Prevalence and diagnosis of *Giardia* infection in dogs and cats using a fecal antigen test and fecal smear

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Abstract — The SNAP fecal enzyme-linked immunosorbent assay (ELISA) *Giardia* test was used to determine the prevalence of *Giardia* in dogs and cats with gastrointestinal signs. The test was positive in 241 (13.0%) dogs and 16 (4.1%) cats. Giardia cysts were detected in only 61 of the 241 dogs and 4 of the 16 cats that were test positive.

Résumé — Prévalence et diagnostic d'une infection à *Giardia* chez les chiens et les chats en utilisant une épreuve antigène des fèces et un frottis fécal. L'épreuve fécale SNAP de titrage immunoenzymatique utilisant un antigène absorbé (ELISA) pour le *Giardia* a été utilisée afin de déterminer la prévalence de *Giardia* chez les chiens et les chats avec des symptômes gastro-intestinaux. L'épreuve a été positive chez 241 (13,0 %) des chiens et 16 (4,1 %) des chats. Des kystes de *Giardia* ont été détectés chez seulement 61 des 241 chiens et chez 4 des 16 chats dont les épreuves ont été positives.

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Giardiasis is a commonly reported intestinal infection in humans and many domesticated and wild mammals in many countries (1–4). *Giardia* is a major cause of outbreaks of waterborne infection (5,6). In dogs and cats, giardiasis is associated with a wide spectrum of clinical signs and varies from asymptomatic to severe gastrointestinal disease (5). Animal-to-animal and animal-to-human transmission are major concerns. Diagnosis of *Giardia* infections using a fecal flotation or fecal smear is considered difficult because the cysts are small and similar in appearance to many pseudoparasites such as yeast (7). Recently, a *Giardia* fecal enzyme-linked immunosorbent assay (ELISA) test kit became available in Canada and other countries. The SNAP *Giardia* Test kit (IDEXX Laboratories, Westbrook, Maine, USA) is a rapid enzyme immunoassay for the detection of *Giardia* antigen in canine and feline feces. The presence of this antigen in fecal samples indicates the animal has *Giardia* trophozoites or cysts in the intestine and may be shedding cysts in the feces. The purpose of this study was to determine the prevalence of *Giardia* in symptomatic dogs and cats using the SNAP test kit and to compare the results to those from fecal smears.

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In June, and again in December of 2006, a letter was sent to 1800 veterinary clinics throughout Canada inviting them to participate in a *Giardia* prevalence study. The letter asked the clinics to evaluate all canine and feline patients presenting signs consistent with giardiasis, including diarrhea and/or vomiting using the SNAP *Giardia* Test. Clinics were also asked to perform a fecal smear to confirm the presence or absence of *Giardia* cysts in the feces. Fecal smears were made by placing a small sample of feces on a glass slide, mixing with a drop of saline, spreading thinly and adding a drop of Lugol's iodine. A glass cover slip was placed on the slide and the entire area under the cover slip was viewed under high and dry magnification. For their participation in the study, the clinics received a rebate based on the cost of the test for each data point submitted. Clinics were given a standard form to indicate the species, clinical signs, test date, and test results for each patient. The data were then entered into an Excel spreadsheet (Microsoft, Redmond, Washington, USA) and analyzed. The geographical distribution of the clinics involved in the study and the age distribution of the animals are provided in Table 1.

Dogs from 134 clinics and cats from 94 clinics were tested. All geographical areas in Canada were represented, and animals of all ages were sampled. A total of 1871 dogs and 389 cats were enrolled in the study. Using the SNAP test, fecal antigen was detected in 241 (13.0%) and 16 (4.1%) symptomatic dogs and cats, respectively (Table 2). Using both test methods *Giardia* was identified in 299 (16.0%) dogs and 30 (7.7%) cats. For both dogs and cats, loose or watery diarrhea with increased frequency were the predominant clinical signs (Table 3). Vomiting was observed in 17.1% and 16.7% of infected dogs and cats, respectively. The duration of abnormal clinical signs varied between days and years. Acute infections were observed in 57.2% of dogs and 56.7% of dogs. Chronic infections with clinical signs for

Table 1. Geographical distribution of clinics involved in the study and the age distribution of animals

	Clinics (number of animals)	
Geographic location	Dogs	Cats
British Columbia	13 (208)	12 (43)
Alberta	20 (376)	14 (37)
Saskatchewan	4 (80)	4 (13)
Manitoba	6 (146)	6 (47)
Ontario	76 (1005)	48 (191)
Quebec	10 (158)	8 (56)
Nova Scotia/PEI	4 (23)	2 (2)
Total	134 (1871)	94 (389)
	Age distribution	
Age (y)	Number of dogs	Number of cats
< 1	615	142
1, 2, 3	454	74
4, 5, 6	259	46
7, 8, 9	204	45
10+	231	52
Not recorded	108	26

Table 2. Bayesian comparison of the SNAP test and the fecal smear (based on the SNAP *Giardia* Test as the reference method)

Variable	Dog	Cat
No test	24	4
+ SNAP/No smear	49	1
− SNAP/No smear	412	75
No SNAP/+ smear	2	4
No SNAP/− smear	19	8
+ SNAP/+ smear	61	4
+ SNAP/− smear	131	11
− SNAP/+ smear	56	10
− SNAP/− smear	1117	272
	Value (95% credibility interval)	Value (95% credibility interval)
Sensitivity	31.8 (25.4–38.9)	26.7 (8.9–55.2)
Specificity	95.2 (93.8–96.3)	96.5 (93.4–98.2)
Positive predictive value	52.1 (42.7–61.4)	28.6 (9.6–58.0)
Negative predictive value	89.5 (87.6–91.1)	96.1 (92.9–97.9)

Table 3. Clinical signs of dogs and cats with and without giardiasis

	Dogs		Cats	
Clinical signs	All dogs (%)	*Giardia* positive (%)	All cats (%)	*Giardia* positive (%)
Total number of animals	1866 (100)	299 (16.0)	385 (100)	30 (7.7)
Vomiting	427 (22.9)	51 (17.1)	55 (14.3)	5 (16.7)
Loose diarrhea	1194 (64.0)	198 (66.2)	260 (67.5)	18 (53.3)
Watery diarrhea	551 (29.5)	84 (28.1)	83 (21.6)	8 (26.7)
Bloody diarrhea	444 (23.7)	70 (23.4)	79 (20.5)	6 (20.0)
Mucus	486 (26.0)	76 (25.4)	83 (21.5)	7 (23.3)
Frequency normal	543 (29.1)	107 (35.8)	148 (38.4)	7 (23.3)
Frequency increased	1017 (54.4)	156 (52.2)	173 (44.9)	18 (60.0)
Frequency decreased	11 (0.59)	0 (0.0)	4 (1.0)	0 (0.0)
Frequency intermittent	106 (5.7)	14 (4.7)	15 (3.9)	1 (3.3)
Duration of C/S (d)	1220 (65.4)	171 (57.2)	218 (56.6)	17 (56.7)
Duration of C/S (wk)	310 (16.6)	68 (22.7)	78 (20.2)	9 (30.0)
Duration of C/S (mo)	80 (4.3)	16 (5.4)	24 (6.2)	1 (3.3)
Duration of C/S (y)	10 (0.54)	1 (0.3)	8 (2.1)	0 (0.0)

CS = clinical signs.

> 1 wk were recorded in 28.4% and 33.3% of *Giardia* positive dogs and cats, respectively.

The comparative results of the SNAP test and a fecal smear are provided in Table 2. The SNAP test was considered the reference method as the relative sensitivity and specificity compared with immunofluorescence microscopy has been reported to be 95% and 99%, respectively and compared with microplate ELISA to be 96% and 100%, respectively (SNAP Giardia Antigen Test Kit product insert). *Giardia* cysts were observed in only 61 (31.8%) of the 241 dogs with positive fecal antigen. Cysts were recorded in 56 of the fecal antigen negative dogs. In cats, cysts were detected in only 4 (26.7%) of the 16 fecal antigen positive cats. Cysts were observed in 10 cats that were fecal antigen negative.

When a Bayesian evaluation was performed using the Giardia SNAP test as a reference the sensitivity of the fecal smear was only 31.8% for dogs and 26.7% for cats and specificity was 95.2% and 96.5% for dogs and cats, respectively (Table 2). The positive predictive value was only 52.1% for dogs and 28.6% for cats.

Giardiasis is diagnosed by the presence of *Giardia* cysts and occasionally *Giardia* trophozoites in the feces of affected animals following a fecal smear or floatation (7). Limitations of the microscopic diagnostic procedure include low numbers of cysts in the feces, intermittent shedding of cysts and small size of the cysts (8 to 12 μm × 7 to 10 μm) leading to possible mis-identification by inexperienced technicians (7). The low sensitivity of the direct smear technique can be enhanced by fecal floatation and/or staining with fluorescent antibodies but this requires expensive reagents and equipment (7). A commercial fecal ELISA SNAP test was developed for the detection of *Giardia* antigens in the feces of dogs and cats. The sensitivity of the test is 95% and the specificity is 99% compared with immunofluorescence microscopy according to product literature and 85% and 100% to fecal floatation according to external validation studies (8). This test kit permits the diagnosis of *Giardia* protozoa in dogs and cats without special equipment and the difficulties associated with floatation and microscopy.

This study demonstrates the difficulties in *Giardia* diagnosis associated with direct examination of fecal smears. *Giardia* infections based on the fecal antigen test were not detected in approximately 70% of the dogs and cats and was misdiagnosed (giardiasis diagnosed in negative animals) in 3.0% of dogs and 2.6% of cats. Our findings are consistent with a recent publication which concluded that a SNAP *Giardia* fecal antigen test kit improves a clinic`s ability to arrive at a correct diagnosis of giardiasis (7). The veterinary laboratory was not blinded to the results of the SNAP test or fecal smear. In spite of this, the fecal smear had a poor positive predicative value. The results in this study are similar to that in a recent report where immunofluorescence and the SNAP test were observed to be more sensitive than microscopic methods not involving immunofluorescence (9).

Giardia is now considered the most prevalent intestinal parasite in dogs and cats (1–4,8,10). The overall prevalence is

approximately 8% in dogs and 4% in cats. The results of this survey are similar to those previously reported in Canada, the USA and throughout the world. Using the SNAP *Giardia* test, the prevalence was reported to be 18.5% and 10.8% in symptomatic dogs and cats, respectively (10). The clinical signs of giardiasis are not specific, and in some animals may not have been attributed to *Giardia* infection; however, the increased prevalence of infection in animals demonstrating clinical signs suggests the importance of testing animals presenting with gastrointestinal disease. In addition, *Giardia* causes a zoonotic disease with approximately 50% of animals shedding zoonotic genotypes (10,11). Diagnosis and treatment of *Giardia* infections is important to not only eliminate clinical signs but to also prevent transmission to other animals and to humans (11,12). The SNAP *Giardia* test appears to be a valuable tool in the diagnosis of this protozoan parasitic infection. CVJ

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