

Nine cases of human dipylidiasis in Moscow region during 1987 to 2017

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Abstract. *Dipylidium caninum* is a parasite that commonly infects dogs and cats worldwide. The large population of wild and stray dogs and cats may potentially transmit *D. caninum* to humans via their flea and lice. Humans are an accidental host, and dipylidiasis is more commonly seen in infants and children. There is scant information about human dipylidiasis in Russia. We report nine cases of dipylidiasis – eight in children and one in an adult. The patients were asymptomatic, except for excreting active proglottids in their faeces, which was the most common complaint. The clinical significance of asymptomatic dipylidiasis is not understood, except mothers were anxious because of the continuous appearance of active worms in the faeces of their children. The patients were successfully treated with praziquantel (15 mg/kg). Preventing dipylidiasis in pets and humans requires the control of fleas and lice, avoiding the outdoor defecation of definitive hosts, deworming pets, preventing children from playing with stray animals and spread of information about dipylidiasis among pet owners. Dogs and cats in many places in Russia breed freely, defecate outdoors in any area, and are not subjected to deworming and insect control. These circumstances favour the fact that, although this zoonosis is rare, it is a re-emerging disease and might reach important levels in Russia.

INTRODUCTION

Dipylidiasis is a parasitic zoonosis caused by infestation with *Dipylidium caninum* cestodes (synonym: dog tapeworm), which is an ordinary cosmopolite parasite of dogs and cats, as well as other wild dog and cat species, and is encountered in all regions of the world. *D. caninum* is taxonomically a member of the Dilepidiidae family, Dilepidiidae order and Eucestoda subclass. The adult worm of *D. caninum* is 15–30 cm long and consists of proglottids whose shape reminds one of pumpkin, melon or cucumber seeds (2–3 cm wide at the largest). Mature proglottids contain cocoons with helminth eggs (Schmidt and Roberts, 1985). Dogs, cats and humans are the definitive hosts, and pubescent helminths parasitize in their small

intestine. Dipylidiasis is transmitted by arthropods, such as the dog flea (*Ctenocephalides canis*) and cat flea (*C. felis*) as well as the dog-biting louse (*Trichodectes canis*, a type of parasitic insect from the Mallophaga family – Philopterae) and sometimes the human flea (*Pulex irritans*) (Schmidt and Roberts, 1985).

In Malaysia, trials have provided the first documentation of a potentially new species of *Dipylidium* infecting the cat louse (*Felicola subrostratus*) and cat flea (*C. felis*). These results highlight the role of ectoparasites from free-ranging animals, including cats and dogs, in harbouring transmissible pathogens (Low *et al.*, 2017).

The molecular characterization of *D. caninum* isolates collected from infected fleas, and also proglottids collected from

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dogs and cats, confirmed the existence of two distinct genotypes. These genotypes are related to host origin (dogs or cats), and they present a biological adaptation to their respective host. The genetic differences and biological observations enabled authors to suggest the existence of two distinct species within *D. caninum*, which will have to be clarified (Beugnet *et al.*, 2018; Labuschagne *et al.*, 2018).

When the helminth matures in the intestines of the definitive host, mobile proglottids start to be excreted with faeces. Proglottids actively crawl out of the anus or are passively excreted with faeces. When proglottids pass through the anus, they are crushed and cocoons and eggs of *D. caninum* come out (Schmidt and Roberts, 1985).

If the environment or animal fur is polluted with their faeces, flea and dog-biting louse larvae may swallow the eggs of *D. caninum*, and the invasion larva is further developed. Dogs and cats are infested when they swallow fleas. Humans are infested through the accidental swallowing of fleas and dog-biting lice or, if they are crushed, further pollution of the fingers with helminth eggs and their swallowing. Infection is also possible in the case of fleas accidentally hopping into milk, porridge and other food, causing the flea to be swallowed (Schmidt and Roberts, 1985).

Nine patients from Russia are described in this survey and were followed by the authors from 1987 to 2017.

The survey was focused on eight children from 11 months to 12 years old and one adult. All children and parents permanently resided in the Moscow region in private houses with a household plot. The youngest child fell ill in all families, regardless of the number of children.

In all families, there were dogs and/or cats that slept in the house. All dogs and cats lived on the land plot and freely walked not only in the territory of the plot but also around the settlement. All cats and dogs were random bred ones.

Out of eight children, two were from 11 months to 1 year old, four were 1–5 years old, and two – 6 and 12 years old. The data of the dipylidiasis cases are shown in Table 1.

The children’s parents noted that their cats and dogs often scratched themselves and supposed that they had fleas. Nevertheless, they never treated their dogs and cats for fleas. A dog and a cat were kept in the house, but there was no illness or signs of parasitic infestation in them.

Children regularly played with the cats and dogs, including on the floor. Their parents never advised children to wash their hands after playing with the animals.

Dipylidiasis was found in children by parents who, as they say, saw a chain of connected “cucumber” or “pumpkin” ivory-coloured segments or seeds in their children’s faeces several times. The parents were asked

Table 1. Nine cases of dipylidiasis in Moscow region from 1987 to 2017

Case no.	Age at the first excretion of proglottids (month/year)	Sex (M/F)	Pet animal	Excreting proglottids	Treatment: Praziquantel 15 mg/kg for 1 dose
1	11 m	F	Dog	yes	yes
2	11 m	M	Dog	yes	yes
3	1 y	M	Dog	yes	yes
4	3 y	F	Dog, cat	yes	yes
5	3 y	F	Dog, cat	yes	yes
6	4 y	M	Dog, cat	yes	yes
7	6 y	F	Cat	yes	yes
8	12 y	M	Dog, cat	yes	yes
9	27 y	F	Dog	yes	yes

Proglottids of *D. caninum* collected from the present case (Fig. 1–3).

in more detail, and it was found that they also saw similar formations sometimes in the faeces of domestic animals.

Before going to our clinic, parents either treated their children independently or addressed at different medical institutions where the kind of helminth was not identified. They were treated with drugs, including levamisole, mebendazole, albendazole and pyrantel, which are the most popular for the treatment of helminth infestation in Russia and which can be bought without a prescription.

Strobila of *D. caninum* excrete irregularly, and the children's parents noted their excretion at an approximate interval from 3 to 9 months. Therefore, they supposed that they had treated their children with the above prescribed drugs. If strobila were found repeatedly, treatment with the same drug was repeated.

No patients had any clinical signs of the disease. They preserved good appetite, the abdomen was soft and painless, and they had formed stool. There were no changes in routine blood examination. Six out of nine patients applied for a consultation 3 months from the start of finding the proglottids in their faeces, and three patients right after the first finding of proglottids.

In all cases, the diagnosis was set by studying the strobila or proglottid delivered by patients' parents to our laboratory. Patients were treated with praziquantel in one dose (15 mg/kg). Control of treatment efficiency was carried out 1, 2, 3 and 6 months after treatment. The patients were cured in all cases (Table 1).

The pet dogs and cats were seen by the veterinarian and also showed parasitism with *D. caninum* and were treated with praziquantel in one dose (15 mg/kg).

There is a description of one case below.

Patient N., 11 months old. According to her mother, proglottids were excreted in the child's faeces for 3 months. The baby grew and developed normally, and there were no complaints. The baby and parents lived in a private house in the Moscow region. According to parents, the girl often played on the floor with a dog that had fleas. The dog lived in the street, but it often went into the

house and slept there. Although the baby's parents knew their dog had fleas, they did not take any measures to deal with it. In particular, they did not treat the dog or perform home disinfection.

The child's mother also observed excretion of helminth strobila parts in her faeces. The patient thought that she and her baby had *Enterobius vermicularis* and were both treated with pyrantel for 3 days. As there was no effect after pyrantel, she also treated herself with levamisole. It was only after her treatment proved ineffective that she went to the hospital.

A 24 h stool test was requested, which found one adult cestode of approximately 17 cm in length with some of mature pumpkin-seed-like mature proglottids. Each proglottid segment was about 6–8 mm long and 2–5 mm thick. After treatment with praziquantel and purgation, the proglottids were fixed in Barbagallo's solution (3% formalin in 0.85% saline solution) and observed under light microscopy. A scolex bearing two of the four suckers, the rostellum and a number of hooklets (Figure 1); proglottids with genital pores (Figure 2); and eggs within an ovigerous capsule (Figure 3) were observed. With all these microscopic and macroscopic morphological data, the parasite species was established as *D. caninum* (Figures 1–3).

Their dog was treated with praziquantel in one dose (15 mg/kg).

DISCUSSION

Fleas are an important group of blood-sucking insects widely spread all over the world. Fleas move by hopping, and some types hop up to 30 cm in height. In the house, fleas can migrate from the feeder to a distance of 1–5 metres. Fleas are distributed unevenly in houses themselves. They are often found on bedside mats or ground cloths where pets sleep (Dremova, 2005).

The level of infestation of pet dogs and cats is high in practically all regions of the world. However, this helminthosis is found quite rarely in people, probably due to resistance to infestation. Dipylidiasis is found much more frequently in children aged

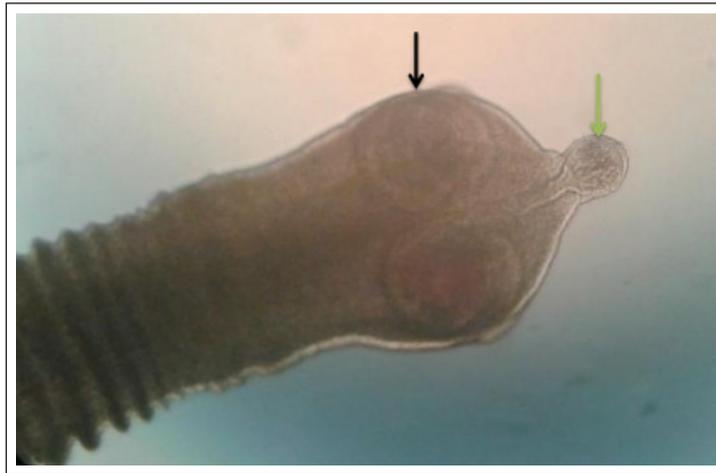


Figure 1. The scolex, neck and part of strobiles of *D. caninum* recovered in the diarrhoea after treatment with praziquantel and purgation. Green arrow indicates a rostellum. Black arrow indicates the mouth suckers of the parasite. Enlargement 4×10.



Figure 2. Gravid proglottids of *D. caninum* with genital pores. Black arrow indicates a proglottid. Enlargement 10×10.



Figure 3. *D. caninum* eggs within an ovigerous capsule in a patient's faeces. Enlargement 10×40.

from 1 to 5, probably due to their closer contacts with pets (Faust and Russel, 1958). According to the databases of medical literature, Medline and Web of Science, 349 cases of dipylidiasis in 24 countries had been detected by 2016, with 100 cases in Italy (the largest number), 86 in the USA and 81 in Japan (Jiang *et al.*, 2017). It is specified in another work that only 16 cases of dipylidiasis have

been detected in the past 20 years in the European countries, China, Japan, India, Sudan, Latin American countries and the USA (Garcia-Agudo *et al.*, 2014). As a rule, single samples of *D. caninum* are found, but cases of multiple infestations have also been described. In particular, six samples of the helminth were found in a 13 month old baby (Wong, 1955).

Russia is not present in the above list of the countries where cases of dipylidiasis have been registered, which is probably explained by insufficient availability of Russian studies for foreign readers. At the same time, dipylidiasis is one of the most frequent kinds of cat and dog helminthosis in the majority of Russian regions, including the Central region. The level of dog infestations in different regions ranges from 2.1% to 26.1% (Moskvina and Ermolenko, 2016). In some regions, extremely high levels of dog and cat infestations are found. In particular, infestation of stray dogs with dipylidiasis in the Moscow region was 100%, 64.8% in home dogs and 12.8% in service dogs (Trusova *et al.*, 2008). Consequently, infestation of dogs in the Voronezh region reached 72.7%, while infestation of cats in the same region reached 11.7% (Nikulin and Romashov, 2011).

Human dipylidiasis in Russia was described for the first time by Brandt in 1887. New cases of infestation with dipylidiasis in different Russian cities were described between 1928 and 1964 and concerned predominantly children (Gefter, 1968). In subsequent years, only a few cases of human dipylidiasis have been described in Russia (Chmeleva and Kovaleva, 1968). Dipylidiasis is not registered in the reports of the sanitary and epidemiological service on the incidences of parasitic diseases, but it may be included in other helminthoses groups (Guzeeva, 2008). Considering a high level of dog and cat infestations with dipylidiasis in Russia and their growing population in the past years, including stray dogs, we may suppose that the real number of cases of dipylidiasis is considerably higher, and many cases remain undetected and unregistered.

One factor that influences a low statistical level of incidence is poor expression of clinical symptoms or their absence and, consequently, the desire of the majority of parents to treat children independently with the drugs sold in pharmacies without a prescription. If treatment was inefficient, the patients had to apply for medical assistance.

It is mentioned in the literature that patients with dipylidiasis sometimes complain of a mild stomach ache, sickness,

decreased appetite and unstable stool (Faust and Russel, 1958). In our observations, children had no clinical signs of disease. It was only the excretion of strobila or proglottids with faeces that pointed to their infestation with helminthosis.

Although children had no complaints about their state of health and all children felt well, the fact that excretion of helminths contributed to the strong emotional distress of their mothers. Our observations show that infestation with enteral cestodiasis, characterized by their excretion from the intestines, usually causes psychological trauma in women. Their fear was strengthened by the sudden appearance of helminths in faeces, a relatively large cestode, and the impossibility to explain this phenomenon, which testifies to the fact that something lives in their children's intestines. Fear and revulsion at the sight of cestodes excreted from the intestines have also been noted many times by other authors (Schmidt and Roberts, 1985). Thus, the mothers of all the children were extremely worried and looking for doctors.

It may be supposed that this lack of logic or consistency in behaviour of parents is explained by their insufficient general culture. To a certain extent, this is confirmed by the fact that owners have never tested their pets for infections or invasions and, consequently, never treated them, including for fleas. We did not follow up any children contaminated by expensive pedigree dogs and cats under permanent control of veterinarians. All families had low incomes.

It may be supposed that the number of cases of dipylidiasis may rise in Russia as there are more and more families that keep cats and dogs, and the quantity of stray dogs is also increasing (Moskvina and Ermolenko, 2016). Taking care of homeless animals is relatively popular, and many of them are later kept at home. For some Russian people, keeping and taking care of homeless animals is a fashionable trend. In the summer time, these animals are taken to rural areas where they live on land plots, and they are left there after their owners return to the city.

The current drug of choice for treatment of enteral cestodiasis is praziquantel. It is

specified in practically all guidelines on the treatment of helminthosis that treatment with praziquantel is contraindicated in children under 4. At the same time, there are observations that treatment of 2 year old children infested with *Schistosoma mansoni* with praziquantel in a dose 20–60 mg/kg dose was not accompanied by pronounced side effects (Coulibaly *et al.*, 2017). Efficient treatment for dipylidiasis in a 9 month old baby with praziquantel in the dose of 10 mg/kg (Garcia-Agudo *et al.*, 2014) and 18 month old child with praziquantel in the dose of 25 mg/kg (Cabello *et al.*, 2011) was described. In our observations, treatment was achieved in all cases by administration of one dose of praziquantel (15 mg/kg). No disease recurrences were observed during control examinations at 1, 2, 3 and 6 months.

Prevention of dipylidiasis in humans is based on the following: fighting arthropods and regular deworming of pets, prevention of children from contacts with stray dogs and cats and prevention of children from eating near pets on the floor, as fleas may hop down from the animals and get into the dish from which the child is eating.

Conflict of interest

The authors declare no conflict of interest.

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