoms that occur most often in children (Despommier, 2003). There are four distinct syndromes, and these are described in Table 1.

PREVALENCE

Humans

Before you panic, consider the prevalence of HT and the relative risk of infection. Research has estimated the worldwide prevalence of HT in healthy humans at 19%; this has increased non-significantly in the past few decades and varies widely between countries (Rostami et al., 2019). Table 2 summarises the seroprevalence data in New Zealand, with these studies linking higher seropositivity among people with rural location, age, ethnicity, myalgic encephalomyelitis, recent pregnancy and close regular contact with dogs. Numerous screening studies have also found higher seroprevalence in certain populations, such as asthmatic children (Momen et al., 2018) and farmers (Deutz et al., 2005; Strube et al., 2020).

The small number of veterinarians sampled in Christchurch in 1988 did not have a significantly higher seroprevalence than the general population. However, in Austria two percent of apparently healthy individuals were seropositive, compared to 27% (37/137) of veterinarians (Deutz et al., 2005).

Toxocara canis *in a dog intestine.*

PHOTOGRAPHY: BOEHRINGER INGELHEIM

Toxocara canis *in a dog intestine.*

Dogs and cats

The most commonly used tool for estimating prevalence in dogs and cats is coproscopy (the analysis of stool samples). In a recent review and meta-analysis of published studies on *Toxocara* spp., dogs were found to have a global prevalence of 11.1% (Rostami et al., 2020). However, the prevalence was lower in older, healthy animals.

A Dutch study that sampled adult pet dogs monthly for a median of 14 months found prevalence to be 4.5%, with 32.1% of the dogs shedding eggs in faeces at least once during that period (Nijsse et al., 2016).

Studies in New Zealand show a nine percent prevalence in working dogs in the central North Island (O'Connell et al., 2019) and Hawke's Bay (Matthews, 2016). In a 2015 survey, one pet dog (17 years old) from 36 tested (three percent) was positive, as were three pet cats (two under one year old, one unknown) from 31 tested (9.7%) (Woollett et al., 2016).

Dogs are more often implicated in HT than other animals, but we can't dismiss the role of the domestic cat. A recent survey of public spaces in New York showed *Toxocara cati* as the predominant *Toxocara* spp., leading the authors to conclude that feral or untreated cats represent a significant source of environmental contamination (Tyungu et al., 2020).

IS IT TIME TO UPDATE THE TREATMENT ADVICE WE GIVE?

It's extremely easy to treat *Toxocara*, with choices including tasty chews for dogs and spot-on products for cats. Given that the prepatent period of *Toxocara* spp. is

TABLE 1:

The four syndromes seen in human toxocariasis. A review of the clinical syndromes was published in *The Lancet* in 2018 (Ma et al., 2018).

Visceral larval migrans	Covert/common toxocariasis	Ocular larval migrans	Neural larval migrans
Most common syndrome in infected people, particularly children under 10.	Challenging syndromes to diagnose clinically because of non-specific symptoms.	Rare but most commonly reported in children 3-16 years.	Rare in midle-aged people but emerging evidence of developmental effects in children.
Coughing, wheezing, myalgia and eczema. Additionally, long-term effects such as the development of asthma and promotion of pulmonary fibrosis.	**Children:** fever, anorexia, headache, wheezing, nausea, abdominal pain, vomiting, lethargy, sleepiness and behavioural disorders, pulmonary symptoms, limb pain, cervical lymphadenitis and hepatomegaly. **Adults:** weakness, pruritus, rash, pulmonary dysfunction, pulonary insufficiency and abdominal pain.	Immune response to migrating or dead larvae causes visual impairment.	Fever and headache. Possible associations with seizures, schizophrenia, cognitive deficits, idiopathic Parkinson's disease and dementia. **Cognitive or developmental delays (eg, reduced reading or working memory ability) in children who become infected is concerning.**

TABLE 2:

Summary of *Toxocara* spp. prevalence studies in humans in New Zealand. When prevalence is reported in the human population, it is estimated by the presence of anti-*Toxocara* spp. antibodies in serum.

Group	% anti-*Toxocara* antibodies	Number	Median age and/or range
1984. Hydatid Control Officers' Annual Conference. Study undertaken by Christchurch School of Medicine (Clemett et al., 1985)			
Hydatid control officers	25.6%	90	43 (21-66)
1985. Hydatid Control Officers' Annual Conference. Study undertaken by Christchurch School of Medicine (Clemett et al., 1985)			
Hydatid control officers	28.4%	102	43 (20-67)
1987. Veterinarian samples taken from a Christchurch NZVA regional network meeting. Dog owners and breeders sampled at the 1986 Kennel Club Centennial Show. Study undertaken by Christchurch School of Medicine (Clemett et al., 1987)			
Urban adult blood donors (Christchurch)	2.8%	318	34.1 (17-61)
Urban student blood donors (Christchurch)	3.4%	119	16.4 (16-18)
Rural blood donors (Canterbury)	7%	187	33.9 (16-59)
Rural student donors (Canterbury)	3.1%	33	16.8 (16-19)
Veterinarians (Christchurch)	5.6%	18	40 (27-66)
Dog breeders/exhibitors	13.9%	79	41 (11-66)
1988. Sera collected from urban and rural areas. Study undertaken by Christchurch School of Medicine (Williamson et al., 1988)			
Cord blood (neonates)	1%	88	1 day
Postpartum mothers	33%	75	No data
Myalgic encephalomyelitis patients	25%	79	No data
Rural Māori children (Kāeo)	51%	49	11-14
Rural European children (Kāeo)	30%	44	11-14
Urban Māori children (Whāngarēi)	43%	40	14-16
Urban European children (Whāngarēi)	15%	41	14-16
Urban Māori children (Ōtara)	31%	26	14-15
Urban European children (Ōtara)	22%	9	14-15
Urban Pacific Islander children (Ōtara)	31%	26	14-15
Rural European children (East Coast)	44%	25	7-12
Rural Māori children (East Coast)	83%	87	9-12
2007. 82 rural and 58 urban blood donors in Waikato. Study undertaken by Waikato Hospital (Zarkovic et al., 2007)			
Adult blood donors (Waikato)	0.7%	140	43 (17-69)

just over a month, worming monthly is the best way to minimise egg shedding in animals. However, the common advice to worm every three months has been around for decades, and it appears veterinarians are reluctant to update it based on two main objections:

1. *Toxocara* spp. have low prevalence in adult animals and cause little to no clinical disease.

2. Over-medication could cause resistance.

The fact that infection in adults is less common than it is in juveniles should be weighed against the comparatively large ratio of adults to puppies and kittens; this means adults account for a significant proportion of eggs entering the environment (Morgan et al., 2013). In addition, unnecessary drug exposure and resistance should always be considered when prescribing prophylaxis, but not at the expense of minimising zoonotic risk and safeguarding children's health (Pennelegion et al., 2020).

Veterinarians' worries about resistance development (eg, Matthews, 2016) are understandable when we look at production animals. Production animals are in closed environments where those animals that shed eggs are all treated at the same time. Therefore the only contamination on pasture would be from resistant parasites that survived treatment. The epidemiology for pets is very different. Parasites of dogs and cats have large natural reservoirs of infection (refugia) (Pennelegion et al., 2020) that are not exposed to dewormers, such as birds, rodents and feral cats, and of course the numerous pet owners who are actively providing refugia for us (they probably use a neighbouring practice).

Given this, an argument for not treating monthly to reduce the risk of resistance development doesn't make sense. We would be deliberately withholding treatment and allowing zoonotic worm eggs to be shed into the

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environment – a practice that's difficult to justify on public health grounds. In addition, treating animals that don't have infections poses no risk of anthelmintic resistance development, and there are no reports worldwide of resistance in *Toxocara* spp. (European Scientific Counsel Companion Animal Parasites, 2020).

KEY RECOMMENDATIONS

The European Scientific Counsel for Companion Animal Parasites provides research-based, independent advice to veterinarians and pet owners. It recommends that adult dogs and cats who go outside be wormed four times a year, and monthly if they:

- are fed raw meat
- are working or therapy dogs
- are in contact with children under five years (that includes if dogs or cats go near areas where children play such as playgrounds or sandboxes)
- live with individuals who are immunocompromised.

I've always been in the 'let kids eat soil' camp, and there's lots of evidence to suggest that ingesting small numbers of all sorts of allergens and microbes prevents some autoimmune diseases. *Toxocara* is not one of those. Veterinarians have an important role in protecting public health as well as animal health and there are many ways to reduce environmental contamination from *Toxocara*.

For readers wanting more information, a good resource is a webinar by Eric Morgan, a Professor of Veterinary Parasitology at Queen's University Belfast. The webinar is aptly titled Toxocara Canis: *How safe is that sandpit?*. It can be viewed online at

https://bit.ly/3eHtFdv

Since this video is from the UK, veterinarians in New Zealand should use professional discretion if applying it here. VS

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