

# Gastrointestinal foreign bodies in dogs and cats: a retrospective study of 208 cases

**OBJECTIVES:** To establish predilection sites of obstruction and to investigate clinical factors associated with a poor outcome.

**METHODS:** A retrospective study of 208 consecutive cases over a 48-month period from first-opinion practice.

**RESULTS:** Overall, 91 per cent of cases recovered with higher survival rates from discrete foreign bodies (94 per cent in dogs and 100 per cent in cats) as opposed to linear foreign bodies (80 per cent in dogs and 63 per cent in cats). English bull terriers, springer spaniels, Staffordshire bull terriers, Border collies and Jack Russell terriers were over-represented. In dogs, 63 per cent of obstructions occurred in the jejunum but foreign objects were encountered at all points along the gastrointestinal tract. A longer duration of clinical signs, the presence of a linear foreign body and multiple intestinal procedures were associated with significantly increased mortality. Neither the degree of obstruction (partial or complete) nor the location of the foreign body was shown to have a significant influence on survival.

**CLINICAL SIGNIFICANCE:** Prompt presentation, diagnosis and surgical intervention improve the outcome of gastrointestinal obstruction by foreign bodies. At surgery, the minimal number of intestinal procedures should be performed to restore the integrity of the alimentary tract.

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## INTRODUCTION

Gastrointestinal foreign bodies are commonly encountered in first-opinion companion animal practice and may present with a variety of clinical signs depending on the location, the degree and the duration of the obstruction (Aronson and others 2000, Papazoglou and others 2003).

Gastrointestinal obstruction results in disturbances of fluid balance, acid-base status and serum electrolyte concentrations due to hypersecretion and sequestration within the gastrointestinal tract which is exacerbated by vomiting and

impaired oral intake of fluid and nutrients (Boag and others 2005). Gastrointestinal foreign bodies may cause complete or partial obstruction. In general, complete obstruction is associated with more dramatic clinical signs and a rapid deterioration whereas partial obstruction may be associated with more chronic signs of maldigestion and malabsorption (Papazoglou and others 2003).

The majority of obstructive non-linear gastrointestinal foreign bodies compromise the blood supply to the intestinal segment by luminal distention leading to intestinal wall oedema and progressive necrosis. These factors contribute to ileus and to an increase in the number of pathogenic intraluminal bacteria leading to the breakdown of the mucosal barrier and systemic endotoxaemia (Ellison 1993a).

Alongside the challenges of diagnosis and anaesthesia, surgical treatment and wound healing are compromised by intestinal wall viability, intraluminal bacterial overgrowth, ileus and hypoproteinaemia (Allen and others 1992, Ellison 1993b, Ralphs and others 2003). Enteric wound breakdown and leakage are the most serious and catastrophic complications of surgery on the gastrointestinal tract (Allen and others 1992, Evans and others 1994, Shales and others 2005).

Retrospective studies concerning linear foreign bodies exist (Felts and others 1984, Evans and others 1994) and two case series in dogs have been published (Capak and others 2001, Boag and others 2005). These studies all originate from veterinary teaching hospitals, report a referral caseload and focus on different aspects of presentation and treatment. To the author's knowledge, there are no studies from first-opinion practice despite the fact that the vast majority of gastrointestinal foreign bodies are probably managed in first-opinion practice.

The aims of the present study are: to report a large series of cases of gastrointestinal obstruction from first-opinion (charity) practice; to report predilection sites of obstruction and types of objects recovered

and to investigate clinical factors associated with a poor outcome.

## MATERIALS AND METHODS

The case records of all cats and dogs admitted to the RSPCA Greater Manchester Animal Hospital with a diagnosis of gastrointestinal obstruction due to a foreign body during the period June 2003 to May 2007 (48 months) were reviewed. Gastrointestinal foreign bodies were defined as all clinically significant ingested foreign bodies (whose main bulk was) located distal to the cardia. Case details retrieved included age, breed, bodyweight, presenting clinical signs, duration of clinical signs, surgical findings and treatment, postoperative complications and outcome. The duration of clinical signs was either the time since known ingestion or from the start of clinical signs if ingestion was not observed. The surgical findings and treatment recorded were the site of obstruction, type of foreign body (that is linear or discrete), the degree of obstruction (that is partial or complete) and the treatment (that is gastrotomy, enterotomy or enterectomy and the number of incisions made into the alimentary tract). Patients which passed the foreign body before diagnosis were excluded.

Dog breeds which were over-represented had a relative risk calculated (relative to crossbreed dogs) taking into account the prevalence of these breeds in the hospital population. Selected ratio measurements were summarised as mean ( $\pm$ sd) and statistical comparisons (independent t-tests, with the type indicated by Levene's test for equality of variances) were made between surviving patients and those with a fatal outcome. Nominal data were statistically compared between surviving patients and those with a fatal outcome (Fisher's exact test). All variables were examined with the null hypothesis of homogeneity between the groups with significance taken at  $p$  less than 0.05 (two-tailed tests). Logistic regression was performed on selected variables using forward stepwise regression and verified with forced entry regression. All statistics were performed using SPSS for Windows 16.0 (SPSS Inc).

## Diagnosis

Cases were investigated and treated by nine veterinary surgeons with variable clinical experience working within the limited resources of a charity hospital in the context of a persistently high caseload. Diagnostic workup was limited to that necessary to make a tentative diagnosis or to indicate the need to surgically explore the abdomen. In most cases, the decision to perform a coeliotomy was based on history and careful clinical examination, with particular emphasis on abdominal palpation. If further investigations were necessary, abdominal palpation under sedation (or anaesthesia), abdominocentesis, radiography and endoscopy could be performed. In certain cases blood tests and radiographs had been performed at private veterinary practices before a charitable referral with or without a diagnosis.

## Presurgical treatment and surgical technique

All cases with a history of vomiting received fluid therapy before anaesthesia and coeliotomy. All cases received intramuscular or subcutaneous 15 mg/kg amoxicillin (Betasol; Norbrook) preoperatively and patients undergoing enterotomy or enterectomy also received iv 10 mg/kg metronidazole (Flagyl; Aventis) intra-operatively. A ventral midline coeliotomy was performed and the entire gastrointestinal tract was examined before replacement within the abdomen. The obstructed segment was exteriorised and packed off with swabs. Enterotomy incisions were made on the antimesenteric border and all enterotomy, enterectomy and gastrotomy sites were closed using two metric polydioxanone (PDS II; Ethicon) in a simple interrupted appositional pattern. A two-layer closure was performed following gastrotomy. The exteriorised segment was lavaged before omentalisation (simple wrapping with or without tacking sutures) and routine abdominal closure.

Cases with multiple ruptures, generalised peritonitis or extensive non-viable bowel were generally euthanased intra-operatively at the discretion of the individual surgeon (with informed owner consent).

## Postoperative treatment

All patients were offered oral fluids 12 to 24 hours postoperatively (unless vomiting)

and food 18 to 30 hours postoperatively, at the discretion of the surgeon. Intravenous fluids were continued until oral intake was sufficient. Antibiotics and analgesics were normally continued for at least three days postoperatively. No cases underwent re-operation.

## RESULTS

### Eligibility, clinical signs and presentation

One hundred and seventy-four dogs comprising 24 different breeds were included in the study (summarised in Tables 1 and 2). Ten individuals were presented on two separate occasions with gastrointestinal foreign bodies, hence 184 distinct incidents (cases) were recorded.

Twenty-one cats were included in the study (summarised in Tables 1 and 2). Three individuals were presented on two separate occasions with gastrointestinal foreign bodies, hence 24 distinct incidents (cases) were recorded.

Presenting clinical signs included vomiting (87 per cent), anorexia (72 per cent), greater than 10 per cent bodyweight loss (8 per cent), diarrhoea (5 per cent) and haemorrhagic diarrhoea (2 per cent). In 14 cases animals were presented before clinical signs developing as the owner had witnessed ingestion of an object. In a total of 54 cases (26 per cent) the owner was aware of foreign body ingestion (Fig 1).

### Dogs

**Diagnosis** In six of 184 cases (3 per cent) a linear foreign body was evident in the oral cavity or at the anus during clinical examination. In 139 of 184 cases (76 per cent) the foreign object (or an intestinal abnormality) was palpable in the conscious patient (111 cases) or anaesthetised/sedated patient. Abdominal radiography was performed in 42 cases, which was essential to the diagnosis in 21 of 184 cases (11 per cent), and two of 184 cases (1 per cent) underwent endoscopy to confirm the diagnosis. An exploratory coeliotomy was performed in 16 of 184 cases (9 per cent) without a definitive diagnosis for the investigation of chronic vomiting, the owner's insistence of foreign body ingestion, previous history of foreign body ingestion or the presence of fragments of foreign material

**Table 1. Breeds represented**

| Breed                                                                                                           | Number    | Relative risk* | 95 per cent confidence interval |
|-----------------------------------------------------------------------------------------------------------------|-----------|----------------|---------------------------------|
| <b>Dogs (n=174)†</b>                                                                                            |           |                |                                 |
| Staffordshire bull terrier                                                                                      | 52        | 3.3            | 2.2-5.1                         |
| English bull terrier                                                                                            | 13        | 10.9           | 6.0-20.0                        |
| Jack Russell terrier                                                                                            | 13        | 2.2            | 1.2-4.2                         |
| Border collie                                                                                                   | 9         | 3.0            | 1.4-6.1                         |
| Springer spaniel                                                                                                | 9         | 8.3            | 4.1-16.8                        |
| Yorkshire terrier                                                                                               | 7         | 1.0            | 0.5-2.3                         |
| German shepherd dog                                                                                             | 6         | 1.1            | 0.5-2.6                         |
| Labrador                                                                                                        | 5         | 2.2            | 0.9-5.6                         |
| Bull mastiff                                                                                                    | 4         |                |                                 |
| Cocker spaniel                                                                                                  | 3         |                |                                 |
| Golden retriever                                                                                                | 3         |                |                                 |
| Shih-tzu                                                                                                        | 2         |                |                                 |
| West Highland white terrier                                                                                     | 2         |                |                                 |
| Dobermann, Dalmatian, Rough collie, great Dane, boxer, Rottweiler, Samoyed, Toy poodle, Lurcher, Border terrier | 1 of each |                |                                 |
| Crossbreed                                                                                                      | 36        | 1.0            |                                 |
| <b>Cats (n=21)†</b>                                                                                             |           |                |                                 |
| Domestic shorthair                                                                                              | 20        |                |                                 |
| Siamese                                                                                                         | 1         |                |                                 |

\*Based on incidence proportion per breed relative to crossbreeds in the hospital population, calculated for breeds with at least five individuals represented.  
†Ten dogs and three cats presented on two separate occasions (174 individual dogs and 21 individual cats with 208 distinct incidents of foreign body obstruction).

**Table 2. Patient details at presentation**

|                                   | Dogs (n=174)* | Cats (n=21)* |
|-----------------------------------|---------------|--------------|
| Age (years)                       |               |              |
| Mean (sd)                         | 2.5 (3.0)     | 1.8 (1.8)    |
| Range                             | 0.10-14.0     | 0.2-5.3      |
| Bodyweight (kg)                   |               |              |
| Mean (sd)                         | 13.8 (9.8)    | 2.8 (0.8)    |
| Range                             | 1.1-39.4      | 1.4-4.9      |
| Duration of clinical signs (days) |               |              |
| Mean (sd)                         | 4.8 (6.8)     | 6.2 (7.7)    |
| Range                             | 0.04-60       | 0.08-30      |

\*Ten dogs and three cats presented on two separate occasions (174 individual dogs and 21 individual cats with 208 distinct incidents of foreign body obstruction).

in vomit or faeces. These 16 cases had no palpable gastrointestinal abnormality and no abnormalities on abdominal radiography. One case died between diagnosis and surgery.

**Surgical findings** Overall, 199 foreign objects were recovered from 183 cases (Table 3). Two cases passed the foreign object in vomit or faeces after diagnosis but before surgery. One hundred and eighty cases underwent a coeliotomy (summarised in Table 4).

Discrete foreign objects were found at all points along the gastrointestinal tract in

152 cases as summarised in Fig 2. Fifteen cases ingested two or more different objects; in six of these, concurrent obstructions were present at different levels of the gastrointestinal tract. In 126 of 180 cases (70 per cent) the foreign object was subjectively judged to be causing complete luminal obstruction and partial obstruction in the remaining 54 of 180 cases (30 per cent). One foreign object was removed from the omentum, having penetrated through the duodenum (Hunt and others 2004).

Linear foreign bodies were found in 30 cases (16 per cent of all canine cases). In

dogs the linear foreign body originated at the pylorus in 20 cases (67 per cent) as summarised in Fig 3.

**Complications and outcome** Of 184 cases admitted into the hospital, 169 were discharged (92 per cent) and made a full recovery with follow-up for at least 10 days (summarised in Table 5).

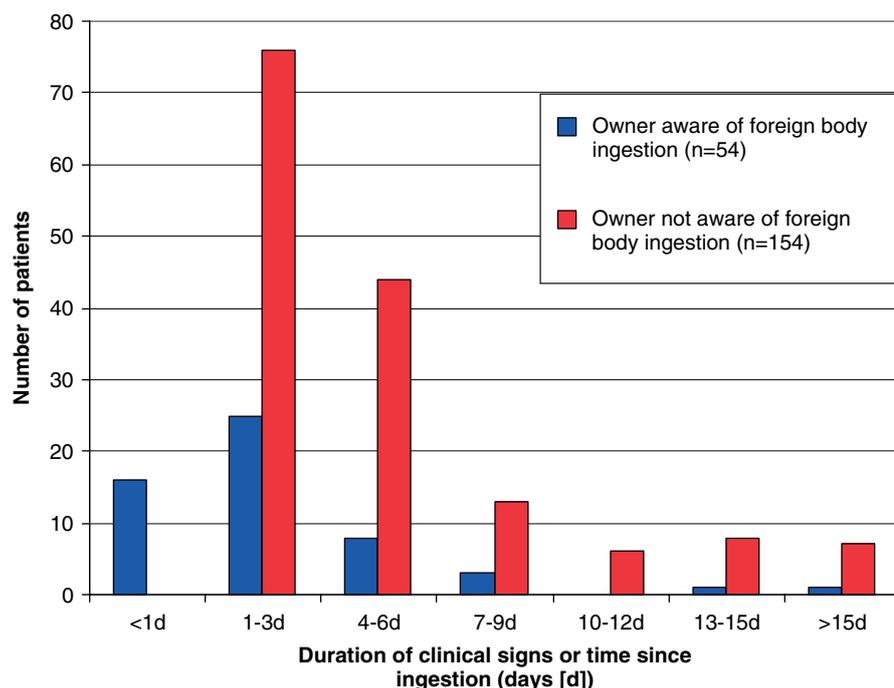
Of the five cases euthanased, one case was euthanased preoperatively (on humane grounds), two cases were euthanased intra-operatively (both linear foreign bodies of five days duration, with multiple ruptures and generalised peritonitis) and two cases were euthanased postoperatively (mean 4.5 days later; range 4 to 5 days) with signs of peritonitis suggestive of enteric dehiscence. Four of the five cases euthanased were linear foreign bodies.

Of the 10 cases which died, one died preoperatively (six hours after admission) and nine cases died postoperatively (mean 3.1 days later; range 0.13 to 10 days). Of these nine cases, one was an anaesthetic recovery death, one developed pancreatitis and jaundice and seven developed signs of peritonitis suggestive of enteric dehiscence. Three of these seven cases (and the one case which died preoperatively) had been treated with anti-emetics for periods of between 3 and 14 days by the referring practices which were thought to have masked the progression of their clinical signs. It was not possible to statistically determine the contribution of preoperative anti-emetic usage to the outcome.

Minor complications were recorded in seven of 184 cases (4 per cent) and included postoperative pyrexia, anorexia or vomiting treated medically (five cases), wound infection or seroma (one case of each). The average period of hospitalisation postoperatively was 2.8 days (range 1 to 10 days).

### Cats

**Diagnosis** In six of 24 cases (25 per cent) a linear foreign body was evident under the tongue or protruding from the anus during clinical examination. In 14 of 24 cases (58 per cent) the foreign body (or an intestinal abnormality) was evident during gentle abdominal palpation of the conscious patient (13 cases) or anaesthetised patient. Abdominal radiographs were taken in six



**FIG 1.** Graph to show the duration of clinical signs or the time since known ingestion before presentation for definitive treatment

**Table 3. Foreign objects recovered from the gastrointestinal tract**

| Type of foreign body                                                                                        | Dogs*     | Cats†     |
|-------------------------------------------------------------------------------------------------------------|-----------|-----------|
| Latex teat                                                                                                  | 58        | 5         |
| Plastic/rubber object                                                                                       | 32        | 6         |
| String/rope/fishing line                                                                                    | 22        | 8         |
| Stone                                                                                                       | 19        |           |
| Balls                                                                                                       | 15        |           |
| Underwear/nappy                                                                                             | 9         |           |
| Corn-cob                                                                                                    | 9         |           |
| Leather                                                                                                     | 5         |           |
| Metallic object/coins                                                                                       | 5‡        |           |
| Bone                                                                                                        | 3         |           |
| Cassette tape                                                                                               | 2         |           |
| Needle and thread                                                                                           | 1         | 3         |
| Fish hook and line                                                                                          | 1         |           |
| Plastic bag, blanket, 2 ft electric cable, peach stone, wooden skewer, potato, pine cone, bead, lolly stick | 1 of each |           |
| Dustbin contents (multiple small objects)                                                                   | 9         |           |
| Sellotape, almond, trichobezoar                                                                             |           | 1 of each |

\*One hundred and ninety-nine foreign objects from 183 dogs (12 dogs had two types of objects and two dogs had three different types of objects). One dog died preoperatively and the foreign object was not identified.

†Twenty-five foreign objects from 24 cats.

‡One case had 20 coins in the stomach.

cases which were essential to make a diagnosis in three of 24 cases (13 per cent). In one of 24 cases (4 per cent) an exploratory coeliotomy was performed without a diagnosis to investigate chronic vomiting and anorexia following unremarkable blood results and radiographs.

**Surgical findings** Overall, 25 foreign objects were recovered from 24 cases (Table 3). All 24 cases underwent a coeliotomy (summarised in Table 4). In 10 of 24 cases (42 per cent) the foreign object was subjectively judged to be causing complete luminal obstruction and partial

obstruction in the remaining 14 of 24 cases (58 per cent). In one case a trichobezoar was removed from the duodenum (Barrs and others 1999).

The majority of discrete foreign objects were found in the proximal parts of the gastrointestinal tract as summarised in Fig 2. One patient had foreign objects at two locations.

Linear foreign bodies were found in eight cases (33 per cent) originating from the base of the tongue in five cases (63 per cent) as summarised in Fig 3.

**Complications and outcome** Of the 24 cat cases admitted into the hospital, 21 were discharged (88 per cent) and made a recovery with follow-up for at least 10 days (summarised in Table 5).

Three cases were euthanased intra-operatively (linear foreign bodies of over 14 days duration with multiple ruptures and generalised peritonitis). No cats died postoperatively and only one minor complication was recorded (an upper respiratory tract infection). The average period of hospitalisation postoperatively was 2.2 days (range 1.5 to 4 days).

### Statistics

The relative risk for eight dog breeds with at least five individuals represented was calculated based on the incidence proportion per breed relative to crossbreeds in the entire hospital population. Five breeds were at significantly higher risk of requiring treatment for a gastrointestinal foreign body than the "bench-mark" crossbreed dogs (summarised in Table 1).

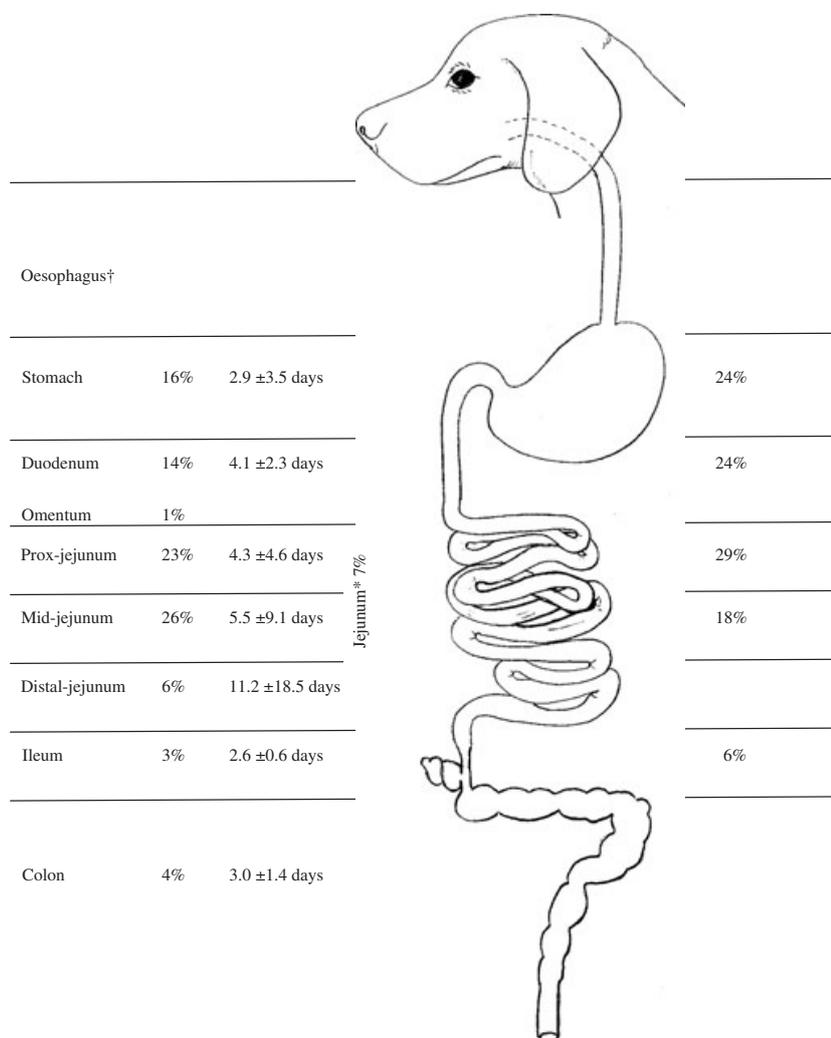
Owners aware of foreign body ingestion presented animals for treatment significantly earlier (mean  $2.8 \pm 3.6$  days of clinical signs) than those not aware of foreign body ingestion (mean  $5.7 \pm 7.6$  days of clinical signs;  $P < 0.01$ ).

There was no statistical difference between surviving cases and those with a fatal outcome with regard to age ( $P = 0.98$ ) or bodyweight ( $P = 0.65$ ), but surviving cases had a significantly shorter duration of clinical signs (mean  $4.6 \pm 6.8$  days) than those with a fatal outcome (mean  $8.7 \pm 7.7$  days;  $P = 0.02$ ).

There was a trend for foreign bodies judged to be causing a complete obstruction to present earlier (mean  $4.1 \pm 3.5$

**Table 4. The results of coeliotomy in dogs and cats**

| Treatment                               | Dogs (n=180) | Cats (n=24) |
|-----------------------------------------|--------------|-------------|
| Gastrotomy only                         | 28           | 3           |
| One or more enterotomies only           | 115          | 14          |
| Gastrotomy and one or more enterotomies | 24           | 3           |
| Enterectomy                             | 2            |             |
| One gastrointestinal incision           | 137          | 14          |
| Two gastrointestinal incisions          | 14           | 2           |
| Three gastrointestinal incisions        | 8            | 1           |
| Four gastrointestinal incisions         | 1            | 1           |
| Five gastrointestinal incisions         | 5            | 2           |
| above five gastrointestinal incisions   | 2            |             |
| Foreign body removed per rectum         | 8            | 1           |
| Foreign body removed from omentum       | 1            |             |
| Euthanased intra-operatively            | 2            | 3           |



**FIG 2.** Diagram to illustrate the locations of 160 discrete foreign bodies in 152 dogs<sup>‡</sup> (left side) and 17 discrete foreign bodies in 16 cats (right side). For the dogs the mean duration of clinical signs (±sd) is also displayed for each location

\* Sub-division of jejunum not specified.

† Oesophageal foreign bodies were excluded from this study due to the differing pathophysiology and treatment. However, to increase the usefulness of this diagram the author would like to report that one feline and 10 canine oesophageal foreign bodies were presented during the course of this study.

‡ One dog died and one patient vomited the foreign body preoperatively after diagnosis.

days) than those causing partial obstruction (mean 6.7 ± 10.8 days; P=0.06), but there was no statistical difference in the outcome between foreign bodies causing complete or partial obstruction of the gastrointestinal tract (P=0.59). Too few enterectomies were performed to judge whether this treatment was associated with a poor outcome. There was no significant difference in the outcome in relation to the location of discrete foreign bodies: stomach (P=0.36), duodenum (P=0.28), jejunum (P=0.22), ileum (P=0.73) or colon (P=0.63).

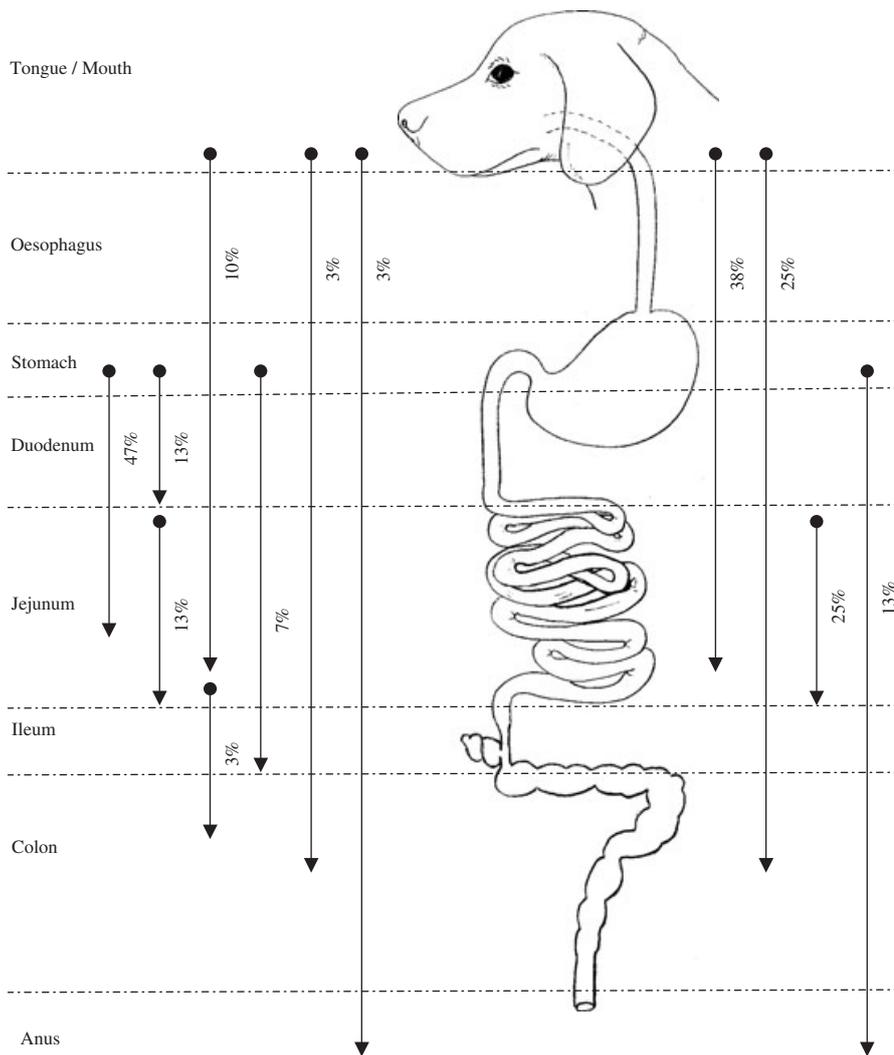
The presence of a linear foreign body was associated with a significantly higher mortality rate than the presence of a discrete foreign body (P<0.01), and cases undergoing multiple gastrointestinal incisions had a significantly higher mortality than those treated with a single gastrotomy or enterotomy (P=0.01). However, the presence of a linear foreign body closely correlated with multiple gastrointestinal incisions (P<0.01) making it difficult to evaluate which variable was more significant.

Independent variables entered into the logistic regression model included the duration of clinical signs, type of foreign body (linear or discrete), number of incisions, degree of obstruction (partial or complete) and the interaction type of foreign body times number of incisions. The dependent variable investigated was outcome (dead or alive). The only independent variable included in the final model was the number of incisions (OR 1.807; 95 per cent CI 1.255 to 2.601). All other variables were insignificantly associated with predicting the outcome and were rejected from the model. This suggested that the number of incisions was a more significant predictor of a poor outcome than the presence of a linear foreign body or an interaction between these variables.

## DISCUSSION

### Presentation

Staffordshire bull terriers, English bull terriers, Jack Russell terriers, Border collies and springer spaniels were found to be at higher risk than crossbreeds to require treatment for a gastrointestinal foreign



**FIG 3.** Diagram to illustrate the location of linear foreign bodies in 30 dogs (left side) and eight cats (right side). The circle at the beginning of each arrow indicates the proximal “anchorage point” and the arrowhead indicates the most distal extent of the linear foreign body

| Table 5. Summary of major complications and outcome |              |                 |                            |            |      |                            |
|-----------------------------------------------------|--------------|-----------------|----------------------------|------------|------|----------------------------|
| Species                                             | Foreign body | Total incidents | Total surviving (per cent) | Euthanased | Died | Total surviving (per cent) |
| Dogs                                                | Discrete     | 154             | 145 (94)                   | 1          | 8    | 169 (92)                   |
|                                                     | Linear       | 30              | 24 (80)                    | 4          | 2    |                            |
| Cats                                                | Discrete     | 16              | 16 (100)                   | 0          | 0    | 21 (88)                    |
|                                                     | Linear       | 8               | 5 (63)                     | 3          | 0    |                            |
| Totals                                              |              | 208             | 190                        | 8          | 10   | 190 (91)                   |

body. Breed predispositions have not been previously reported.

Owners aware of foreign body ingestion tended to present their animals for treatment significantly earlier than those not aware of ingestion. This is important because this study also found that the success

rate declined with increasing duration of clinical signs of obstruction. These intuitive findings have not previously been reported.

**Discrete foreign bodies**

This study reports foreign bodies causing obstruction at all points along the gastro-

intestinal tract, with the jejunum being the most common location. Most patients presented within one day of ingestion had a gastric foreign body, although foreign bodies were found which had moved to the mid-jejunum within one day. With increasing duration of clinical signs objects were more likely to be found in the proximal and mid-jejunum. This suggests that (initially at least) the majority of foreign bodies will slowly move distally along the small intestine despite causing clinical signs of obstruction. Some may pass all the way through but most are eventually immobilised by the distended small intestine or a physical barrier such as the ileocolic junction.

The location of the canine discrete foreign bodies in this study is comparable to that recorded by Capak and others (2001) where the mean duration of clinical signs at presentation was six days. The series reported by Boag and others (2005) recorded 50 per cent of foreign bodies in the stomach in comparison with 16 per cent in the present study. The median duration of vomiting in the Boag study was two days (mean not reported, 124 dogs), whereas the median duration of clinical signs in this study was three days (mean 5.0 ± 7.0 days, 184 cases). These factors imply that the referral population of dogs in the Boag study was different from the first-opinion (charity hospital) population of dogs in the present study. It is possible that many of the cases in the present study had a gastric foreign body for a period of time and were presented for treatment only when the foreign body entered the proximal small intestine and their condition deteriorated.

The survival rate for the treatment of discrete foreign bodies in dogs in the present study was 94 per cent. This compares favourably with the 83 per cent survival rate reported by Capak and others (2001), but is less than the 99 per cent survival rate in the study by Boag and others (2005). These are “crude statistics” and do not take into account any confounding factors between the study populations and institutions. Capak and others (2001) reported a higher survival in dogs less than two years of age but this was not found in the present study.

For cats neither the locations of discrete gastrointestinal foreign bodies nor the

surgical survival rate has previously been described. There appears a more uniform distribution of locations than in dogs, although far fewer cases were recorded. All cats with discrete foreign bodies in this study survived.

### Linear foreign bodies

In dogs, linear foreign bodies accounted for 16 per cent of the foreign bodies in the present study, and the most common anchorage point was the pylorus (67 per cent) with the foreign material extending into the proximal jejunum. Canine linear foreign bodies are usually fabrics, plastic and textile materials.

In cats, linear foreign bodies accounted for 33 per cent of the foreign bodies in the study, and the pylorus was an unusual location, with the majority being anchored around the tongue (63 per cent) and mostly comprising single strands of thread or string.

Gastrointestinal foreign bodies have been previously reported to be linear in 50 to 61 per cent of feline cases (Felts and others 1984, Basher and Fowler 1987, Bechuk 2002) and 36 per cent of canine cases (Boag and others 2005). These proportions are higher than in the present study which may indicate differences in first-opinion and referral populations or in the definition of a linear foreign body.

The survival rate for linear foreign bodies in the present study was 80 per cent for dogs which is very similar to the 78 per cent survival rate reported by Evans and others (1994) but less than the 98 per cent survival eluded to in the study by Boag and others (2005).

For cats the survival rate for linear foreign bodies was 63 per cent which is lower than the 84 per cent survival rate reported by Felts and others (1984) and the 92 per cent survival reported by Basher and Fowler (1987). The duration of clinical signs was not recorded in the Felts study, and for the Basher and Fowler study the median duration of clinical signs was only two days (range 0.5 hours to 10 days). In the present study, the median duration of clinical signs for cats presented with linear foreign bodies was four days (mean 10 ± 9.9 days, range 2 to 30 days). Of the cats not surviving in the present study, all had clinical signs of over 14 days duration.

This study reports a significantly higher mortality rate in animals presented with a linear foreign body (rather than a discrete foreign body) and in animals treated with more than one gastrointestinal incision. There are likely to be many reasons for the lower survival rates for linear foreign bodies. First, linear foreign bodies may cause a chronic partial obstruction. Secondly, a greater proportion of the bowel is likely to be affected and compromised. Thirdly, multiple ruptures and peritonitis were a common finding during exploratory coliotomy in this study. Multiple incisions were required for most linear foreign bodies (and in some cases with multiple foreign bodies in the gastrointestinal tract) which increases surgical time, contamination and suture material usage. It is intuitive to minimise the number of gastrointestinal incisions, and in certain cases foreign objects can be manipulated along the alimentary tract to the rectum or stomach. A technique of single enterotomy removal of linear foreign bodies has been reported and used with good success by others (Anderson and others 1992), although many chronic foreign objects cannot be safely manipulated due to severe compromise of the local gastrointestinal segment. The number of intestinal procedures performed was found to have a detrimental effect on survival in a study reported by Wylie and Hosgood (1994) but this association was not found by Evans and others (1994).

Over half of the animals euthanased in this study were euthanased intra-operatively due to multiple ruptures and generalised peritonitis as a consequence of chronic linear foreign bodies. This was performed at the discretion of the surgeon (with informed owner consent) due to the perceived poor prognosis (Evans and others 1994, Ralphs and others 2003) and the inability to provide intensive care postoperatively. Some of these cases may have survived with extensive bowel resections and intensive management of peritonitis (King 1994, Mueller and others 2001, Staatz and others 2002, Costello and others 2004, Boag and others 2005).

In this study, of 189 cases that underwent intestinal surgery, two were euthanased postoperatively and nine died. Nine of these cases showed signs of peritonitis suggestive of enteric wound breakdown,

although further investigations (such as abdominocentesis and cytology) were not performed to confirm this diagnosis. However, these figures do allow an estimate to be made of the dehiscence rate of five per cent. This dehiscence rate may have been higher if treatment had been attempted on the five cases euthanased intra-operatively. The comparison of dehiscence rates from different studies is complicated by the large numbers of variables between and within studies. The presence of a gastrointestinal foreign body, preoperative peritonitis and greater than 15 per cent preoperative weight loss all increase the risk of dehiscence (Allen and others 1992, Ellison 1993b, Evans and others 1994, Ralphs and others 2003). Reported dehiscence rates following foreign body surgery are 27.7 per cent (n=36), 13.9 per cent (n=122) and 2.9 per cent (n=138) (Allen and others 1992, Capak and others 2001, Boag and others 2005).

This study reports a low incidence of cases treated by enterectomy (two of 189) in comparison with other studies [13 of 32 dogs with linear foreign bodies (Evans and others 1994), 12 of 123 dogs (Capak and others 2001) and 38 of 138 dogs (Boag and others 2005)]. The five cases euthanased intra-operatively may have been treated with this procedure, had treatment been attempted. This low rate of resection and anastomosis may reflect differences in the way surgeons judge intestinal viability, may reflect a reluctance to perform a more complex procedure in a first-opinion practice or may be another reflection of the different patient populations seen in first-opinion and referral practices.

In this study neither the location of the foreign body nor the degree of obstruction were shown to affect the outcome. This finding does not seem to support the widely held belief that patients with complete or proximal obstructions tend to deteriorate more quickly than those with partial or more distal obstructions. Another interpretation could be that animals with more proximal or complete obstructions recover better or were treated more quickly.

### Limitations of this study

There are many limitations inherent in a retrospective study performed in a busy,

first-opinion urban charity hospital. The treatment performed and surgical success rate achieved depended on many factors including the owner's wishes and expectations and the experience and clinical skills of the veterinary surgeon managing the case. There was no financial motivation to treat cases or perform extensive workup and in some cases the perception of owner neglect or indifference to the outcome may have influenced the decision to recommend euthanasia. It was impossible to correct for such confounding factors.

Diagnostic techniques were limited to those necessary to make a diagnosis of gastrointestinal obstruction or to indicate the need for surgical exploration of the abdomen. The goal of treatment was to remove the gastrointestinal obstruction and promptly restore enteric nutrition. The limited facilities did not allow the routine measurement of biochemical, acid-base or electrolyte abnormalities which commonly occur with gastrointestinal obstruction (Papazoglou and others 2003, Boag and others 2005). However, attempts were made to correct fluid deficits preoperatively, followed by the prompt restoration of oral alimentation to rectify electrolyte abnormalities. Routine biochemical, acid-base and electrolyte stabilisation may have improved patient recovery times and reduced the incidence of adverse postoperative complications.

Better imaging investigations and technological skill may have reduced patient morbidity; foreign bodies past the ileocolic junction may not have undergone coliotomy and some gastric foreign bodies may have been recovered endoscopically.

Antibiotic protocols were not optimal; intravenous, broad spectrum cephalosporins or potentiated amoxicillins at induction are recommended (Papazoglou and others 2003), used according to the cascade, for a duration determined by the classification of the surgery. Intensive postoperative management, prompt re-operation and open-abdominal drainage techniques may have reduced patient mortality.

A limitation of one aspect of this study is the low number of cats presented, with insignificant numbers for statistical analysis. Only 12 per cent of the cases reported were in felines despite cats accounting for 35 per cent of the surgical caseload of the hospital. It would seem that cats are genuinely less likely to ingest significant gastrointestinal foreign objects than dogs, but it is nevertheless interesting to compare these cats with the dogs.

Despite these justifiable criticisms this study does present new information on the predilection sites for obstruction and on clinical factors associated with a poor outcome.

## CONCLUSIONS

This study has demonstrated that certain dog breeds are predisposed to gastrointestinal obstruction by foreign body and that obstruction mostly occurs in the jejunum. A longer duration of clinical signs, the presence of a linear foreign body and multiple intestinal procedures were shown to be significantly associated with increased mortality. Neither the degree of obstruction (partial or complete) nor the location of the foreign body was shown to have a significant influence on survival.

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