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Gastrointestinal disorders in dogs with excessive licking of surfaces

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Abstract Excessive licking of surfaces (ELS) refers to licking of objects and surfaces in excess of duration, frequency, or intensity as compared with that required for exploration. This behavior is a nonspecific sign and may be the consequence of several conditions. The objectives of our prospective clinical study were to characterize ELS behavior in dogs and to examine the extent to which it may be a sign of an underlying gastrointestinal (GI) pathology as opposed to a primarily behavioral concern. Nineteen dogs presented with ELS were included in the licking group and 10 healthy dogs were assigned to a control group. Behavioral, physical, and neurological examinations were performed before a complete evaluation of the GI system. Treatment was recommended on the basis of diagnostic findings. Following initialization of treatment, dogs were then monitored for 90 days during which their licking behavior was recorded. GI abnormalities were identified in 14 of 19 dogs in the licking group. These abnormalities included eosinophilic and/or lymphoplasmacytic infiltration of the GI tract, delayed gastric emptying, irritable bowel syndrome, chronic pancreatitis, gastric foreign body, and giardiasis. Significant improvement in both frequency and duration of the basal ELS behavior was observed in 10 of 17 dogs (59%). Resolution of ELS occurred in 9 of 17 dogs (53%). Based on video analysis, it was found that ELS dogs were not significantly more anxious than the dogs in control group in the veterinary context. In conclusion, GI disorders should be considered in the differential diagnosis of canine ELS.

Introduction

Excessive licking of surfaces (ELS) in dogs refers to constant repetitive licking of objects and surfaces such as floors, walls, carpets, and furniture (Tynes, 2008). Canine ELS is poorly documented in the literature. It is difficult to assess the prevalence of this behavior because, although it appears abnormal and intolerable to some owners, most accept the behavior or simply ignore it (Tynes, 2008). According to the literature, differential diagnosis of ELS

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includes dental and oral disease, primary central nervous system disturbances such as brain tumors or hydrocephalus, electrolyte imbalances, metabolic diseases, toxicants (lead), side effects of drug therapy, brain aging or cognitive dysfunction, and gastrointestinal (GI) disorders (Landsberg et al., 2003; Tynes, 2008).

However, some authors also attribute this behavior to obsessive–compulsive disorder (Landsberg et al., 2003; Luescher, 2003; Tynes, 2008), that is, a normal behavior performed in an inappropriate, excessive, or out-of-context manner. According to some behaviorists, this repetitive, exaggerated, and sustained behavior is brought on by conflict, stress, and anxiety, and can be generalized out of this context, and interfere with daily activities (Luescher, 2003; Tynes, 2008). Generally, the recommended treatment for obsessive–compulsive disorder is medication acting on the serotonergic system (tricyclic antidepressants; selective serotonin reuptake inhibitors) combined with behavioral therapy (Overall and Dunham, 2002; Hewson et al., 1998; Seksel and Lindemans, 2001; Tynes, 2008).

Our hypothesis is that the majority of dogs presented with ELS (L dogs) are affected by an underlying GI disorder. The aims of this prospective study were to (1) characterize ELS (age of onset, duration of behavior, frequency and duration of the episodes, context, etc.), (2) perform a complete GI diagnostic evaluation of L dogs and of control non-ELS dogs, (3) evaluate the outcome of this behavior after appropriate treatment of any identified underlying GI disorder, and (4) explore whether in the veterinary context the ELS dogs exhibited more signs compatible with anxiety than non-ELS dogs.

Materials and methods

Case selection

The study protocol followed Canadian Council on Animal Care guidelines and was approved by the Animal Care Committee of the University of Montreal. Dogs were recruited between February 2007 and May 2008 at the Veterinary Teaching Hospital of the University of Montreal, from referring veterinarians, hospital staff, and advertisements in a veterinary newspaper and through a local television program. Nineteen licking dogs (L group) were included in the study. Owners were asked to fill out a questionnaire about the frequency and duration of the licking behavior and to video record typical episodes at home. A board-certified behaviorist (D.F.) reviewed the questionnaires and videotapes to determine whether a given dog met inclusion criteria for the study. Dogs were included in the study if they licked surfaces such as floors, walls, carpets, and furniture in a manner (increased duration, frequency, or intensity) that prompted the owner to seek medical advice. Dogs were excluded if they only licked their owners or themselves or if they were receiving medication for GI or ELS disorders. Additionally, for 2 weeks before the medical investigation, owners had to record daily licking behavior and/or GI signs in a logbook prepared by the investigators. Ten healthy dogs recruited through referrals from students and staff of the hospital were assigned to the control group (C group). These animals were included if they had no history or current ELS, nonremarkable physical, neurological, and behavioral examinations, and nonremarkable complete blood cell count, serum biochemistry panel, and urinalysis.

Clinical evaluation

An informed consent form was signed by all owners. Dogs were fasted for a minimum of 12 hours before the evaluation. All dogs underwent a complete medical and behavioral history as well as physical examination by a board-certified internist (M.C.B.). Specific questions about the presence, duration, and frequency of concomitant vomiting, diarrhea, flatulence, borborygmus, and eructation were asked, followed by neurological examination by a board-certified neurologist (J.P.). If an abnormality was found, further investigation was performed. If any L dog presented with concomitant history of self-licking or evidence of dermatologic abnormality on physical examination it underwent complete evaluation by a board-certified dermatologist. In these cases, skin scrapings, cytology, and histopathology were performed if indicated, and dermatological treatment was completed before the GI treatment to eliminate possible confounding factors associated with improvement of the licking behavior.

GI diagnostic evaluation

All study dogs (L and C) underwent complete GI evaluation, including complete blood cell count (CBC), serum biochemistry panel, measurement of total serum bile acids before and after a test meal (Medi-cal/Royal Canin's Canine Development Formula, Guelph, ON, Canada), and canine specific pancreatic lipase immunoreactivity. Stool samples were examined for endoparasitic ova and *Giardia* species using zinc sulfate flotation technique. A rectal smear was obtained for fecal cytology and culture. Complete abdominal ultrasonography, followed by ultrasonography-guided cystocentesis for urinalysis was performed by a board-certified radiologist. Food and water were then withheld for the night. Dogs were anesthetized the following day. Premedication was achieved with butorphanol ± acepromazine (Wyeth, Ville Saint-Laurent, QC, Canada). Propofol (AstraZeneca, Mississauga, ON, Canada) was used for induction, and isoflurane (Pharmaceutical Partners of Canada, Richmond Hill, ON, Canada) was used for maintenance. During anesthesia, dogs underwent a complete oral and dental examination. A standard upper GI endoscopy (Olympus GIF-160 Video Gastroscope, Richmond Hill, ON, Canada) was

performed. The macroscopic appearance of both the stomach and the duodenum was evaluated (Guilford, 2005). A minimum of 16 mucosal samples were collected from all dogs using a flexible through-the-endoscope-coated disposable pinch biopsy forceps with a jaw configuration and 2.3 mm Alligator cups with needle (Center Valley, PA). Two mucosal samples were taken from each of the following 5 gastric locations: cardia, greater curvature and fundus, lesser curvature, pyloric antrum, and pylorus. A minimum of 6 mucosal samples were obtained from the orad duodenum. Other samples were also collected if specific lesions were observed. A subjective diagnosis of delayed gastric emptying was made when a large amount of food was still present and obstructed the entire pyloric antrum and/or fundus after more than 10 hours of fasting (Tams, 2003; DeNovo, 2003). If any dog had a history or clinical signs compatible with a colic disorder, such as dyschezia, tenesmus, or presence of mucus in the stools, a colonoscopy with colonic biopsies was performed.

Tissue samples were fixed by immersion in 10% neutral buffered formalin, routinely processed, embedded, sectioned, and stained with hematoxylin and eosin. Sections were evaluated by a blinded board-certified pathologist (P.H.). Histological evaluation was done in accordance with the guidelines recently published by the World Small Animal Veterinary Association GI Standardization Group (Day et al., 2008).

Behavioral evaluation

Behavior was evaluated using a standardized questionnaire (Appendix A and Appendix B). Medical history, feeding, drinking, elimination, grooming, sleeping, exploratory, play, sexual, and maternal behaviors as well as aggression (growling, snarling, lip lifting, barking and lunging, biting, etc., directed at people or animals), behavioral development, family composition, and physical environment were recorded. Information about ELS (Appendix C) included age at onset, frequency and duration of bouts, changes in frequency and duration of bouts since onset, occurrence of any situation eliciting the behavior, and time of the day when it occurred.

All dogs were filmed during the first 30 minutes of the clinical behavioral assessment (Sony Handycam, digital video camera video recorder, model number DCR-HC30). Dogs were also filmed for 2 hours after their test meal to record their postprandial behaviors. A battery-powered camera (Panasonic AG 195 VHS video recorder) was mounted on the outside of each kennel, and it was activated as soon as the dog was fed and turned off 2 hours later. A single blinded observer, unfamiliar with the study protocol, reviewed all videotapes of the behavioral appointment and the first 30 minutes after the test meal, using The Observer software program (Noldus Information Technology Inc., Leesburg, VA). Behaviors were sampled and recorded in terms of frequency or duration of occurrence. Postures (standing, sitting, lying with head on the floor, or lying with head raised), respiratory rate (panting, not panting, invisible), locomotion (moving, immobile, not visible), vocalization (presence, absence, undetermined), attention to environment (oriented, passive, unknown), and oral behavior (feeding, drinking, no oral behavior, other oral behavior, not seen) recorded as "state" were reported as percentage of observation time, and "events" (licking lips, yawning, swallowing) were reported in terms of frequency of occurrence. The specific goals of the video analysis were as follows: (1) to evaluate whether some dogs behaved differently in the stressful contexts of veterinary consultation and hospitalization, (2) to determine whether licking dogs were more anxious than control dogs in the veterinary context, and (3) to determine whether licking dogs had subtle or typical behaviors after ingesting their meal (e.g., excessive lip licking present only after the meal could be a sign of nausea or discomfort).

Treatment and monitoring

Based on clinical presentation, laboratory test results, endoscopic and histopathological findings, a diagnosis was made and a specific treatment was recommended by a board-certified internist (M.C.B.) for all L dogs. If no specific GI disorder was diagnosed, a nonspecific treatment was recommended, such as an elimination diet (Hypoallergenic Formula, Medi-cal, Guelph, ON, Canada), and the use of antacid (famotidine or omeprazole) and/or antiemetic (metoclopramide) because nausea was considered a potential cause of ELS (Tynes, 2008). Response to treatment in ELS dogs was monitored and evaluated after telephone conversations with the owners at day 30, 60, and 90 from onset of treatment. During this follow-up period, owners had to complete the logbook (Appendix D) in which they recorded every episode of licking, its duration, and any digestive signs. At day 30, 60, and 90, logbooks were sent to the investigators. If the investigators noted inadequate compliance (owners did not follow treatment recommendations correctly) or if a new treatment was needed, follow-up time was prolonged until the proper treatment was correctly administered for 90 consecutive days. Owners of control dogs were also called to ensure that no licking behavior or digestive signs had developed during the course of the study period. Improvement in frequency and duration was established using a 4-scored scale that relied on logbooks and owner perceptions. At day 30, 60, and 90, the following improvement score was attributed based on frequency of licking: 1 = dogs licked as often as day 0 (frequency unchanged); 2 = dogs improved $<50\%$ in frequency; 3 = dogs improved $\geq 50\%$ in frequency; and 4 = dogs stopped licking. The same scale was used for bout durations. A global improvement was then extrapolated from the frequency and duration improvement scoring as positive or

negative outcome. A positive outcome was attributed if frequency and duration both improved 50% or more (frequency and duration score of 3 or 4). A negative outcome was attributed if frequency or duration improved <50% (frequency or duration score of 1 or 2).

Statistical methods

Differences between groups in terms of age and weight were examined with the Wilcoxon signed rank test, whereas differences between groups in terms of gender were examined with the exact chi-square test. The exact chi-square test and Cochran–Mantel–Haenszel test were used to evaluate associations between GI disorders and groups, and GI disorders and outcome. For the behavioral analysis, a repeated measures negative binomial regression model was used for events. Environment (hospitalization or consultation) was the factor within subject, group was the factor between subjects and, length of the film was used as an offset. For "state" variables, repeated measures linear models were used with the same aforementioned factors. Contrasts between groups in each environment and between environments for each group were conducted with the Bonferroni sequential correction procedure. Only data from video recording were analyzed at this time. A value of $P < 0.05$ was considered statistically significant. All analyses were performed using commercially available statistical software (SAS, version 9.1, SAS Institute Inc, Cary, NC).

Results

Description of study dogs

There was no difference in gender distribution between the L group and the C group and no gender predilection was found in the L group. Five males and 5 females belonged to the C group, whereas 11 males and 8 females belonged to the L group. No distinction was made regarding the neutering status, as only 4 dogs in the study (3 of them belonging to the C group) were intact. Descriptive data for the L and C groups are presented in Tables 1 and 2. Mean age at presentation for the L group was 5.03 years (range, 1.5-10). Based on the answers to the initial behavioral questionnaires, mean age of onset of ELS was 2.4 years (range, 0.17-7.5). Mean duration of ELS was 32 months (range, 0.08-82). Different types of surfaces were licked, such as floors, doors, banisters, chairs, other furniture, sofas, carpets, blankets, cushions, clothes, metallic objects, and dishes. Frequency of bouts varied from 1/wk to 20/d. Daily ELS was observed in 16 of 19 dogs. Duration of a single bout varied from a few seconds to 16 hours in length. At home, ELS was more frequent following feeding in 7 L dogs.

Of the 29 dogs enrolled, 2 (1 L and 1 C) were receiving phenylpropanolamine for urinary incontinence and 1 (C) was treated with clomipramine for interdog aggression.

Clinical evaluation

A variety of GI signs were observed (Table 1). In the L group, 6 dogs were presented with upper GI signs, 1 with lower GI signs, 3 showed upper and lower GI signs, and 9 had no clinical signs other than ELS. Colonoscopy was performed in 2 dogs, one with lower GI signs (dog 9) and one with upper and lower GI signs (dog 6). Neurological evaluation did not reveal any abnormality except for 1 dog with an abnormal gait, in whom breed and history suggested craniocervical abnormality. Fourteen L dogs also licked themselves excessively, particularly thoracic or pelvic limbs; dermatological examination, including skin scraping, cytology, and histopathology, did not reveal any dermatological abnormality, except for 1 dog that was diagnosed with a mild *Malassezia pachydermatis*.

GI disorders

The prevalence of GI abnormalities was significantly higher in L dogs compared with C dogs ($P = 0.046$); 74% (14 of 19) of the L dogs had GI abnormalities as compared with 30% (3 of 10) of the C dogs. Several GI disorders were found in the L group (Table 1), including eosinophilic infiltration (EI) of the GI tract (n = 5), lymphoplasmacytic infiltration (LPI) of the GI tract (n = 3), delayed gastric emptying (n = 7), irritable bowel syndrome (n = 1), chronic pancreatitis (n = 1), giardiasis (n = 1), and gastric foreign body (n = 1). Sixty-eight percent of licking dogs (13 of 19) had a proximal GI disorder. Three C dogs had mild inflammatory infiltration (n = 1: gastric EI, n = 1: duodenal LPI, n = 1: duodenal EI). For L dogs, infiltrations of the stomach were classified as mild (n = 3), moderate (n = 2), or severe (n = 1). Infiltrations of the small intestine were classified as mild (n = 4) or moderate (n = 1). Subjective delayed gastric emptying was also observed in 4 L dogs showing cellular infiltration. Treatments included fenbendazole, commercial elimination diets, and prednisone, sometimes associated with cyclosporine for infiltrative disorders. Prokinetic drugs and canned food were prescribed for delayed gastric emptying. Sulfasalazine and a supplementation in soluble fibers were used for the dog diagnosed with irritable bowel syndrome. The dog with giardiasis was treated with fenbendazole. During the endoscopic procedure, the gastric foreign body (30 cm [12 inches] nylon rope) was removed with grasping forceps. No GI abnormality was found in 5 L dogs. Therefore, a nonspecific treatment (elimination diet, antacids ± antiemetic drugs) was instituted.

Outcome

The outcome of ELS behavior throughout the study period is summarized in Table 3. Two L dogs were excluded from the study, one at day 30 for owner noncompliance, and the other at day 60 because of loss to follow-up. At day 30, a

Table 1 GI signs, GI diagnosis, and outcome following GI treatment in L dogs

	Breed	ELS (d 0)	Type of surfaces licked	GI signs	Diagnosis	Outcome (d 90)
1	MB	1-3/wk; 1-3 hours	Floor	V, pica (grass ingestion)	No GI disorder identified	+ (R)
2	BMD	1-3/wk; 30 minutes to 1 hour	Floor	V, ptyalism, abd pain	Mild E enteritis	+ (R)
3	Boxer	2-3/d; 5-10 minutes	Dish, blanket	V; abd pain, small bowel diarrhea, bb	Mild E enteritis DGE	+ (R by d 120)
4	Black Russian Terrier	1-5/d; <30 seconds	Floor, carpet	Ptyalism, changing in appetite, depression	Severe E gastritis Mild E enteritis DGE	+ (R)
5	Maltese	1-8/d; 1-5 minutes	Sofa	V, regurgitation	Mild E gastritis Moderate E enteritis	− (+ by d120)
6	MB	1/wk; 30 seconds to 16 hours	Floor, sofa, blanket	V, ptyalism, bb, soft stools	Gastric foreign body	+ (R)
7	Coton de Tulear	20/d; 30 seconds to 7 minutes	Floor	V, abd pain	Moderate LP gastritis DGE Chronic pancreatitis	− (+ by d180)
8	MB	2-4/d; 2-15 minutes	Sofa, blanket, cushion	V, bb, small bowel diarrhea	Moderate E gastritis Mild E enteritis	+ (R)
9	Beagle	2-3/d; 20 minutes to 1 hour	Bed, sofa, owner's clothes	Dyschezia, soft stools	Irritable bowel syndrome	+ (R)
10	Jack Russell	1-2/d; 10-30 minutes	Floor, banister	V, flatulence, pica	Giardiasis	+ (R)
11	Dachshund	2/d; 30 minutes	Dish, floor	None	DGE	+ (R)
12	WHWT	1-2/d; 10-60 minutes	Sofa, floor, furniture	None	No GI disorder identified	+ (R)
13	Labrador	1-3/d; <30 seconds to 2 minutes	Carpet	None	DGE	− (+ by d140)
14	MB	1-2/d; 5-50 minutes	Carpet	None	DGE	−
15	Maltese	3-5/d; <30 seconds to 15 minutes	Blanket, cushion	None	No GI disorder identified	[a]
16	Yorkshire	2/d; <30 seconds to 35 minutes	Floor, sofa	None	Mild LP gastritis	−
17	MB	2-3/d; <30 seconds to 45 minutes	Metallic objects	None	No GI disorder identified	[b]
18	MB	2-3/d; 5-20 minutes	Floor, carpet, blanket	None	No GI disorder identified	−
19	Shih Tzu	2-3/d; 1-10 minutes	Floor, sofa	None	Mild LP gastritis DGE	−

GI, gastrointestinal; ELS, excessive licking of surfaces; MB, mixed-breed; BMD, Bernese mountain dog; WHWT, West Highland White Terrier; d, day; wk, week; E, eosinophilic; V, vomiting; abd, abdominal; bb, borborygmus; LP, lymphoplasmacytic; DGE, delayed gastric emptying; +, positive outcome; −, negative outcome; R, resolution.

[a]Excluded for noncompliance at day 30.

[b]Lost to follow-up at day 60.

Table 2 Descriptive data and GI diagnosis in C dogs

Dog	Breed	Age (years)	Gender	Diagnosis
1	Boxer	5	SF	Normal
2	Labrador	1.5	F	Normal
3	Labrador	8	F	Normal
4	Doberman	6	SF	Mild E gastritis
5	Labrador	7	NM	Normal
6	GD	4	SF	Normal
7	MB	2.5	NM	Mild E enteritis
8	MB	6	NM	Normal
9	MB	3	NM	N
10	MB	2	M	Mild LP enteritis

E, eosinophilic; F, female; GD, Great Dane; LP, lymphoplasmacytic; M, male; MB, mixed-breed; NM, neutered male; SF, spayed female.

positive outcome was observed in 56% (10 of 18) of the L dogs. At day 60, a positive outcome was observed in 47% (8 of 17), and at day 90, the positive outcome increased to 59% (10 of 17). At day 30, 60, and 90, 3 of 18 (17%), 4 of 17 (24%), and 9 of 17 (53%) L dogs, respectively, had stopped licking. Of the 5 dogs that were without GI abnormality and were treated nonspecifically (hypoallergenic diet and famotidine), 2 had stopped licking at day 90. One dog did not improve. Interestingly, type of GI disorder, duration of clinical ELS behavior before enrollment, and presence of concomitant GI signs did not significantly affect outcome at day 90.

Behavioral measures

Statistical analysis included events and states that were most frequently observed (yawning, lip licking, standing, sitting, lying with head on the floor or lying with head raised, panting, immobility, vocalization, oriented to the environment, feeding, oral behavior). No significant differences were noted for events or states between groups during consultation or hospitalization (Tables 4 and 5). Licking dogs did not show signs compatible with nausea such as lip licking, swallowing, or drooling during the first postprandial 30 minutes of filmed behavioral measures.

Table 3 Number of L dogs having a positive (+) or a negative (−) outcome at day 30, 60, and 90

	Day 30[a]		Day 60[b]		Day 90	
	−	+	−	+	−	+
n = 19	8	10	9	8	7	10

[a]One dog excluded for noncompliance.
[b]One dog lost to follow-up.

Table 4 Behavior observed between groups during consultation

Behavioral categories	C	L	*P* value
Events[a]			
Yawning	7.8	3.7	0.35
Lip licking	26.5	33.3	0.57
States[b]			
No locomotion: immobile	85.0	79.6	0.22
Oriented to the environment	98.0	95.7	0.81
Vocalization	1.1	6.1	0.59
Feeding	NM	NM	—
No oral behavior	95.7	94.9	0.84
Panting	35.3	53.3	0.25
Standing	49.9	61.9	0.31
Sitting	17.3	15.6	0.85
Lying with head on the floor	31.2	14.9	0.29
Lying with head raised in the air	21.7	15.0	0.49

C, control group; L, licking group; NM, not measured.
Note: *P* values for contrasts within a given environment are provided. None of the *P*-values are significant after the Bonferroni sequential correction.
[a]Number of occurrences (means).
[b]% Observation time (means).

Discussion

In the present study, we sought to characterize licking behavior of surfaces or objects and learn whether this behavior was associated with any identifiable GI condition(s). Evidence that ELS behavior can be associated with

Table 5 Behavior observed during hospitalization between groups

Behavioral categories	C	L	*P* value
Events[a]			
Yawning	1.5	2.6	0.35
Lip licking	51.6	52.5	0.94
States[b]			
No locomotion: immobile	92.2	94.3	0.60
Oriented to the environment	81.3	80.8	0.95
Vocalization	23.4	27.5	0.64
Feeding	3.7	7.11	0.15
No oral behavior	94.0	90.5	0.35
Panting	44.2	42.7	0.92
Standing	43.8	33.6	0.37
Sitting	25.8	16.9	0.31
Lying with head on the floor	27.0	32.6	0.66
Lying with head raised in the air	17.4	28.0	0.21

Note: *P* values for contrasts within a given environment are provided. None of the *P*-values are significant after the Bonferroni sequential correction.
[a]Number of occurrences (means).
[b]% Observation time (means).

an underlying GI disorder is provided. When a GI disorder is identified and properly treated, significant improvement occurs in the majority of ELS dogs, with resolution in 9 of 17 dogs (53%). Our data suggest that the majority (14 of 19; 74%) of ELS dogs have concomitant GI abnormalities. The prevalence of GI disorders was significantly higher in the L dogs compared with the C dogs (74% vs. 30%, $P = 0.046$). Additionally, the positive outcome (59%) and resolution rate (53%) of ELS at the end of the study are clinically important.

A 90-day study period is likely too short to efficiently manage some chronic GI diseases (e.g., inflammatory bowel disease) that may require several treatment adjustments. Although the following data were collected after the end of the study, the internist noted a positive outcome in 4 L dogs previously labeled with a negative outcome at 90 days (Table 1). Two dogs with EI reached a positive outcome at day 120; one of them stopped licking and the other improved $\geq$50%. One dog with delayed gastric emptying also improved $\geq$50% by day 140. Finally, 1 dog with LPI, delayed gastric emptying, and chronic pancreatitis improved $\geq$50% by day 180, suggesting that some cases may require long-term treatment for clinical improvement.

This study raises the question about the pathophysiological link between GI disorders and licking behavior. Nausea and/or abdominal discomfort may cause ELS in some dogs (Tynes, 2008). The proximal GI tract is known to have the richest vagal afferent system connecting the GI tract to the brain and plays an important role in the generation of vomiting and nausea (Twedt, 2005). At home, 7 L dogs presented more ELS after feeding, suggesting postprandial nausea or discomfort. However, L dogs did not show signs compatible with nausea such as lip licking, swallowing, or drooling during the first postprandial 30 minutes of filmed behavioral measures. Pathways of nausea are not well understood. In humans, strong antiemetics such as neurokinin or 5-hydroxytryptamine receptor antagonists are effective at abolishing acute vomiting but not as successful at dissipating the sensation of nausea induced by chemotherapy (Herrington et al., 2000; Warr et al., 2005). This disparity suggests that emetic and nausea pathways are not identical (Steele and Carlson, 2007; Andrews and Horn, 2006; Horn, 2008; Sanger and Andrews, 2006). The brainstem is essential for the integration of the emetic signal and coordination of the motor components of emesis. It is hypothesized that projection of information from the brainstem to "higher" centers is required for the genesis of the sensation of nausea (Andrews and Horn, 2006). The negative outcome observed in some L dogs could therefore be explained by a persistent sensation of nausea despite nonspecific GI therapy. Further investigations are needed, notably in identifying pathways of nausea in dogs. Another possibility would be that these unresponsive dogs were expressing ELS because of abdominal pain or discomfort. In humans, functional GI disorders are defined as various combinations of chronic or recurrent GI signs that cannot be explained by structural or biochemical abnormalities (Drossman, 2006). These symptoms relate to several physiological determinants: increased motor reactivity, enhanced visceral hypersensitivity, altered mucosal immune and inflammatory functions, and altered central nervous system-enteric nervous system (brain-gut axis) (Drossman, 2006). For instance, functional dyspepsia is characterized by persistent or recurrent pain or discomfort centered in the upper abdomen without evidence of organic disease likely to explain the symptoms (Talley et al., 1999). No GI abnormality was identified in 5 of the licking dogs. However, with nonspecific GI treatment, 4 of the 5 dogs had a positive outcome, 2 of which resolved by day 90, suggesting that functional GI disorders may exist in dogs. As antacids improved some L dogs, it would have been interesting to measure the gastroesophageal junction and gastric pH-curve in L dogs compared with C dogs. However, this method has not yet been validated in dogs.

Another objective was to explore if in the veterinary context the L dogs exhibited more signs compatible with anxiety than C dogs. Videos were meant to identify behaviors compatible with anxiety such as increased vigilance (oriented to the environment, lying down but head raised), pacing (locomotion), panting, vocalization, yawning, and lip licking (Beerda et al., 1997, 1998; Schwizgebel, 1982; Palestrini et al., 2010). All dogs spent most of their time immobile and oriented to the environment during the initial 30 minutes for both the behavior appointment and the hospitalization. Anxiety can increase attention and stimulate risk assessment (Lang et al., 2000; Ohl et al., 2008). During risk assessment, environmental exploration, self-grooming, feeding, and social interaction are inhibited (Blanchard et al., 1998; Mastripieri et al., 1992; Shuhama et al., 2007). The study dogs may have been anxious in the veterinary context, because they were attentive to, but not exploring the environment. Vocalization was rare during consultation (owner presence) and occurred more during hospitalization (owner absence), but again without significant differences between L and C dogs. Therefore, we can only conclude that the veterinary context is likely stressful for all dogs and that there were no behavioral differences observed between groups during the initial 30 minutes in the consultation room or the hospitalization cage.

Our study had several limitations. Diagnosis of inflammatory bowel disease is challenging and relies mostly on symptoms and clinical scoring systems (Jergens et al., 2003). Several pitfalls can make histopathologic interpretation contentious and frustrating (Yamasaki et al., 1996; Roth et al., 1990; Willard et al., 2002; German et al., 1999). The coloration, number, and quality of tissue samples obtained by endoscopy play a major role for accurate identification of lesions (Willard et al., 2001, 2008). Interobserver variation among pathologists can also be considerable (Willard et al., 2002). Our study design included a minimum of 10 gastric and 6 duodenal samples. One

blinded board-certified pathologist performed all analyses according to recent World Small Animal Veterinary Association guidelines (Day et al., 2008).

The diagnosis of delayed gastric emptying on endoscopy can be argued, but some authors consider that presence of undigested food in the stomach of a fasted dog (>8-10 hours) is suggestive of delayed gastric emptying (Tams, 2003). All study dogs were fasted for a minimum of 15 hours before endoscopy was performed. The gold standard for gastric emptying assessment is scintigraphy but this technology is not readily available.

Theoretically, spontaneous ELS improvement could have occurred in some L dogs. Treated L dogs should have been compared with untreated L dogs. However, the mean ELS behavior duration in L dogs was 32 months (median = 24 months) before inclusion in the study, so it is unlikely that spontaneous improvement occurred within the 3-month trial period.

The improvement scoring system (frequency and duration) used in the study is subjective. This scoring system could have been further improved by using a ratio of the absolute number of events over the total observed time. To counteract this subjectivity, only dogs that improved >50%, both in duration and frequency, were considered as having positive outcome. In fact, 1 L dog assessed by its owners as having improved ≥50% (licking for a shorter duration but frequency unchanged) was still rated as having a negative outcome.

Conclusion

In summary, GI disease should be considered in dogs presented for ELS. With appropriate GI treatment, a positive outcome, including resolution, is expected in the majority of ELS dogs. L dogs are not necessarily anxious animals. The causal link between GI disease and ELS is still unknown and thus requires further investigation.

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Appendix A

General Canine Questionnaire Faculté de Médecine Vétérinaire, Université de Montréal

General information	
Owner's name	
Address	
Home phone	
Work phone	
Fax	
E-mail	
Patient	
Breed	
Color	
Date of birth	
Age	
Sexual status	Male / Female / Neutered male / Spayed female
Medical history	
Who referred you to the behavior service?	
Name of your dog's regular veterinarian	
Clinic/Hospital address and phone/fax	
Any ongoing medical conditions?	If yes, what condition(s)?
Current medication?	If yes, what medication(s)? Dosage and duration of treatment?
Tranquillizers?	
Feeding behavior	
Appetite:	
Rate of ingestion:	
Habits:	Eats alone Eats only if owner present Eats during the day Eats at night Eats night and day Empties dish immediately Nibbles Do not know
Location (s):	
Brand name of food:	
Treats:	
Drinking behavior	
Quantities:	
Rate of ingestion:	
Habits:	
Elimination behavior	
Defecation:	

Number of bowel movements per day:
Location(s):
Urination:
Frequency: Locations: How often daily?
Surfaces: House-soiling: Vertical
Horizontal
Vertical and horizontal
Urine: yes/no Where?
Stool: yes/no Where?
Housetraining: Crate training: yes/no Crate is still used with the door:
Closed
Opened
Closed or opened
How was the dog trained?

Grooming behavior

Licking body parts:
Chewing body parts:

Sleep behavior

Duration of sleep: Estimate
Sure
Not idea
Number of hours per 24 h: Number of hours per day:
Number of hours per night:
Sleep: normal/increased/decreased
Sleeping habits:
Locations: Daytime:
Nighttime:

Exploratory behavior

Normal/inhibited/increased
Carries an object in his mouth: yes/no
Swallows nondigestible items: yes/no

Play Behavior

Does your dog play with other dogs?
Does your dog play with you?
How do you play with your dog?

Aggression

Is your dog aggressive to other dogs?
Is your dog aggressive to people?
Frequency:

Sexual behavior

Mounting people:
Mounting dogs:
Mounting other animals:
Masturbation:

Maternal behavior

Describe/does not apply

Behavioral development

Age at adoption:
Age at weaning: Estimated
Sure
Do not know

Number of puppies in the litter: Do not know
Source of dog: Breeder
Pet store
Shelter or SPCA
Another person
Stray
Other
Did you see the adult dogs?
Did you see the breeder's facility?
Source of dog: Urban area
Semi rural
Rural
Do not know
At the breeders: Puppies with adults:
Yes
No
Do not know
Puppies in contact with children:
Yes
No
Do not know

Family

Humans: Adults
Children
Seniors
Number of people including you:
Age of children: Boys:
Girls:
Dogs: Yes
No
Number of dogs (including the patient):
Name(s) and age(s) of the other dog(s):
Cats: Yes
No
Number of cats
Name(s) and age(s) of the other cat(s):
Other animals: Yes
No

Physical environment

Number of square feet available: House
Apartment
Condo
Access outdoors: Yes
No
Loose
Loose in fenced yard
On leash

Other questions

Does your dog react to thunderstorms, fireworks, or gunfire?
Does your dog destroy during your absence?
Does your dog vocalize during your absence?
Does your dog eliminate during your absence?
Does your dog lick surfaces (floors, walls, furniture)?
Other comments

Appendix B Specific questionnaire

Presenting complaint(s) - List in order of importance from the most important to the least important.
Description of the last three incidents
When did you first notice the problem?
Duration of the problem (in weeks or months)?
What have you tried as treatment so far?
What are you hoping for?

Appendix C Specific questionnaire for lickers

Which behavior(s) exhibited by your pet motivated you to seek help?	
Frequency?	If variable indicate the lowest frequency to the highest frequency:
How long does the behavior last (if variable indicate the shortest duration to the longest duration)?	
How did this behavior change over time?	Improved Remained the same Worsened
When did you first notice the behavior?	
Does this behavior occur in specific circumstances?	
What treatments have you tried so far to deal with this behavior?	

Appendix D Log book for baseline and follow-up of your dog

	Day 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Licking behavior															
What time of day?															
Which surface?															
Duration?															
Circumstances?															
Other abnormal behaviors? Specify…															
Digestive signs															
Vomiting when?															
Diarrhea how many times?															
Other signs? specify…															