Research Article

# Evaluation of Postoperative Outcomes for Linear and Non-linear Gastrointestinal Foreign Body Obstruction in Cats (Retrospective Study of 52 Cases)

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## ABSTRACT

This study aims to determine the localisation of foreign bodies (FBs), surgical sites, the impact of the time elapsed after FB ingestion on prognosis, and survival rates in cats. A total of 52 cats presented to Selcuk University Faculty of Veterinary Medicine with suspected FB ingestion between 2022 and 2024 were evaluated. Among these cats, 63.4% were short-haired domestic cats, 59.6% were female, and 51.9% were under two years old. The most common types of FBs were linear (40.5%) and plastic (40.5%). The most frequent clinical signs were vomiting, anorexia, lethargy, and abdominal distension. Hematological examinations revealed hypokalaemia (61.9%) and electrolyte imbalances. Radiographic and ultrasonographic evaluations showed gastrointestinal obstruction, intestinal dilation, and reduced peristaltic movements. Surgical procedures, including gastrotomy and enterotomy, were performed, with multifocal intervention required in 36.5% of cases. The survival rate was 76.9%, while the mortality rate was 23.1%, mainly due to complications from linear FBs. Postoperative complications such as septic peritonitis and sepsis were observed in 21% of cases, contributing to the mortality rate. The average time to surgery was 67.2 hours in survivors and 96 hours in those who did not survive. In conclusion, early diagnosis and appropriate surgical intervention are crucial, with prognosis depending on the type of FB and the intervention time.

**Keywords:** *Cat, Gastrointestinal foreign body, Peritonitis*

## Kedilerde Linear ve Linear Olmayan Gastrointestinal Yabancı Cisim Tıkanıklıklarının Postoperatif Sonuçlarının Değerlendirilmesi (52 Olgunun Retrospektif Çalışması)

### ÖZET

Bu çalışma, kedilerde yabancı cisim (YC) yutma vakalarında, YC'lerin lokalizasyonu, operasyon bölgeleri ve YC yutma sonrası geçen sürenin prognoz üzerindeki etkisi ile sağkalım oranlarının belirlenmesini amaçlamaktadır. 2022-2024 yılları arasında Selçuk Üniversitesi Veteriner Fakültesi'ne YC yutma şüphesiyle getirilen 52 kedi değerlendirilmiştir. Çalışmadaki kedilerin %63,4'ü kısa tüylü ev kedisi, %59,6'sı dişi ve %51,9'u iki yaşın altındaydı. YC türleri olarak en sık; linear YC'ler (%40,5, n = 21) ve plastik YC'ler (%40,5, n = 21) tespit edilmiştir. En yaygın klinik belirtiler arasında kusma, anoreksi, halsizlik ve abdominal distansiyon gözlemlenmiştir. Hematolojik incelemelerde hipokalemi (%61,9) ve diğer elektrolit dengesizlikleri dikkat çekmiştir. Radyografik ve ultrasonografik incelemelerde, gastrointestinal obstrüksiyon, bağırsak segmentlerinde genişleme ve peristaltik hareketlerde azalma görülmüştür. Cerrahi müdahaleler arasında gastrotomi ve enterotomi uygulanmış olup, bunların %36,5'inde multifokal girişimde bulunulmuştur. Çalışmada olguların sağkalım oranı %76,9 iken, %23,1 oranında mortalite, özellikle lineer YC kaynaklı komplikasyonlara bağlı olarak görülmüştür. Postoperatif komplikasyonlar arasında septik peritonit ve sepsis, vakaların %21'inde gözlenmiş ve mortalite oranına katkıda bulunmuştur. Sağ kalanlarda cerrahiye kadar geçen ortalama süre 67,2 saat iken, hayatını kaybedenlerde bu süre 96 saat olarak belirlenmiştir. Sonuç olarak, YC yutma vakalarında erken teşhis ve uygun cerrahi müdahalelerin önem taşıdığı, prognozun YC'nin türüne ve müdahale süresine bağlı olduğu sonucuna varılmıştır.

**Anahtar kelimeler:** *Kedi, Gastrointestinal yabancı cisim, Peritonitis*

## INTRODUCTION

Gastrointestinal (GI) foreign body (FB) ingestion is a common condition in veterinary practice, particularly in cats, and often necessitates prompt  medical or surgical intervention. This condition is frequently linked to pica, a compulsive behavioural disorder influenced by  factors such as genetic predisposition, early weaning, boredom, lack of social interaction, malnutrition, and anxiety. GI obstruction caused by FB ingestion can be categorised as  partial or complete, with clinical manifestations varying depending on whether the FB is linear or non-linear (Parlak et al., 2022).

Linear FBs are associated with higher morbidity and mortality due to their potential to cause severe complications, including peritonitis and sepsis. These complications arise from mechanical trauma, leading to intestinal plication, ischemia, and subsequent necrosis (Parlak et al. 2022). Radiographically, linear FBs typically present as dilated, tortuous intestinal loops with multiple intraluminal gas bubbles. Additionally, the presence of free air on abdominal radiographs suggests peritonitis, warranting immediate surgical intervention (Willis and Farrow, 1991; Papazoglou et al., 2003). While clinical signs of linear FBs are typically acute,  some cases may follow a more protracted course. In contrast, non-linear FBs are more likely to cause complete obstruction, resulting in complications such as proximal gas accumulation, bowel distension, and bowel wall edema or necrosis. These cases often present acutely and carry significant risks of morbidity and mortality (Willis and Farrow, 1991; Papazoglou et al., 2003). The clinical manifestations of GI FB ingestion in cats—including vomiting, regurgitation, depression, anorexia, and hypoxia—vary depending on the type, location, severity, and duration of the obstruction. Radiographic findings frequently reveal segmental bowel enlargement, a characteristic indicator of obstruction (Gülaydın and Akgül, 2024).

The management of GI FBs involves medical or surgical intervention based on the nature of the FB, the severity of obstruction, and the risk of perforation. Timely and appropriate treatment is critical to mitigating the pathophysiological consequences and preventing complications (Pratt et al., 2014). While gastrotomy or a single incision enterotomy may suffice for non-linear FBs, the removal of linear FBs often requires multiple enterotomies (Miller et al., 2024).

The aim of this study was to analyse the characteristics of linear and non-linear FBs in feline GI cases and evaluate their relationships with clinical signs, time to intervention, and treatment methods in relation to survival rates.

## MATERIAL AND METHODS

This study was conducted with the approval of the Selcuk University Faculty of Veterinary Medicine Experimental Animal Production and Research Center Ethics Committee, dated 30.01.2025 and numbered 2025/13. The study cohort comprised 52 cats presented to the Faculty of Veterinary Medicine at Selcuk University between 2022 and 2024 with symptoms of FB ingestion or severe vomiting and anorexia of unknown origin. These cats were diagnosed with FBs of varying characteristics through clinical, radiografic, and ultrasonographic (USG) imaging. Inclusion criteria required the availability of complete USG and radiographic data, as well as accessible clinical records.

Anamnestic data collected from the patients, including loss of personal belongings, partial protrusion of FBs from the mouth or anus, expulsion of FBs via vomiting, and the presence of a string at the root of the tongue, were systematically documented in patient observation forms. Following a brief initial clinical examination, a comprehensive inspection of the oral cavity, particularly the root of the tongue, was performed to detect any linear FBs. In addition to the physical examination, venous blood samples were collected for venipuncture (v. cephalica) for systemic blood gas analysis (GEM Premier 3000, Werfen, Barcelona, Spain), complete blood count (MS4e, Melet Schloesing, Maria Enzersdorf, Austria), and biochemical analyses (BT 3000, Biotecnica Instruments, Roma, Italy) at the Central Laboratory of the Faculty of Veterinary Medicine, Selcuk University. Fluid replacement therapy was initiated based on the patients' blood parameters.

To determine the location of the FB, assess indicators of peritonitis, and detect  obstruction, USG and direct radiography (Siemens X-ray, Rayence Veterinary DR unit) were performed in all cases. In cases where clinical,

radiological, and haematological examinations did not suggest peritonitis and no intestinal perforation was present, contrast radiography with 60% barium sulphate solution (2 mL/kg, orally) was performed. Radiographic imaging was utilised to ascertain the FB's location, degree of obstruction, and its characteristics. Treatment decisions were based on factors including the FB's diameter, location, and composition, as well as the severity of obstruction, food intake, defecation status, clinical presentation, the owner's financial capacity, and the patient's blood parameters.

For surgical sedation, Medetomidine HCl (Domitor®, Zoetis, New Jersey, USA) (0.025 mg/kg, IM) and butorphanol (Butomidor, Interhas, Ankara, Turkey) (0.1 mg/kg, IM) were administered. Anaesthesia was induced with propofol (Propofol-Lipuro 1%®, B. Braun, Melsungen, Germany) (1.5–3 mg/kg, IV) and maintained with isoflurane (2% isoflurane-Adeka Pharmaceuticals, Samsun, Turkey) at a flow rate of 2 L/min with 100% oxygen after endotracheal intubation. Following routine surgical preparation (shaving, asepsis, antisepsis), the patient was placed in the ventro-dorsal position on the operating table.

Except for cases where FBs were located in or around the oesophagus, all cats underwent abdominal exploration extending from the stomach to the rectum, with careful examination of the intestinal segments. Once the location of the FB was identified, it was removed via enterotomy or gastrotomy. In cases where linear FBs had caused chronic penetration into the intestinal mesenchyme or perforation, multiple enterotomies were performed to minimise further trauma to the intestinal mesenchyme. After the removal of all FBs, the incisions were closed using a double continuous suture technique with atraumatic polydioxanone (PDO 4/0) or polyglycolic acid (PGA 4/0) sutures, employing parallel suturing in the antimesenteric region or transverse suturing in stenotic segments (Fig. 1). Following suture placement, the intestinal segments were meticulously examined for any leaks. Prior to the closure of the abdominal wall, the abdominal cavity was irrigated with a body-temperature isotonic (0.9%) solution. Postoperative care included the administration of Metoclopramide HCl (0.2 mg/kg, IM) to prevent vomiting, along with appropriate fluid therapy (Lactated Ringer, isotonic 0.9% NaCl, etc.) to correct dehydration and improve tissue perfusion, based on blood gas results. Antibiotic therapy consisted of metronidazole (Polygyl 0.5%, Polifarma, Istanbul, Turkey) (7.5 mg/kg, q24h, IV) for 3 days and cefazolin sodium (Iespor®, Ulagay Pharmaceutical, Istanbul, Turkey) (30 mg/kg, q24h, IM) for 7 days. Analgesia was provided with meloxicam (Metacam®, Boehringer Ingelheim, Ingelheim, Germany) on day 1 (0.1 mg/kg, q24h, PO), followed by 0.05 mg/kg (q24h, PO) for the next 2 days. If non-steroidal analgesics were insufficient, additional analgesia was administered via subcutaneous injection of butorphanol hydrogen tartrate at a dose of 0.4 mg/kg (Butomidor-Interhas, Ankara, Turkey) (0.1 mg/kg, IM).

As a statistical method in the study, the findings were evaluated by taking the statistical average.
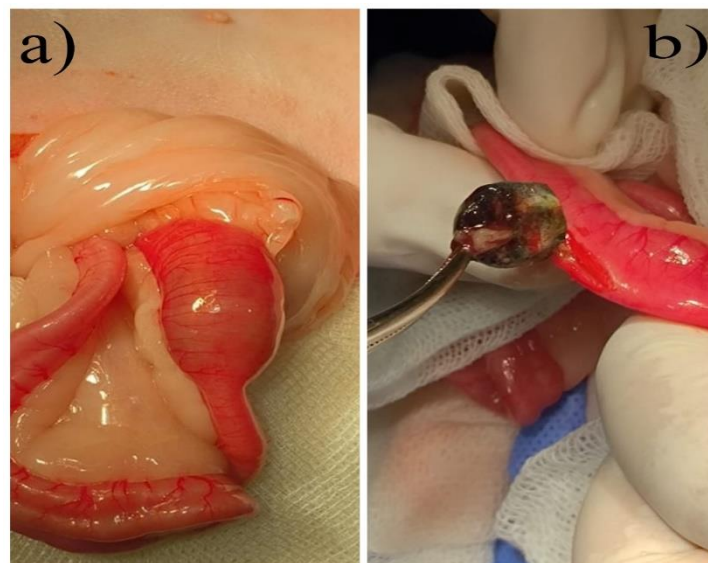


**Figure 1.** *a) The non-linear plastic FB causing complete obstruction in the intestinal region of case 6, b) the non-linear plastic FB removed from the intestinal region of case 6 via enterotomy.*

# RESULTS

## Clinical findings

The breed distribution of the cases included in the study was as follows: Domestic Shorthair (63.5%) (n=33), Scottish Fold (13.5%) (n=7), British Shorthair (9.5%) (n=5), Angora (7.5%) (n=4), Siamese (2%) (n=1), Chinchilla (2%) (n=1) and Persian (2%) (n=1). The age distribution of the cases was as shown below: 27% were less than 1 year old (n=14), 25% were 2 years old (n=13), 21% were 1 year old (n=11), 11.5% were 3 years old (n=6), 4% were 4 years old (n=2), 7.5% were 5 years old (n=4), 2% were 6 years old (n=1) and 2% were 10 years old (n=1). When analysing the gender distribution of the cases, 59.6% were female (n=31) and 40.4% were male (n=21). In some cases with linear FBs, they FBs were located in the oral cavity or at the root of the tongue, extended outwards from the anus, or included ingested needles attached to the FB. Cases with linear FBs at the root of the tongue often exhibited chewing movements, and in some cases, transversal cuts were observed on the tongue due to the FBs. In all cases of linear FB, severe vomiting (more than five times per day), anorexia, weakness, pyrexia and abdominal tenderness were observed (Fig. 2) (Table 1).

Clinical examination of other cases of FB revealed clinical symptoms of anorexia, weakness, severe vomiting, dehydration, abdominal distension and increased tenderness. Defecation varied depending on the FB's location in the GI tract and the degree of obstruction, being observed in some cases but absent in others.



**Figure 2.** *Detection of a linear FB at the root of the tongue in a cat.*

**Table 1.** *Details of the cases included in the study.*

| Cases | Breed | Age (Month) | Sex | Intervention Time (Day) | Surgical Procedure | Foreign Body(FB) | Minor Postoperative Complications | Major Postoperative Complications | Prognosis | Hospitalization Duration (Hours) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Persian | 6 | Male | 0 | Duodenal enterotomy | Non-Linear FB (Plastic) | Wound infection | - | Moderate | - |
| 2 | Scottish Fold | 12 | Male | 6 | Multifocal enterotomy | Linear FB (String, Thread, Wire, etc.) | Anorexia, Pyrexia | Septic peritonitis, Sepsis | Expired at 12th Hour | 12 |
| 3 | Mixed breed | 24 | Female | 0 | Esophageal FB-Endoscopic intervention | Non-Linear FB (Bone) | - | - | Good | 12 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **4** | British | 12 | Male | 0 | Multifocal enterotomy | Linear FB (String, Thread, Wire, etc.) | - | - | Good | - |
| **5** | Mixed breed | 24 | Male | 3 | Duodenal enterotomy | Linear FB (String, Thread, Wire, etc.) | - | - | Good | - |
| **6** | Mixed breed | 12 | Female | 2 | Jejunal enterotomy | Non-Linear FB (Plastic) | - | - | Good | - |
| **7** | Mixed breed | 36 | Male | 8 | Duodenal enterotomy | Non-Linear FB (Plastic) | Bloody diarrhoea, Pyrexia, Vomiting Anorexia | Septic Peritonitis, Sepsis | Expired on 14th Day | - |
| **8** | British | 9 | Female | 6 | Duodenal enterotomy | Non-Linear FB (Plastic) | Anorexia | - | Expired on 2nd Day | 48 |
| **9** | Mixed breed | 24 | Male | 0 | Multifocal enterotomy | Linear FB (String, Thread, Wire, etc.) | - | - | Good | 72 |
| **10** | Mixed breed | 72 | Female | 3 | Multifocal enterotomy | Linear FB (String, Thread, Wire, etc.) | İlues, Wound infection | Septic Peritonitis, Sepsis | Expired on 2nd Day | - |
| **11** | Scottish Fold | 36 | Male | 3 | Duodenal enterotomy | Non-Linear FB (Cat hair) | Anorexia | - | Expired on 7th Day | 72 |
| **12** | Mixed breed | 120 | Female | 5 | EsophagealFB- Endoscopic intervention | Non-Linear FB (Bone) | Anorexia | - | Moderate | 72 |
| **13** | Mixed breed | 12 | Female | 2 | Multifocal enterotomy | Linear FB (String, Thread, Wire, etc.) | - | - | Good | - |
| **14** | Mixed breed | 24 | Female | 0 | Gastric endoscopic procedure | Non-Linear FB (Cat hair) | - | - | Good | - |
| **15** | Mixed breed | 12 | Male | 3 | Duodenal enterotomy | Non-Linear FB (Plastic) | - | - | Good | - |
| **16** | Ankara | 4 | Female | 10 | Jejunal enterotomy | Non-Linear FB (Fruit seed) | Anorexia | - | Expired on 6th Day | - |
| **17** | Mixed breed | 36 | Female | 2 | Jejunal enterotomy | Non-Linear FB (Plastic) | - | - | Good | - |
| **18** | Mixed breed | 60 | Female | 2 | Multifocal enterotomy | Linear FB (String, Thread, Wire, etc.) | - | - | Good | - |
| **19** | Mixed breed | 60 | Female | 1 | Multifocal enterotomy | Linear FB (String, Thread, Wire, etc.) | Incisional hernia | - | Expired on 1st Day | - |
| **20** | Mixed breed | 8 | Female | 2 | Jejenum | Non-Linear FB (Plastic) | - | - | Good | - |
| **21** | Mixed breed | 36 | Female | 4 | Multifocal enterotomy | Linear FB (String, Thread, Wire, etc.) | Vomiting | - | Moderate | - |
| **22** | Scottish Fold | 12 | Female | 2 | Gastrotomy | Non-Linear FB (Plastic) | - | - | Good | - |

| 23 | Scottish Fold | 24 | Male | 2 | Duodenal enterotomy | Non-Linear FB (Plastic) | - | - | Good | 12 |
|---|---|---|---|---|---|---|---|---|---|---|
| 24 | British | 4 | Male | 4 | Duodenal enterotomy | Non-Linear FB (Fruit seed) | - | - | Good | - |
| 25 | Siamese | 7 | Female | 1 | Multifocal enterotomy | Linear FB (String, Thread, Wire, etc.) | - | - | Good | 12 |
| 26 | Mixed breed | 60 | Male | 8 | EsophagealFB-Endoscopic intervention | Non-Linear FB (Bone) | - | - | Good | - |
| 27 | Mixed breed | 24 | Female | 4 | Multifocal enterotomy | Linear FB (String, Thread, Wire, etc.) | - | Septic Peritonitis, Sepsis | Espired on 2nd Day | - |
| 28 | Scottish Fold | 24 | Male | 10 | Multifocal enterotomy | Linear FB (String, Thread, Wire, etc.) | İleus | - | Moderate | - |
| 29 | Mixed breed | 24 | Female | 0 | Multifocal enterotomy | Linear FB (String, Thread, Wire, etc.) | - | - | Intraoperatif Ex | - |
| 30 | Mixed breed | 36 | Female | 2 | Multifocal enterotomy | Linear FB (String, Thread, Wire, etc.) | - | - | Good | 12 |
| 31 | Mixed breed | 9 | Male | 2 | Gastrotomy | Non-Linear FB (Plastic) | - | - | Good | 12 |
| 32 | Mixed breed | 6 | Male | 12 | Duodenal enterotomy | Non-Linear FB (Plastic) | - | - | Good | - |
| 33 | Mixed breed | 12 | Male | 5 | Multifocal enterotomy | Linear FB (String, Thread, Wire, etc.) | - | - | Expired on 1st Day | - |
| 34 | Ankara | 8 | Female | 2 | Multifocal enterotomy | Linear FB (String, Thread, Wire, etc.) | - | - | Good | 168 |
| 35 | Mixed breed | 24 | Male | 3 | Duodenal enterotomy | Non-Linear FB (Plastic) | Incisional hernia | - | Moderate | -- |
| 36 | Mixed breed | 24 | Female | 3 | Ileum enterotomy | Non-Linear FB (Plastic) | Wound infection | Local peritonitis | Worst | 168 |
| 37 | Mixed breed | 6 | Female | 2 | Duodenal enterotomy | Non-Linear FB (Plastic) | - | - | Good | - |
| 38 | Mixed breed | 12 | Female | 0 | Duodenal enterotomy | Non-Linear FB (Needle) | - | - | Good | - |
| 39 | Chinchilla | 8 | Male | 0 | Gastric endoscopic procedure | Non-Linear FB (Plastic) | - | - | Good | - |
| 40 | Mixed breed | 12 | Female | 0 | Gastrotomy | Non-Linear FB (Needle) | - | - | Good | - |
| 41 | British | 24 | Male | 1 | Duodenal enterotomy | Non-Linear FB (Plastic) | - | - | Good | - |
| 42 | Mixed breed | 12 | Female | 4 | Multifocal enterotomy | Linear FB (String, Thread, Wire, etc.) | Incisional hernia | - | Moderate | - |
| 43 | Mixed breed | 60 | Female | 3 | Duodenal enterotomy | Non-Linear FB (Plastic) | - | - | Good | 48 |
| 44 | Ankara | 7 | Male | 1 | Multifocal enterotomy | Linear FB (String, Thread, Wire, etc.) | - | - | Expired on 1st Day | - |

| 45 | Ankara | 36 | Male | 7 | Multifocal enterotomy | Linear FB (String, Thread, Wire, etc.) | - | - | Good | - |
| 46 | Scottish Fold | 11 | Female | 7 | Multifocal enterotomy | Linear FB (String, Thread, Wire, etc.) | - | - | Good | - |
| 47 | British | 5 | Female | 4 | Jejunal enterotomy | Non-Linear FB (Plastic) | Wound ınfection | - | Moderate | - |
| 48 | Mixed breed | 48 | Female | 1 | Jejunal enterotomy | Non-Linear FB (Plastic) | Anorexia | - | Expired on 4th Day | 168 |
| 49 | Mixed breed | 12 | Male | 1 | Gastrotomy | Non-Linear FB (Plastic) | - | - | Good | 72 |
| 50 | Mixed breed | 24 | Female | 3 | Duodenal enterotomy | Non-Linear FB (Needle) | - | - | Good | - |
| 51 | Scottish Fold | 24 | Female | 3 | Jejunal enterotomy | Linear FB (String, Thread, Wire, etc.) | İleus | - | Moderate | - |
| 52 | Mixed breed | 48 | Female | 2 | Duodenal enterotomy | Non-Linear FB (Plastic) | - | - | Good | - |

## Haematological findings

In the preoperative blood parameters (whole blood, blood gas and serum biochemistry) of patients presenting with FB complaints (Table 2), the following findings were observed: hypokalaemia (61.90%, n=26), hypernatraemia (42.8%, n=18), hypochloraemia (40.47%, n=17), decreased BUN (66.66%, n=14), elevated $HCO_3$ (26.19%, n=11), decreased $HCO_3$ (14.28%, n=6), decreased total protein (42.85%, n=9), elevated total protein (19.04%, n=4), metabolic alkalosis (19.04%, n=8), decreased creatinine (33.33%, n=7), hyperlactataemia (16.66%, n=7), increased Hct (15%, n=3), hyponatraemia (7%, n=3), decreased Hct (5%, n=1), and decreased WBC (5%, n=1) (Table 2).

**Tablo 2.** *Preoperative biochemical, hematologic and blood-gas values for cats with GI FB obstruction.*

| Parameters | Mean | Reference Range | Below the reference (n) | Above Reference (n) | Total Cases (n) |
| --- | --- | --- | --- | --- | --- |
| White blood cells $10^9$/L | 12.11 | 5.5-19.5 | 1 | - | 20 |
| Haematocrit % | 44.08 | 31-48 | 1 | 3 | 20 |
| Ph | 7.35 | 7.24-7.40 | 3 | 8 | 42 |
| Potassium (K) mmol/L | 3.48 | 3.7-6.1 | 26 | - | 42 |
| Sodium (Na) nmol/L | 155 | 146-156 | 3 | 18 | 42 |
| Chlorine (Cl) nmol/L | 113.07 | 115-130 | 17 | - | 42 |
| Lactat nmol/L | 3.24 | 0.9-3.9 | - | 7 | 42 |
| Hco3 nmol/L | 20.88 | 17-24 | 6 | 11 | 42 |
| BUN mg/dL | 27.32 | 19-34 | 14 | - | 21 |
| Creatinine mg/dL | 1.10 | 0.9-2.2 | 7 | 1 | 21 |
| Total protein g/dL | 6.56 | 6-7.9 | 9 | 4 | 21 |

## Radiological and USG findings

Direct and indirect radiographs with barium sulphate were taken in all patients who presented with the complaint of swallowing FB. Radiographic examination revealed clustered or tortuous small bowel segments, particularly in patients with linear FB ingestion. Depending on the nature and size of the ingested FB, partial or complete obstructions were observed in various parts of the GI tract (Fig. 3). Radiological findings also indicated dilated intestinal segments. Ultrasonographic examination revealed the presence of shadowing in

some regions of the GI tract due to an ingested FB, decreased peristalsis, and gastric and intestinal dilatation in cases of FB causing complete obstruction (Fig. 4; Fig.5).
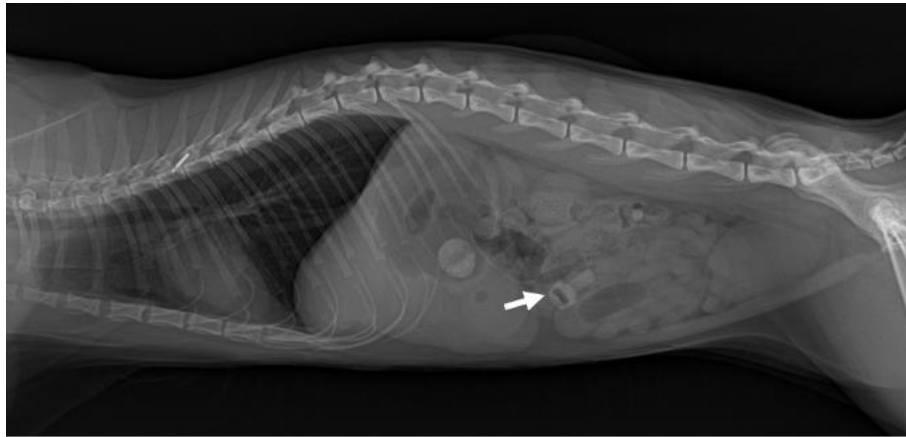


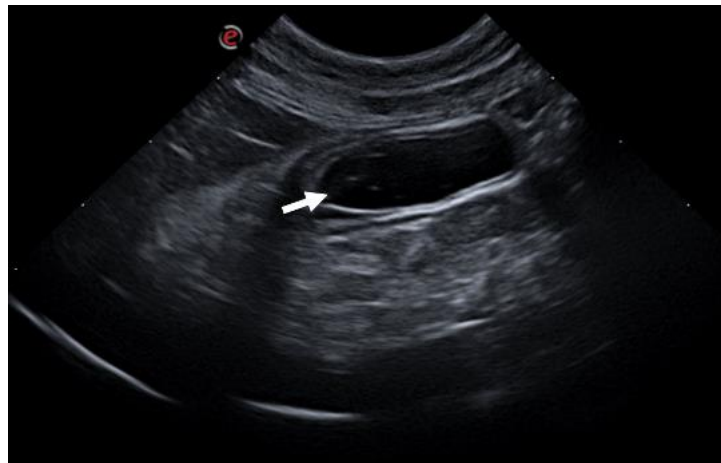**Figure 3**. *X-ray image of a FB (white arrows) in the small intestine of a cat.*



**Figure 4**. *Longitudinal ultrasonographic image of small intestinal segment dilation (white arrow) secondary to a linear FB in a 5-year-old female mixed-breed cat (Case 18)*
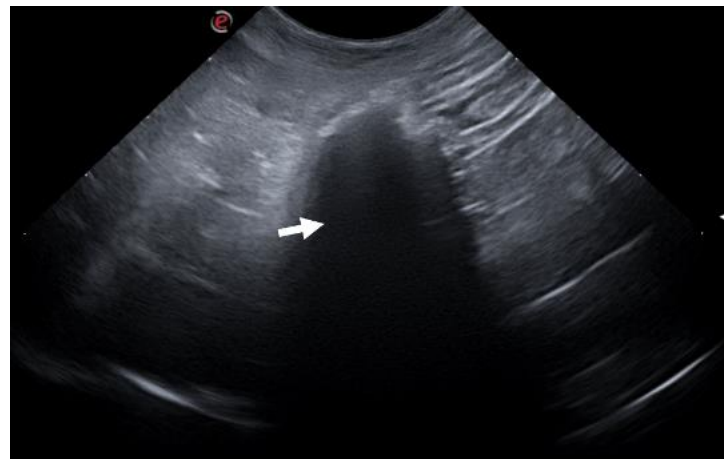


**Figure 5**. *Oblique sagittal ultrasound image of the jejunum in a 4-month-old female kitten (case 16). A fruit seed causes an acoustic shadow artefact (white arrow) by obstructing deeper sound wave penetration.*

**Surgical findings**

The nature of the FBs removed from various segments of the GI tract, either through surgery or endoscopy, was analysed. The majority of FBs identified were linear in shape, accounting for 40.5% (n=21) of cases, followed by plastic materials, also representing 40.5% (n=21). Other FBs included needles (5.5%, n=3), bone fragments (5.5%, n=3), fruit stones (4%, n=2), and hairballs (4%, n=2).

Endoscopic removal was performed under general anaesthesia in 4% (n=2) of cases, avoiding the need for surgical intervention. Surgical procedures, including enterotomy and gastrotomy, were required for FB removal depending on their location within the GI tract. The distribution of FBs by anatomical site was as follows: 36.5% (n=19) were multifocal, meaning they were found in multiple locations; 31% (n=16) were located in the duodenum; 13.5% (n=7) in the jejunum; 7.5% (n=4) in the stomach; 5.5% (n=3) in the oesophagus; and 2% (n=1) in the ileum.

Regarding survival outcomes, 23.1% (n=12) of the cases resulted in death, while 76.9% (n=40) of the cases survived to the time of assessment. Among the deceased, 58.3% (n=7) were attributed to linear FBs, 25% (n=3) to plastic objects, 8.3% (n=1) to fruit seeds, and 8.3% (n=1) to hairballs. Upon further analysis of the cases that resulted in death, it was noted that 8.3% (n=1) of deaths occurred intraoperatively. Postoperatively, deaths occurred at varying intervals: 8.3% (n=1) at 6 hours, 8.3% (n=1) at 12 hours, 25% (n=3) on the first day, 16.6% (n=2) on the second day, 8.3% (n=1) on the third day, 8.3% (n=1) on the fourth day, 8.3% (n=1) on the seventh day, and 8.3% (n=1) on the fourteenth day.

Postoperative complications were observed in 21% (n=11) of cases, including minor issues such as anorexia, pyrexia, bloody diarrhoea, paralytic ileus, vomiting, wound infection, and incisional hernia. Major complications, specifically septic peritonitis and sepsis, were documented in 7.6% (n=4) of cases. In cases involving linear FBs, minor complications occurred in 42% (n=3) and major complications in 57% (n=4); all instances of septic peritonitis and sepsis resulted in mortality. For FB cases, the mean time from onset of clinical signs to time of surgery was 67.2 hours for surviving cases and 96 hours for deceased cases. In the postoperative evaluation of the cases; cases without minor or major complications were recorded as "good", cases with minor complications were recorded as "moderate", and cases with major complications but still alive were recorded as "worst".

## DISCUSSION

FBs in the GI tract remain a common health problem in cats, and according to our study, 59.6% of the 52 cats with FBs were female. In our study, 40.5% (n = 21) of FB cases were classified as linear FB, while (59.5%, n = 31) were categorised as non-linear FB. Notably, the rate of treatment success was observed to increase significantly (76.9%) with early surgical intervention. However, mortality was predominantly associated with cases involving linear FB. Furthermore, surgical intervention for linear FB cases was typically delayed, with an average time to surgery of 96 hours. These findings underscore the critical importance of prompt diagnosis and early intervention, particularly in cases of linear FB, to improve clinical outcomes and reduce mortality rates. Analyses of studies on FB events showed the majority of events to be in domestic shorthair breeds (95%), with a gender distribution of 70% males (n=7) and 30% females (n=3) (Hayes, 2009; Cola et al., 2009; Miller et al., 2024). In the study by Gülaydın and Akgül (2024) it was reported that 66.6% of the cases were domestic shorthair (n=8) and 33.4% were Scottish breed cats (n=4), and the sex distribution was 75% male (n=9) and 25% female (n=3). In the present study, the breed distribution of GI FB cases revealed that domestic shorthair cats were the most commonly affected breed, accounting for 63.4% of cases (n=33). This finding aligns with the results of previous studies, suggesting a potential predisposition of this breed to GI FB ingestion. However, the data obtained regarding the sex distribution are not compatible with previous findings; 59.6% of the cases in our study were female cats (n=31). This difference may be explained by an excess of female cats in the population. Nevertheless, further extensive and detailed studies are required to validate these hypotheses.

Previous studies have indicated that cats presenting with FB ingestion are predominantly younger than two years of age, a finding supported by the data from our study, in which 48% of affected cats fell within this age group (Hayes, 2009; Pratt et al., 2014; Crinò et al., 2023). The high prevalence observed in younger cats may be attributed to their heightened exploratory behaviour and curiosity about foreign objects. Additionally, the

increased incidence of pica behaviour during the permanent teething period is thought to contribute to the higher risk of FB ingestion in this age group.

The literature indicates that cats exhibit a particular interest in linear FBs and are more prone to swallowing such objects due to the unique anatomical structure of their tongues (Çamkerten and Şahin, 2006; Hayes, 2009; Demirel, 2021; Gülaydın and Akgül, 2024). In our study, an analysis of the types of FBs revealed that 40.4% (n=21) of cases involved linear FBs, while an equal proportion (40.4%, n=21) consisted of plastic materials. The frequent occurrence of linear FBs may be attributed to several factors, including the ease of access to these objects, cats' natural tendency to play with string-like materials, and their anatomical predisposition to engaging with and ingesting such items.

Metabolic alterations caused by GI FBs in cats and dogs have been extensively discussed in the literature. Gollnick et al. (2023) reported that hyponatraemia was the most commonly observed metabolic disturbance in cats with GI lesions, accompanied by decreases in serum chloride and calcium levels in 32% of cases and elevated serum lactate levels in 30% of cases. These findings highlight the impact of GI system damage on electrolyte and metabolite balance. Similarly, Boag et al. (2005) reported hypochloraemia in 51.8%, metabolic alkalosis in 45.2%, hyperlactataemia in 40.5%, hypokalaemia in 25%, and hyponatraemia in 20.5% of dogs with GI injuries, emphasising the need to consider these metabolic changes in clinical management. In contrast, studies focusing on cats and dogs that ingested suture needles suggest more limited changes in metabolic parameters. For instance, in a study by Demirel et al. (2021), sodium, chloride, potassium, haematocrit, total protein, creatinine, and glucose levels were generally within normal limits in both species. This observation suggests that the type and location of the FB may play a significant role in determining the extent of metabolic changes. Supporting this, Parlak et al. (2022) found hypokalaemia in 42%, hypochloraemia in 20%, and hyperlactataemia in 50% of cats with linear FBs. These findings underline the importance of considering FB characteristics in the evaluation of metabolic disturbances associated with GI FB cases.

Sayın (2024) reported hyperlactataemia in 67.3%, hypochloraemia in 43.4%, hyponatraemia in 27.6%, and hypokalaemia in 13% of GI FB cases, further demonstrating the prevalence and clinical importance of these metabolic alterations. These findings highlight the need for careful monitoring of electrolyte and metabolic parameters during the clinical evaluation of GI cases. The data obtained in our study are consistent with findings reported in the literature (Boag et al., 2005; Parlak et al., 2022; Gollnick et al., 2023; Sayın, 2024). Hypochloraemia and hypernatraemia observed in some cases are thought to result from prolonged vomiting and dehydration. Furthermore, hyperlactataemia is likely influenced by decreased tissue perfusion caused by intestinal wall compression by the FB, emphasising the significant local and systemic effects of FBs on metabolic parameters.

In this study, radiographic imaging was an important diagnostic tool, and direct radiography was found to be sufficient for the detection of radiopaque FBs. However, both ultrasonography (USG) and radiography were employed for the diagnosis of radiolucent FBs. In cases where FBs could not be detected using either method, indirect radiography was utilised. In cases with linear FBs, clustering and tortuosity of intestinal segments were readily apparent on direct radiographs, while dilated intestinal segments were noted in non-linear FB cases. These findings align with reports in the literature, which emphasise the utility of radiography in identifying radiopaque FBs, determining obstruction sites, and assessing gas and fluid content within the GI tract (Arıcan, 2011; Finck et al., 2014; Erol et al., 2019). However, as previously noted by Elser et al. (2020), radiographic findings alone can be non-specific, particularly in differentiating FBs from neoplasia, adhesions, or strictures. Additionally, typical radiographic findings for linear FBs are not always present. Ultrasonography, performed immediately after radiography, proved invaluable in accurately identifying FBs, especially non-radiopaque ones. It also provided critical information regarding intestinal wall integrity, mesenteric changes, and free peritoneal fluid, which guided treatment decisions. This aligns with previous studies highlighting the diagnostic value of ultrasonography in GI FB cases (MacPhail, 2002; Penninck, 2002; Tyrrell et al., 2006; Hayes, 2008). The combined use of radiography and ultrasonography expedited the diagnosis and facilitated timely surgical intervention, ultimately improving clinical outcomes.

It has been well established that delayed intervention decreases treatment success in cases of intestinal obstruction in cats and dogs (Hayes, 2009; Kan et al., 2022). Additionally, the literature identifies the most critical complications of GI surgery as disruption of suture line integrity and leakage of intestinal contents into the abdominal cavity (Allen et al., 1992; Evans et al., 1994; Shales et al., 2005; Hayes, 2009). Hayes (2009)

noted no mortality in cats during the postoperative period, with only minor complications such as upper respiratory tract infections reported. Similarly, Gollnick et al. (2023) observed no intestinal perforation or septic peritonitis in cats with GI FBs, although intestinal perforations were more frequently associated with linear FBs. These cases were linked to a higher incidence of postoperative ileus and a higher infection rate at the surgical site (43%) compared to other FB cases. The increased infection rate in linear FB cases may be attributed to factors such as prolonged operative durationss, the requirement for multiple GI incisions, or the risk of incisional contamination during manipulation of the linear FB. These findings underscore the importance of timely surgical intervention and meticulous intraoperative management to optimise outcomes in cats and dogs with GI FBs. In this study, the timing of surgical intervention in cases with GI FBs was evaluated, revealing that surgery was performed after an average of 67.2 hours in surviving cases and 96 hours in cases that succumbed. Among cases with linear FBs that resulted in mortality, the average time to surgery was 76.8 hours. These findings align with those reported by Hayes (2009) and Kan et al. (2022), clearly demonstrating that mortality rates increase with delayed intervention. Particularly in cases involving linear FBs, delayed surgical intervention is thought to exacerbate damage, as linear FBs located in cranial regions of the GI tract (e.g., tongue root) can cause intestinal clustering due to continued caudal peristalsis, cumulatively increasing intestinal damage. The prognosis for cats undergoing surgical removal of FBs is generally favourable, with low rates of postoperative septic peritonitis and mortality (Gollnick et al., 2023). However, cases involving linear FBs are often more complex, and the postoperative care process is typically more challenging. While Miller et al. (2024) reported no significant difference in the occurrence of postoperative complications between linear and other FB cases, they documented two fatalities in the postoperative period. One case was suspected to have developed systemic inflammatory response syndrome (SIRS), and both cases experienced complications such as hypotension, acute kidney injury, and pleural effusion. These findings highlight the critical need for timely surgical intervention and comprehensive postoperative care, particularly in cases involving linear FBs, to optimise outcomes and minimise the risk of severe complications. Of the 52 cases evaluated in this study, 43 (82.69%) were successfully discharged, while 9 cases (17.31%) succumbed to complications during hospitalization. Additionally, 3 cases (6%) were reported to have died due to complications after discharge. When minor and major postoperative complications were analysed, minor complications—such as anorexia, pyrexia, bloody diarrhoea, paralytic ileus, vomiting, wound infection, and incisional hernia—were observed in 21% (n=11) of the cases. Major complications, including septic peritonitis and sepsis, were identified in 7.6% (n=4) of the cases. Among cases with linear GI FBs, minor complications occurred in 42.85% (n=3), and major complications occurred in 57.15% (n=4), with all cases of septic peritonitis and sepsis resulting in mortality. These findings differ from those reported by Hayes (2009), Gollnick et al. (2023), and Miller et al. (2024) regarding the type and frequency of minor and major complications. However, the observed mortality in all cases with peritonitis and sepsis aligns with previous studies (Allen et al., 1992; Evans et al., 1994; Shales et al., 2005; Hayes, 2009). The higher frequency of complications in this study compared to prior literature is likely attributable to the predominance of linear FB cases and prolonged surgical intervention times. The increased complication and mortality rates in linear FB cases appear to be associated with delayed presentation to the clinic and the subsequent development of septic peritonitis due to intestinal perforation. The presence of postoperative complications, such as incisional hernia and wound infection, highlights the critical importance of meticulous postoperative care. Moreover, the fact that most deaths occurred within the first 48 hours post-surgery underscores the need for improved postoperative critical care. While no significant differences were observed in age or breed between survivors and nonsurvivors, mortality was significantly higher among cases with linear FBs (33.3%) compared to non-linear FBs (16.1%). Perforation and peritonitis caused by multifocal localisation of linear FBs in the intestinal system likely explain the increased mortality rate. All linear FB cases resulting in mortality (33.3%) exhibited multifocal localisation, which contributed to longer surgical intervention times and increased contamination.

## CONCLUSION

This study highlights the critical importance of early diagnosis and timely intervention in the clinical management of GI FBs in cats. The results show that linear FBs in particular are associated with higher complication rates, and septic peritonitis and mortality are more common in these cases. Mortality rates were found to be higher in cases where surgical intervention was delayed, clearly demonstrating the negative effects of late intervention. Our study supports the necessity of a multifaceted diagnostic approach combining radiographic and ultrasonographic imaging methods to accurately localise FBs and determine the degree of obstruction. In addition, electrolyte imbalances such as hypochloraemia, hyponatraemia, and hyperlactataemia

were observed as important metabolic changes. These changes are thought to be due to prolonged vomiting, dehydration, and impaired intestinal perfusion due to obstruction caused by FBs. Given the increased risk of postoperative complications, meticulous management during surgery and intensive postoperative care are vital to improve clinical outcomes.

## CONFLICT OF INTEREST

The authors confirm that they have no potential conflicts of interest related to the research, authorship, or publication of this article.

## AUTHOR CONTRIBUTION

N. Z. E., concept, design and writing the manuscript
H. E., S. P., İ. A., data collection and analysis.
K. P., concept, design  and writing the manuscript

## ETHICAL APPROVAL

This study was conducted with the approval of the Selcuk University Faculty of Veterinary Medicine Experimental Animal Production and Research Center Ethics Committee, dated 30.01.2025 and numbered 2025/13.

## DATA AVAILABILITY

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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