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Case Report

Enterolithiasis in Two Cats: Clinical, Radiographic, and Surgical Findings

İki Kedide Enterolitiyazis: Klinik, Radyografik ve Cerrahi Bulgular

Ebru ERAVCI YALIN[1,✉], Simge BAYRAKTAR[1], Sıla Şeyda ÇINAR[2], Lora KOENHEMSİ[3], Batuhan NEYSE[4]

[1]Department of Surgery, Faculty of Veterinary Medicine, İstanbul University Cerrahpaşa, İstanbul, Türkiye

[2] VetAmerikan Hayvan Hastanesi, İstanbul, Türkiye

[3] Department of Internal Medicine, Faculty of Veterinary Medicine, İstanbul University Cerrahpaşa, İstanbul, Türkiye

[4] PhD Program in Veterinary Surgery, Graduate School, İstanbul University Cerrahpaşa, İstanbul, Türkiye

Corresponding Author:
Ebru ERAVCI YALIN
✉ebru.eravciyalin@iuc.edu.tr

ORCID:
EEY: 0000-0002-0941-6745
SB: 0000-0002-4181-2334
SŞÇ: 0000-0003-2447-1619
LK: 0000-0002-4979-170X
BN: 0000-0001-6862-482X

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Abstract

Enterolithiasis is a rare gastrointestinal disorder characterized by mechanical obstruction caused by enteroliths formed within the intestinal lumen. Dietary composition, environmental factors, and breed predisposition have been reported to contribute to enterolith formation, with these structures typically developing through mineral accumulation around foreign materials. Although enterolithiasis is relatively common in horses, it has been rarely reported in cats and dogs. Surgical intervention is considered the most effective treatment option in clinically symptomatic cases. In this case report, two cats presented to our faculty clinic with complaints of lethargy and weight loss were evaluated. Hematological examinations revealed anemia in both cases. Abdominal radiographs demonstrated multiple similarly sized radiopaque structures within the small intestinal lumen. Surgical exploration revealed jejunoileal dilatation and ileocecal stenosis. In one case, removal of the enteroliths alone was sufficient, whereas the other case required enterotomy followed by segmental intestinal resection and anastomosis. These cases indicate that enterolithiasis should be considered among the differential diagnoses in patients presenting with chronic gastrointestinal signs and multiple radiopaque intestinal structures. The aim of this case report was to describe the clinical, radiographic, and surgical findings of enterolithiasis in two cats and to contribute to the limited literature regarding this rare condition in small animal practice.

Keywords: Cat, Enterolithiasis, Foreign body, Gastrointestinal obstruction

Öz

Enterolitiyazis, bağırsak lümeninde oluşan enterolitlerin mekanik obstrüksiyona neden olduğu nadir bir gastrointestinal hastalıktır. Enterolit oluşumunda diyet içeriği, çevresel faktörler ve ırksal yatkınlığın etkili olduğu; bu yapıların çoğunlukla yabancı cisimler etrafında gelişen mineral birikimleri sonucu oluştuğu bildirilmektedir. Hastalık atlarda görece yaygın görülmesine rağmen, kedi ve köpeklerde nadiren rapor edilmektedir. Klinik semptomların geliştiği olgularda cerrahi müdahale en etkili tedavi yöntemi olarak kabul edilmektedir. Bu olgu sunumunda, halsizlik ve kilo kaybı şikâyetleri ile fakültemiz kliniğine getirilen iki kedi değerlendirildi. Her iki olguda hematolojik incelemelerde anemi saptandı. Abdominal radyografilerde ince bağırsak lümeni içerisinde çok sayıda ve benzer boyutlarda radyopak yapılar izlendi. Cerrahi eksplorasyonda jejunoileal dilatasyon ve ileosekal stenoz belirlendi. Bir olguda yalnızca enterolitlerin uzaklaştırılması yeterli olurken, diğer olguda enterotomiye ek olarak segmenter bağırsak rezeksiyonu ve anastomoz uygulandı. Bu olgular, kronik gastrointestinal semptomlar ile birlikte multipl radyopak intestinal yapıların varlığında enterolitiyazisin ayırıcı tanılar arasında değerlendirilmesi gerektiğini göstermektedir. Bu olgu sunumunun amacı, iki kedide enterolitiyazise ait klinik, radyografik ve cerrahi bulguları tanımlayarak küçük hayvan pratiğinde nadir görülen bu hastalığa ilişkin literatüre katkı sağlamaktır.

Anahtar Kelimeler: Enterolitiyazis, Gastrointestinal obstrüksiyon, Kedi, Yabancı cisim

Introduction

Enterolithiasis is a pathological condition characterized by the formation of stone-like hard masses, referred to as enteroliths, within the intestinal lumen. These masses may move freely throughout the gastrointestinal tract or become fixed and localized in a specific region (Gurvits & Lan, 2014).

In human medicine, enterolithiasis is classified as primary and secondary enterolithiasis. Primary enterolithiasis is associated with alterations in gastrointestinal pH and motility, occurring in conditions such as ileal diverticula, duodenal diverticula, Meckel's diverticulum, Crohn's disease, or secondary small intestinal obstruction. Primary enterolithiasis is further subdivided into "true" and "false" types. True enteroliths develop as a result of the accumulation of naturally occurring mineral substances within the intestinal lumen, whereas false enteroliths form when organic materials such as hair, fur, or fibers, or inorganic substances including aluminum or barium sulfate, act as a nidus. Secondary enterolithiasis results from the passage of gallstones into the ileal lumen through a cholecystoenteric fistula (Gurvits & Lan, 2014).

In veterinary medicine, enterolithiasis has been reported predominantly in horses. However, although enteroliths may be encountered sporadically in small animal practice, the number of cases documented in the veterinary literature remains limited, with only a few cases reported over the past 50 years (Pitcher, 1983; Barrs et al., 1999). The first feline case of enterolithiasis reported in Japan in 2006 by Yuki and colleagues significantly increased awareness that this condition is not restricted to horses and may also occur in other species (Yuki et al., 2006). Nevertheless, due to the limited number of reported cases and studies, the pathophysiology of enterolithiasis in cats has not yet been fully elucidated. In contrast, studies conducted in horses have demonstrated that magnesium- and protein-rich diets, breed predisposition, and certain therapeutic protocols may play a role in enterolith formation (University of California Davis, 2008).

Case Description

This study is a retrospective case report based on routine clinical diagnostic and therapeutic procedures. No experimental or interventional procedures were performed on animals for research purposes. All procedures were conducted in accordance with relevant institutional and ethical standards.

Case 1

The first case involved a five-year-old female cat that was housed outdoors. According to the medical history obtained from the owner, the cat had a history of multiple parturitions and had an aggressive temperament. The cat was presented to the clinic for marked lethargy and chronic weight loss. Physical examination revealed pronounced cachexia on inspection, and abdominal palpation identified multiple firm, stone-like structures. Hematologic and biochemical analyses disclosed no remarkable abnormalities other than anemia (RBC: $4.12\times10^{6}\cdot\mu L^{-1}$; reference range: $6.54–12.20\times10^{6}\cdot\mu L^{-1}$; HCT: 14.7%; reference range: 30.3–52.3%; hemoglobin: 6.3 $g\cdot dL^{-1}$; reference range: 9.8–16.2 $g\cdot dL^{-1}$). Right lateral radiographic examination demonstrated multiple small radiopaque bodies (Figure 1).Based on these findings, diagnostic laparotomy was recommended for the removal and definitive identification of the structures.

Figure 1. Abdominal right lateral radiographic image of Case 1.

Case 2

The second case involved a six-year-old, neutered male mixed-breed indoor cat. According to the medical history obtained from the owner, the cat had been presented to various clinics approximately 1.5 years earlier because of vomiting occurring once or twice weekly over a one-month period; this condition was temporarily controlled with symptomatic treatment but subsequently recurred. Over time, vomiting was partially managed with commercially available gastrointestinal diets; however, despite a preserved appetite, progressive weight loss became evident and could not be prevented despite ongoing interventions. Hematologic and biochemical evaluation revealed marked monocytosis (MON%: 63.6; reference range: 1.0–7.0), decreased hematocrit (HCT: 23.3%; reference range: 26.0–49.0), increased blood urea nitrogen (BUN: 41.8 mg·dL^{-1}; reference range: 17.6–32.8 mg·dL^{-1}), and decreased creatinine concentration (CREA: 0.62 mg·dL^{-1}; reference range: 0.8–1.8 mg·dL^{-1}), while all other hematologic and biochemical parameters were within reference limits. Left Lateral and ventrodorsal radiographic examinations revealed multiple small formations with radiopaque outer margins and radiolucent centers, similar to those observed in the first case (Figure 2). Diagnostic laparotomy was recommended to identify and remove the radiographically detected structures; however, due to the patient's poor general condition, medical management was initiated first. Treatment consisted of fluid replacement therapy comprising 15 mL Duphalyte (Zoetis, Türkiye) and 15 mL 0.9% NaCl solution (Polifarma, Türkiye) administered intravenously (IV), and 30 mL 0.9% NaCl solution (Polifarma, Türkiye) administered subcutaneously (SC), metoclopramide (Sifar, Türkiye) at 0.2 mg·kg^{-1} intramuscularly (IM), vitamin C (Bavet, Türkiye) in combination with 1 mL of a vitamin B complex (Sanofi, Türkiye), metronidazole solution (Polifarma, Türkiye) at 15 mg·kg^{-1} IV, probiotic and prebiotic (Nestlé Purina PetCare, USA) supplementation, and administration of mineral oil (Atabay, Türkiye) as a laxative. During this period, fecal passage was monitored for elimination of foreign material; although defecation occurred after two days of treatment, no foreign bodies were observed to be expelled.

Figure 2. Abdominal left lateral and ventrodorsal radiographic image of Case 2.

In both cases, ventral midline laparotomy was performed for surgical management, and diagnostic laparotomy was carried out. After completion of preoperative clinical examinations and fasting periods, butorphanol (Richter Pharma, Austria) was administered IM at a dose of 0.4 mg·kg^{-1} for premedication. Following adequate sedation, the cephalic vein was catheterized to establish intravenous access. Anesthesia was induced with propofol (Fresenius Kabi, Türkiye) at a dose of 4–6 mg·kg^{-1}, administered by slow IV injection until effect, and the patients were endotracheally intubated. Maintenance of general anesthesia was achieved with isoflurane (Adeka İlaç, Türkiye) at a concentration of 2–3% in 100% oxygen. Prior to surgical incision, pre-emptive analgesia was provided with meloxicam (Bavet, Türkiye) at a dose of 0.2 mg·kg^{-1} administered SC, and ceftriaxone (Yavuz İlaç, Türkiye) was administered IV at 25 mg·kg^{-1} for surgical infection prophylaxis. To maintain hemodynamic stability throughout the procedure, isotonic 0.9% NaCl solution (Polifarma, Türkiye) was infused intravenously at a rate of 10 mL·kg^{-1}·h^{-1}, and vital parameters were continuously monitored perioperatively using a multiparametric monitor.

During surgery, the animals were positioned in dorsal recumbency, and the surgical field was prepared in accordance with routine aseptic and antiseptic principles. A ventral midline skin incision was initiated at the level of the xiphoid process and extended caudally to the pubis. The subcutaneous tissues were dissected until the external fascia of the rectus abdominis muscle was exposed, and the linea alba was identified. Incision of the linea alba allowed exposure of the abdominal organs. Although the abdominal cavity and organs appeared generally normal, jejunoileal dilatation and ileocecal stenosis were observed. Following localization of the suspected foreign bodies by palpation, enterotomy was performed.

Outcomes

In the first case, enteroliths localized exclusively within the small intestine were removed via enterotomy. Subsequently, the enterotomy site was closed using a single-layer simple interrupted appositional suture pattern with 4-0 absorbable monofilament suture material while preserving the intestinal lumen diameter. Following irrigation of the abdominal cavity with sterile saline solution, the abdominal wall was routinely closed in anatomical layers; the linea alba was apposed using a simple continuous suture pattern with 2-0 absorbable monofilament suture material, the subcutaneous tissue was closed with 3-0 absorbable suture

material, and the skin was closed using a simple interrupted suture pattern with 3-0 non-absorbable suture material.

In the second case, markedly dilated jejunoileal segments containing enteroliths, exhibiting compromised intestinal viability characterized by severe mural thinning, discoloration, and reduced peristaltic activity, were resected, followed by end-to-end anastomosis. In both cases, the abdominal muscle layers and the median laparotomy incision were closed using standard surgical techniques. Recovery from anesthesia was uneventful in both animals. Postoperative recovery progressed without major complications, and both cats regained normal appetite, defecation, and activity levels during the follow-up period. Clinical follow-up examinations performed over a 2-month period revealed no evidence of recurrence or postoperative gastrointestinal complications, and both animals returned to normal health status. Photographs of the enteroliths removed during surgery were obtained, as well as of their cross-sectional appearances after sectioning (Figures 3 and 4). The surgically removed calculi were submitted to a specialized laboratory for compositional analysis. In one of the analyzed stones, carbonate, phosphate, calcium, and oxalate reactions were positive, indicating a composition of calcium carbonate, calcium phosphate, and calcium oxalate. In the other stone, positive reactions for carbonate, phosphate, calcium, magnesium, ammonium, and oxalate were detected, leading to the conclusion that it consisted of calcium carbonate, calcium phosphate, ammonium magnesium phosphate, and calcium oxalate (Table 1).

Figure 3. Macroscopic appearance of the enteroliths removed from Case 1.

Figure 4. Macroscopic appearance of the enteroliths removed from Case 2.

Table 1. Stone analysis results of both cases

Test Parameter	Results of Case 1	Results of Case 2
Maximum Size	1.3 cm×0.8 cm	1.2 cm×1.1 cm
Minimum Size	0.5 cm×0.3 cm	0.5 cm×0.4 cm
Color	Brown	Black
Surface	Rough	Smooth
Shape	Irregular	Oval/Irregular
Number	10	44
Color After Sectioning	Brown	Black
Chemical Analysis	Positive reactions for carbonate, phosphate, calcium, and oxalate	Positive reactions for carbonate, phosphate, calcium, magnesium, ammonium, and oxalate
Interpretation	Calculus containing calcium carbonate, calcium phosphate, and calcium oxalate	Calculus containing calcium carbonate, calcium phosphate, ammonium magnesium phosphate, and calcium oxalate

*cm: centimeter

Discussion and Conclusion

Enterolithiasis is most commonly reported in horses, whereas it is considered extremely rare in dogs and cats (Thong et al., 2024; Yuki et al., 2006). Therefore, presentation of such uncommon cases in small animal practice is important for improving diagnostic awareness and clinical recognition.

Previously reported cases have emphasized clinical signs characteristic of acute or subacute mechanical intestinal obstruction, including nausea, vomiting, abdominal pain, distension, and constipation. In addition, it has been noted that clinical manifestations may vary depending on the localization and mobility of the enteroliths within the gastrointestinal tract (Gurvits & Lan, 2014). In the two cases presented herein, weight loss, lethargy, and vomiting constituted the main clinical findings. Notably, despite the presence of a large number of enteroliths within the intestinal lumen in both cases, no overt intestinal obstruction was observed.

The exact pathogenesis of enterolith formation has not yet been fully elucidated. However, evidence from previous reports and the findings of the present cases suggest that trichobezoars may cause partial intestinal obstruction, leading to impaired motility and intestinal stasis, thereby facilitating mineral deposition on hair aggregates and promoting enterolith formation. In addition, it has been proposed that enteroliths may develop around ingested foreign materials (e.g., cat litter, stones, soil, metal fragments, marbles, wire, hair, plastic, rubber) through progressive accumulation of magnesium ammonium phosphate (struvite). Diets with high magnesium and protein content have also been considered predisposing factors for enterolith development (Yuki et al., 2006).

In a case reported by Thong et al. (2024), enteroliths were identified by abdominal ultrasonography and radiography, and subsequently removed via laparotomy, with small trichobezoars detected adjacent to the enteroliths. Similarly, in both cases presented in this study, abdominal radiographs revealed multiple radiopaque masses, and macroscopic examination of the surgically removed structures demonstrated stone-like formations resulting from deposition of calcified granular material on hairballs. These findings support a possible association between trichobezoars and enterolith formation; however, larger-scale studies are required to clarify this relationship definitively.

Previous reports, particularly in cats, have indicated that enteroliths often form through mineral accumulation around organic cores such as hair, fur, or other foreign materials (Thong et al., 2024). In the case reported by Thong et al. (2024), hair-like fibrous tissue was observed at the center of the stone, surrounded by calcium phosphate and calcium carbonate deposits. In both cases described in the present study, similar calcified material deposition around hair aggregates was identified, further supporting the hypothesis that trichobezoars may serve as a nidus for enterolith formation.

In the case reported by Yuki et al. (2006), the stones were composed of calcium phosphate and calcium carbonate, whereas Thong et al. (2024) described a composition predominantly consisting of calcium phosphate (Thong et al., 2024; Yuki et al., 2006). In contrast, the stones analyzed in the present study contained calcium carbonate, calcium phosphate, calcium oxalate, and magnesium ammonium phosphate (struvite) in varying combinations. This compositional diversity suggests that factors such as intestinal pH, dietary content, and local microcirculatory conditions may influence the direction and extent of mineral deposition.

The definitive treatment for enterolithiasis is surgical removal of the enteroliths, an approach that resulted in clinical improvement both in the present cases and in previously reported ones. However, in the presence of

accompanying intestinal stenosis or chronic inflammation, intestinal resection and anastomosis may be required (Thong et al., 2024; Yuki et al., 2006). In the cases reported by Yuki et al. (2006) and Thong et al. (2024), ileocecal resection and anastomosis were performed with favorable postoperative outcomes. Similarly, intestinal resection was required in one of the cases presented in this study. In both cases, postoperative recovery was uneventful, and no related problems were reported by the owners during follow-up.

In conclusion, although enterolithiasis is rare in cats, it should be considered in the differential diagnosis of cases presenting with chronic gastrointestinal signs and multiple radiopaque structures on abdominal radiographs. Trichobezoars and partial intestinal obstruction may act as predisposing factors for enterolith development. Further studies supported by larger case series and comprehensive metabolic analyses are warranted to better elucidate the relationship between intestinal motility disorders and enterolith formation.

Conflict of interest: No conflict of interest declared.

Obtaining Informed Consent: All participants provided written informed consent prior to data collection.

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Artificial Intelligence Usage Declaration Statement: During the preparation of this work, the author(s) used ChatGPT (OpenAI) for language and stylistic editing purposes. The use of this tool was limited to improving grammatical accuracy, clarity, coherence, and consistency of academic tone. After using this tool, the author(s) carefully reviewed and edited the content as needed and take(s) full responsibility for the content of the published article. This declaration does not apply to the use of basic tools such as those used to check grammar, spelling, and references. The author(s) hereby declare that, throughout all stages of the manuscript preparation process, including preparation, literature review, data collection, data analysis, presentation, and related processes, all ethical principles and responsibilities have been fully observed.

Data Availability Statement: The data supporting the findings of this study are available from the authors upon reasonable request after publication of the article. Corresponding Author Contact: ebru.eravciyalin@iuc.edu.tr.

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