Giardia and Tritrichomonas Foetus: An Update
Michael Leib, DVM, MS, DACVIM
Virginia-Maryland Regional College of Veterinary Medicine
Blacksburg, VA

Giardia

*Giardia* is a flagellate protozoan parasite commonly encountered in small animal veterinary practice. The most common clinical syndrome associated with *Giardia* is acute small bowel diarrhea, but in some cases acute large bowel diarrhea, chronic small or large bowel diarrhea, or rarely acute or chronic vomiting may occur. Studies throughout the world have found infection rates ranging from 1%-39% in pet and shelter dogs and cats. Recently a study utilizing PCR found 80% of cats in Perth Australia to be positive. Many of the *Giardia* infected animals did not have diarrhea. Younger animals had a higher rate of infection.

It appears that various strains possess differing degrees of pathogenicity. Clinical signs may be self-limiting in some patients. Severe disease may occur in puppies or kittens, animals with other gastrointestinal parasites or diseases, or debilitated animals, but also can occur in otherwise healthy patients. *Giardia* cysts are not routinely identified by commonly used fecal flotation solutions because cysts become shriveled and cannot be identified. In addition, the numbers of cysts shed in the feces fluctuate over time. Many commonly used anthelmintics are not effective against *Giardia*. Although the issue is presently unresolved, some strains of *Giardia* are a zoonotic threat. This paper will review the important clinical aspects of giardiasis and will present a practical diagnostic plan and differential diagnosis.

Infection is acquired by ingestion of cysts, only a small number are necessary. Most dogs and cats infected with *Giardia* remain asymptomatic. When clinical signs occur, acute small bowel diarrhea is most common. Small bowel diarrhea has the following characteristics: liquid to semi-formed feces, moderately increased frequency of defecation, and normal to increased quantity of feces per defecation. The presence of melena (digested blood) is uncommon in cases of giardiasis. Diarrhea usually is self-limiting in animals that develop clinical signs, and has been described as pale, malodorous, and fatty. Severe diarrhea may be accompanied by dehydration, lethargy, and anorexia. However, most affected patients remain bright and alert, afebrile, and maintain a normal appetite. Occasionally acute vomiting may accompany diarrhea. The author has endoscopically observed severe erosion of the duodenum in some cases that resolved following successful treatment for *Giardia*. A mild eosinophilia has been demonstrated.

Chronic small bowel diarrhea with weight loss, poor body condition, and intermittent vomiting may also occur. In addition, the author occasionally has identified *Giardia* in cases of chronic vomiting. *Giardia* may be found in dogs and cats that have other gastrointestinal diseases, especially inflammatory bowel disease. In these cases, the clinical signs and laboratory findings reflect the underlying disease. In humans, *Giardia* may mimic inflammatory bowel disease.

Acute or chronic large bowel diarrhea with hematochezia, excess fecal mucus, and tenesmus may occur on occasion. In cases of large bowel diarrhea, the frequency of defecation is moderately to greatly increased and quantity of feces per defecation in reduced. Excess fecal mucus is often seen in infected cats.

Differential diagnosis and diagnostic plan

There are many causes of diarrhea in dogs and cats. Common causes for acute diarrhea include the following: *Giardia*, hookworms, roundworms, coccidia, dietary indiscretion, foreign body, toxins, drugs, hemorrhagic gastroenteritis (HGE), coronavirus, parvovirus, and intussusception. A thorough and logical diagnostic plan should be followed to facilitate reaching an accurate diagnosis, minimizing stress to the patient and expense for the owner.

The initial step in evaluation of cases with acute diarrhea is to distinguish between self-limiting and life-threatening causes. Most cases are self-limiting and can be diagnosed with a thorough history, careful physical examination, and fecal examination. Life-threatening cases may be associated with some of the following findings: frequent diarrhea, moderate to severe dehydration or abdominal pain, frequent vomiting, or systemic signs such as fever, icterus, lymphadenopathy, coughing, nasal discharge, or dyspnea. Puppies and kittens with severe clinical signs, especially if unvaccinated, should be suspected of having an infectious disease.

A recent dietary change, dietary indiscretion, or administration of medication may be identified in the history and suspected as the cause of self-limiting diarrhea. If the history does not identify an underlying problem, a fecal examination should be performed to identify *Giardia* or other parasites. Appropriate therapy for GI parasites, correction of dietary indiscretion, discontinuing suspect medications, or feeding a low-fat, highly digestible diet will often resolve clinical signs. Animals that are mildly dehydrated may require subcutaneous fluid therapy while those with very frequent diarrhea may benefit from motility modification with narcotics. Failure of the diarrhea to resolve indicates that a more thorough diagnostic approach should be followed.

Animals suspected of having a potentially life-threatening problem should receive: fecal examinations for parasites, complete blood count, biochemical profile, urinalysis, and survey abdominal radiographs. Additional procedures may be necessary to confirm specific disorders.
Giardia can be identified in animals with either self-limiting or life-threatening acute diarrhea. Because fecal examination should be the initial diagnostic test ordered, a diagnosis can often be reached without performing many unnecessary and expensive diagnostic tests.

Diagnosis of Giardia can usually be made by appropriate fecal examination techniques. If giardiasis is suspected, but cannot be confirmed, a therapeutic trial may be indicated. However, cessation of diarrhea after treatment does not confirm a definitive diagnosis of giardiasis.

Microscopic examination of a drop of fresh feces mixed with a drop of normal saline may allow identification of motile trophozoites. Trophozoites can be identified by their rapid "falling leaf" motion and concave ventral surface. Trophozoites may be associated with mucus and the only motility visible may be the flagella. Trichomonads are the only other motile organism similar in size (11×7um) to Giardia. They may be differentiated from Giardia by an undulating membrane along the entire length of the body, rolling rapidly progressive and erratic motility, lack of a concave surface and a single nucleus. Trophozoites are not often found in semi-formed or firm feces. One study in dogs showed that examination of fresh feces on 3 separate days identified approximately 40% of dogs infected with Giardia. In that study, approximately 90% of infected dogs were identified with three zinc sulfate fecal examinations.

Examination of feces by zinc sulfate flotation is considered to be the most accurate, practical, rapid, and inexpensive, diagnostic test available. In addition to identifying Giardia cysts, eggs of common parasites can also be seen. Approximately 2 gm of feces are mixed with 15 ml of a 33% solution of zinc sulfate, strained, the tube filled with additional zinc sulfate, and centrifuged for 3-5 minutes at 1500 rpm. If a free-swinging head centrifuge is available, additional zinc sulfate is added to create a meniscus and the tube covered with a coverslip. The coverslip can be transferred to a microscope slide for examination after centrifugation. If a fixed-head centrifuge is used, the surface layer of fluid can be transferred to a microscope slide with the bottom of a small glass tube or bacteriologic loop. The microscope slide or coverslip can be examined for cysts. Lugol's iodine may be added to the centrifuge tube to stain cysts and make identification easier. However, with experience, cysts can be identified without staining. Yeast can sometimes be confused with Giardia. Most yeast are approximately half as large as Giardia cysts and don't contain internal structures. Barium sulfate, several proprietary antidiarrheals, and enemas administered prior to collection of feces may interfere with Giardia detection. A recent study clearly demonstrated the importance of centrifugation of zinc sulfate fecal flotations. In fecal samples in which the solution was not centrifuged, 1/50 samples was positive for Giardia cysts. When the samples were centrifuged, 11/50 samples were positive for Giardia cysts and an additional 8 cases of whipworms were also identified.

Duodenal aspiration of fluid with examination of the sediment for motile trophozoites was at one time considered the gold standard for diagnosis of Giardia in dogs. Unfortunately this requires either endoscopy or exploratory laparotomy. Ten ml of saline can be infused into the duodenum, through a polyethylene tube passed through the biopsy channel of an endoscope or with a needle and syringe during exploratory laparotomy. The fluid should be aspirated, centrifuged, and immediately examined microscopically for motile trophozoites. A study published in 1983 comparing duodenal aspiration and zinc sulfate flotation found that duodenal aspiration was positive in 89% of cases while a single zinc sulfate flotation was positive in only 39% of cases. Two more recent studies performed in the author's institution have contradicted these findings. In a group of research dogs carefully monitored for parasites during a 17 month period, a single zinc sulfate examination identified 77% of infected dogs while a duodenal aspirate identified 67%. More recent investigation found that 3 zinc sulfate examinations identified 96% of infected dogs verses 88% with duodenal aspiration. These recent studies support the validity of zinc sulfate flotation as the diagnostic test of choice for Giardia in dogs. A recent review of clinical cases in which duodenal aspiration was performed during upper GI endoscopy, found very few positive tests for Giardia. The reasons why so few Giardia infections were identified were thought to be due to the frequent treatment with metronidazole and the use of zinc sulfate fecal flotation prior to endoscopy. Thus, cases with Giardia were either identified or responded to treatment, avoiding the necessity of endoscopic examination. The authors recommended that duodenal aspiration be performed in cases undergoing upper GI endoscopy if treatment for Giardia has not administered or if zinc sulfate flotation was not performed.

Several fecal ELISA tests have been marketed for human use. These tests identify Giardia specific antigens from trophozoites. Use of one of these tests (Prospect T/Giardia™, Alexon Inc., Mountain View, CA) yielded similar results to zinc sulfate flotation in 84% of examinations in dog feces. However, in 15% of examinations, the ELISA was positive when a single zinc sulfate examination was negative. Giardia was subsequently identified in approximately half of these cases when two additional zinc sulfate flotations were examined. In 1% of fecal samples, the ELISA was negative while the fecal examination was positive. Another report found that a fecal ELISA test was falsely negative in 14% of zinc sulfate positive samples from dogs. This study also found a positive ELISA in 10% of zinc sulfate negative samples. These studies point out that falsely negative ELISA tests occur, and suggest that a negative fecal ELISA does not eliminate the possibility of Giardia infection. In addition, it is possible that the fecal ELISA may be a more sensitive test and identify some cases of Giardia missed with zinc sulfate examination. Because of the expense of the fecal ELISA tests, the time required to perform the assay, the lack of identification of other parasite eggs, and the lack of data from cats, the author recommends using zinc sulfate flotation as the test of choice in identifying animals infected with Giardia. The Prospect/Giardia assay
has been modified and is available as a rapid in-office test. In one study of natural infection in research dogs, in 31.6% of fecal samples cysts were identified by zinc sulfate flotation, but the rapid ELISA was negative. In 4.3% of fecal samples cysts were not seen with zinc sulfate but the ELISA was positive. Recently, a rapid in-office ELISA has been marketed for veterinarians (IDEXX SNAP® Giardia). Preliminary sensitivity and specificity data look promising.

### Treatment

The author recommends using either metronidazole or fenbendazole for treating giardiasis in dogs and cats. The dosage of metronidazole should be 50 mg/kg SID for 5 days. It has been previously suggested to split the dosage and administer it BID. In one study it was effective in 67% of infected dogs at 22 mg/kg BID for 5 days. In a different study in a group of research cats, 25mg/kg BID of metronidazole benzoate suspension resulted in negative fecal samples 15 days after treatment. Tablets should not be divided as the medication is bitter and unpalatable. Compounding with tasty flavors, such as tuna or sardine juice, will increase palatability for cats and small dogs that receive less than one tablet. Some authors have found that a lower dosage, 10 mg/kg BID, is effective in cats. Severe neurologic side effects, including seizures and coma, have been reported in dogs receiving higher dosages or prolonged treatment. However, neurologic signs can occur with lower dosages, but are usually reversible if the drug is discontinued.

Metronidazole is a potential mutagen and carcinogen, so treatment of pregnant animals should be avoided. Metronidazole enters the parasite by passive diffusion. Under anaerobic conditions, the compound is reduced, forming toxic derivatives that bind to DNA, RNA, and other proteins, leading to denaturation and strand breakage. In humans, metronidazole is metabolized in the liver. Sixty to eighty percent of the metabolites and parent compound is eliminated by the kidney. Approximately 15% is eliminated in the feces. Drug interactions are uncommon, but phenobarbital and prednisone may increase hepatic metabolism while cimetidine may decrease it.

Fenbendazole, a drug that has been utilized for many years in dogs without toxicity, has been shown to be very effective in treating research dogs with *Giardia* at a dosage of 50 mg/kg SID for three days. Fenbendazole has the advantage of being effective against hookworms, roundworms, whipworms, and some tapeworms. It is poorly soluble in water and rapidly passes through the gastrointestinal tract. It mechanism of action is believed to be binding with the parasite tubulin and inhibiting microtubule assembly. It is safe to administer to pregnant animals. Fenbendazole has been shown to be safe in cats at up to 250 mg/kg SD for 9 days. Fenbendazole, 50 mg/kg SID for 5 days, resulted in negative fecal samples 23 days after treatment in 4 of 8 research cats that were co-infected with *Cryptosporidium parvum*. Febantal, which is metabolized to fenbendazole, combined with praziquantel and pyrantel was effective in research dogs naturally infected when treated for either 3 or 5 days. In this research setting bathing the dogs after treatment and moving to a clean environment was very important. The large animal anthelmintic, albendazole (Valbazen® Suspension, SmithKline Beecham) was reported to be safe and effective in treating dogs with *Giardia* at a dosage of 25 mg/kg bid for 2 days. However, recent clinical data has demonstrated bone marrow depression can develop in dogs and cats. The author does not currently recommend the use of albendazole.

Furazolidone (Furoxone® Suspension, SmithKline Beecham) is available as a suspension and is convenient to administer to cats and small dogs (4 mg/kg BID for 7 days). It has been shown to be effective in cats. Quinacrine has been shown to be 100% effective in dogs at 6.6 mg/kg BID For 5 days. Approximately half of the dogs treated developed minor and reversible anorexia, fever, or lethargy. Quinacrine has been shown to improve clinical signs in cats but not to eliminate infection. Unfortunately, quinacrine is not currently available in the United States.

Persistent clinical signs or shedding of cysts after treatment may suggest treatment failure, lack of client compliance, reinfection (can be from the animal’s hair coat), misdiagnosis, or underlying gastrointestinal disease. Confirming the diagnosis by a different diagnostic test or having a fecal sample evaluated by a commercial laboratory, evaluating client compliance, treating for 10 days, using a different medication, changing the animal's environment, or further diagnostic testing to identify a primary gastrointestinal disorder is indicated.

### Zoonosis

Estimates of the number of human infections within the United States in 2002 ranged from 424,000 to 2.1 million. Human infection is acquired via consumption of contaminated food or water, or person to person or animal to person transmission (the Centers for Disease Control and Prevention consider *Giardia* to be a potentially zoonotic disease). Direct animal to person transmission may be responsible for only a small percentage of human cases. However, the contribution of animals to contamination of water is unknown. Some *Giardia* strains are capable of infecting humans and dogs and cats. In the past, studies evaluating zoonosis have yielded contradictory results. The genetic diversity and population structure of *Giardia* has not been fully understood until recently. Molecular genetic studies have recently found that most strains that infect humans are different from most strains that infect dogs and cats. However, it is prudent to consider zoonotic transmission from dogs and cats possible, so adequate precautions should always be taken when contacting feces or infected animals.

3
Large numbers of cysts can be intermittently shed for long periods of time. Cysts are very susceptible to drying and many common disinfectants. Quaternary ammonium compounds inactivated cysts more rapidly and at lower concentrations than phenolic or a group of miscellaneous compounds. Phenolic compounds were effective but required longer application times. Many of the miscellaneous disinfectants were effective only at higher temperatures. Dog and cat feces should be disposed of promptly and hands washed immediately after contact with feces or infected pets. If the hair coat is soiled with feces, the pet should be shampooed to remove fecal material. Children and immunocompromised adults should avoid contact with feces or infected pets.

**Trichomoniasis**

*Trichomonas foetus* is an anaerobic protozoa with an undulating membrane and 3-5 flagella. It varies in length from 10-25 um and 3-15 um in width. It has been described as causing chronic large bowel diarrhea and fecal incontinence, especially in purebred cats from catteries. Clinical signs often develop around 1 year of age. Greatly increased frequency of defecation and hematochezia are typical. Diarrhea often spontaneously resolves after approximately 1 year, although it may take up to 2 years in some cats. In one study, approximately 50% of cats were found to be positive by PCR despite resolution of diarrhea for almost 3 years! In a study from a cat show, approximately 30% of catteries were found to have a positive cat and about 30% of all cats tested were positive. Recently the organism was found to be a separate species from that found in cattle and renamed *Trichomonas blagburni*.

Diagnosis can be made by examination a fresh fecal / saline smear, InPouch TF culture, or PCR of feces. On a saline smear the organisms move in a jerky erratic and rapid manner. Movement can be observed on the following websites:
www.vetmed.auburn.edu/~blagbbl/blagburn.mpg
www2.ncsu.edu/unity/lockers/project/cvmaprhome/gookin_jody.htm

Examination of a fecal smear may be positive in only about 15% of cases. The BioMed Feline InPouch™ contains antibiotics to limit bacterial growth. Approximately 0.05 g of fresh feces is incubated at 25°C and examined under 400x every 48H. This method may detect approximately 55% of positive cats. PCR evaluation of feces has been shown to detect approximately 95% of infected cats.

Treatment of cats is difficult. The best currently available treatment is ronidazole 30mg/kg SID-BID for 10 days. Many cats will develop reversible neurologic toxicity 3-9 days into treatment. Clinical signs include anorexia, lethargy, trembling, agitation, instability, and a blank stare. In many cats, signs of toxicity will resolve 6-10 days after stopping the treatment. Feces often become normal within 10 days of treatment. Treatment with paromomycin cannot be recommended as acute renal failure may occur!

**References**


