International symposium on hunting, »Modern aspects of sustainable management of game population«
Zemun-Belgrade, Serbia, 22. – 24. June, 2012.
Review paper UDC: 569.74

ENDOPARASITOSES OF DOGS - REVIEW

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Summary: As a species, dogs have a significant role as definitive hosts of a large number of parasites, shedding helminth eggs and protozoan cysts and oocysts *via* faeces in environment and spreading of diseases. Intestinal parasitoses are common diseases in young dogs. The most common intestinal parasitoses are caused by protozoa and helminths. The most common parasites in dog`s small and large intestines belong to genera *Trichuris*, *Toxocara*, *Ancylostoma*, *Echinococcus* and *Dipylidium*.
They do not have to cause clinical manifestations in dogs, but might cause persistent diarrhoea which takes turns with constipations, followed by reduced appetite, weight loss, stunted growth and development, and occurrence of anaemia. Many of these endoparasites are common to dogs and humans. In order to prevent their spread, it is necessary to take care of the dog food hygiene, especially when it comes to the use of abattoir waste. Cleaning of accommodation facilities and a regular antihelminthic treatment and control are essential.

Key words: dog, intestinal parasites, parasitoses

Introduction

As a species, dogs play a significant role of definitive host a large number of endoparasites, when *via faeces* allow dissemination of eggs, cysts and oocysts in environment and lead to the spread of disease [20].
The presence of intestinal parasites in dogs can lead to a wide spectrum of clinical manifestations, from mild or imperceptible, to very heavy which can lead to death. The occurrence of severe diarrhea, loss of fluids and minerals, and also the appearance of nerve symptoms in the form of epileptiform attacks is more common in young animals with intestinal parasitic infestation, but it should be noted that their presence is a common cause of chronic diarrhea in adult dogs [27]. Symptoms that occur in young dogs indicate the severity of changes in health status are related to the occurrence of apathy, retardation of growth and development, dry and brittle hair, dull, their stomach is often swollen and painful on pressure, with profuse diarrhea, with or without intestinal parasites in faeces. Sometimes a puppy vomit and the worms may be found in the vomit [26].
Intestinal parasitoses are common diseases in young dog category. The most common intestinal parasitoses are caused by protozoa and helminths. The most common parasites in dog`s small and large intestines belong to genera *Trichuris*, *Toxocara*, *Ancylostoma*, *Echinococcus* and *Dipylidium*. *T. vulpis* persists in the colon of dogs and foxes and causes chronic cataral inflammation. *T. canis* parasitic in front of the small intestine and is especially dangerous in puppies causeing anemia, dehydration and death. The infection is transmitted *via* placenta so that the puppies are born infected [14]. *A. caninum* is characterized by large buccal capsule by which sucks the blood of the host-dog, what can cause severe anemia; in humans as paratenic host, can cause the migration in the tissues [14]. *Uncinaria stenocephala,* is very rare, even in humans [2]. *Dipylidium* is tapeworm with cycle indirect development, in which the infective larvae are developing in fleas due to ingestion into the digestive tract of dogs and sometimes humans [26], [15]. *Echinococcus* is a small dog cestode, for whom a human is random transitional host, when echinococcus cyst develops in his liver and lungs [14].
Protozoan diseases in dogs that may occur are coccidiosis, giardiasis, neosporosis and toxoplasmosis. For the diagnosis of intestinal parasites coprological exploration is crucial, when veterinarian according to its results prescribes the most effective remedy for the elimination of intestinal parasites.

Coccidiosis

Coccidiosis is a rare disease in dogs, caused by protozoa *Isospora caninum*, which is most common in kennels, especially in puppies aged 1 to 6 months. Disease in an adult dog runs without clinical symptoms or mild symptoms of diseases of the digestive tract. Basic conditions for the occurrence of the disease are poor hygiene care, keeping and feeding of dogs. The causative agent multiplies in the epithelium of the small intestine, a part of development - sporulation (stage at which cysts arise - the infectious forms of the parasite) carried out in the environment. Sporulation occurs in the environment under favourable conditions of temperature, humidity and the presence of air. When the cysts reach the dog's small intestine, sporozoites are released to attack the mucose of the small intestine, where they multiply, with deterioration of the intestinal mucose. Damage of blood vessels and bleeding occurs in the intestine. Damaged mucose is not resistant and bacteria settle with development of more severe changes. Damaged capillaries easily absorb toxins from the intestines, which leads to poisoning of the organism. Coccidiosis usually affects young dogs, aged 1 to 6 months [1]. Dogs older than 18 months do not become ill, but being infected, can

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shed numerous cysts to puppies. Infection occurs *per se* when contaminated food or water in the digestive tract enter the cyst coccidia. Incubation lasts from 7 to 14 days. First cysts are being excreted in environment seven days from onset of symptoms. In diseased puppies persistant and bloody diarrhea appear. Appetite is reduced, in most cases completely reduced, with increased thirst. Abdomen is sensitive to touch, sometimes painful cramps occur. Affected puppies are unhappy and do not respond to the invitation of the owner. Very soon they become skinny, very weak and developing anemia. Mucous membranes are pale, sometimes a body temperature is elevated [5].
The most significant preventive measure is strict application of hygienic measures, especially in kennels, taking care of puppies.

Neosporosis

Neosporosis is protozoan disease in dogs caused by *Neospora caninum*. Oocysts are being excreted by dog`s faeces and sporulate in isospore type (every oocyst contains 2 sporocysts with 4 sporozoits each). This protozoa causes intrauterine infection of entire litter. Sick puppies manifest paresis and hyperaesthesia and adults manifest abnormal behaviour and sometimes blindness. Asexual forms of this parasite (tahyzoites and body tissue cysts containing bradyzoites) are significant agents for cow abortion and may be found in horses. Diagnosis have to be based on clinical symptoms and serologically. Necroses in nerve tissue and in liver and cysts in brain may be found *post mortem* [4].

Hamondiasis

Hamondiasis is intestinal parasitosis in dogs and foxes, caused by *Hammondia heydorni*, with life cycle in domesticated and wild ruminants, rabbits and guinea pig with cysts predominantly in musculature. Mostly does not cause symptoms in dogs or intermediate hosts [20].

Sarkocistosis

Sarkocistosis is a parasitic disease of a large number of domestic and wild animals and humans, caused by the coccidian parasite of the genus *Sarcocystis spp.* Sarcocysts are obligatory parasites with two host life cycle that creates cysts in muscle and nervous tissue of intermediate hosts [19]. Generally, carnivores and humans are definitive hosts in whose digestive system sexual phase of cycle takes place, while herbivores and omnivores are intermediate hosts with asexual phase of *Sarcocystis* life cycle, in muscular and nervous tissue [10].
Numerous investigations of *Sarcocystiosis* spp. prevalence took place in many countries [21], [1], [9], primarily in intermediate hosts. For example, there are three papers in Serbia related to prevalence in dogs as definitive hosts [25] [23], [24].

Giardiasis

Giardiasis is a parasitic disease of dogs caused by flagelata *Giardia duodenalis*. Like most parasites, *Giardia* development cycle has several stages. Vegetative – active stadium (*trophosoite*) exists in small intestine of dog. Parasite has a pear form with eight flagellas. When they stick to the small intestine epithelium, they rapidly divide and create new trophosoites. Trophosoites are sensitive to environment influences and cannot survive outside the dog's body, and eventually in the large intestine transform into the second stage of inactivated parasites - cysts, which can be found in the faeces of infected dogs, contributing to the spread and invasion of new animals. According to some surveys, over 30% of dogs younger than one year and about 15% of adult dogs were contaminated with the *G. duodenalis* [11].
Dogs are infected through food or water contaminated with cysts or licking hair of sick animals. In favorable environmental conditions, cysts can survive for months. Unlikely to other parasites, *G. duodenalis* cysts are infective immediately after being excreted by sick dog. When the cyst reaches the dog's digestive system, influenced by the acid in the stomach, trophosoites are released which are responsible for the appearance of symptoms that may or may not arise. If the dog is healthy, trophosoites can live in the small intestine for years without any signs of illness. However, in terms of stress, long-term use of corticosteroids can consequently disrupt the body resistance or in very young animals with underdeveloped immune system, they will be multiplied, which will eventually lead to the appearance of clinical symptoms, disrupting normal digestion and absorption which is accompanied by rare, bold and bright diarrhea with mucus. Blood analyses usually do not show any differences, although it is possible to find signs of mild anemia and an increased number of eosinophils. Without treatment the symptoms of disease occur periodically or disease takes a chronic course. In diagnosis, method of flotation is used, looking for cysts in faeces. There are few therapeutic protocols which last 3-5 days, but therapy takes up to 10 days sometimes, mostly using metronidazole or fenbendazole, with repetitive treatment every 7 days with coprological exploration [18].

Toxoplasmosis

The parasite which causes this disease is *Toxoplasma gondii*. Toxoplasmosis affects many warm-blooded vertebrates, but the cat is required to host a complete development cycle. Like all warm-blooded vertebrates, dogs

also can be infected by toxoplasmosis, most commonly when a dog eats meat or thermally untreated kittens faeces [17].

T. gondii can cause disease both in dogs and cats, but more often in cats. Symptoms of toxoplasmosis are nonspecific: fever, loss of appetite, depression. Other signs depend on whether it is acute or chronic course of disease and parasites from the residence in the body. Therefore if it is in the eye can cause inflammation, pneumonia in the lungs, the heart arrhythmia, in the digestive tract, vomiting, diarrhea, abdominal pain and jaundice, in the nervous system, neurological attacks, impaired nerve function and paralysis [20]. In animals and humans, the disease is more common in those with damaged immune system. Thus, cats that are infected FeLV, FIV or FIP virus are more susceptible to the emergence of this disease. In dogs it is the case with distemper [3].

Toxocarosis

Toxocarosis or ascaridosis of dogs is the most widespread parasitic disease in dogs, caused by *Toxocara canis*. It is a nematoda, with a clear sexual dimorphism, females 10-18 in length and males 5-10 cm. Adult worms parasitize the small intestine, where eggs are laid rounded size 72-85 μm. Eggs are discharged by feces into the environment, becoming infectious. Under favorable environmental conditions (humidity, air temperature between 20 and 30˚C) the development takes 2-4 weeks. The disease occurs in almost all dogs, especially in dogs bred in kennels and boarding houses, as well as in conditions of poor care, housing and food. Primarily affects puppies, while adult dogs are nearly always just a source of infection, without the appearance of clinical symptoms. The importance of this disease is not only detrimental to the parasite directly applied, but also weaken the body resistance to other diseases, especially viral, and poor response to the vaccine, in the absence of the desired immune response, as the effect of incomplete vaccination [1].

Due to thick-layer membrane, worm eggs are quite resistant in the environment. Tolerate low temperature, they easy overwinter in the environment. They are quite resistant to disinfectants. In the dogs body, worms act adversely in many ways. Adult parasites reduce passage or even completely close intestinal lumen, bile duct, or ductus of the pancreas and damage the intestinal mucose. All this causes a disturbance in the digestion and resorption of food, and the general state of disorder and contribute to the metabolic products of parasites that have toxic. Larvae damage and cause inflammation of the liver and pneumonia. Skinny puppy becomes anemic with symptoms of toxemia with the consequences of the hematopoietic organs and nervous system. Defense forces in the body weaken, and the dog is more likely to develop other diseases. For the same reason, and a weaker response at the vaccination, it does not create a sufficient level of protection [26].

Source of infection are adult dogs. The main source of infection for puppies are bitches. The dog becomes infected when through food or water infective eggs enter into its body. In the intestine the eggs release larvae that penetrate the intestinal wall, enter the bloodstream and reach the liver. From the liver, through bloodstream go to the lungs, where swallowed sputum due to the intestine, which mature into adult parasites. This development, the introduction of infective eggs in the dog's body to the development of adult worms, called prepatent period and lasts about 4 weeks [16]. In addition to this type of infection, by mouth, there are two ways of dog worm infection - infection of the fetus through the mother's bloodstream and infection of newborn pups through breast milk. In both these ways of infections of the fetus, or newborn puppy occurs, no egg infectious worms, but larvae. For infection of adult dogs and the most resistant larvae completes its journey through the liver and lungs in the small intestine, but falling behind in the body tissues (liver, lung, mammary gland) or muscle. These remaining larvae can remain capable of further development of a long period of time for which they are called "dormant larvae." They are those female larvae that infect puppies during pregnancy or during breast-feeding newborn puppies [6].

Clinical disease depends on the degree of infection and the number of parasites, dog's age and general health. In most cases, especially when it comes to adult dogs, the disease runs hidden. Appetite is good, and often increased, but still lean animals. Appetite is often eccentric, the animals eat feces, grass, and various items, as are at his nose. Mucous membranes are pale because of anemia. Feces is often mushy. In severe cases, with strong infection of puppies and young dogs, the disease begins with a weakened or complete cessation of appetite, vomiting and general state of disorder.

In the vomit sometimes, as in the feces, worms can be found. Feces is sometimes mushy, liquid, or mucous, and very rarely with traces of blood. Puppies have a very bloated belly. Thinness is expressed, poorly developed muscles, a frequent occurrence of rachitis. In the final stage of the disease disorders of the nervous system involve, often in the form of epileptic attack, with skidding along the way, pointed motion, falls, muscle cramps and paresis. Disease caused by larvae that pass through the liver and lungs, inflammation of the liver, mostly unnoticed, except in extremely severe infections, and inflammation of lungs with coughing, wheezing, nasal discharge and fever. The deaths are relatively rare and occur in severe infections, and in puppies. Mortality is generally due to rupture of the intestine and leakage of intestinal contents into the abdominal cavity, which causes sepsis - blood poisoning. In order to prevent askaridosis in dogs, measures of hygiene should always be undertaken. Adult dogs should be 3-4 times a year checked for the presence of parasites, puppies each month and, if possible, antihelmintic treatment should be performed. Females should be treated 20 days before the birth and apply hygienic measures in their space for birth. Puppies are first treated at 21 days and then every month until 9 months of age[16].

Ancyclostomosis

Ancyclostomosis is a parasitic disease of dogs that causes nematodes of the genus *Ancylostoma*. The disease occurs in greater extent in the kennels of dogs, especially if the conditions of poor care and rearing, as a significant health problem, especially in puppies and young dogs. Signs of infestation with *A. caninum* range from imperceptible to a bloody and profuse stools, vomiting, general weakness, lack of appetite, dehydration, and stunting. In difficult infected puppies, there is anemia, which can lead to death. Infestation occurs prenataly, through breast milk, infective larvae entering through the mouth, accidentally entering the host and the infective larval penetration through the skin. Pathogenic effect of parasites is directly related to the amount of blood that these parasites suckle, and with bleeding and fluid loss that they cause in the dog`s intestine, small intestine and laying eggs in the feces excreted into the environment in which the external environment becomes infectious. Eggs and larvae are sensitive to heat and low temperature. They die rapidly during the dry and sultry days, and also do not survive the winter. Direct sunlight destroys them quickly. Under favorable environmental conditions they can survive for 15 weeks [7].
Worm`s effect is detrimental in dog's body in several ways. Adult parasites exhibit adverse effects in the small intestine, especially in the duodenum [1]. They hook onto the mucose and damage it. Also, worms damage capillaries as they feed on blood, leading to the development of anemia. Products of metabolism of parasites are toxic to the dog organism. Harmful effects of larvae are manifested on the skin if the infection occurs in this way, and it is characterized by inflammation of the skin with itching, especially on the feet, among toes. Also, the larvae cause damage to the lung and the bowel wall during development. Larvae can carry various agents of infectious diseases from the environment in the dog's body. Source of infection is infected animal.
Special risk are adult dogs, which are often latently infected. Dogs become infected when they eat food or drink water contaminated with infective eggs or larvae ankilostoma, or breastfeeding, through the milk. Larvae entered in these ways in the body, enter the small bowel wall and one phase of development takes place, and then go to the intestine which become mature - mature parasites. Infection can occur when larvae penetrate into the dogs skin. When the larvae develop from an egg, it is very easy to navigate on the surface of the soil or on plants. Places for dog training, running out and walk, parks with heavy vegetation - branched trees, kennels and dog kennel, sandy and pebbled floors and all other places where moisture retains longer and little sunlight penetrates, are extremely suitable for long maintain larvae in infectious and steady state, are possible sources of infection. When the larvae penetrate the skin, travel into the bloodstream and enter the lungs, where after coughing with sputum are swallowed and reach the small intestine where the adult parasites develop. After birth, some larvae mature into the mammary gland and milk by infected puppies. Infected bitches can transmit to the puppies through the milk ankilostoma larvae in the next three litters from the moment of infection, because the larvae incapsulate in the subcutaneous tissue and remain in the infective state for 2-3 years [26].

Trichurosis

Trichurosis is commonly spread parasitic disease, especially in young dogs, kept in big agglomerations, caused by *Trichuris vulpis*. Adult parasites are localized in colon and cecum of dog, where they lay small eggs of characteristic lemon shape, excreted *via* faeces in environment. There, under favourable conditions, resilient eggs became infective in 2-4 weeks, surviving and staying infective up to 5 years. *Trichuris* worms have detrimental effect on dog's body in many ways. Larvae damage the wall and glands of the small intestine, and adult parasites colon. Severe infections can lead to obturation of colon. Source of infection are infected dogs. Infection starts through the mouth, by contaminated food or water. Disease becomes apparent only in puppies, and to the mass infection, with diarrhea, which is usually mixed with fresh - uncoagulated and red blood, vomiting and weight loss. Sometimes nervous symptoms and severe anemia are expressed. Adult dogs may reveal the obstruction with severe infections of the colon, while other symptoms are not observed. In adult dogs usually passes without clinical symptoms. The deaths in this disease is very rare [26], [16].

Alariosis

Agent is relatively small thrematoda *Alaria alata*, that persists in small intestine of fox, and occasionally in dogs. *Alaria* eggs are similar to those of *Fasciola spp*, so is life cycle. Eggs reach water transformed into *miracidium*, when enter into the water snail and leave it transformed into *mezocercaria*, looking for tadpoles, which are infective for dogs. After dog ingests tadpoles with *mezocercari*a, they travel from intestine through peritoneum and diaphragm to the lungs, transforming into *metacercarija*, then through trachea reach intestine, causing catharal enteritis. More common way of invading dog is ingestion of frogs and snakes. Method of flotation is being used to found a diagnose [26].

Cestodoses

In the small intestine of dogs several tapeworm species parasitize, primarily of the genus *Dipylidium* (*Dipylidium caninum*) and *Echinococcus* (*Echinococcus granulosus*). Their length vary depending of species from several millimetres to 5 meters. Tapeworms are flat, small headed with neck and proglotydes which may be numerous, from three to few thousands. In the rear ones, which are the biggest, eggs are carried, excreted in faeces [26].

All tapeworms have two host life cycle. Dogs are infested with adult stages of *Dipylidium caninum, Taenia*, or *Mesocestoides spp.*when eats (part of) infested intermediate, and then disseminate their eggs *via* faeces [1].
Adult dogs are commonly infected, but mostly without clinical signs, which are typical for young dogs in bad condition. Puppies are seldom infested by tapeworms. This is very important dog disease, because many of species can have part of their life cycle in domesticated animals and humans, and fish, frogs and flies, as well as intermediate hosts, which became infested when ingest tapeworm egg **[12]**. Depending on tapeworm species, transformation into adult tapeworm in intermediate host lasts from 1 to up to several months **[8]**.
Tapeworms hurt organism of the dogs in many ways: with their hooks and mouth they hurt intestinal mucose, iritate it and cause inflamation, disturb digestion and resorption of nutrients. Numerous tapeworms obstruct lumen of the intestine, sometimes completely. Worms metabolites are toxic for parenchymatose organs of dog, especially for liver, kidneys, pancreas and spleen, haematopoetic organs and nervous system **[26]**.
Infected dogs shed great number of eggs, which are very resistant to unfavourable environmental conditions, enabling ingestion by intermediate hosts. Dogs cannot be infected by eating feaces of other positive dogs, which are mostly stray dogs, shepherd dogs and village dogs.
Most common signs of infection with tapeworms in dog are weight loss despite good appetite expressed, alternately appearance of constipation and diarrhea. Proglotydes could be found in faeces. Intensive itching reveals in anal region, so dogs drag their bottom on the ground and bite it. Vomiting and strange appetite may occur. Surface of mucoses are pale, hair is dry, without shine and fragile. Nervous symptoms may occur. Good hygiene in kennels is essential. It is necessary to take care of food hygiene. The confiscates should not be included in dog meals. Dehelminthisation and cleaning from fleas should take place on regular basis **[16]**.

Conclusions

According to the presented data, it could be concluded:

- the presence of intestinal parasites in dogs can lead to a wide spectrum of clinical manifestations, from mild or imperceptible, to very heavy, which can lead to death;
- intestinal parasitoses are common diseases in young dogs category;
- many endoparasites in dogs are common for a man;
- most common intestinal parasitoses are caused by protozoa and helminths;
- it is necessary to take care of the food hygiene of dogs, especially when it comes to the use of slaughterhouse waste;
- hygiene of accommodation facilities and a regular antihelmintic treatment and control are essential.

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