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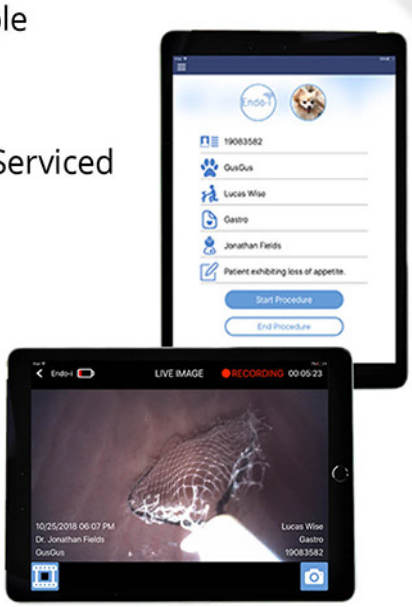

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Risk Factors for Death in Dogs Treated for Esophageal Foreign Body Obstruction: A Retrospective Cohort Study of 222 Cases (1998–2017)

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Background: Limited data exist describing risk factors for death, and long-term outcomes in dogs with esophageal foreign body (EFB) obstruction.

Hypothesis/Objectives: To evaluate short- and long-term outcomes, and analyze risk factors for death in dogs with EFB obstruction. We hypothesized duration of entrapment and treatment type would affect outcome.

Animals: A total of 222 dogs were treated for EFB obstruction at an emergency and referral hospital between March 1998 and March 2017.

Methods: Medical records for dogs with EFB were retrospectively evaluated.

Results: Foreign material most frequently was osseous (180/222 [81%]), with distal esophagus the most common location (110/222 [49.5%]). Duration of clinical signs was not associated with risk of death (OR = 1.08, 95% CI 0.99–1.17; $P = 0.2$). Entrapment was treated by endoscopy (204/222 [91.8%]), surgery after endoscopic attempt (13/222 [5.9%]), and repeat endoscopy after surgery was recommended but declined (5/222 [2.3%]). In-hospital case fatality rate was 11/222 (5%). Risk of death was significantly higher with surgery (OR = 20.1, 95% CI 3.59–112.44; $P = 0.001$), and 5/5 (100%) of dogs died if undergoing endoscopy after surgery was recommended but declined. Increasing numbers of postprocedural complications (OR = 3.44, CI 2.01–5.91; $P < 0.001$), esophageal perforation (OR = 65.47, CI 4.27–1004.15; $P = 0.003$), and postprocedure esophageal hemorrhage (OR = 11.81, CI 1.19–116.77; $P = 0.04$) increased in-hospital risk of death. Esophageal strictures were reported in 4/189 (2.1%) of survivors available for follow-up.

Conclusions and Clinical Importance: Death is uncommon in canine EFB; however, treatment type affects outcome, and these data should be used to guide decision-making in dogs with EFB.

Key words: Canine; Endoscopy; Esophageal stricture; Esophagitis; Esophagoscopy.

Esophageal foreign body (EFB) obstruction is a common condition in dogs.[1–8] Entrapment of material within the esophageal lumen can result in numerous acute complications including ulceration and esophagitis,[7] esophageal perforation, pneumothorax, pneumomediastinum,[9] and even aortic perforation.[10] Compli cations secondary to obstruction can have a delayed onset, such as broncho-esophageal fistulae and esophageal strictures.[3,5,11,12] Due to the potential for these serious and often life-threatening complications, EFB obstruction is considered an emergency.

Abbreviation:

EFB	esophageal foreign body

Relatively few large retrospective studies have been published on this topic. To the authors' knowledge, 7 studies with >50 cases are reported in the English veterinary literature;[1,6,7,9,13–15] however, 5 of these report only descriptive statistics and do not investigate the importance of different factors that might contribute to complications or death. Of the limited number of studies to investigate such factors, most focus on risk of complications such as esophagitis. Prolonged entrapment of foreign material within the esophagus increases the risk of developing moderate to severe esophagitis,[2] and severe esophagitis increases the risk of other complications such as esophageal stricture, perforation of the esophagus, and aspiration pneumonia.[7] One study demonstrated an increased risk of death with duration of clinical signs >3 days,[1] although esophageal and gastric foreign bodies were analyzed together. Treatment type to relieve obstruction (endoscopic removal versus surgery) was not associated with death in one study.[4]

The objectives of this study were to report the clinical features of EFB in a large cohort of dogs, describe the short- and long-term outcomes, and analyze potential independent risk factors associated with death. We hypothesized that prolonged entrapment of foreign material, and the treatment method employed would lead to increased complication and case fatality rates.

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Materials and Methods

Case Selection

Dogs with EFB obstruction were identified retrospectively by evaluating the computer records of all dogs undergoing endoscopy, thoracotomy, or EFB removal at Queensland Veterinary Specialists and Pet Emergency between March 1998 and March 2017. These databases were then searched for all animals with endoscopic or radiographic assessment confirming a diagnosis of EFB obstruction. Dogs were included if endoscopic or surgical intervention was attempted to treat the obstruction. Cases in which euthanasia was requested without any attempts at treatment, or where treatment was declined, were excluded from this study because lack of survival was independent of efforts at clinical intervention.

Medical Records Review

Details extracted from the medical records included signalment (age, sex, body weight, and breed), clinical signs and duration of these before presentation, radiographic and endoscopic findings, methods of treatment, and acute complications associated with removal efforts. Location of the obstructed material within the esophagus was based on radiographic and endoscopic reports. Location of entrapment was classified as being at or cranial to the thoracic inlet, between the thoracic inlet and the heart base, or in the distal esophagus caudal to the heart base.

Endoscopy was performed using either flexible or rigid endoscopy. Foreign material subsequently was removed PO via forceps or pushed distally into the stomach. The recommendation for surgical intervention was decided by the endoscopist at the time of the procedure. Numerous factors were cited in the medical records that influenced this decision, including ease of endoscopic removal/amount of traction required to dislodge the obstruction, subjective assessment of degree of esophagitis, gross appearance of the esophageal mucosa, and the suspected presence of perforation.

Long-term assessment was achieved via telephone interview with owners and referring veterinarians by 2 authors (AGB and CTT), using a standardized questionnaire. A minimum period of 3 months after discharge was required before long-term outcome was evaluated. The information obtained included any ongoing clinical signs, the duration of these signs after the procedure, and if any diagnostics were performed to investigate these clinical findings. Cause of death of those animals identified as dead at the time of follow-up was determined to be related to, or unrelated to EFB obstruction. Owners were questioned on any dietary changes, whether or not their animal was allowed subsequent access to the obstructing material, and if any further episodes of esophageal obstruction occurred.

Statistical Methods

Descriptive statistics were compiled. Variables were assessed for normality by a Shapiro-Wilk test, and for those not normally distributed, the median and range are reported. Logistic regression analyses were performed to investigate the risk of death associated with different variables. Variables analyzed included age, sex, weight, signalment combined, clinical signs, number of clinical signs, duration of clinical signs before presentation, location of foreign material within the esophagus, type of foreign material, procedural complications, number of procedural complications, and treatment method. For statistical analyses, type of foreign material data were categorized as bone/cartilage, fishhook, and others. Statistical analyses were performed by commercial software.[a] A value of $P < 0.05$ was considered significant.

Results

The medical records of 230 dogs in which radiographic or endoscopic evidence of EFB obstruction was reported were identified. Two hundred and twenty-two of these cases were found to be eligible for this study after the exclusion of those dogs in which euthanasia was requested without treatment (n = 6/8), or treatment was declined (n = 2/8).

All continuous variables were checked for normality and were not found to be normally distributed (data not shown). Median age of affected dogs was 5.3 years (range, 0.2–15 years). There were 126 females (103 spayed) and 96 males (66 neutered). Median body weight was 15.7 kg (range, 0.8–60 kg). Age ($P = 0.55$), sex ($P = 0.27$), weight ($P = 0.1$), and signalment combined ($P = 0.36$) did not affect outcome. Fifty breeds of dogs were represented. West Highland White Terriers (n = 22) and Labradors (n = 22) were the most commonly represented breeds, followed by Staffordshire Bull Terriers (20), Maltese (17), Boxers (14), and Chihuahuas (n = 10).

Clinical signs were recorded in 200/222 (90.1%). A subset of dogs (n = 22) presented with no clinical signs, and only a history of ingesting foreign material. Dogs with clinical signs had a median of 2 clinical signs (range, 1–6), including vomiting, regurgitation or both (n = 142), gagging, retching or both (66), lethargy (54), ptyalism (50), anxiety (47), inappetence or anorexia (37), altered respiration (32), cough (25), postural changes (15), recumbency (4), vocalization (4), halitosis (1), and cyanosis (1). The median duration of clinical signs reported before presentation was 1 day (range, 1 hour to 42 days). Known access to foreign material that would subsequently become entrapped in the esophagus was reported in 190 dogs. In 17/222 dogs (7.7%), it was specifically noted by the owner that there was no known access to the obstructing material.

Survey radiographs were diagnostic in most cases (215/222 [96.8%]), ranging from single-view to three-view series. In the remaining cases (7/222 [3.2%]), a contrast study was utilized to further delineate the obstruction. Barium was used in 6 of these cases, and barium impregnated polyspheres (BIPS) were used in 1 dog. Of these 7 cases, obstructive material was bone (n = 3), meat (2), and cartilage (2). Obstruction was most commonly caused by osseous material ± cartilage (180/222 [81.0%]), followed by fish hooks (15/222 [6.8%]). Other foreign bodies accounted for 27 cases (12.2%) including meat (8/222 [3.6%]), rawhide chews (7/222 [3.2%]), wooden skewers (4/222 [1.8%]), pig ears (4/222 [1.8%]), dog biscuits (2/222 [0.9%]), pig snout (1/222 [0.5%]), and raw carrot (1/222 [0.5%]). Obstructing material was located most commonly in the distal esophagus, caudal to the heart base (110/222 [49.5%]), and less commonly between the thoracic inlet and heart base (75/222 [33.8%]), and proximal to the thoracic inlet (37/222 [16.7%]).

Endoscopy was attempted in all 222 cases. It was determined in 18/222 (8.1%) dogs that surgical intervention was required to safely remove the obstructed

material. In these cases, foreign material was located proximal to the thoracic inlet (n = 2/18), between the thoracic inlet and the heart base (n = 3/18), and in the distal esophagus (n = 13/18). Surgery was performed immediately after endoscopy in 13/222 (5.9%) dogs via left intercostal thoracotomy. Foreign material was removed via a single incision into the esophageal lumen, and thoracostomy tubes were placed in all surgery cases. No mention of concurrent lesions was documented in surgery reports. Fatality rate for surgical cases was 3/13 (23.1%). Cause of death was poorly defined as acute deterioration with severe respiratory distress in all 3 cases and occurred 1, 3, and 5 days postoperatively. No necropsies were performed. For the 5 dogs in which surgery was recommended but declined by the owner, flexible endoscopy was re-attempted. All cases had material in the distal esophagus, caudal to the heart base with increased traction applied to dislodge foreign material. Full thickness perforation, pneumothorax, and sudden death were reported in all 5 (100%) dogs.

Endoscopy was recommended and was used to successfully relieve the obstruction in the majority of dogs (204/222 [92%]). Of those treated with rigid endoscopy 41/204 (20%), foreign material was extracted *per os* (38/41 [93%]) or advanced into the stomach (3/41 [7%]). Using flexible endoscopy (163/204 [80%]), oral delivery (114/163 [69.9%]) and distal advancement (45/163 [27.6%]) were also utilized, with a small number of cases where material was both pushed distally and then removed *per os* (4/163 [2.5%]). Fatality rate for endoscopy recommended and performed was 3/204 (1.5%), with flexible endoscopy removal resulting in sudden death in all 3 cases due to one or more of esophageal perforation, pneumomediastinum, or pneumothorax.

All 222 cases, were assessed for the presence and type of acute complications after treatment. The median number of complications was 1 (range, 0–5). Acute complications were recorded in 134/222 (60.3%) cases. Varying degrees of mucosal ulceration and esophagitis were the most common finding (n = 86) with multiple other lesions described including erythema (46), hemorrhage (31), perforation (19), necrosis (16), pneumothorax (14), pyothorax (4), and pneumomediastinum (3). Broncho-esophageal fistula was diagnosed in 1 dog at the time of treatment. The duration of clinical signs before presentation in that dog was 11 days. None of these complications reported after the procedure were reported to be present before treatment.

Overall, 211 dogs were discharged from the hospital alive and 11 dogs died during their hospital stay (5%, 95% CI = 2.75–8.76). All dogs with EFB obstruction proximal to thoracic inlet (n = 37/37 [100%]) survived until discharge, while 72/75 (96%) dogs with obstruction between the thoracic inlet and heart base, and 102/110 (92.7%) with their foreign body located in the distal esophagus, caudal to the heart base survived until discharge. There was no significant difference in survival based on location of foreign material (OR = 2.74, 95% CI 0.87–8.69, $P = 0.05$). Foreign body composition was not associated with risk of in-hospital death ($P = 0.4$), and 171/180 (95%), 15/15 (100%), and 25/27 (92.6%) dogs with bone, fishhook, and other foreign bodies, respectively, survived until discharge. Increasing duration of clinical signs before presentation did not increase risk of death ($P = 0.2$).

Dogs undergoing surgery after endoscopic attempts have an increased risk of death (OR = 20.1, 95% CI = 3.59–112.44, $P = 0.001$). The case fatality rate for dogs undergoing re-endoscopic attempts after surgery was recommended but declined was 100%, which perfectly matched the statistical model, so was dropped from analysis. An increasing number of complications at the time of procedure was associated with an increased risk of death (OR = 3.44, 95% CI = 2.01–5.91, $P < 0.001$). Complications specifically associated with increased risk of death included perforation of the esophagus (OR = 65.47, 95% CI = 4.27–1004.15, $P = 0.003$), with 9/19 (47%) of dogs with perforation at the time of procedure dying, and hemorrhage within the esophagus (OR = 11.81, 95%CI = 1.19–116.77, $P = 0.04$), with 4/31 (13%) of dogs with hemorrhage at the time of procedure dying.

Management of cases after the procedure varied greatly, but always employed one or more of administration of antimicrobials, gastric protectants, dietary management (fasting, feeding of a soft food diet or feeding tube placement), and administration of analgesics. Long-term follow-up was available for 189/211 (89.6%) dogs discharged from hospital, with a median follow-up time of 4.0 years (range 3.0–10.5). Full clinical recovery at the time of discharge was reported in 177/189 (93.7%) of dogs. Clinical signs in the remaining 12 dogs included one or more of cough, tender throat on palpation, dysphagia, or vomiting/regurgitation. Clinical signs resolved over a 2-week period in 4 of these dogs. Two further dogs were euthanized due to ongoing clinical signs, both 2 weeks after the procedure. One of the dogs euthanized had protracted vomiting, whereas the second suffered severe dysphagia. Neither dog underwent endoscopic re-examination, and the dog with severe dysphagia was also diagnosed with lymphoma at the time of EFB removal. No intrathoracic lymphadenopathy was present on radiographs at the time of procedure, making dysphagia secondary to EFB more likely; however, thoracic radiographs were not repeated at the time of euthanasia. Additionally, it is unknown whether the diagnosis of lymphoma influenced the decision for euthanasia in this dog.

Endoscopic re-examination was performed in the remaining 6 of the 12 dogs with clinical signs beyond discharge. No lesions were recorded in 1 dog, whereas mild esophagitis was diagnosed in another. Both recovered fully by 6 weeks after the procedure. Esophageal stricture was subsequently diagnosed in the other 4 dogs undergoing endoscopy, with a stricture rate of 4/189 (2.1%) of cases available for follow-up. Medical management with feeding soft food, successfully prevented any further clinical signs in 2 of these dogs, one of which had a 12- to 14-mm-wide stricture approximately 50 mm proximal to the lower esophageal sphincter (follow-up available at 3.5 years postprocedure), and one

had a 16-mm-wide stricture (follow-up obtained 4 years postprocedure). The final 2 dogs had 8-mm and 10-mm strictures, respectively, that were successfully treated with 6 and 3 balloon dilatation procedures, respectively. Endoscopy also was performed on 2 dogs that made a full recovery with no clinical signs, and no esophageal lesions were found.

Subsequent refeeding or supervised access to previously obstructing foreign material was supplied by the owner in 40/189 (21.2%) dogs, with the majority of owners (149/189 [78.8%]) avoiding refeeding of the obstructing material. Six dogs suffered subsequent esophageal obstructions, 1 of which re-presented twice.

Discussion

The current study found that risk of death in dogs with EFB obstruction is increased in those undergoing surgery after failed endoscopic attempts at removal, as well as those in which endoscopy is repeated after surgery is recommended but declined. Increasing numbers of procedural complications, as well as esophageal perforation and hemorrhage within the esophagus, also are associated with increased risk of death.

The clinical features of esophageal entrapment have been documented previously, and the findings in the current study largely are consistent with these reports.[1–3,6,9,15,16] Obstructions in the distal esophagus, caudal to the heart base were the most common site reported in this study. It has been suggested that a bias toward distal obstructions is created by drawing cases from referral institutions such as that in the current study and that obstructions would be more equally distributed between the 3 predilection sites should more cases be included from primary accession practices.[9] Location of entrapped foreign material was not found to influence the likelihood of survival in the current study, although with a P value of 0.05, it is possible that the study was not powered to detect this. Osseous foreign bodies were the most common obstructing material in the current study and consistently are reported as the most common material obstructing the esophagus, ranging from 30% to 100%.[2,17] The type of foreign material did not impact survival; however, it is noteworthy that all dogs with fishhook foreign bodies survived.

Medical management using endoscopy or fluoroscopy is the preferred retrieval method for EFB obstruction.[3–5,7,13,18] Esophagoscopy allows visualization of both the obstructing material and the esophageal mucosa. Success rates for endoscopic guided removal are consistently high in the literature; a finding replicated in the current study. Dogs requiring surgical intervention after failed attempts at medical treatment were at higher risk of death in the current study. Case fatality rates in dogs with EFB undergoing surgery vary greatly in the literature ranging from 7% to 80%.[5,19] This cohort of dogs have more severe esophageal mucosal damage,[2] which might contribute to the increased risk of death. In a study comparing endoscopic and surgical treatment, the case fatality rate for surgery was approximately twice that of endoscopic cases; however, there was no significant difference between groups.[4] In a different study, the case fatality rate for dogs with EFB treated surgically was 7.9%; however, dogs that died or were euthanized intraoperatively were excluded from the study, likely underestimating surgical fatality rates.[20] Another recent paper reported high success rates for surgical treatment of EFB.[3] In this study, a subset of cases (n = 8/39 [20.5%]) underwent surgery without any attempts at endoscopy, which might explain the lower fatality rate for dogs undergoing surgery. As endoscopy is the preferred method of retrieval, surgery was not initially attempted in any case in the current study, and only recommended for more severely affected cases, which might also account for these differences. It is noteworthy that there can be a high success rate for surgical intervention even when endoscopy has been attempted in all cases.[19]

The current study also found a 100% case fatality rate for those in which endoscopy was repeated after surgery was recommended but declined by owners. In a previous study, such cases were excluded from survival analysis[3]; however, findings in the current study provide an important observation of prognostic significance for clinicians and owners. Such cases died from esophageal perforation and pneumothorax, the severity of which likely was increased due to more severe trauma from excessive force in attempts to dislodge obstructed material. Some cases of esophageal perforation and pneumothorax had favorable outcomes with appropriate treatment in the current study. Increasing numbers of complications at the time of foreign body removal also were associated with an increased risk of death in the current study, and specific complications of esophageal perforation and hemorrhage within the esophagus were associated with increased risk of death. This might also be linked to the previous finding of more severe esophageal mucosal damage being associated with increased death.[2]

Duration of clinical signs prior to presentation was not found to increase the risk of death in the current study. Prolonged duration of clinical signs correlates with esophageal wall damage[2,7] and clinical signs >3 days before presentation increase the risk of death, although this population included EFB and gastric foreign bodies, and the number of deaths analyzed was small.[1] While the current study did not find any increased risk of death with increasing duration of clinical signs, rapid removal of obstructing material is still recommended to decrease the risk of complications.

Esophageal stricture formation secondary to obstruction is a serious complication associated with potentially lethal ramifications. The incidence of formation as a sequel to foreign body obstruction generally is low[1,5,7,15] as was the case in the current study. Additionally, all dogs with strictures in the current study had a favorable outcome, although 2 required additional treatment. The likelihood of stricture formation would appear to correlate with the degree of esophagitis, with animals exhibiting circular or confluent erosions, or complete perforation of the esophagus

reportedly more predisposed to the complication.[7] Other reports have suggested increased stricture formation based on foreign body composition.[1,5] Repeat endoscopy after discharge from hospital would ideally have been performed in all cases; however, this level of follow-up was not feasible in most cases, particularly because of the very high rate of full clinical recovery, as well as the retrospective nature of this study. While the true incidence of stricture formation cannot be known without endoscopy, it was felt a presumptive diagnosis of normal esophageal function could be extrapolated from clinical assessment of the dogs by owners and primary care veterinarians. Conversely, it would appear that clinical signs of coughing, vomiting, or regurgitation in the weeks following treatment should warrant further diagnostic workup due to the spectra of differentials for protracted clinical signs, and the finding that some dogs took up to 6 weeks for full recovery.

The major limitations of this study were both its retrospective nature and the duration of time over which cases were analyzed. Numerous clinicians were involved in the assessment and treatment of animals resulting in variations in case management. Long-term assessment of dogs and their esophageal function also was based on subjective analysis by their owners and primary care veterinarians rather than via repeat endoscopic examinations. Importantly, death is an uncommon event in dogs with EFB obstruction and thus only small numbers of dogs were available for statistical analyses.

Conclusions

The principal findings in the present study include an increased risk of death in dogs treated surgically after failed endoscopic attempts at foreign body removal, and in dogs in which endoscopy is reperformed after surgery is recommended but declined. Additionally, increased risk of death also was associated with increasing numbers of complications at the time of removal, and specifically with perforation of the esophagus and hemorrhage within the esophagus after the procedure. Death is an uncommon event in dogs with EFB obstruction, and additional studies with even larger sample sizes, or meta-analysis studies might be useful to further define risk factors for nonsurvival.

Footnote

[a] Stata 14.2 (StataCorp LP, College Station, TX)

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Conflict of Interest Declaration: Authors declare no conflict of interest.

Off-label Antimicrobial Declaration: Authors declare no off-label use of antimicrobials.

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