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Endoscopic Removal of Sewing-needle Gastric Foreign Bodies in Cats: A Retrospective Analysis of 24 Cases

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In this retrospective study, the aim was to determine the clinical findings and procedural success factors influencing the outcome of endoscopic removal of foreign bodies from the stomach in 24 cats that were confirmed radiographically that had been ingested penetrating and sharp sewing needles and were presented to the Surgery Department of Dicle University Faculty of Veterinary Medicine between 2020 and 2024. Parameters evaluated included operator experience, presence of gastric content, presence or absence of thread attached to the needle, duration of the endoscopic procedure, and the time interval between ingestion and intervention, in relation to procedural success and complications. Endoscopic retrieval of the needle was successful in 18 out of 24 cases (75%), while the combined success rate of both endoscopic and surgical interventions resulted in 23 out of 24 cats (95.8%) being discharged in good health. The success rate of endoscopic procedures was significantly higher (p<0.05) and the procedure duration was shorter in cases without gastric content. In all unsuccessful cases, gastric content was present, which was observed to obscure the field of vision and complicate the procedure. Minor complications included mild gastric mucosal hyperemia and superficial mucosal bleeding observed during endoscopy in some cases. Needle migration was not detected in any of the cases. Based on these findings, although it is well known that sharp and penetrating foreign bodies such as sewing needles pose a risk of gastrointestinal migration and require emergency intervention, we suggest that performing serial radiographs and monitoring for gastric content evacuation may significantly improve success rates of endoscopic removal. Therefore, we believe that rapid diagnosis, proper patient preparation, and well-timed intervention are crucial in the management of such foreign bodies in cats. Furthermore, clarifying the localization through serial radiography and allowing time for gastric content evacuation may reduce complication risks and make the treatment process safer.

Key Words: *Cat, endoscopy, radiography, sewing needle, veterinary emergency*

Kedilerde Gastrik Yabancı Cisim Olarak Dikiş İğnelerinin Endoskopik Yöntemle Çıkarılması: 24 Vakanın Retrospektif Analizi

Bu retrospektif çalışmada, 2020–2024 yılları arasında Dicle Üniversitesi Veteriner Fakültesi Cerrahi Anabilim Dalı Kliniklerine başvuran ve radyografik olarak batıcı-delici dikiş iğnesi yuttuğu saptanan 24 kedide, non-invaziv bir yöntem olan endoskopik girişimle mide içerisinden yabancı cismin çıkarılmasında başarıyı etkileyen bulgular ve girişime ilişkin başarı faktörlerinin belirlenmesi amaçlandı. Operatör deneyimi, mide içeriği varlığı, iğneye bağlı ip bulunup bulunmaması, endoskopik müdahale süresi ile yutma ve girişim arasındaki sürenin, işlem başarısı ve komplikasyonlarla olan ilişkisi değerlendirildi. Endoskopik girişimle iğne çıkarılması 18/24 (%75) olguda başarılı olurken, endoskopik ve operatif yöntem dikkate alındığında 23/24 (%95,8) olgunun sağlıklı şekilde taburcu edildiği belirlendi. Endoskopik müdahale ile yabancı cismin uzaklaştırılmasındaki başarının mide içeriği bulunmayan olgularda istatistiksel olarak anlamlı düzeyde yüksek olduğu (p<0.05) ve işlem süresinin daha kısa sürdüğü tespit edildi. Başarısız vakaların tamamında mide içeriği mevcut olduğu bu durumun görüş alanını kısıtladığı ve müdahaleyi zorlaştırdığı gözlemlendi. Minör komplikasyonlar arasında bazı olgularda endoskopi uygulaması sırasında mide mukozasında sınırlı hiperemi ve yüzeysel mukozal kanama odakları belirlenirken iğnenin göç durumu belirlenmedi. Bu bulgular doğrultusunda, dikiş iğnesi gibi batıcı ve delici yabancı cisimlerin gastrointestinal sisteme göç etme riski nedeniyle acil müdahale gerektirmesi bilinmesine rağmen endoskopik yöntemle çıkarılmasında başarı oranlarını arttırmak için seri radyografiler alınarak mide içeriğinin boşalmasını kontrollü bir şekilde izlenilmesinin başarı oranında oldukça önemli olabileceğini düşünüyoruz. Bu nedenle, kedilerde bu tür yabancı cisimlerin yönetiminde hızlı tanı, uygun hasta hazırlığı ve zamanlamanın planlı yapılması, endoskopik girişimlerin başarısını arttırabileceği kanaatindeyiz. Ayrıca, seri radyografilerle lokalizasyonun netleştirilmesi ve mide içeriğinin boşalmasının beklenmesi, komplikasyon riskini azaltarak tedavi sürecini daha güvenli hâle getirebilir.

Anahtar Kelimeler: *Kedi, endoskopi, radyografi, dikiş iğnesi, veteriner acil*

Introduction

Foreign body (FB) ingestion is a common reason for emergency visits in small animal veterinary practices. Depending on its nature, it may lead to serious complications such as gastrointestinal obstruction or perforation (1). The severity of clinical signs associated with gastrointestinal FB ingestion depends on several factors, including the location of the FB (esophagus, stomach, or duodenum), its size and type (particularly whether it poses a risk of mucosal trauma), the duration of obstruction, and

the overall condition of the patient. Common clinical manifestations include hypersalivation, vomiting, abdominal pain, anorexia, hematemez, absence of defecation, and diarrhea (2-6).

In veterinary medicine, there is limited information regarding the ability of sewing needles to pass through the gastrointestinal tract, the incidence of perforation, and the diagnostic and interventional approaches that aid clinical decision-making. Retrospective studies in human medicine have reported that approximately 65% of ingested sharp objects pass through the gastrointestinal system without complications (7) reports that perforation occurs in 15-35% of cases (1). According to the guidelines published by the American Society for Gastrointestinal Endoscopy (ASGE), endoscopic removal is recommended for all ingested sharp objects in humans (8). In veterinary medicine, a general lack of owner awareness regarding the timing of FB ingestion often results in diagnosis and treatment being based on the onset of clinical signs. Consequently, there are few studies in the veterinary literature focusing on sharp foreign objects such as sewing needles, which may not cause obstruction but carry a significant risk of tissue penetration due to their pointed ends. Case reports involving the migration of sewing needles have been documented but remain limited in number (8, 9) and several retrospective studies including descriptions of sewing needle foreign bodies (10, 11). Although several case reports and retrospective studies on sewing needle migration have been published in the veterinary literature, there is currently a lack of strong evidence supporting specific recommendations for their management. Nevertheless, it is commonly advocated that sewing needle foreign bodies be removed—either endoscopically or surgically regardless of clinical presentation, due to their potential to cause perforation and migration (1, 12).

The primary aim of this retrospective study was to evaluate the clinical and procedural factors influencing the success of non-invasive endoscopic removal of sharp sewing needle foreign bodies from the stomachs of cats. Specifically, the study focused on assessing the impact of the operator's level of experience, the presence or absence of gastric contents, the existence of an attached thread on the needle, the duration of the endoscopic procedure, and the time elapsed between ingestion and intervention. In addition, the study aimed to determine the association of these variables with procedural success rates and the incidence of complications during or following endoscopic intervention.

Materials and Methods

Research and Publication Ethics: This study protocol was approved by the Dicle University Health Sciences Application and Research Center Animal Experiments Local Ethics Committee (Approval number: 26/03/2025-16-03).

Animal Material: The material of this study consisted of the retrospective evaluation of medical records from 24 cats of various breeds, sexes, ages, and body weights, which were presented to the Department of Surgery at the Faculty of Veterinary Medicine, Dicle University, between 2020 and 2024. All included cases had confirmed radiographic evidence of sewing needle ingestion and sufficient medical data available for analysis

Diagnosis: The medical records of cats that had ingested sewing needles were reviewed, and only those cases were included in which the needle was radiographically confirmed to be located in the stomach, the clinical history (anamnesis) was complete, and an endoscopic intervention was performed. The data included the success or failure of endoscopic retrieval, the presence or absence of a thread attached to the needle, any surgical or alternative procedures performed in cases of failed endoscopy, post-procedural complications, and available endoscopic video recordings. The study design was based on the categorization described by Maggi et al. (13), which included classification of clinical symptoms as gastrointestinal, respiratory, or non-specific. The operator's experience was categorized as novice (<50 endoscopic procedures per year), intermediate (50–150 per year), or expert (>150 per year). The duration of the extraction procedure was also categorized as excellent (<30 minutes), good (<60 minutes), acceptable (<90 minutes), or unacceptable (>90 minutes). Complications were classified as minor—such as localized hyperemia, edema, or minor mucosal bleeding—or major, including mucosal erosion/ulceration, gastrointestinal wall perforation, or death. In all cases, ratigator grasping forceps was used for the endoscopic removal of the sewing needle from the stomach. The duration of the extraction procedure was recorded as the time elapsed from the insertion of the endoscope into the oral cavity to its withdrawal.

Statistical Analysis: Descriptive statistics were calculated for all variables. The Shapiro–Wilk test was used to assess the normality of continuous variables, and Levene's test was applied to evaluate homogeneity of variances. For continuous variables, Pearson's correlation coefficient was used when normal distribution was confirmed, while Spearman's rank correlation coefficient was applied in non-normally distributed data. For the analysis of relationships between categorical variables, Fisher's Exact Test was employed due to low observed frequencies (<5) in some contingency table cells. This test was used to evaluate the association between gastric content presence and clinical parameters such as time from ingestion to intervention and endoscopic procedure duration.

A significance level of $p<0.05$ was considered statistically significant. All p-values were reported as exact values. Statistical analyses were performed using IBM SPSS Statistics software (version 28.0; IBM Corp., Armonk, NY, USA).

Results

This study included 24 cats in which the ingestion of sharp, penetrating suture needles was confirmed through radiographic imaging. Radiographs revealed the presence of suture needles of various lengths and thicknesses located within the stomach in all cases (Figure 1). Among the included cats, 58.3% (n=14) were male and 41.7% (n=10) were female. Ages ranged from 7 to 45 months, with 14 cats younger than 18 months and 10 cats older than 18 months. The average body weight was 4.2±1.6 kg. The most frequently represented breed was Tabby (n=9), followed by Scottish Fold (n=7), mixed breed (n=4), Turkish Angora (n=3), and British Shorthair (n=1).

In this study, it was found that 12 cats visited the clinic within the first 24 hours after ingesting the swing needle, while the other 12 visited after 24 hours. Among all cases, 21/24 (87.5%) cats had a medical history indicating that the ingestion of the swing needle was either confirmed or suspected. Additionally, 19/24 (79.1%) cats had a swing thread of varying lengths attached to the needle. For cats presenting within the first 24 hours, the medical histories included severe hypersalivation, dyspnea, dysphagia, restlessness, and hyperactivity, with 7/12 exhibiting these signs. In contrast, for cats presenting after 24 hours, the medical histories indicated anorexia, dysphagia, immobility, a hunched operate, apathy, and retreat to remote areas, with these symptoms reported in 9/12 cats.

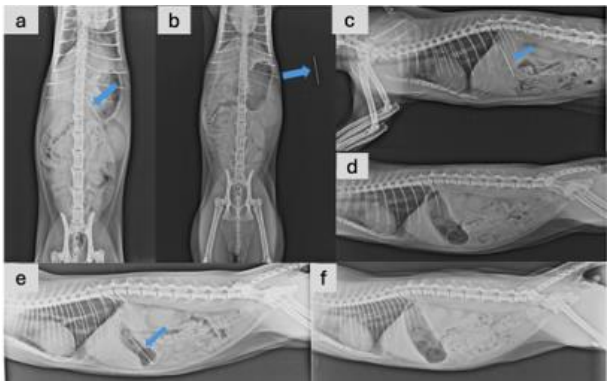

Figure 1. Radiographic images of the cases in the study. **A.**Diagnostic radiograph of the second case and the sharp-tipped foreign body, the sewing needle, indicated by the blue arrow. **B.** Sharp-tipped sewing needle removed from the stomach with the help of endoscopy and subsequent V/D radiographic image of case two. **C.** Diagnostic radiograph of case fourteen and the sharp-tipped foreign body, the sewing needle, indicated by the blue arrow. **D.** Sharp-tipped sewing needle removed from the stomach with the help of endoscopy and subsequent L/L radiographic image of case fourteen. **E.**Respiratory distress and foreign body sharp-tipped sewing needle presence detected on clinical examination due to effusion in the thorax with diagnostic L/L radiography case twenty-two. **F.** Successful removal of the suture needle with the help of endoscopy and aggravation of the effusion after the procedure with L/L radiography case twenty-two

The time spent attempting endoscopic removal of the swing needle varied, with <30 minutes in 5/24 (20.8%), 30-60 minutes in 11/24 (45.8%), and 60-90 minutes in 8/24 (33.4%). The removal of the swing needle was successful in 18/24 (75%) cats, while failure occurred in 6/24 (25%). In cases where the swing needle could not be removed endoscopically, surgical procedures were performed. Following both endoscopic and surgical interventions, 23/24 (95.8%) cats were discharged in healthy condition.

The cases were divided based on the presence or absence of gastric fullness, with 17/24 (70.8%) having no stomach content and 7/24 (29.2%) having stomach content (Table 1). Among the 6 cats where needle removal was unsuccessful, all had stomach content present. Three of these cats had unknown ingestion times in their medical history. In four of the unsuccessful cases, the endoscopic procedure was stopped after exceeding 90 minutes, while in the remaining two cases, there was an excess of stomach content and the absence of a thread on the needle, as indicated in the hospital records.

The cases were managed by two distinct operators, each performing approximately 110-120 endoscopic procedures annually. It was presumed that both operators possessed a moderate level of experience in the field.

As a result of the statistical analyses, when the clinical findings of the patients were examined, it was observed that 50% of the cases received intervention within 24 hours, 45.8% had an endoscopic duration between 30 and 60 minutes, 75% had successful removal of the foreign body, 70.8% had no gastric fullness, and 62.5% experienced no complications during the removal procedure.

When the relationship between clinical findings and the presence of gastric fullness was evaluated, it was found that 58.3% of the cases that received intervention within 24 hours had gastric fullness.

Table 1. Valuations regarding clinical findings

	Clinical Findings	n	%
Time from ingestion to intervention	< 24 hours	12	50.0
	> 24 hours	12	50.0
	Total	24	100.0
Endoscopic duration	less than 30 min	5	20.8
	30-60 min	11	45.8
	60-90 min	8	33.3
	Total	24	100.0
Removal success	Yes	18	75.0
	No	6	25.0
	Total	24	100.0
Gastric fullness	No	17	70.8
	Yes	7	29.2
	Total	24	100.0
Comlications	Yes	9	37.5
	No	15	62.5
	Total	24	100.0

Statistical comparisons revealed a significant association between the time elapsed from foreign body ingestion to intervention and the endoscopic duration with the presence of gastric fullness (p<0.05, Table 2). When clinical findings were evaluated in relation to the presence of complications, no statistically significant difference was found in terms of the time from swallowing the foreign body until the time of intervention and the endoscopic duration (p>0.05, Table 3).

When the observed complications were examined, no major complications were detected in any cases where the foreign body was removed with the help of endoscopy. As for minor complications, no ruptures were observed, except for the presence of mild hemorrhagic foci localized in the gastric mucosa during endoscopy. However, in only one case, the patient presented with hematemesis one day after the procedure and get well after medical treatment.

During the attempt to remove the suture needle with endoscopic assistance, it was observed that the thread attached to the needle often broke, and the procedure had to be repeated to locate the needle, resulting in an extended duration. When removing a penetrating suture needle through endoscopy, the presence of gastric fullness significantly limited the ability to maneuver the needle or locate it within the contents. As a result, the time spent on endoscopic removal was found to increase. In cases without gastric fullness, the removal of the suture needle via endoscopy was observed to be both quicker and easier (Figure 2).

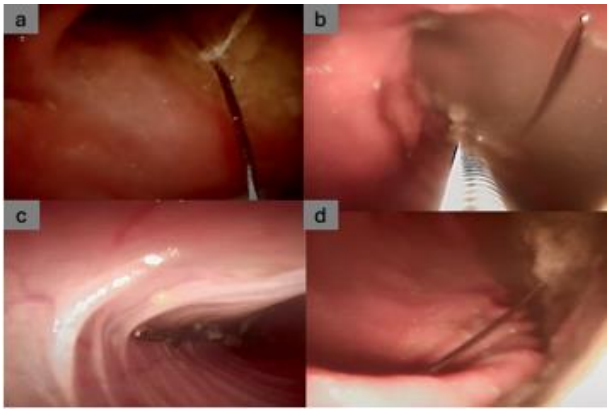

Figure 2. Difficulties identified during endoscopy for removal of sewing needles. **A.** The thread attached to the sewing needle was used as a guide, allowing the needle to be reached in a short time. **B.** Difficulty in reaching and removing the sewing needle when the patient has gastric fullness. **C.** Second intervention is performed to remove the thread and needle that broke in the esophagus as a result of grasping the thread attached to the sewing needle with forceps. **D.** Sewing needle inserted into gastric fullness and gastric mucosa in the case

Table 2. Clinical findings based on gastric fullness

Clinical Findings	Gastric Fullness – No (n=17)	Gastric Fullness – Yes (n=7)	*p*-value
Time from ingestion to intervention			
< 24 h (n=12)	5 (41.7%)	7 (58.3%)	0.018*
> 24 h (n=12)	12 (100.0%)	0 (0.0%)	
Endoscopic duration			
< 30 min (n=5)	5 (100.0%)	0 (0.0%)	
30–60 min (n=11)	11 (100.0%)	0 (0.0%)	0.007*
60–90 min (n=8)	1 (12.5%)	7 (87.5%)	

Values represent number of cases (%). *not significant at p<0.05

Table 3. Clinical findings based on complications

Clinical Findings	No Complications (n=15)	Complications (n=9)	Exact *p*-value
Time from ingestion to intervention			
< 24 h (n=12)	4 (33.3%)	8 (66.7%)	0.657
> 24 h (n=12)	5 (41.7%)	7 (58.3%)	
Endoscopic duration			
< 30 min (n=5)	2 (40.0%)	3 (60.0%)	
30–60 min (n=11)	5 (45.5%)	6 (54.5%)	0.772
60–90 min (n=8)	2 (25.0%)	6 (75.0%)	

Values represent number of cases (%).

Discussion

The high success rate and low complication rate observed in our study support the notion that endoscopic removal of foreign bodies is the first-line treatment method. Although there is no clear consensus in the field of veterinary medicine, the need for definitive treatment of cats that have ingested a sewing needle or exhibit clinical signs attributable to a sewing needle, due to concerns about potential life-threatening complications such as extra-gastrointestinal migration (8), is considered standard care in veterinary teaching hospitals, similar to human medicine (14, 15). In our hospital, animals known to have ingested a sewing needle or displaying clinical signs attributable to needle ingestion are routinely provided with definitive treatment due to concerns over gastrointestinal migration (8), which could lead to life-threatening complications. The success rate of endoscopic removal of sewing needles, a sharp foreign body, from the stomach in this retrospective study was found to be 18/24 (75%). The aim of this study is to explore the factors that influence the success of non-invasive endoscopic removal of sewing needles.

In the current study, when the age range of the 24 cases was evaluated, the average age of the cases being close to 1 year is consistent with previously reported findings. Indeed, Pratt et al. (1) noted that the cases were under 2 years of age; Crino et al. (16). reported the median age of the cases as 1 year. Gülaydın and Akgül (17), suggest that the occurrence of foreign body ingestion is more common in young cats and is associated with factors such as feeding habits, a desire to play, and lack of experience. In addition to these explanations, it can be argued that the pet owner's home environment and lifestyle may also play a role. Considering the age distribution of the cats included in our study, the current findings align with this perspective.

In the study conducted by Pratt et al. (1), it was stated that 63.8% of cats with clinical signs associated with a suture needle foreign body were asymptomatic, while Crino et al. (16) reported that 82.3% of cats diagnosed with sharp foreign bodies presented without clinical signs. However, in contrast to their findings, in our study, 87.5% of the cases involved cats that were either symptomatic or presented with clinical signs associated with the ingestion of a sharp foreign body. The most common reason operat clinic visit, as indicated by the patients' histories, was the presence of clinical symptoms. Additionally, the most prominent symptoms reported in cases that were seen within the first 24 hours were hypersalivation, vomiting, and retching. In contrast, the symptoms found in the 9 cases that were seen after 24 hours included vomiting, retching, dysphagia, lethargy, anorexia, and abdominal pain. Contrary to the aforementioned studies, the clinical symptom rate in our study was identified as 66.6%, leading to different findings in this aspect. In the 3 cases where no foreign body ingestion was diagnosed, symptoms such as anorexia, dysphagia, vomiting, retching, and dyspnea were present.

The high rate of identifying a sharp foreign body in our study, coupled with the clear identification of clinical symptoms by the pet owners, may explain the observed difference. This could be due to the fact that once the pet owners realized that their cat had ingested a sharp foreign body, they were more likely to observe the cat more closely. Furthermore, we believe that the thread attached to the suture needle may have contributed to hypersalivation during the ingestion process. The clinical signs of vomiting, retching, and dyspnea could also be attributed to the presence of the thread, and its excessive presence may have led to the more pronounced symptoms observed in our study. Additionally, since the study exclusively involved cats, which are known to be more sensitive to foreign bodies, this could have contributed to the clearer presentation of symptoms.

In the present study, there was a high success rate in the endoscopic removal of suture needle foreign bodies from the stomach, and failures were attributed to the inability to visualize the needle due to gastric fullness or the termination of the procedure after exceeding 90 minutes, which necessitated conversion to surgical intervention. The causes of failure were similar to those reported in previous studies, which indicated that increased gastric air ingestion, the presence of gastric contents, or fluids could complicate endoscopic foreign body removal (18). In our study, these factors were identified as the most significant reasons for failure on the other hand, Pratt et al. (1) stated in their study that they did not encounter any evidence of gastric fullness, which contrasts with the findings of the present study. These differences may be attributed to factors such as the type and location of the foreign body, the experience of the operator, and the type of endoscope used.

There are reports indicating that complications such as the thread detaching from the suture needle during the attempt to grasp and remove it via endoscopy, or sometimes the needle becoming trapped within the endoscope, can extend the procedure time and lead to unsuccessful outcomes (18, 19). In the cases noted among the complications in the present study, instances were observed where the thread became detached during the attempt to grasp and pull the suture needle with forceps due to the presence of gastric contents, or where the needle became trapped in the endoscopic lumen. These complications were noted as factors that contributed to the extension of the procedure time. To prevent these complications, we believe it would be more appropriate to use the thread as a guide and remove the suture needle by holding it from its tip, rather than attempting to grasp the thread with forceps.

A previous veterinary study conducted to evaluate the success of endoscopy for foreign body removal (20) reported success rates ranging from 26% to 86%. In our study, endoscopy was successful in 18/24 cases, yielding a success rate of 75%, which is relatively high and comparable to other veterinary studies. However, a different study, which is considered the first to report endoscopic success rates for the removal of suture

needles from cats' stomachs, achieved a success rate of 26/28 (92.9%) (1). The success rate in our study was lower than this, but we believe this discrepancy can be attributed to the retrospective nature of our study and the higher number of unsuccessful cases resulting from the presence of gastric fullness, particularly since half of the cases were emergency interventions.

Although various treatment options for suture needle ingestion have been reported, endoscopy, a non-invasive method, has yielded highly successful results in removing the suture needle. Previous reports have shown that 98.1% of the patients treated with this approach survived and were discharged. On the other hand, earlier studies reporting a gastrointestinal system perforation rate of 17.2% (10/58) align with similar rates found in humans (ranging from 15% to 35%) (14, 15). In the present study, the absence of any perforations can be attributed to the high incidence of foreign body ingestion observed in the cats, the retrospective nature of the study, and the early intervention of the cases. Additionally, the high survival rate of 95.8% suggests that, similar to humans, the intervention for penetrating foreign bodies is necessary to achieve successful outcomes.

Crino et al. (16) conducted a retrospective study on a total of 17 cases (13 dogs and 4 cats), in which they evaluated the conservative treatment of metallic sharp objects. The study reported that 15 out of the 17 cases were successful. As stated in the study conducted, cases that could not be removed endoscopically or were not subjected to surgical treatment were retrospectively evaluated, and only 4 cats were included in the study. In the present study, only cats were involved, and in line with the recommendation for the emergency endoscopic removal of sharp foreign bodies, as indicated in both human and veterinary literature, all cases were intervened with endoscopic procedures. Furthermore, this study's sample being composed solely of cats and the fact that even in cases where a foreign body was not observed to have been ingested, the presence of a metallic foreign body in the stomach, does not align with recent reports on this topic.

According to the data from the present study, during the endoscopic removal of the sewing needle using a non-invasive method before 24 hours, no gastric fullness were found in 5 cases, while the presence of gastric fullness was detected in 7 cases. Additionally, in the cases intervened after 24 hours, gastric fullness were not found in any of the 12 cases, and the statistical analysis revealed a significant difference, suggesting that in cases without gastric fullness, both the endoscopic duration and the likelihood of achieving successful results could be enhanced. Furthermore, among the cases without gastric fullness, 5 had endoscopic procedures lasting less than 30 minutes, while 11 cases had durations of 30-60 minutes. In contrast, the foreign body removal time in 1 case without gastric fullness and in 7 cases with gastric fullness was between 60-90 minutes. Specifically, for the cases intervened after 24 hours, the absence of gastric fullness and the reduction in endoscopy time were statistically identified as factors that decreased the risk of complications and increased the chances of achieving successful outcomes.

Based on the findings of the present study, in cats where the ingestion of penetrating and sharp foreign bodies, such as a sewing needle, was observed by the pet owner and the time of ingestion was clearly known, it was concluded that hospitalization of the animal for serial radiographs and endoscopic intervention performed after the gastric fullness have emptied would shorten the intervention time, facilitate the successful removal of the needle, and reduce the risk of complications. Additionally, in cases where the needle is ingested along with thread material, it is suggested that the thread can be used as a visual guide during the endoscopic procedure, allowing quicker and safer access to the needle. However, instead of directly gripping the thread, holding the needle's tip is recommended, as this will prevent the thread from breaking and the foreign body from falling into the stomach, thus preventing prolonged procedure times and potential complications.

In conclusion, endoscopic interventions performed in cases where gastric fullness are absentstomach is not full and the time of ingestion is known have a higher success rate and a significantly shorter procedure time.

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