Giardia Infection in Cats

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Abstract: The protozoon Giardia duodenalis is a common gastrointestinal parasite of cats. While most Giardia-infected cats are asymptomatic, acute small bowel diarrhea, occasionally with concomitant weight loss, may occur. Giardia poses a diagnostic challenge, but newer tests, including a commercially available ELISA kit, have improved clinicians’ ability to obtain an accurate diagnosis. Several treatment options have been reported, and although none has been shown to be universally effective, most cases can be successfully managed with drug therapy, supportive measures, and environmental control. Current recommendations suggest that combination therapy with fenbendazole and metronidazole may be the safest, most effective treatment option for symptomatic cats.

Giardia spp are intestinal protozoal parasites capable of causing clinical and subclinical disease in numerous species, including humans and cats. Prevalence estimates in cats commonly range between 1% and 10%, but prevalences as high as 50% have been reported in some catteries and animal shelters. Unfortunately, the zoonotic potential of Giardia spp that infect cats remains undetermined. Recent molecular research has demonstrated several different genotypes, known as assemblages, of Giardia duodenalis. Both the potentially zoonotic assemblage A and the host-adapted feline assemblage F have been detected in cats. While the presence of genotypes that do not have a narrow host specificity implies that zoonotic transmission is possible, it does not verify the occurrence or direction of transmission. Experimental observations of zoonotic transmission from cats to humans are lacking, and therefore, data on the frequency of such transmission are based on circumstantial evidence. It appears that transmission from cats to humans is rare, if it occurs at all.

Life Cycle, Transmission, and Pathogenesis

G. duodenalis has a simple, direct life cycle, and transmission occurs via the fecal–oral route or through contact with contaminated fomites. The prepatent period in cats is 5 to 16 days. Affected cats intermittently shed small, oval to teardrop-shaped infective cysts, which contain two mitotically arrested trophozoites. Cysts are excreted in the feces along with noninfective, nonencysted trophozoites. Excreted cysts are immediately infective and capable of surviving outside of the gastrointestinal tract. After ingestion, the encysted trophozoites emerge in the duodenum of the new host. Cysts can become well adhered to the perianal region of cats, facilitating reinfection and complicating control efforts. They may also survive for weeks to months in cool, moist environments, but they are susceptible to drying out. Rapid environmental contamination is thus likely in multicat environments, especially animal shelters and catteries, and infections may become endemic.

Clinical Signs

Most cases of Giardia infection in cats are subclinical, but clinical disease is possible and signs may precede cyst shedding by 1 to 2 days. The development of clinical signs apparently relies on a combination of factors, most notably on the host’s immune status. The exact mechanisms of disease remain unknown, but enterocyte apoptosis, as well as morphologic and functional changes, including villus atrophy, diffuse shortening of microvilli, loss of epithelial barrier function, and increased permeability of enterocytes, have all been reported. The most common sign in cats is acute small bowel diarrhea, occasionally accompanied by weight loss. Disease may be severe or chronic in a limited number of cases, and large bowel diarrhea, vomiting, and failure to thrive have been described in affected cats.

Diagnosis

Even though numerous testing options exist (TABLE 1), Giardia presents a diagnostic challenge and is generally
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This is considered to be underdiagnosed in cats. Diagnosis of Giardia infection requires detection of either trophozoites or cysts in the feces. Cysts are small (approximately 12 × 7 μm) and can be difficult to identify on fecal flotation even when concentrating techniques are used. The cysts are shed intermittently, can be confused with pseudoparasites such as yeast, and are easy to overlook even with careful microscopic inspection. Although identification of Giardia cysts or trophozoites confirms an infection, their absence does not exclude the diagnosis. Furthermore, the presence of Giardia cysts on a fecal examination does not confirm that clinical disease is a result of Giardia infection because cysts can be found in both healthy and diarrheic animals. Thus, the significance of finding Giardia cysts in a fecal sample does not always clear and must be interpreted in light of the clinical presentation and other findings.

Because the intensity of cyst shedding varies substantially, the clinical significance of finding only a few cysts in a fecal sample may be no different than that of finding large numbers. Because most Giardia infections are subclinical in cats and the zoonotic risk is low, widespread screening of healthy cats is not recommended. Diagnostic efforts should be reserved for cats with compatible clinical signs or cases in which a specific concern regarding zoonotic transmission exists (such as with immunocompromised caregivers).

### TABLE 1: Available Tests for the Diagnosis of Giardia Infection in Cats

<table>
<thead>
<tr>
<th>Type of Test</th>
<th>Benefits</th>
<th>Potential Limitations</th>
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| Direct immunofluorescence tests | • Easy to interpret  
• Detection of low numbers of cysts  
• Can use fresh or formalin-fixed feces | • Reference laboratory only  
• Expense  
• Turnaround time |
| Reference lab antigen ELISAs  | Ease of use, interpretation                   | Reference laboratory only  
• Expense  
• Turnaround time |
| In-house antigen ELISAs       | • Ease of use, interpretation  
• Rapid in-house results | False-positive results after treatment |
| Zinc sulfate centrifugation–flotation | • Inexpensive  
• Most practices already have equipment  
• Same-day in-house results  
• Detects other GI parasites | • Poor sensitivity with low cyst numbers  
• Difficulty in accurately identifying Giardia cysts  
• Requires multiple samples to avoid false-negative results |
| Direct fecal smear            | • Highly specific  
• Inexpensive  
• No special equipment or kits  
• Rapid in-house results | • False-negative results  
• Potential misidentification of Trichomonas foetus trophozoites  
• Requires fresh feces |

Fecal Flotation

Historically, the zinc sulfate centrifugation–flotation test (ZNCT) has been considered the gold standard for the diagnosis of Giardia when used by trained personnel. Fecal samples that have been freshly collected or refrigerated at 4°C for up to 48 hours are centrifuged with zinc sulfate solution to concentrate the cysts (FIGURE 2). Unlike sucrose solutions, which cause significant distortion, the zinc sulfate solution preserves the integrity of the cysts. Because cyst shedding is intermittent, a single ZNCT will identify approximately 70% of infected cats, while two or three tests will identify approximately 93% and >95% of infected cats, respectively. For this reason, at least three ZNCTs performed on consecutive fecal samples must be negative to rule out Giardia infection. While the ZNCT increases recovery and maintains the integrity of cysts, it does not eliminate problems associated with cyst identification and low numbers of organisms and is impractical in many settings because multiple samples are required for accurate results.

A videomicrograph of trophozoite movement can be seen at http://www.ncsu.edu/project/cvm_gookin/Tfoetusvideo.mov.
**Antigen-Based Assays**

The use and acceptance of ELISAs and direct immunofluorescence tests in the diagnosis of *Giardia* infection are increasing. These tests are generally highly sensitive and specific and can be used on fresh or formalin-fixed feces. They can alleviate problems associated with detection and identification of *Giardia* cysts but, with the exception of one commercially available in-house test kit (SNAP *Giardia* Test, IDEXX Laboratories), generally need to be performed by diagnostic laboratories.

Because they detect *Giardia* antigens, these tests are less affected by low numbers of organisms than the ZNCT. By coupling the antigen–antibody binding to a secondary reaction, ELISAs produce a color change and thus are easier to interpret than fecal flotation (FIGURE 3). The SNAP *Giardia* test targets a continuously shed trophozoite antigen, thereby theoretically avoiding the problem of intermittent cyst shedding (FIGURE 4). Direct immunofluorescence tests must be run by a diagnostic laboratory because they require a fluorescent microscope (FIGURE 5). Although this limits their practical utility, immunofluorescence tests have been shown to be more sensitive than the ZNCT when few cysts are present, and they may be most useful to rule out a diagnosis of *Giardia* if previous diagnostics have been unrewarding.

Debate continues over which testing protocol is the most accurate, but most experts agree that some combination of multiple tests on multiple samples is necessary to minimize false-negative results. In our opinion, the ease of use of antigen-based tests, combined with the difficulties in identification of *Giardia* cysts, intermittent cyst shedding, and difficulty in obtaining multiple fecal samples, makes antigen-based tests such as the ELISA superior to the ZNCT in many clinical settings.

**Treatment Considerations**

Cats with clinical disease should be treated for *Giardia*; however, the necessity of treating asymptomatic *Giardia*-positive cats has been debated. Current professional guidelines published by the Companion Animal Parasite Council (http://www.capcvet.org) state that cats should not be treated solely for the purpose of preventing zoonotic transmission and that repeated courses of treatment are not indicated in dogs or cats without clinical signs. Based on the current understanding of the epidemiology and pathogenesis of disease, we recommend appropriately counseling clients and reserving treatment for cats exhibiting clinical signs consistent with *Giardia* infection. Cats that test positive for *Giardia* in the absence of consistent clinical signs should not be routinely treated unless there is a compelling clinical reason to administer specific anti-*Giardia* drug therapy. Such reasons may include client wishes, ownership by an immunocompromised individual, eradication of infection from a group housing setting (e.g., cattery, animal shelter, multicat household), or prevention of introduction to naïve animals. In addition to specific drug therapies, it is imperative that steps be taken to improve an infected cat’s overall health and immune system, including treatment of concurrent diseases and other parasitic infections, reduction of stress, and improved nutrition.

**Environmental Control Measures**

Successful clearance of *Giardia* infection from individual cats can be difficult, and elimination of endemic disease
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in feline populations is particularly challenging. Even when initial treatment is successful at stopping cyst shedding, reinfection from a contaminated facility, other cats, or an infected cat’s own haircoat while grooming is common. For these reasons, increased sanitation and disinfection are essential factors in eliminating infection. Giardia cysts are destroyed by many disinfectants used in animal holding facilities, including 5% sodium hypochlorite (e.g., household bleach) at a 1:30 dilution and quaternary ammonium–containing products used in accordance with manufacturers’ recommendations. Cysts are also susceptible to desiccation, and ensuring a dry environment is helpful in breaking the cycle of transmission. The importance of bathing cats in order to remove infective cysts from their haircoats should not be overlooked. After bathing, drying the haircoat (especially in the perineal area) using warm air may help ensure thorough decontamination. Litterboxes and litter scoops should be replaced. Disposable litterboxes can be used while the cat is being treated; new boxes and scoops should be purchased after successful elimination of infection. Other cats in the household should be tested and treated if infected, or all cats can be empirically treated if there are no contraindications to treatment. Although such procedures are usually recommended only for populations of cats, they may be particularly helpful in eliminating difficult infections.

Specific Drug Therapy

No FDA-approved drugs exist for the treatment of giardiasis in cats. Although designed and FDA approved as a preventive rather than a treatment, a commercially available vaccine (GiardiaVax, Fort Dodge Animal Health) has been studied as a possible treatment for experimental Giardia infection but has not been demonstrated to be effective for this purpose. Available but unapproved drugs (e.g., extralabel use) include metronidazole, albendazole, fenbendazole, and a combination product of praziquantel, pyrantel pamoate, and febantel (Drontal Plus, Bayer HealthCare; TABLE 2). Little information exists on the effectiveness of these products in eliminating cyst shedding in cats, with reported efficacies as low as 20% in some clinical trials. Furthermore, it is unclear whether drug therapy eliminates Giardia infections or merely suppresses cyst shedding, and efficacy may be further reduced in animals with diarrhea because rapid gastrointestinal transit time may result in decreased drug contact with the trophozoites. Fenbendazole is highly effective against Giardia and many other gastrointestinal parasites, seldom produces adverse effects, and can be used in pregnant animals. Once-daily dosing makes this a convenient choice for cats that may be difficult to medicate. Metronidazole may be useful for its effects against other gastrointestinal organisms but should be used with caution, as high doses (>30 mg/kg) can cause numerous adverse effects, including vomiting, anorexia, ataxia, and nystagmus. The use of albendazole should be avoided in cats because of the potential for myelosuppression. Some authors suggest concurrent treat-
ment with metronidazole and fenbendazole; although no controlled studies have been performed to evaluate such a protocol,16 these drugs act on two different targets and may have synergistic effects. In our experience, such therapy is more effective than single-drug protocols, and in our opinion, this is the treatment of choice in cats, particularly when timely elimination of infection is a high priority.

**Evaluation of Treatment Efficacy**

Ideally, all cats undergoing treatment for *Giardia* infection should be reevaluated 1 to 3 days after completion of treatment and then again 2 to 3 weeks later to assess their response. Cats that are shedding cysts at the end of treatment or immediately thereafter have not successfully cleared the infection, while those cats that are initially negative after treatment but are shedding cysts a few weeks later have become reinfected; this distinction is critical to refining the treatment strategy. Most apparent treatment failures are the result of rapid reinfection rather than failure of the drug to eliminate cyst shedding. However, it is important to note that SNAP *Giardia* test results can remain positive for several weeks after treatment even in the absence of detectable cyst shedding.2 It is unknown whether this truly represents a false-positive result or if such results are indicative of the presence of trophozoites with no, or low numbers of, *Giardia* cysts. Because the cyst is the infective form of the organism, we recommend that treatment success or failure be defined by the presence of cysts detected in the feces withZNCTs or immunofluorescent tests and that the SNAP test not be used as the sole indicator of treatment efficacy.

In general, cats that continue to have detectable cysts in their feces but are not showing clinical signs should not receive multiple courses of treatment unless such treatment is prescribed in conjunction with treatment of multiple cats or of a facility.16 Symptomatic cats that continue to have detectable cysts in their feces should be reevaluated. Further treatment may be indicated, but the clinician must also consider whether *Giardia* infection is causing the clinical signs noted. In some cases, empirical therapy for other common gastrointestinal parasites and infections or dietary manipulation may yield an adequate clinical response. However, further diagnostics are often indicated and may include fecal flotation for other gastrointestinal parasites, fecal and rectal cytology, fecal cultures for *Salmonella* and *Campylobacter* spp using the dedicated media for these agents, appropriate diagnostics for *T. foetus*, blood tests (complete blood count, chemistry panel, total T4, and cobalamin, folate, and feline trypsin-like immunoreactivity levels), abdominal imaging, endoscopy, and biopsy.

**Summary**

Diagnosis of *Giardia* is challenging, but by combining the available tests to evaluate multiple fecal samples from cats with compatible clinical signs, clinicians can greatly improve the chance of obtaining a correct diagnosis. Because of their relatively high sensitivity compared with other in-house tests, commercially available ELISA kits are a practical way to improve diagnostic yield, especially if collection of multiple fecal samples is not feasible. Because most infections are subclinical and there are no conclusive data that *Giardia*-infected cats pose a human health risk, treatment may not be indicated for every cat found to be shedding cysts. When treatment is elected, a multimodal approach using pharmacologic therapy, supportive care, and environmental control is thought to be the most efficacious at eliminating cyst shedding.

**TABLE 2** Specific Drug Therapy for *Giardia* Infection in Cats

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Route</th>
<th>Interval</th>
<th>Duration</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albendazole</td>
<td>25 mg/kg</td>
<td>PO</td>
<td>q12h</td>
<td>5 days</td>
<td>May cause bone marrow suppression</td>
</tr>
<tr>
<td>Febantel–pyrantel pamoate–praziquantel combination</td>
<td>37.8 mg/kg febantel&lt;sup&gt;a&lt;/sup&gt;</td>
<td>PO</td>
<td>q24h</td>
<td>5 days</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7.56 mg/kg pyrantel pamoate&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7.56 mg/kg praziquantel&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fenbendazole</td>
<td>50 mg/kg</td>
<td>PO</td>
<td>q24h</td>
<td>3–5 days</td>
<td></td>
</tr>
<tr>
<td>Metronidazole</td>
<td>10–25 mg/kg</td>
<td>PO</td>
<td>q12h</td>
<td>5–7 days</td>
<td></td>
</tr>
<tr>
<td>Fenbendazole–metronidazole combination</td>
<td>50 mg/kg fenbendazole</td>
<td>PO</td>
<td>q24h</td>
<td>5 days</td>
<td>Treatment may be extended to 10 days if cyst shedding persists despite bathing</td>
</tr>
<tr>
<td></td>
<td>10–25 mg/kg metronidazole</td>
<td></td>
<td>q12h</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>Drontal Plus, Bayer HealthCare.

<sup>c</sup>Personal communication. Allison Hamlyn, IDEXX Technical Support; June 23, 2009.
Key Points

- **Finding Giardia** cysts on a fecal examination in a cat with consistent clinical signs does not confirm that the clinical disease is a result of *Giardia* infection.

- Diagnostic efforts should be reserved for cats with compatible clinical signs or cases in which a specific concern regarding zoonotic transmission exists.

- Data on the frequency of zoonotic transmission from cats to humans are lacking, but it appears that such transmission is rare, if it occurs at all.

- ELISAs and direct immunofluorescence tests are practical diagnostic options that may improve diagnostic yield when only a single fecal sample is available for testing.

- Supportive care, good nutrition and husbandry, and treatment of concurrent conditions are always indicated, and environmental decontamination may be necessary to prevent reinfection.

- ELISAs are likely superior to the ZNCT in many practical settings because of the difficulties of obtaining multiple fresh fecal samples from a patient and accurately identifying *Giardia* cysts.

- Replacing litterboxes and bathing cats to remove infective cysts from their haircoats and prevent reinfection are important but often overlooked components of the treatment plan.

- Combination therapy using fenbendazole and metronidazole has been suggested to improve treatment efficacy because these drugs possess different mechanisms of action and therefore have the potential to work synergistically.

- Most apparent treatment failures are the result of rapid reinfection rather than failure of the drug to eliminate cyst shedding.

References


**Giardia Infection in Cats**

1. Most *Giardia* infections in cats are characterized by
   a. acute small bowel diarrhea.
   b. weight loss.
   c. vomiting.
   d. no apparent clinical signs.

2. *Giardia* infection is generally underdiagnosed in cats because
   a. most infections are subclinical.
   b. cyst shedding is intermittent.
   c. the organisms can be difficult to identify.
   d. all of the above

3. Which statement is false regarding the zoonotic potential of *Giardia* spp that infect cats?
   a. Host-adapted genotypes have been detected in cats.
   b. The presence of a potentially zoonotic genotype does not guarantee that transmission to humans takes place.
   c. *Giardia*-infected cats have been clearly demonstrated to pose a risk to human health.
   d. Treatment decisions for cats found to be shedding *Giardia* cysts should be based on the presence or absence of clinical signs, the host’s general health and immune status, the environment, and the risk of zoonotic transmission.

4. Which statement is false regarding the diagnosis of *Giardia* infection in cats?
   a. ELISAs and immunofluorescent assays have high sensitivities and specificities when a single fecal sample is tested.
   b. ZNCTs are highly sensitive when a single fecal sample is tested.
   c. Examination of a direct fecal smear for trophozoites is an inexpensive and rapid test that can be performed in-house.
   d. In-house ELISAs such as the SNAP *Giardia* test can remain positive for several weeks after treatment even in the absence of detectable cyst shedding.

5. Why are treatment decisions for *Giardia*-infected cats problematic?
   a. The zoonotic potential remains unknown.
   b. Most infections are subclinical.
   c. No universally effective treatment protocol exists.
   d. all of the above

6. Which statement is false regarding treatment of *Giardia* infection in cats?
   a. Environmental control measures are not necessary for control of *Giardia* infection.
   b. Treatment of concurrent illness, stress reduction, and good nutrition are important considerations.
   c. Bathing and drying cats is an important part of the treatment plan.
   d. Most difficult cases of *Giardia* infection are due to reinfection rather than to drug resistance.

7. The most important factor influencing the development of clinical signs in cats infected with *Giardia* spp is whether the
   a. genotype is host-adapted or potentially zoonotic.
   b. genotype is resistant to commonly used drugs.
   c. cat has a competent immune system.
   d. none of the above

8. For which cat would treatment be indicated?
   a. A cat with consistent clinical signs and cysts or trophozoites detected in its feces.
   b. An apparently healthy cat found to be shedding cysts on a routine fecal examination.
   c. A cat that has been treated for *Giardia* infection but is still positive on an in-house ELISA.
   d. A cat owned by a person diagnosed with *Giardia* infection by a physician.

9. Which statement is false regarding specific drug therapy for *Giardia* infection in cats?
   a. Current treatment options may only suppress cyst shedding rather than eliminate infection.
   b. Efficacy may be reduced in animals with diarrhea.
   c. The vaccine has been proven effective at reducing the severity of disease in *Giardia*-infected cats.
   d. No FDA-approved treatments exist for *Giardia* infection in cats, but several drugs can be used extralabel.

10. When should cats receiving treatment for *Giardia* infection be reevaluated?
    a. never; treatment is highly effective and follow-up monitoring is not necessary
    b. within 1 to 3 days after completion of therapy
    c. 2 to 3 weeks after completion of therapy
    d. b and c