Introduction

Esophageal strictures have been well-documented in dogs and cats although they are uncommon when compared to other gastrointestinal diseases (Burk, 1987; Harai, 1987; Zawie, 1989; Willard, 1994; Twedt, 1995). Fibrous scarring resulting in intramural stricture formation occurs when an ulcerative inflammatory process extends into the submucosa and, potentially, deeper into the muscular layers of the esophagus. These changes have been reported in the dog and cat secondary to gastric reflux which occurs during anesthesia or sedation, esophageal foreign bodies, esophageal surgery, and any cause of severe esophagitis (Zawie, 1989; Twedt, 1995). Diagnosis is not generally difficult, but therapy for these strictures can be challenging.

The purpose of this article is to retrospectively analyze the medical records of a group of dogs and cats diagnosed with intramural, inflammatory esophageal strictures which were managed by conservative means using the balloon dilation procedure.

Materials and methods

The medical records of animals diagnosed with esophageal strictures in the last 10 years at either Colorado State and Texas A&M University Veterinary Teaching Hospitals were reviewed. Cases were included if the strictures were diagnosed with the aid of endoscopy and/or contrast radiography, treated using balloon dilation techniques, and there was at least a one month of follow-up. Cases were excluded if endoscopy was not performed or if the stricture was treated by surgical methods or other means. Twenty-three cases fit the criteria for inclusion in this study. Two of these cases were already reported in the veterinary literature as single case reports (Willard, 1993; Willard, 1994). Data extracted from the medical records included: signalment, cause of stricture formation, duration of clinical signs, number and location of esophageal strictures, number of dilation procedures performed, presence and degree of esophagitis, and outcome. Pharmacologic therapy, post-dilation feeding methods, or complications associated with the stricture or treatment (such as aspiration pneumonia, esophageal perforation, and mucosal tearing) were noted. Ancillary procedures performed during endoscopy to aid in resolution of the stricture were also noted. Outcome was described as either inability to tolerate canned or dry food, ability to tolerate canned food only, or ability to tolerate dry food with complete resolution of regurgitation.

Results

Eighteen dogs and five cats were represented in this study. Eleven dogs were male with an even...
distribution of those who were castrated versus intact. Of the females all were ovariohysterectomized. Four of the cats were spayed females; the remaining cat was a castrated male. The ages of canine patients ranged from less than six months to thirteen years (mean-5.9 years). Feline ages ranged from 6 months to 4 years (mean-2.8 years). Duration of signs of regurgitation varied from 1 week to 2 months. Mean duration of clinical signs was three weeks.

Causes of stricture formation were identified in 91% of the cases. Thirteen dogs and 2 cats had stricture formation secondary to reflux esophagitis following either anesthesia or sedation. In these cases, clinical signs were noted by owners starting 3-7 days following the anesthetic procedure. Other causes include foreign body ingestion (3/23) and drug-induced esophagitis (doxycycline therapy-1/23). A cause for esophagitis and resulting stricture was not found in two dogs. One dog developed a stricture after being hit by a car, and one cat developed a stricture secondary to esophagostomy tube placement at the site of tube placement.

Endoscopic evaluation of the esophagus and balloon dilation of strictures were performed in all patients (Figg. 1-3). Patient size and esophageal lumen diameter at the location of the stricture determined the size of catheter used. Balloon catheters (Microvasive, Watertown, MA) ranged in diameter from 10-40 mm. A pressure of 30 pounds per square inch was standardly used in these cases. The balloon diameter was maintained at this pressure for approximately 60 seconds, deflated and then repeated 3 times. In some cases, multiple catheters of increasing diameters were used in order to achieve the optimal esophageal lumen diameter. Nineteen cases had only 1 stricture. One dog was diagnosed with 3 strictures and 2 dogs had 2 strictures. All dogs with multiple strictures had one of the strictures close to the lower esophageal sphincter (LES). Eighteen (67%) of all strictures were located in the lower third of the esophagus in the vicinity of the LES. Seven (26%) were located in the middle third of the esophagus, the majority of these near the heart base. The remaining two were found in the cervical esophagus. The number of procedures for
repeat dilations ranged from 1-9 with a mean of 3. The interval between dilation procedures ranged from 2 to 11 days. Moderate to severe esophagitis was reported in 15/23 cases (65%). The presence of esophagitis was associated with the need for further anesthetic procedures for repeat balloon dilation (mean= 4) at a later date.

Pharmacologic therapy varied greatly from case to case and within an individual case depending on the course of the disease. One case was given no medications at all. The remainder were placed on combination therapy which generally included the use of a prokinetic agent (metoclopramide or cisapride), H2 receptor blocker or omeprazole, sucralfate, glucocorticoids, and occasionally, antibiotics. There is no evidence to suggest that the use of one combination or drug regimen provided better resolution compared to another.

Endoscopically guided gastrostomy tubes (G-tubes) were placed in order to rest the esophagus in 19/23 cases (82%). In 2 cases requiring multiple dilation procedures, G-tubes were used to provide nutrition initially, but oral feeding was initiated halfway through the treatment period. The data does not suggest that this provided faster resolution when compared to animals who were fed solely through a G-tube. Four animals were fed orally beginning twenty-four hours post initial dilation. None of these animals had esophagitis, and they required only 1-2 dilations. Three out of 4 were still on canned food at the time of follow-up; the remaining case had returned to eating dry food. Gastrostomy tube placement and enteral nutrition appears to be of benefit if the animal has moderate to severe esophagitis and/or has been regurgitating to the point of significant weight loss and weakness. In cases with little to no esophagitis and the ability to tolerate elevated feedings or slurried food during the post-dilation period, oral feedings are adequate.

Injection of triamcinolone at the site of the stricture was attempted in one dog without apparent benefit (Fig. 4). Four-quadrant electrocautery incisions (Gualtieri, 1993) were made through the fibrous portion of the stricture prior to balloon dilation in two dogs after repeated recurrence of the strictures using balloon dilation alone (Fig. 5). These dogs did not require further procedures. The electrocautery technique was also used in one cat whose stricture diameter was too small to place a balloon. This cat required only a second dilation procedure. No complications associated with electrocautery developed. Electrocautery incisions appear to be of benefit in decreasing the frequency of balloon procedures.

Complications reported during the treatment period included mucosal tears in 7 animals (30%), diverticulum formation in 2 dogs (9%), aspiration pneumonia in 3 dogs (13%), and esophageal perforation in 2 animals (9%). Death occurred in two dogs secondary to aspiration pneumonia which occurred following regurgitation and in one dog secondary to septic peritonitis due to G-tube failure. One dog was euthanized due to poor response to therapy. Another dog returned 18 months after resolution of the stricture was diagnosed with lymphoma, and was euthanized.

One dog required a permanent, low-profile G-tube placement because of intractable regurgitation and continued stricture formation. Three dogs still

Figure 4 - Triamcinolone injection of esophageal stricture.

Figure 5 - Electrocautery incisions of esophageal stricture.
Discussion

Common causes for esophageal stricture formation in small animals include gastroesophageal reflux during anesthesia/sedation, persistent vomiting, and ingestion of foreign bodies or caustic agents. Other causes of extensive, ulcerative esophagitis must also be considered including retention of tablets or capsules in the esophagus, thermal and radiation burns, esophageal motility disorders, and any disease that allows for lower esophageal sphincter disfunction i.e hiatal hernia (Zawie, 1989; Twedt, 1995). Formation of a mature stricture can take up to a week; however, clinical signs of dysphagia and regurgitation can begin as early as 2 days post-initialiation of esophagitis

(Pearson, 1978; Zawie, 1989). In this study 13 dogs and 2 cats (65% of all cases) had esophageal strictures due to anesthesia related gastroesophageal reflux. Several anesthetic agents and sedatives have been proven to decrease lower esophageal sphincter pressure and esophageal motility resulting in reflux of gastric contents and decreased acid clearance by the lower esophagus (Zawie, 1989). Five of the strictures in this study were secondary to foreign body ingestion (9%). A trauma-induced stricture apparently formed secondary to gastric reflux occurred in one dog that was hit by a car; one cat developed severe esophagitis with a resultant stricture after doxycyline administration, and another cat developed a stricture at the site of an esophagostomy tube. Twelve of 15 cases with post-anesthetic strictures had moderate to severe esophagitis. This group of cases required more dilation procedures (mean of 4 procedures vs. mean of 2 procedures for non-anesthesia related cases). Of the twelve cases of anesthesia related strictures that survived to the one month follow-up, 2 required a gruel, 7 did very well on canned food, and 3 were eating dry food with no regurgitation. Of the seven cases whose strictures were due to causes other than anesthesia that survived to one month follow-up, 1 required a slurred diet, 4 required canned food, 1 was eating regular food, and 1 required a permanent G-tube. Eighteen (67%) of the strictures in this study were located in the lower third of the esophagus, the majority within 4 cm of the LES. Because most of strictures formed secondary to gastroesophageal reflux related to anesthesia, this finding is not surprising. Seven strictures (26%) were found in the middle esophagus, and two (7%) were located in the cervical esophagus. Location did not significantly affect number of dilations required or the outcome of the case.

Fifteen of the twenty-three cases were reported to have moderate to severe esophagitis. Two of these cases died after initial endoscopic evaluation and balloon catheter dilation (one due to gastrostomy tube failure and septic peritonitis, the other due to aspiration pneumonia). The remaining thirteen cases having esopaghitis required a mean 3.77 procedures for resolution of disease compared to 2.5 procedures for the cases without reported esophagitis. This did not appear to be statistically significant (P=0.06).

Therapy for esophageal strictures includes surgery, bougienage, and balloon dilation (Twedt, 1995). Surgery to reset the structured portion of the esophagus has fallen out of favor with a success rate reported of <50% due to stricture formation and/or leakage at the anastomosis site (Harvey, 1985; Gregory, 1988; Johnson, 1992). The esophagus is fixed and cannot be stretched making resection and anastomosis difficult. Techniques using intestinal segment grafts and creation of traction diverticula have been described but rarely performed (Gregory, 1988; Johnson, 1992). Bougienage has a reported success rate of <25%; this technique consists of placing various sizes of rigid instruments through the stricture lumen and physically breaking down the scarred tissue. Complications include mucosal tears, esophageal perforation and diverticulum formation (Harvey, 1985; Zawie, 1989). Balloon dilatation is the preferred method, first reported in small animals in 1987 (Burk, 1987; Hardie, 1987; Harai, 1987; Sooy, 1987). Complications are similar to those reported with bougienage; however, this method uses radial force instead of the longitudinal shearing forces created by bougienage making esophageal perforation and diverticulum formation less likely (Burk, 1987). Dilation of strictures in human studies with balloon catheters has been shown to provide longer symptom-free intervals between procedures and/or a decrease in the total number of procedures required (Stark, 1984; Goldthorn, 1984; Dawson, 1984). More recent studies in humans have been contradicting. Cox et al (1994) reported an initial benefit of bougienage over nonendoscopic balloon dilation for patients, significant in the first five months, but not at the one year follow-up. Shemesh (1990) found no significant difference between the two procedures, and it has been suggested that differences in the two procedures are likely due to subtle differences in technique (Saeed, 1994). In this study, 7 of the cases had some degree of mucosal tearing; the majority were reported as mild. Diverticulum for-
mation was reported in one case, and 2 animals developed pneumothorax secondary to full thickness esophageal perforation, neither of which was severe; both resolved spontaneously.

Intramural, inflammatory esophageal strictures form as a fibrosing response to an ulcerative process that extends into the submucosa and potentially the muscle layers of the esophagus (Zawie, 1989). Because esophagitis is generally present, and because the act of stricture balloon dilation causes further tissue damage, pharmacologic therapy is generally initiated as an adjunct to the balloon procedure. Many combinations of pharmacologicals have been used including a prokinetic agent, such as metoclopramide or cisapride, that potentiates contraction of the LES and increases gastric emptying preventing further gastric reflux which can potentiate esophagitis. Human studies show that daily cisapride decreases the relapse rate of gastroesophageal reflux disease (Vigneri, 1995; Blum, 1993). An agent that reduces gastric acidity is concurrently administered. Proton pump inhibitors such as omeprazole are preferred over H2 receptor antagonists in cases of human esophagitis (Marks, 1994; Smith, 1994). Gastroesophageal reflux disease caused by LES failure is a common cause of esophagitis in humans leading to the development of peptic strictures. Studies indicate that omeprazole is superior to H2 receptor antagonists in healing of reflux esophagitis, and relieving dysphagia. There was also less need for dilatation of peptic strictures with treatment using omeprazole. Omeprazole was also shown to decrease the rate of relapse of reflux esophagitis (Marks, 1994; Smith, 1994). These two drugs (cisapride and omeprazole) used concurrently have proven the most effective at preventing relapse (Vigneri, 1995).

Most cases of esophagitis and resultant stricture formation in small animals are due to gastroesophageal reflux that occurs during anesthesia (65% of the cases in this study) (Burk, 1987, Harai, 1987). Therapy using prokinetic agents and gastric acid reducers were used in all cases. Glucocorticoids were used to decrease inflammation and fibrosis and stricture reformation following a balloon procedure. A prospective study in children who ingested a caustic substance found no apparent benefit from the use of steroids (Anderson, 1990). In this set of cases, only one dog with no esophagitis did not receive steroids, required only one procedure, and was eating regular dry food at one month follow-up. Sucralfate has been shown to be beneficial in mucosal healing in a study in which esophagitis was induced in cats (Katz, 1988). In humans, sucralfate has been proven to decrease the recurrence rate of reflux esophagitis in patients with erosions previously healed with antisecretory therapy. (Tytgat, 1995) Most of these cases were treated with sucralfate as well. In this study, pharmacologic regimens varied greatly from patient to patient and within the course of treatment of an individual patient making it impossible to compare various regimens. Controlled studies using specific combination therapies have not been performed in small animals, but would be of benefit to determine the optimal post-dilation therapy to prevent stricture recurrence.

Burk et al (1987) reported the first case series utilizing balloon catheter dilation in small animals. Out of six cases, five were asymptomatic on canned food at follow-ups of 1-28 months later. The remaining case was doing well on a slurred diet 15 months following balloon dilation. In a separate study evaluating 7 dogs and 6 cats, 3 had complete resolution of signs and could eat food of any consistency. Seven animals were substantially better with few to no signs if fed either canned food or a gruel. Eleven of thirteen animals (84%) in all were considered to have successful outcomes defined as moderate to complete resolution of signs (Harai, 1987). Four dogs in this study died, one due to the development of septic peritonitis secondary to gastrostomy tube failure, two due to aspiration pneumonia, and one due to unknown causes (lost to follow-up). One dog was euthanatized due to poor response to therapy, and one dog required permanent g-tube placement because of intractable regurgitation and continued stricture formation (10.5% poor response). Four animals had complete resolution of signs, and ten showed no signs if maintained on canned foods (73.6%), and three required a slurry diet (15.8%).

In summary, esophageal strictures occur in small animals for many reasons, the most common being secondary to gastric reflux which occurs during anesthesia. Veterinarians should be aware of the possibility of stricture formation from surgical procedures and should be alerted to clinical signs of stricture formation. If signs occur, endoscopy will confirm a diagnosis of esophagitis and/or esophageal stricture formation. Balloon dilation has proven to be successful in treating esophageal strictures, but multiple dilation procedures are likely. Adjunctive pharmacologic therapy for esophagitis and enteral feeding maybe necessary to rest the esophagus during healing.

Prospective research comparing the use of enteral nutrition using g-tube feedings versus oral feeding on stricture resolution would be of benefit as would controlled studies evaluating the use of glucocorticoids on stricture reformation following balloon catheter dilation. Because of the strong support for omeprazole and cisapride in the human literature, research directed at the benefit of these two drugs over H2 receptor antagonists and metoclopramide would also be of benefit.
Summary

Twenty-three medical records of cases diagnosed with intramural, inflammatory esophageal strictures and conservatively treated with balloon catheter dilation were evaluated for cause, location and number of strictures, degree of esophagitis, number of procedures, and outcome. The majority of strictures developed secondary to gastro-esophageal reflux which occurred during anesthesia or sedation (62%). Other causes included foreign body ingestion, drug-induced esophagitis, trauma, and esophagostomy tube placement. The majority of strictures were found in the vicinity of the lower esophageal sphincter (67%). Fifty-six percent of cases had moderate to severe esophagitis. Eighty-seven percent of cases had only one stricture. The number of procedures required ranged from 1-9 with a mean of 3. Of the nineteen cases who survived to the one-month follow-up, 74% were able to tolerate canned or dry food without regurgitation.

References


