



Link between Foreign Body Ingestion and Behavioural Disorder in Dogs



Sylvia Masson^{a,*}, Nadège Guitaut^b, Tiphaine Medam^c, Claude Béata^d

^a Clinique de la Tivollière, 37 rue des martyrs, 38340 VOREPPE, France

^b Clinique Vétérinaire du Vallon fleuri, Centre commercial Richelieu, 81 rue Richelieu, 73490 La Ravoire, France

^c Independent researcher, Jouques, France

^d 353A boulevard Grignan - 83000 Toulon

ARTICLE INFO

Article history:

Received 15 June 2019

Revised 30 March 2021

Accepted 3 April 2021

Available online xxx

Keywords:

Foreign body

Pica

hyperactivity

Impulsivity

Anxiety

Dogs

ABSTRACT

Foreign body (FB) ingestion in dogs can threaten the animal's life and often result in an emergency surgery. The causes of pica (ingestion of non-nutritive substance) remain unexplored, although behavioral conditions including hyperactivity, impulsivity, obsessive-compulsive oral/ingestive disorders, anxiety or attachment related troubles have been implicated. Such behavioral causes of pica were investigated with two grids: Lit's owner-based questionnaire, which measures inattention and hyperactivity-impulsivity, and Beata's clinical 4A grid which investigates aggression, anxiety, attachment, and autocontrols of dogs. These grids were fulfilled for 42 FB ingesting dogs and 42 pair-matched control dogs.

The main results show that FB ingestion is rarely related to digestive pain (12% of cases) but is primarily of a behavioural nature (88% of cases). Total Scores from both grids are significantly different between FB and control group (Lit scores: Wilcoxon signed-rank test, $W = 665.5$; $P = 0.007$; 4A: Wilcoxon signed-rank test, $W = 41$; $P < 0.001$). Regular shredding of objects is mainly related to a hyperactivity-impulsivity disorder (Lit total score: Mann-Whitney test, $U = 99$; $P = 0.02$; 4A Autocontrols Scores: Mann-Whitney test, $U = 35$; $P < 0.001$), whereas its absence in FB ingestion suggests anxiety or attachment disorder.

Behavioral pathology should be assessed not only for dogs ingesting non-edible objects, but also for those shredding objects. This exacerbated oral exploration is a sufficient sign for veterinarians to consider a behavioral investigation.

© 2021 Elsevier Inc. All rights reserved.

Introduction

Foreign bodies (FB) ingestion or pica refers to ingestion of non-nutritive, non-food items such as fabric, plastics, sticks or stones (Riva et al., 2008; Overall, 2013).

In dogs and cats, intestinal FB are some of the most common causes of obstruction (Papazoglou et al., 2003) and can result in life-threatening complications caused by hypovolemia, toxemia, intestinal necrosis, perforation, or peritonitis (Hayes, 2009; Pratt et al., 2014), especially when the FB are not spherical, i.e., linear or angular (Hobday et al., 2014). The care usually consists in

the removal of the FB by endoscopy or surgery and monitoring for possible complications (Lindquist and Lobetti, 2017).

Importantly, the causes underlying the FB ingestion are barely investigated or mentioned (Papazoglou et al., 2003; Hayes, 2009; Pratt et al., 2014; Hobday et al., 2014). A recent study indicates that "there are no reports of an apparent underlying reason for the ingestion of the FB" (Lindquist and Lobetti, 2017). Other papers report several causes such as malnutrition, parasites, pancreatic failure, abdominal pain, liver encephalitis, hypothyroidy, anemia, zinc intoxication (Hand et al., 2000) but they do not mention behavioral pathology as possible cause.

Yet, in humans, in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), pica is classified in feeding and eating disorders (American Psychiatric Association, 2013), and it indicates that this compulsive eating of non-nutritive substances can have psychiatric origins. Causal explanations causes in-

* Address for reprint requests and correspondence: Sylvia Masson, Clinique de la Tivollière, 37 rue des martyrs, 38340 VOREPPE, France, Tel: 0033 619913835

E-mail address: s.masson@hotmail.com (S. Masson).

clude the obsessive-compulsive spectrum of disorders, anxiety or impulse control disorders (Rose et al., 2000). Despite these reference to a psychiatric origin of pica, psychological investigation in cases of repeated FB ingestion remains limited (Gitlin et al., 2007). Understanding the mechanisms of this behavior is critical to develop treatments combining pharmacological, medical and cognitive interventions (Poynter et al., 2011).

Some publications on canine behavior also suggest a behavioral cause of pica including hypersensitivity-hyperactivity syndrome (Merola, 2000). Others mention a link with oral obsessive-compulsive disorder (Overall and Dunham, 2002; Luescher, 2004), anxiety (Riva et al., 2008), or the owner's work routine (i.e., attachment issues) (Col et al., 2016). In cats, the literature also evokes infantile behavior, stress of rehoming, territorial behavior (Bradshaw et al., 1997) and abnormal appetite (Borns-Weil et al., 2015), especially in the Burmese and Siamese breeds.

Altogether, pica and object destructions are a frequent complaint in behavioral consultations (Col et al., 2016; Masson and Gaultier, 2018) as they can lead to punishment (Sylvia Masson et al., 2018) or isolation in a crate, which are both detrimental to the dog's welfare (Masson et al., 2018) and to the dog-owner relationship (Marston et al., 2004).

We investigated whether FB ingestions are related to behavioral disorders, especially hyperactivity, impulsivity and compulsive oral disorder. The role of behavioral disorders was tested with two different behavioral assessment grids submitted to FB ingesting dogs and pair-matched control dogs.

Material and methods

Sample

Forty-two FB ingesting dogs were recruited in two veterinary referral centers based in France. Forty-two control dogs were recruited from the two first authors' veterinary clinics.

The data of the FB ingesting group were collected from dogs that received surgery for FB removal between January 2015 and October 2018. The surgery performed to remove the FB included gastrotomy, gastrectomy, enterectomy, enterotomy, gastric endoscopy. All the operated dogs were seen by a specialist in internal medicine before the surgery, who either diagnosed a medical problem explaining the ingestion (e.g., pancreatitis, lymphoma) or ruled out an organic origin. All necessary complementary exams, such as intestinal biopsy, ultrasonography, scanner or blood analysis were performed before the surgery. Only dogs who had no identifiable medical condition leading to their foreign body ingestion were included in the study. Similarly, dogs under 6 months of age were excluded from the study as accidental ingestion might be more frequent in puppies and dogs who ingested materials like fishhook or peach pit were excluded from the study too because these ingestions could result from normal attempts to consume edible food.

In addition, the FB group was further split into two groups: dogs who regularly shred and/or ingest items according to their owners (S group) and dogs that did not (NS group).

The data of the control group were collected from the two first authors' database between January 2018 and January 2019. The control dogs were healthy and selected for their breed, sex, neutering status and age to be as close as possible to those of the FB dogs.

All the owners were contacted by e-mail to participate to a phone questionnaire aiming to identify the possible behavioral cause of the dog's recent surgery (for the FB dogs) or to check that their dog had never ingested non-edible objects (for the C dogs). Forty-two owners in each group accepted to answer the questions

of the clinical "4A" grid (Table 1). The owner-based "Lit questionnaire" (Table 2) was sent by e-mail afterwards or also read to the owners on the phone without influencing their answers.

Investigated items

For each dog the following set of data were collected for the purpose of the investigation:

1. Breed type
2. Sex and reproductive status
3. Age
4. Number of non-edible objects ingested by the dog until the interview
5. Type of object ingested
6. Number of ingestions that resulted in surgery for foreign-body removal
7. Presence or absence of a behavioral care proposed after the surgery
8. Presence or absence of regular items shredding
9. 4A grid clinical score (see below for details)
10. Lit ADHD rating scale (see below for details)

The 4A grid (Tables 1 and 3) (Massal and Beaumont-Graff, 2010; Beata et al., 2018), consists in 20 questions, i.e., 5 questions for each of four axes: aggressivity, anxiety, attachment and autocontrols. Self-control is the learned ability of the dog to control his motivation or emotional state, whereas autocontrol is the both inherited and acquired capacity of the dog to control his movements and locomotion when under strong internal motivation or emotional state.

In this grid, each response is scored: 0,1,2,3 and 5 with 0 indicating a normal behavior and 5 indicating a severely abnormal one. Several scores were calculated. 4A global score was the sum of the scores obtained in the 20 questions. 4A sub-scores (i.e., 4A Aggressivity, 4A Anxiety, 4A Attachment, 4A Autocontrols) were the sum of the scores obtained in the 5 questions of each axis.

Because the 4A grid score intervals are not equals (0,1,2,3,5), all scores of 5 were converted into 4 scores to perform statistical analysis.

The purpose of its use was to detect any behavior abnormality that could explain the observed pica, without establishing a precise diagnosis that would have been beyond the scope of this study.

The Lit ADHD rating scale assesses inattention and hyperactivity-impulsivity based on owner report (Lit et al., 2010). This scale includes 12 items (Table 2) (Lit et al., 2010). The question 8 was used as in the original questionnaire from Vas and colleagues (Vas et al., 2007) (i.e., your dog would always play and run), because Lit and colleagues' (Lit et al., 2010) rewording (i.e., your dog likes active play and running around) was changing the original meaning.

Each response was scored on a 5-point scale as follows: 0 (Never/ Rarely), 1 (Occasionally), 2 (Often), 3 (Very Frequently), or 4 (Always). A global score was calculated for each dog by summing the scores of the 12 responses. Three subscales were also calculated (Lit et al., 2010): the inattention subscale (IA, sum of converted responses to questions 1, 2, 3, 7, 9, and 11), the hyperactivity-impulsivity subscale 1 (HI1, sum of converted responses to questions 4, 5, 6, and 12), and the hyperactivity-impulsivity subscale 2 (HI2, sum of converted responses to questions 6, 8, and 10).

The purpose of its use was to measure hyperactivity-impulsivity which, as said above, is the behavioral disorder that is the most suspected in cases of FB ingestion (Merola, 2000; Luescher, 2004).

Table 1
Beata's 4A grid for dogs

All the "5" results have been changed to "4" for statistical analysis

Aggressivity

1. Deferential and submissive postures	Easy with everybody	0
	Generally easy, refuses in rare situations	1
	Possible most of the time	2
	Difficult, only possible with one person	3
	Impossible	5
2. Aggression toward family members	No growling or biting	0
	Some growling only	1
	Growling and pinching	2
	Non-injurious bites	3
	Injurious bites	5
3. Aggression toward strangers	No growling or biting	0
	Some growling only	1
	Growling and pinching	2
	Non-injurious bites	3
	Injurious bites	5
4. Aggression toward dogs	No growling or biting	0
	Appropriate and controlled aggression (reacts when attacked)	1
	Targeted threats (e.g. specific sex, size, breed or colour)	2
	Targeted attacks (e.g. specific sex, size, breed or colour)	3
	Threatens/attacks all types of dogs	5
5. Aggression toward animals other than dogs	No aggression	0
	It sometimes seems afraid, growls	1
	Ambiguous games	2
	Chases without success	3
	Chases and sometimes catches	5

Anxiety

1. Staying alone	No issues with being left alone	0
	Rare and minor undesirable responses	1
	Limited undesirable responses	2
	Marked and frequent undesirable responses	3
	Constant and very strong undesirable responses	5
2. Afraid of certain situations	Never	0
	Rarely	1
	In identified situations	2
	In numerous situations	3
	At any slightly unusual situation	5
4. Contact with people	Easy-going, friendly	0
	Usually at ease, but may be afraid of some individuals	1
	Sometimes uneasy	2
	Uncomfortable and seldom sociable	3
	Avoids any unfamiliar people	5
Contact with animals	Curious, friendly	0
	Cautiously goes to contact	1
	Sometimes uneasy	2
	Uncomfortable and seldom sociable	3
	Avoids any unfamiliar animal	5
5. Adaptability	Excellent, shows no signs of fear	0
	Good, low and transient organic manifestations	1
	Sometimes can't adapt, minor organic signs	2
	Manages changes with difficulties, marked organic manifestations	3
	Unable to adapt, intense organic manifestations	5

Attachment

1. Attachment to the group	Happy if one member of the group is present	0
	Marked preference for one member of the group	1
	Does not seem very attached	2
	Exaggerated manifestations when greeting	3
	Sometimes runs away (does not come back easily)	5
2. Reaction to separation	No signs of distress if left alone anywhere	0
	OK if alone at home	1
	Concerned if everybody leaves	2
	Concerned if one person leaves	3
	Does not tolerate the absence of a specific person	5

(continued on next page)

Table 1 (continued)

All the "5" results have been changed to "4" for statistical analysis

3. Resting place	In its bed/basket, alone	0
	With another animal	1
	Within sight of a person	2
	In contact with any member of the group	3
	In contact with only a specific person	5
4. Contact-Exploration	Relaxed, explores far away, comes back, establishes contact	0
	Stays with family members, never strays	1
	Stays within sight, allows contact with the owner present	2
	Hesitant contact, with owner or unfamiliar people	3
	Avoids contact with members of the group	5
5. Manifestations of strong bond with owner	Regular, frequent, pleasant bond for both owner and pet	0
	Good bond between owner and dog	1
	Limited contacts, little bond	2
	No pleasant contacts	3
	"Clingy" dog	5
<i>Autocontrols</i>		
1. Vocalises (barks, whines...)	Rare, only relevant or acceptable barking	0
	Not a problem	1
	Annoying in some situations (cars...)	2
	Frequent	3
	Unbearable	5
2. Jumps on people	Never	0
	Not a problem	1
	Annoying in some situations (cars...)	2
	Difficult to control	3
	Unbearable	5
3. Destroys objects	Never	0
	Not a problem	1
	Annoying in some situations	2
	Frequent and a nuisance	3
	Unbearable	5
4. Scratches or bruises	Never	0
	Not a problem	1
	Used to cause some injuries, less frequent now	2
	May be brutal during interactions	3
	Always brutal	5
5. Moments of excitement	Never	0
	Not a problem	1
	Can get excited for no reason for a few minutes every day	2
	Frequent, tiring	3
	Incessant, can hardly settle down	5

Table 2

Lit's ADHD rating scale for dogs

1	Your dog has difficult time learning, because it is careless or other things can easily attract its attention
2	It's easy to attract its attention, but it loses its interest soon
3	It's difficult for it to concentrate on a task or play
4	It leaves from its place when it should stay
5	It cannot be quiet, it cannot be easily calmed
6	It fidgets all the time
7	It seems that it doesn't listen even if it knows that someone is speaking to it
8	<i>It would always play and run (original question from Vas et al., 2007)</i>
9	It solves simple tasks easily, but it often has difficulties with complicate tasks, even if it knows them and has practiced them often
10	It is likely to react hastily and that's why it's failing tasks
11	Its attention can be easily distracted
12	It cannot wait as it has no self-control

Table 3

Interpretation of Beata's 4A grid

<i>Global score (4A score)</i>	
If ≥ 20	a behaviour trouble should be investigated. Each sub score should be checked out
<i>For each sub score</i>	
From 0 to 5	Normal behaviour
From 6 to 12	Behaviour should be monitored closely
From 13 to 18	Abnormal behaviour
From 19 to 25	Severe abnormal behaviour

Statistical Analysis

Statistical analysis was performed using R statistical software (<https://www.r-project.org>). It was assumed that the data should not be normally distributed, therefore non-parametric tests were preferred, including Pearson's Chi squared for qualitative data, and Mann-Whitney and Wilcoxon Sum Rank tests for quantitative data. A p value of < 0.05 was chosen, as threshold for statistical significance.

Table 4
Sex and reproductive state distribution of the 84 dogs enrolled in the study

Sex and reproductive state	Total frequency, n (%)	Frequency n (%) FB group	Frequency n (%) Control group
<i>Males</i>	43 (51.2)	21 (50)	52.4
Intact male	30 (35.7)	15 (35.7)	15 (35.7)
Castrated male	13 (15.5)	6 (14.3)	7 (16.7)
<i>Females</i>	41 (48.8)	21 (50)	20 (47.6)
Intact female	23 (27.4)	11 (26.2)	12 (28.6)
Spayed female	18 (21.4)	10 (23.8)	8 (19.0)

FB group = group of dogs that underwent surgery after foreign body ingestion

Control group = matched dogs with no history of non-food objects ingestion

Table 5
Breed distribution of the sample ($n=42$)

Breed group/type	Frequency, n (%)
FCI Group 1 – Sheepdogs and cattle dogs	7 (16.7)
FCI Group 2 – Pinscher and Schnauzer – Molossoid and Swiss Mountain and Cattle dogs	9 (21.4)
FCI Group 3 – Terrier	4 (9.5)
FCI Group 4 – Dachshunds	0
FCI Group 5 – Spitz and primitive types	0
FCI Group 6 – Scent hounds and related breeds	5 (11.9)
FCI Group 7 – Pointing dogs	1 (2.4)
FCI Group 8 – Retrievers – Flushing dogs – Water dogs	5 (11.9)
FCI Group 9 – Companion and Toy dogs	7 (16.7)
FCI Group 10 – Sighthounds	0
Crossbreed	3 (7.1)
Not recognized by the FCI	1 (2.4)

FCI = Federation Cynologique International

Results

Demographics

The sex and reproductive state of the 84 dogs (i.e. 42 FB ingesting dogs and 42 control dogs) included in the study are shown in Table 4.

All but five (12%) of the FB dogs were matched with control dogs in terms of sex and reproductive status: two males (an intact one and a castrated one) and two females (an intact one and a spayed one) were matched with dogs of the same sex but a different reproductive status; one spayed female of the FB group could only be matched with a castrated male.

The breed and age distribution are shown in Tables 5 and 6, respectively. Even though FB and control dogs were not perfectly matched according to age, there was no significant age difference between FB group (47.8 months \pm 36.2, ranging from 6 to 168 months) and control group (mean = 46.6 months \pm 33.1, ranging from 7 to 159 months) (Mann-Whitney U test $U=875$; $p=0.95$).

Characterization of the FB ingesting dogs

In the FB group, 69% ($n=29$) of the dogs underwent one surgery, 19% ($n=19$) underwent two surgeries and 11.9% ($n=5$) underwent three surgeries. The kind of procedure used to remove the FB was gastric endoscopy for 11.9% ($n=5$), gastrotomy for 23.8% ($n=10$), enterotomy for 45.2% ($n=19$) and enterectomy for 19% ($n=8$) of the dogs.

Two dogs (4.8%) of the FB group died in the days following the surgery.

Even though, as explained above, the dogs included in our study had no identifiable medical condition which could explain their foreign body ingestion, the surgeons provided different hypotheses about this behavior to the dogs' owners: a medical cause (e.g. anorexia, gestation, abdominal pain, or abdominal disease) was suspected despite the absence of medical evidence in 11.9%

($n=5$) of the cases, a medical origin was ruled with no other explanation in 76.2% ($n=32$) of the cases and a behavioral origin (i.e. behavior, boredom, normal for a young dog, wool sucking syndrome, pica) was suspected for 11.9% ($n=5$) of the cases.

Owners' reports show that 52% ($n=22$) of the dogs ingested between 1 and 5 objects, 19% ($n=8$) between 6 and 10, 24% ($n=10$) between 11 and 50 and 5% ($n=2$) over 50, before the surgery episode.

81% ($n=34$) of the dogs ingested only one type of object, whereas 19% ($n=8$) ingested at least two types (Table 7).

Investigation of behavioral disorders as a possible explanation for FB ingestion

A significant difference between FB and C groups was found for 4 out of the five scores of the 4A grid: the 4A Total Score (Wilcoxon test, $W=41$; $P < 0.001$), the 4A Autocontrols (Wilcoxon test, $W=31.5$; $P < 0.001$), the 4A Anxiety Score (Wilcoxon test, $W=174.5$; $P=0.004$), and for the 4A Attachment Score (Wilcoxon test, $W=235$; $P=0.02$) (Table 8). The 4A Aggressivity sub score was not different between groups (Wilcoxon test, $W=221.5$; $P=0.08$).

The Total Score, HI1 and IA Scores of the Lit ADHD rating scale were significantly different between FB group and control group (Total Score: Wilcoxon test, $W=665.5$; $P=0.007$; HI1 Score: Wilcoxon test, $W=567.5$; $P=0.004$; IA Score: Wilcoxon test, $W=533$; $P=0.046$) (Table 9). HI2 Score was not significantly different between the two groups (HI2: Wilcoxon test, $W=426$; $P=0.14$).

The owners were asked whether their dogs were regularly shredding or ingesting non-edible objects before the surgery (i.e. whether they were surprised that their dogs underwent surgery for FB removal). The FB dogs which owners answered yes (71.4%, $n=30$) formed the S group and the FB dogs which owners answered no (28.6%, $n=12$) formed the NS group. All dog owners from the control group answered negatively.

Dogs from the S group were significantly younger (mean = 37 months \pm 26.9) than those from the NS group (mean = 74 months \pm 46.3) (Mann-Whitney test, $U=278.5$; $P=0.006$).

Only one dog (8 %) from the NS group ingested at least five objects whereas 19 dogs (63%) of the S group did, and this difference was significant (Chi squared test $\chi=10.4$; $P=0.001$).

The Lit Total Score was significantly different (Mann-Whitney test, $U=99$; $P=0.02$) between S group (mean = 12.0 \pm 8.0) and NS group (mean = 6.3 \pm 4.0) indicating that dogs of the S group were significantly more impulsive than those of the NS group.

The Total 4A Score, as well as Aggressivity, Anxiety and Attachment sub scores were not significantly different between the two groups, but Autocontrols was (S group mean = 11.6 \pm 4.4; NS group mean = 4.9 \pm 2.2; Mann-Whitney test, $U=35$; $P < 0.001$).

In the S group, 100% of the dogs have at least one of the sub score 4A Autocontrols, 4A Attachment or 4A Anxiety over 5, that is the threshold beyond which behavior should be closely monitored (Table 3). In the NS group, only 58% ($n=7$) have such a score.

Table 6
Age distribution within the sample of 84 dogs

Age (months)	Total frequency, n (%)	Frequency n (%) FB group	Frequency n (%) Control group
Juvenile (6–12)	10 (11.9)	6	4 (9.5)
Adolescent (12–24)	16 (19)	8 (19)	8 (19)
Adult (25 – 96)	52 (61.9)	26 (61.9)	26 (61.9)
Senior (> 96)	6 (7.1)	2 (4.8)	4 (9.5)

FB group = group of dogs that underwent surgery after foreign body ingestion
Control group = matched dogs with no history of non-food objects ingestion

Table 7
Type of non-edible objects ingested by the 42 dogs in the FB group

Type of non-edible object	Frequency, n (%)
Fabric	23 (54.8)
Plastic	12 (28.6)
Rubber	9 (21.4)
Stone	2 (4.8)
Metal	2 (4.8)
Wood	1 (2.4)

The sum of percentages is not 100% because some dogs ingested multiple non-edible objects

Altogether, in 88% ($n = 37$) of the FB ingestions, a behavioral disorder is suspected, which doesn't prove any causal relationship, but underlines the need for further behavioral investigation.

Even though our sample size is not large enough to draw conclusions about breeds, the Bernese mountain dog emerged with noticeable results. This breed with 14.3% ($n=6$) of the study subjects. One Bernese mountain dog had high scores in both Lit score and 4A Autocontrols (i.e., the same behavioral scores as many breeds of the FB group), the 5 others show very low scores in all behavioral scores (e.g., lower than the control group ones in both 4A and Lit scores) but they ingested many fabrics as soon as they were able to do so (e.g., each time the owner forgot to remove every fabric object from the dog environment).

Discussion

Recruiting only dogs that went under surgery for ingestion might have limited our results, but this choice was made to be able to obtain a high-quality medical diagnosis given by specialists (i.e. internal medicine and surgery specialties). This way either a medical diagnosis was already established, or a medical origin was ruled out for all dogs of the FB group.

No effect of sex or age on FB ingestion could be established. Besides, sex and reproductive status were not significantly different in the FB group and the French dog population, obtained from TNS SOFRES 2016 data (Pearson's Chi squared $P = 0.96$).

No link could be established between the type of FB ingested and behavioral scores. It might be an individual preference, and it seems that this preference is fixed for a dog with a tendency to always swallow the same type of non-edible object.

Two different approaches were used to measure a possible correlation between FB ingestion and behavioral disorder (i.e., a clinical grid and an owner-based grid). In both cases, hyperactivity-impulsivity appears to be strongly related to FB ingestion (Luescher, 2004; Zamansky et al., 2018), with highly significant differences between the FB and the control groups. The 4A approach also suggested that anxiety (Riva et al., 2008) and attachment (Col et al., 2016) could be involved in some cases of FB ingestion, which is in line with the literature.

The fact that dogs from the S group were younger cannot explain their shredding behavior for two reasons. First, these dogs were not only part of the S group but also, and especially, part of the FB group, and the ingestion of non-edible objects can hardly be considered as a normal behavior. Second, their age-matched control did not exhibit this behavior.

The fact that dogs in the S group are younger would better be explained by the fact that, as in humans (Hoogman et al., 2017), hyperactivity is a developmental disorder, existing since the adoption, whereas anxiety or attachment might appear later. In this perspective, exacerbated oral exploration would lead to ingestion behavior.

Consequently, our S group consisted mainly in young possibly hyperactive dogs (mean=37 months) regularly shredding and ingesting non-eatable objects whereas our NS group consisted in older dogs (mean=74 months), occasionally ingesting non-edible objects, and of senior dogs exceptionally ingesting because of pain or underlying abdominal cause. To our knowledge, no cut-off exists using Lit's questionnaire to draw a line between normal and pathological behavior (i.e. between normal and hyperactive dogs). However, it seems that the tendency to regularly shred items is a good predictor to suspect a possible hyperactivity-hypersensitivity syndrome (Masson and Gaultier, 2018). Moreover, asking this single question about shredding or FB ingestion can easily be done by any veterinarian as a preliminary indicator of behavioral disorder.

In our study, the Bernese Mountain breed was overrepresented, which is contradictory with previous results from the literature (Hayes, 2009). Indeed, their behavioral profile differed from that of other dogs, with more repeated FB ingestion and no clear behavioral explanation. However, our sample was not large enough to draw any strong conclusion and according to Fadel and colleagues' work, "there is more difference within breeds than between breeds (Fadel et al., 2016). This particular profile should be investigated further.

Table 8
Relationship between Beata's 4A grid Scores and non-food items ingestion

4A scores and sub scores	Mean (SD) FB group	Mean (SD) Control group	Wilcoxon signed-rank test W	P value
4A Total Score	21.2 (9.5)	10.1 (4.8)	41	< 0.001
4A Aggressivity	3.8 (2.5)	3.0 (2.5)	221.5	0.08
4A Anxiety	3.8 (3.3)	2.0 (1.9)	174.5	0.004
4A Attachment	4.0 (3.6)	2.3 (2.0)	235	0.02
4A Autocontrols	9.7 (5.1)	2.9 (2.1)	31.5	< 0.001

FB group = group of dogs that underwent surgery after foreign body ingestion
Control group = matched dogs with no history of non-food objects ingestion

Table 9
Relationship between Lit's ADHD scores and non-food items ingestion

Lit's ADHDH scores	Mean (SD) FB group	Mean (SD) Control group	Wilcoxon signed-rank test W	P value
Total Score	10.4 (7.3)	6.3 (4.6)	665.5	0.007
IA Score	5.1 (4.3)	3.4 (3.1)	533	0.046
HI1 Score	3.5 (3.1)	1.5 (1.7)	567.5	0.004
HI2 Score	2.6 (2.6)	1.8 (1.7)	426	0.14

FB group = group of dogs that underwent surgery after foreign body ingestion

Control group = matched dogs with no history of non-food objects ingestion

Intestinal surgery remains complex: 5% of the dogs of our FB group died, in line with the literature (Ellison, 2011; Ralphs et al., 2003). This finding highlights the need for preventive measures and detection of the dogs at risk.

Although it should be emphasized that a causal link has not been demonstrated, the high proportion of suspected behavioral disorders in our FB group (88%) suggests that a targeted behavioral assessment should be a first intent advice on any dog susceptible of ingesting non-edible objects. Efficient treatments for the behavioral troubles involved in FB ingestion do exist (Irimajiri et al., 2009; Masson and Gaultier, 2018), and would allow a better care of these dogs. For the remaining 12%, more exams should be prescribed, in either medical or behavioral direction, depending on the clinical picture of the dog.

Although our results suggest that a behavioral consultation of dogs with tendency to ingest or even shred non-edible items might solve their problem, such recommendations are rare in practice. When checking the number of objects ingested by the dogs and the number of surgeries, it appears that the owners might have already reported such tendency. Behavioral medicine still receives insufficient attention from the veterinarians in their daily practice (Shivley et al., 2016).

Conclusion

FB ingestion is a serious problem, putting the dog's life at risk. Our study suggests that it is related to behavioral disorders. Hence, behavioral consultation should be encouraged on any dog reported to ingest or regularly shred non-edible objects in any veterinary interview. This sign that dogs consume non-nutritive substances or have exaggerated oral exploration should be assessed - with other behavioral data - by veterinarians during routine and vaccine consultations.

Policy and Ethics

No approval was required

Authors Contribution

The idea of the paper was conceived by Sylvia Masson, Nadège Guitaut and Claude Beata. The experiments were performed by Sylvia Masson and Nadège Guitaut. Dr. Patrick Lecoindre, Dr. Alexis Lecoindre, Dr. Thierry Dembour, Dr. Pierre Guillaumot and Dr. Quentin Cabon contributed to the collected data. The data were analyzed by Sylvia Masson and Tiphaine Medam. The paper was written by Sylvia Masson, Nadège Guitaut, Tiphaine Medam and Claude Beata. All authors have approved the final article.

Conflict of interest

The authors declare no conflict of interest

Acknowledgements

The authors would like to thank Dr. Frederic Beugnet for his critical view and help for correcting this manuscript. The authors kindly thank Dr. Patrick Lecoindre, Dr. Alexis Lecoindre, Dr. Thierry Dembour, Dr. Pierre Guillaumot and Dr. Quentin Cabon for their contribution to the recruitment of the subjects after surgeries. The authors would also like to warmly thank all the dogs and their owners for their participation to the study.

References

- American Psychiatric Association, 2013. DSM-5: diagnostic and statistical manual of mental disorders, 5e édition American Psychiatric Association, Washington D.C.
- Beata, C., Bleuer-Elsner, S., Van Der Linden, D., Zamansky, A., 2018. The use of 4A Scale for veterinary guiding in canine behavioural disorders: first results. In: ECAWBM ESVCE, AWSELVA, Congress, GTVMT (Eds.), The Use of 4A Scale for Veterinary Guiding in Canine Behavioural Disorders: First Results. ECAWBM ESVCE AWSELVA and GTVMT Congress, Berlin.
- Borns-Weil, S., Emmanuel, C., Longo, J., Kini, N., Barton, B., Smith, A., Dodman, N.H., 2015. A case-control study of compulsive wool-sucking in Siamese and Birman cats (n = 204). : Clin. Appl. Res..
- Bradshaw, J.W.S., Neville, P.F., Sawyer, D., 1997. Factors affecting pica in the domestic cat. Appl. Anim. Behav. Sci. 52 (3–4), 373–379.
- Col, R., Day, C., Phillips, C.J.C., 2016. An epidemiological analysis of dog behavior problems presented to an Australian behavior clinic, with associated risk factors. J Vet Behav.
- Ellison, G.W., 2011. Complications of gastrointestinal surgery in companion animals. Vet. Clin. North Am. Small Anim. Pract..
- Fadel, F.R., Driscoll, P., Pilot, M., Wright, H., Zulch, H., Mills, D., 2016. Differences in trait impulsivity indicate diversification of dog breeds into working and show Lines. Scientific Reports 6.
- Gitlin, D.F., Caplan, J.P., Rogers, M.P., Avni-Barron, O., Braun, I., Barsky, A.J., 2007. Foreign-body ingestion in patients with personality disorders. Psychosomatics.
- Hand, M., Tatcher, C., Remillard, R., 2000. Anomalies du comportement alimentaire. Nutrition Clinique des Animaux de Compagnie In: 4ème Edition.
- Hayes, G., 2009. Gastrointestinal foreign bodies in dogs and cats: A retrospective study of 208 cases. J Small Anim Pract.
- Hobday, M.M., Pachtinger, G.E., Drobatz, K.J., Syring, R.S., 2014. Linear versus non-linear gastrointestinal foreign bodies in 499 dogs: Clinical presentation, management and short-term outcome. J Small Anim Pract.
- Hoogman, M., Bralten, J., Hibar, D.P., Mennes, M., Zwiers, M.P., et al., 2017. Subcortical brain volume differences in participants with attention deficit hyperactivity disorder in children and adults: a cross-sectional mega-analysis. The Lancet Psychiatry.
- Irimajiri, M., Luescher, A.U., Douglass, G., Robertson-Plouch, C., Zimmermann, A., Hozak, R., 2009. Randomized, controlled clinical trial of the efficacy of fluoxetine for treatment of compulsive disorders in dogs. J. Am. Vet. Med. Assoc..
- Lindquist, E., Lobetti, R., 2017. Gastrointestinal disease in cats and dogs with gastrointestinal foreign bodies. Adv. Small Anim. Med. Surg..
- Lit, L., Schweitzer, J.B., Iosif, A.M., Oberbauer, A.M., 2010. Owner reports of attention, activity, and impulsivity in dogs: A replication study. Behav. Brain Funct..
- Luescher, A.U., 2004. Diagnosis and management of compulsive disorders in dogs and cats. Clin Tech Small Anim Pract.
- Marston, L.C., Bennett, P.C., Coleman, G.J., 2004. What happens to shelter dogs? An analysis of data for 1 year from three Australian shelters. J Appl Anim Welf Sci.
- Massal, N., Beaumont-Graff, E., 2010. Première consultation d'un chiot: aspect comportemental. Le point Vétérinaire n° 308.
- Masson, S., de la Vega, S., Gazzano, A., Mariti, C., Pereira, G.D.G., Halsberghe, C., Muser Leyvraz, A., McPeake, K., Schoening, B., 2018. Electronic training devices: Discussion on the pros and cons of their use in dogs as a basis for the position statement of the European Society of Veterinary Clinical Ethology. J Vet Behav 25.
- Masson, S., Gaultier, E., 2018. Retrospective study on hypersensitivity-hyperactivity syndrome in dogs: long-term outcome of high dose fluoxetine treatment and proposal of a clinical score. Dog Behav 2, 15–32.

- Masson, Sylvia, Nigrón, I., Gaultier, E., 2018. Questionnaire survey on the use of different e-collar types in France in everyday life with a view to providing recommendations for possible future regulations. *J Vet Behav* 26, 48–60.
- Merola, G.S., 2000. FB Ingestion in dogs and cats: Preliminary studies. *J Vet Behav*. Vol. 5, 43.
- Overall, K.L., 2013. *Manual of Clinical Behavioral Medicine for Dogs and Cats*. Elsevier Health Science.
- Overall, K.L., Dunham, A.E., 2002. Clinical features and outcome in dogs and cats with obsessive-compulsive disorder: 126 cases (1989–2000). *J. Am. Vet. Med. Assoc.* 221, 1445–1452.
- Papazoglou, L.G., Patsikas, M.N., Rallis, T., 2003. Intestinal foreign bodies in dogs and cats. *Comp Cont Educ Pract Vet.*
- Poynter, B.A., Hunter, J.J., Coverdale, J.H., Kempinsky, C.A., 2011. Hard to swallow: A systematic review of deliberate foreign body ingestion. *Gen. Hosp. Psychiatry.*
- Pratt, C.L., Reineke, E.L., Drobatz, K.J., 2014. Sewing needle foreign body ingestion in dogs and cats: 65 cases (2000–2012). *J. Am. Vet. Med. Assoc.*
- Ralphs, S.C., Jessen, C.R., Lipowitz, A.J., 2003. Risk factors for leakage following intestinal anastomosis in dogs and cats: 115 cases (1991–2000). *J. Am. Vet. Med. Assoc.*
- Riva, J., Bondiolotti, G., Michelazzi, M., Verga, M., Carezzi, C., 2008. Anxiety related behavioural disorders and neurotransmitters in dogs. *Appl. Anim. Behav. Sci.*
- Rose, E., Porcerelli, J., Neale, A., 2000. Pica: common but commonly missed. *J. Am. Board Fam. Med.*
- Shivley, C.B., Garry, F.B., Kogan, L.R., Grandin, T., 2016. Survey of animal welfare, animal behavior, and animal ethics courses in the curricula of AVMA Council on Education-accredited veterinary colleges and schools. *J. Am. Vet. Med. Assoc.*
- Vas, J., Topál, J., Péch, É., Miklósi, Á., 2007. Measuring attention deficit and activity in dogs: A new application and validation of a human ADHD questionnaire. *Appl. Anim. Behav. Sci.*
- Zamansky, A., Bleuer-Elsner, S., Masson, S., Amir, S., Magen, O., Van Der Linden, D., 2018. *Anim Cogn* 380–387.