

Esophagitis and Esophageal Strictures

Alan Glazer, DVM, DACVIM[a]
Patricia Walters, VMD, DACVIM, DACVECC
New England Animal Medical Center
West Bridgewater, Massachusetts

ABSTRACT: Esophagitis and esophageal strictures are relatively uncommon but significant diseases in companion animals. Often, an esophageal disorder is suspected based on the animal's medical history and clinical signs. Esophagitis and acquired esophageal strictures are caused by prolonged contact of caustic substances or foreign bodies with the esophageal lining, leading to mucosal injury. In cases of stricture, damage extends into the submucosal and muscular layers. Timely detection and appropriate management of esophagitis and esophageal strictures significantly improve nutritional status, dysphagia, and pain and often return the animal to a normal quality of life. This article reviews the current literature and focuses on the diagnosis and treatment of esophagitis and esophageal strictures caused by fibrosis secondary to esophageal inflammation.

Esophageal diseases cause a range of clinical signs, including regurgitation, weight loss, and respiratory distress. The diagnosis of esophagitis is challenging and often requires specialized procedures such as endoscopy. If inflammation damages the submucosa and muscularis, a cicatrix may develop, resulting in obstruction of the esophageal lumen and more serious illness. However, significant advances have been made in the treatment of esophagitis and esophageal strictures. With appropriate management of esophageal disease, veterinary patients can have considerable improvement of clinical signs and return to normal lives.


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NORMAL ANATOMY AND PHYSIOLOGY

The esophagus is made up of three layers: mucosa, submucosa, and muscle. The mucosa is lined by squamous epithelium and overlies the submucosa. In dogs, the muscle layer is composed entirely of skeletal muscle; in cats, the distal third is smooth muscle. The esophagus does not have a serosal layer; instead, it is covered by adventitia (Figure 1).

The esophagus has upper and lower sphincters. The upper esophageal sphincter is composed of the cricopharyngeus and thyropharyngeus muscles. The lower esophageal sphincter (LES) is made up of muscle layers around the esophagus and diaphragmatic crura (Figure 2). These layers are thought to create a pressure barrier that prevents reflux of gastric contents into the esophagus. The LES relaxes during swallowing to allow ingesta to pass into the stomach. It has been suggested that the location of the LES could play a role in the occurrence of reflux. In theory, an intraabdominal LES prevents reflux because the positive pressure in the abdomen puts more force on the esophagus relative to the stomach and increases barrier

[a]Dr. Glazer discloses that he owns shares in Pfizer Inc.

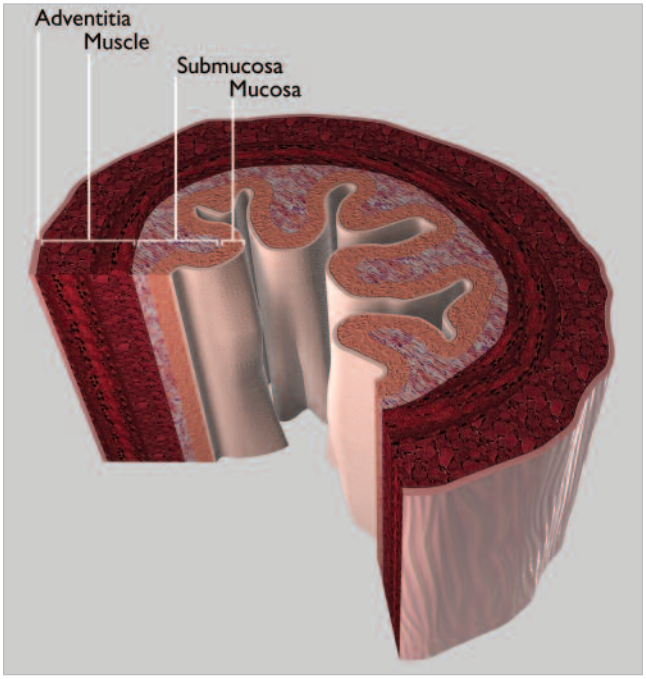


Figure 1. **Cross-section of the esophagus.**

pressure. Consequently, some humans who do not have an abdominal esophageal component are more prone to primary gastroesophageal reflux disease. However, a recent study of greyhounds and beagles indicated that dogs vary with respect to whether the position of the gastroesophageal junction is intrathoracic or intraabdominal. This finding implies that an intraabdominal LES may not be essential to prevent reflux in dogs.[1]

When a bolus of ingesta reaches the caudal pharynx, afferent sensory fibers stimulate the swallowing center in the brain. Respiration is temporarily inhibited while efferent motor fibers stimulate the esophagus via the vagus nerve, causing primary peristalsis to transport the ingesta aborally. Secondary peristalsis is similar to primary peristalsis except that the impulse is initiated by esophageal distention. As food approaches the stomach, transmission of sensory information results in relaxation of the LES. Innervation of the esophagus is mainly parasympathetic from the vagus nerve.

PATHOPHYSIOLOGY

The normal physiologic defenses against esophageal inflammation are the LES, the esophageal mucosal lining, clearance of the esophagus via peristalsis, the neutralizing effect of alkaline saliva, and esophageal cell turnover. *Esophagitis* is defined as inflammation and disruption of the esophageal mucosa with resultant exposure of the esophageal submucosa. Causes of esophagitis include gastroesophageal reflux, vomiting, and ingestion of foreign bodies, caustic substances, or medications. Anesthesia-induced gastroesophageal reflux is the most commonly reported cause in the veterinary literature.[2–6]

The factors that affect the likelihood that a refluxate will cause esophageal damage are the content of the refluxate, the contact time, and the effectiveness of normal esophageal defense mechanisms. Studies have shown that a refluxate with a pH less than 4 is most likely to cause damage. The presence of pepsin and bile acids in refluxate has also been shown to damage the esophageal lining.[7–11] Increased damage is correlated with prolonged contact of these substances with the esophageal mucosa. Normally, the esophagus clears most refluxate with primary and secondary peristaltic waves, and the bicarbonate present in salivary secretions neutralizes any residual refluxate. In animals, esophageal inflammation has been shown to decrease LES tone, which leads to further reflux, thus creating a vicious cycle.[7,11–13]

The LES normally relaxes only during swallowing. However, in humans, transient lower esophageal relaxations have been reported that do not seem to be related to swallowing but have been correlated with reflux events.[7] Primary gastroesophageal reflux disease is rare in animals but has been reported in cats.[14] Gastric distention and certain anesthetic drugs decrease LES tone, increasing the likelihood of reflux events. In animals, morphine, thiopentone, propofol, xylazine, and atropine all decrease LES tone or increase the likelihood of reflux.[15–17] One study in animals suggests that fasting for longer than 24 hours before surgery is more likely to cause reflux under anesthesia than fasting less than 4 hours. The ideal fasting interval suggested by the authors of this study is 8 to 12 hours.[17]

Patients with recurrent respiratory signs should be evaluated for esophageal disease, as should patients that present with regurgitation and gastrointestinal disturbances.

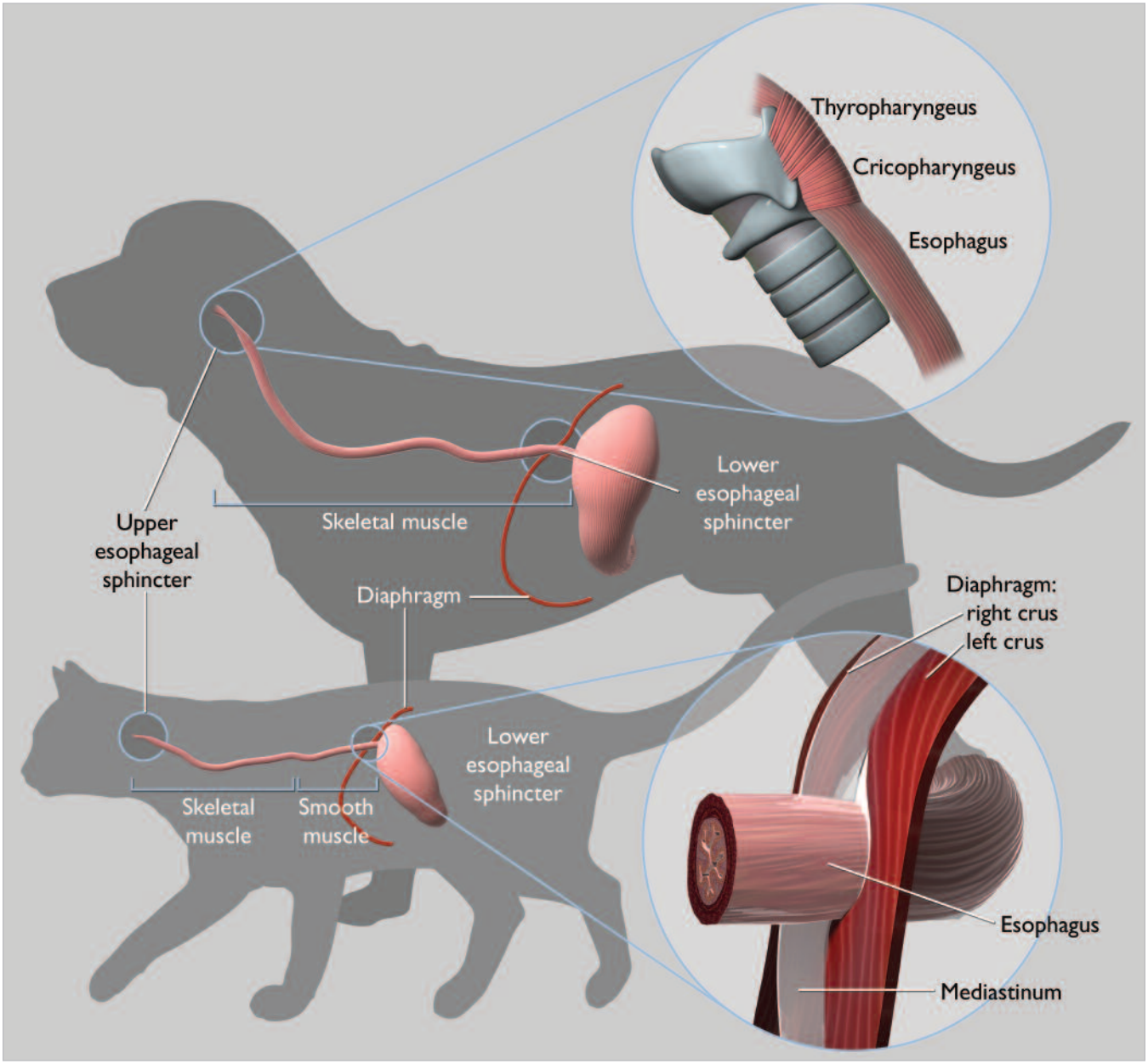


Figure 2. **Normal anatomy of the canine and feline esophagus.**

Body position during anesthesia is not associated with an increase in reflux despite the finding that LES barrier pressure is decreased in dogs positioned in sternal recumbency.[18,19] Intraabdominal surgical procedures are more likely to cause gastroesophageal reflux than other types of procedures. Ovariohysterectomy is the procedure most commonly associated with increased reflux.[18] However, any anesthetic event increases the likelihood of gastroesophageal reflux.

In humans, some oral medications—tetracycline, doxycycline, NSAIDs, potassium chloride, and quinidine—have been shown to induce severe esophagitis and esophageal strictures.[20] In cats, tetracyclines are most frequently associated with esophagitis.[21–23] Tetracycline formulations tend to be very acidic, and prolonged exposure to them results in inflammation of the esophageal mucosa that may progress to formation of a stricture.

Esophageal stricture formation results from extensive damage to the esophageal lining. Esophageal inflammation that extends through the mucosa into the submu-

cosa and muscularis leads to collagen deposition and scarring. If the scarring is severe enough, an esophageal stricture develops. Other causes of esophageal stricture include congenital strictures, persistent right aortic arch, and extramural esophageal compression secondary to a mass. These causes are beyond the scope of this article.

HISTORY AND CLINICAL SIGNS

Animals with esophageal disease often have a variety of clinical signs, including ptyalism, regurgitation, dysphagia, repetitive swallowing, odynophagia (painful swallowing), and weight loss. Events of particular interest in the medical history include exposure to caustic substances, recent medications, and surgeries. It is important to differentiate regurgitation from vomiting and to recognize that esophageal disease and regurgitation may be part of a more complex disorder such as foreign body ingestion or may be secondary to an underlying disease causing chronic vomiting. Timing of events with regard to eating may be helpful in distinguishing between regurgitation and vomiting because regurgitation most often occurs shortly after ingestion. However, animals with distal esophageal disease or esophageal hypomotility may not regurgitate until hours after eating. Unless odynophagia is present, these animals often present with a history of ravenous appetite. Animals with esophageal obstructions or strictures may tolerate liquids better than solids, whereas animals with motility disorders are likely to have problems with liquids as well as solids. Weight loss is common.

Animals with esophageal disease may present with signs that are not immediately suggestive of alimentary tract disease. For example, respiratory signs (e.g., nasal discharge, coughing) may be present because regurgitation can cause nasal inflammation and aspiration. Any animal with recurrent pneumonia and respiratory signs without an obvious cause (e.g., neoplasia, immunosuppression) should be evaluated for esophageal disease.

DIAGNOSTIC TESTING

Observation of the animal while it is swallowing food can help localize disease to the pharynx and esophagus. In animals with suspected esophageal disease, results of the following should be obtained: complete blood count, serum chemistry profile, urinalysis, and thoracic and neck radiography. Systemic disorders that cause similar signs of increased appetite with weight loss, such as diabetes mellitus and hyperthyroidism, should be ruled out. Survey thoracic radiographs can disclose the cause of esophageal disease in cases of neoplasia, megaesophagus, or foreign body ingestion and should also be evaluated for the presence of aspiration pneumonia.

Survey thoracic radiographs are insensitive for the detection of esophagitis or esophageal stricture. A positive contrast barium esophagogram is more useful for determining the presence of strictures and evaluating esophageal motility. However, administration of barium to patients with esophageal disease carries the risk of aspiration. If fluoroscopy is available, it is a valuable adjunct to barium administration to evaluate more specifically for the presence of pharyngeal disorders, more fully assess esophageal motility, and possibly observe reflux episodes.

The most common cause of stricture formation in animals is gastroesophageal regurgitation secondary to anesthesia.

Esophagoscopy is necessary to definitively diagnose esophagitis and esophageal stricture as well as to obtain biopsy samples from esophageal masses. It may be useful to obtain a barium esophagogram before esophagoscopy to identify the length and number of strictures present because the endoscope may not be able to pass beyond a proximal stricture site. However, barium administration must be separated from esophagoscopy because barium obscures visualization through the endoscope. Our preference is to wait 24 hours between obtaining a barium esophagogram and performing esophagoscopy. Esophagoscopy should be performed slowly and carefully to identify lesions and avoid iatrogenic damage. Esophagitis appears as mucosal hyperemia, mucosal edema, ulceration, and bleeding (Figure 3). Lesion characteristics and locations should be carefully noted; the length of the endoscope can be used to record the depth at which a lesion was identified. These records can then be used during follow-up evaluation to identify any response to treatment and newly formed strictures.

Ideally, biopsy samples of mass and proliferative lesions should be obtained for definitive diagnosis.

However, performing a biopsy of the esophagus is difficult because most endoscopic biopsy instruments need to be perpendicular to the tissue being sampled in order to properly grasp and cut the tissue and obtain an adequate sample. Biopsy cups with spikes or suction biopsy instruments can allow esophageal biopsy specimens to be obtained more easily.

The endoscope should be passed into the stomach and duodenum to evaluate for the presence of other upper gastrointestinal disease because esophageal disease may represent only one part of a more complex disease process.

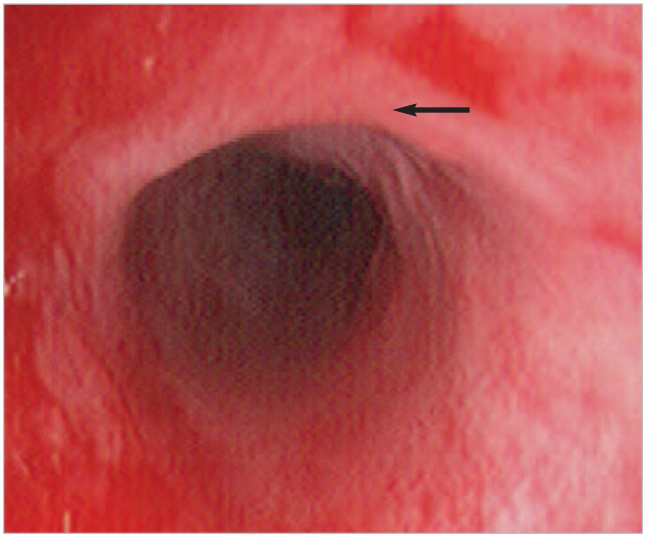


Figure 3. Endoscopic appearance of esophagitis with partial stricture (*arrow*) formation. (Courtesy of Dr. Allyson Berent, Matthew J. Ryan Veterinary Hospital of the University of Pennsylvania)

TREATMENT

Medical Management

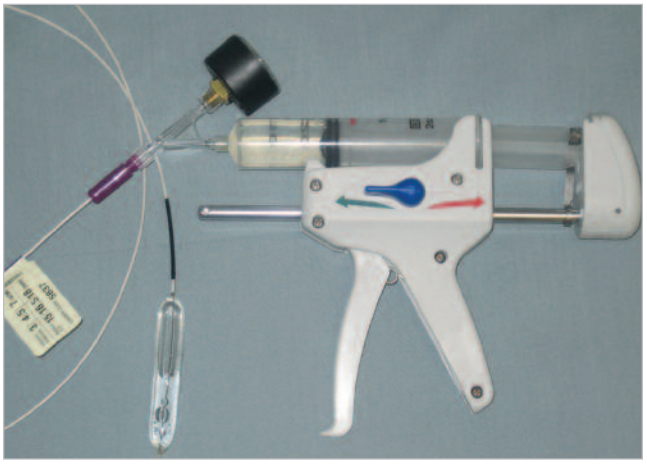
Treatment of esophagitis is directed at healing inflammation and preventing further injury while supporting the animal's nutritional needs. Esophageal healing is promoted by decreasing mechanical trauma to the esophagus through feeding soft or blenderized food or placing a gastrostomy tube. Sucralfate may assist healing of the mucosal surface through stimulation of prostaglandins. This drug has been shown to relieve clinical signs in humans, but results of clinical trials vary as to whether sucralfate is capable of healing esophagitis as a sole agent.[24,25] Sucralfate requires administration as a slurry three to four times per day, ideally separate from food and other oral medications. Administration of sucralfate with food inhibits its ability to adhere to denuded mucosa. Administration with other medications can decrease absorption of the other medications. In veterinary medicine, clinical opinion varies as to the function of sucralfate in the nonacidic environment of the esophagus. The recommendation for esophagitis, in humans and animals, is to use sucralfate in combination (but not simultaneously) with other medications and not as a sole agent.[20,26,27]

Further injury to the esophagus can be prevented by reducing the acidity of gastric secretions and increasing LES tone. Antacids (e.g., calcium carbonate), H_2-blockers, and proton-pump inhibitors are all used to lower gastric acidity. Antacids require frequent administration, which often makes client compliance poor. H_2-Blockers and proton-pump inhibitors have been used successfully (Table 1). Studies in human medicine have proven omeprazole superior to ranitidine for the healing and prevention of ulcers secondary to gastroesophageal reflux disease.[20,28,29] Omeprazole also has the advantage of less-frequent dosing and is available as an over-the-counter medication. Unfortunately, omeprazole is not available in a liquid form, making it

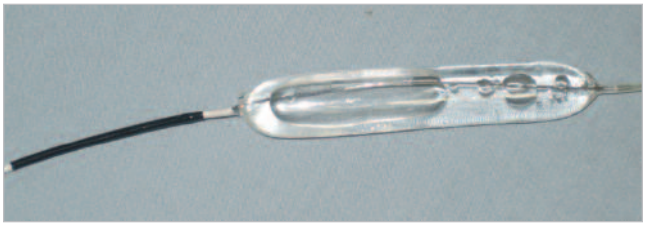
Table 1. Oral Dosages for Drugs Commonly Used to Treat Esophagitis[32]

Medication	Dogs	Cats
Mucosal protectant		
Sucralfate	0.5–1 g PO q8h	0.25–0.5 g PO q8h
H_2-Blockers		
Cimetidine	5–10 mg/kg PO q6–8h	5–10 mg/kg PO q6–8h
Famotidine	0.5–1 mg/kg PO q12h	0.5 mg/kg PO q12h
Ranitidine	1–2 mg/kg PO q12h	3.5 mg/kg PO q12h
Proton-pump inhibitor		
Omeprazole	0.7–1 mg/kg PO q24h	0.7–1.5 mg/kg PO q12–24h
Prokinetics		
Cisapride	0.25–0.5 mg/kg PO q8–12h	1.25–2.5 mg/cat PO q8–12h
Metoclopramide	0.2–0.4 mg/kg PO q8h	0.2–0.4 mg/kg PO q8h

Figure 4. Balloon dilation equipment.



Alliance II Integrated Inflation/Litho Handle with syringe and pressure gauge.



Dilated balloon. (Microvasive, Boston Scientific, Natick, MA)

difficult to use in smaller animals and animals requiring a feeding tube. Injectable proton-pump inhibitors can be prohibitively expensive.

The prokinetics metoclopramide and cisapride are used to increase LES tone and increase gastric emptying. Cisapride is considered superior to metoclopramide.[26,27,30] Metoclopramide has a limited effect on esophageal motility. In cases of megaesophagus that are not secondary to esophagitis, increasing LES tone can further decrease esophageal emptying and increase regurgitation. Cisapride may improve lower esophageal smooth muscle motility in cats.[31] Cisapride is no longer available at traditional pharmacies because of its association with cardiac arrhythmias in humans, but it is available through compounding pharmacies.[26] Side effects appear to be minimal in animals; gastrointestinal disturbances such as cramping and diarrhea have been reported.[26,32] Ranitidine and erythromycin also speed gastric emptying and subsequently reduce the amount of gastroesophageal reflux.[31]

If oral antibiotics are required, liquid formulations are preferred because they are less likely to be retained in the esophagus. If a tablet or pill is to be administered, following the pill with an oral water bolus has been shown to markedly improve esophageal transit time.[33]

Many animals with esophagitis regurgitate or have pain when swallowing, which leads to a chronic decrease in caloric intake. Restoration and maintenance of adequate nutrition is of utmost importance. If the animal is willing to eat, feeding blenderized foods from an elevated position may be all that is needed. If necessary, nutrition can be maintained through placement of a gastrostomy tube. The prescribed diet should be nutritionally complete with adequate protein and calories. Fat in the diet delays gastric emptying, but higher calorie content, often provided as a higher proportion of calories in the form of fat, is often necessary to minimize the volume fed. If an animal has initial difficulty with a high-fat diet, a change to a low-fat diet may be effective.

Esophageal Stricture Dilation

Esophageal strictures generally require dilation to effectively improve the animal's clinical signs. Occasionally, mild strictures may be manageable with a blenderized diet and elevated feedings alone. The two nonsurgical techniques for esophageal stricture dilation are bougienage and balloon dilation (see the box on page 289).

Bougienage involves the use of a long, narrow, rigid instrument (a bougie) that is gently pushed through the stricture to progressively break down and stretch the scar tissue. This technique has been described using an endoscope as a bougie or using specifically designed bougienage instruments.[20] Many types of bougies are available; in general, they are rounded, oblong instruments that are serially passed through the stricture. Once one size is passed easily, the next larger diameter instrument is selected. The goal is to gradually increase the diameter of the esophagus at the stricture site. Fluoroscopy is useful for this technique when a guidewire is used. Bougienage has also been described using measured guidewires or endoscopic guidance.

The procedure of esophageal balloon dilation involves passing an inflatable balloon into the stricture under endoscopic or fluoroscopic guidance. The balloon is expanded with saline or a dilute contrast agent (if using fluoroscopy) to a preset diameter and pressure to gradually stretch the stricture (Figure 4).

There have been many debates over the relative safety and effectiveness of bougienage versus balloon dilation. In theory, the balloon method applies an even radial force, whereas bougies apply both a radial and a shear force. The absence of a shear force has been suggested to make

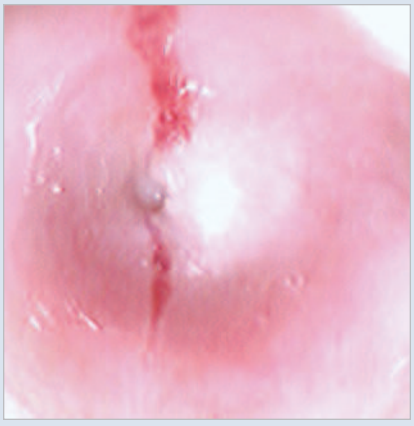
Overview of Bougienage and Balloon Dilation

For either procedure, start with the bougie or balloon that is closest to the stricture in size. The stricture diameter may be estimated by comparing it with the endoscope width or by passing a Foley catheter into the site. For bougienage, use slow, steady pressure to dilate the stricture. Although no specific guidelines for bougienage have been published in the veterinary literature, the recommendation in human medicine is to follow the "rule of three."[a] This states that the clinician should dilate only three sizes (or 3 mm) beyond the first setting for which resistance is felt. This guideline may be useful in veterinary patients but should not supersede clinician assessment.

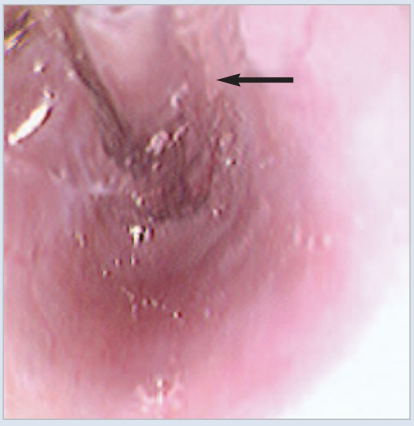
For the technique of balloon dilation, place the balloon within the stricture, leaving a small part of the balloon visible proximal to the stricture. Inflate the balloon to the pressure on the manometer that correlates with the appropriate balloon diameter. Hold this pressure for 60 to 90 seconds. Deflate the balloon and reassess the stricture site. Balloon dilation lessens the resistance that can be felt, so direct visualization of the stricture site is necessary to assess for adequate dilation and potential complications such as bleeding or tears (Figure A). Mild bleeding is expected, but if the bleeding appears excessive, discontinue further dilation and assess for esophageal tears. If the stricture diameter is not sufficiently increased, repeat with the same pressure. If the diameter has increased approximately to the chosen balloon diameter, increase to the next size. Dilation can be repeated until an adequate diameter has been achieved or the clinician feels that further trauma is unacceptable.[37,40] Repeat procedures are usually required at 1- to 3-week intervals for an average of two to four dilations per patient to achieve an adequate clinical response as assessed by improvement in clinical signs and tolerance to food.[4,40,41]

[a]Esophageal dilation. American Society for Gastrointestinal Endoscopy. *Gastrointest Endosc* 1998;48(6):702-704.

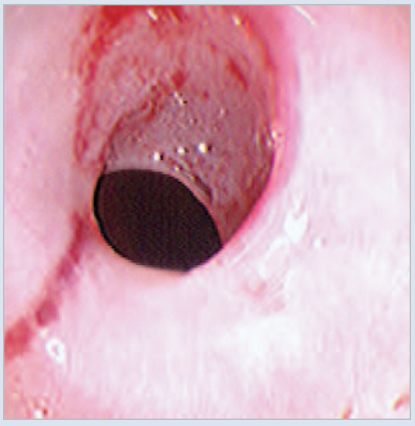
Figure A. Balloon dilation of a stricture. (Courtesy of Dr. Berent)



An esophageal stricture.



Insertion of the balloon through the stricture site. The *arrow* indicates the balloon dilator.



The stricture site after the dilation procedure. Note the mild bleeding associated with the dilation procedure.

balloon dilation safer. Some authors cite personal anecdotes of improved efficacy with fewer complications when using the balloon method; however, retrospective studies have shown no significant difference.[34–36] Factors that may make one method preferable to the other include the cost of equipment and the type of diagnostic imaging available. Bougies tend to be less expensive and are reusable. Balloons are intended for single use, although many clinicians reuse them as long as they remain intact. Endoscopic guidance is required for balloon dilation, while either fluoroscopy or endoscopy may be used with bougienage. With either method, a guidewire may be necessary to safely traverse a long, tortuous stricture. The choice of method used for esophageal dilation should be based on available equipment and the practitioner's level of comfort with the technique.

Potential complications of bougienage or balloon dilation include bleeding, esophageal tear, esophageal diverticulum formation, infection, aspiration, and pain. Mild bleeding is usually self-limiting. Patients with coagulation disorders, recent esophageal surgery, esophageal tears, or respiratory disease should be treated with more gradual dilation to prevent complications. The reported perforation rate is low (0% to 3.9%). Higher perforation rates occur with blind bougienage techniques.[34,37–39] Overall successful outcome, defined as moderate to

complete resolution of clinical signs, has been reported in 74% to 88% of animal patients.[6,37,40,41]

Steroids

Theoretically, corticosteroids could prevent stricture recurrence after dilation because steroids reduce fibrosis and collagen formation. However, in a controlled study of children with esophagitis induced by caustic substance ingestion, oral steroids were not shown to be beneficial.[42] No controlled studies in animals have evaluated the use of systemic steroids after esophageal stricture dilation.

Interest has turned from systemic steroid therapy to local injection of steroids into the stricture using endoscopic guidance. In keloids and dermal scars, intralesional steroid injections have been shown to reduce scar formation. The procedure involves the use of an endoscopic sclerotherapy needle to inject triamcinolone acetonide or dexamethasone at three or four sites around the stricture before or immediately after the dilation procedure. In humans, studies have shown a significant reduction in the number of repeat dilation procedures needed after the use of local steroid injection.[43–46]

Surgical Management

Surgery of the esophagus is difficult. Most of the esophagus resides within the thoracic cavity, making surgery a very invasive procedure. The lack of serosa and the longitudinal orientation of the musculature make secure surgical closure of the esophagus challenging. In human medicine, the most common indication for esophageal surgery is resection of an esophageal tumor. Other indications include esophageal strictures unresponsive to medical therapy and dilation and esophageal perforations. The most commonly reported complications of esophageal surgery are anastomotic leak, ischemia and necrosis, and stricture formation.[47,48] Very small leaks can respond to conservative therapy such as esophageal rest, which involves placement of a gastrostomy tube, antibiotics, wound management (if in the neck), and possibly chest drainage. More severe complications are likely to require additional surgery. Strictures that form after surgical healing are often manageable with dilation. Fortunately, the high success rate with dilation techniques has made surgical resection for benign strictures largely unnecessary.

CONCLUSION

Although primary esophageal disease is a relatively infrequent presentation in companion animals, it is associated with significant morbidity. Many advances in the therapy of esophagitis and esophageal strictures have enabled most veterinary patients to be effectively treated and lead normal lives.

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ARTICLE #2 CE TEST

This article qualifies for 2 contact hours of continuing education credit from the Auburn University College of Veterinary Medicine. ***Subscribers may take individual CE tests or sign up for our annual CE program.*** *Those who wish to apply this credit to fulfill state relicensure requirements should consult their respective state authorities regarding the applicability of this program. CE subscribers can take CE tests online and get real-time scores at* ***CompendiumVet.com****.*

1. Which type of tissue is not a part of normal canine esophageal anatomy?

a. squamous epithelium
b. adventitia
c. smooth muscle
d. submucosa

2. Secondary peristalsis is initiated by

a. food in the caudal oropharynx.
b. conscious perception.
c. the chemoreceptor trigger zone.
d. esophageal distention.

3. In veterinary medicine, the most common cause of esophagitis is

a. gastroesophageal reflux secondary to anesthesia.
b. foreign body ingestion.
c. chronic vomiting.
d. ingestion of caustic substances.

4. Which drug decreases LES tone or increases the likelihood of reflux?

a. morphine
b. atropine
c. propofol
d. all of the above

5. Which factor does not worsen esophageal inflammation secondary to reflux?

a. prolonged contact time
b. bicarbonate
c. refluxate pH less than 4
d. pepsins

6. Which clinical sign is not associated with esophageal strictures?

a. odynophagia
b. recurrent pneumonia
c. weight loss
d. difficulty in ingesting liquids but not solid foods

7. In humans, _____ has been proven superior for treating esophageal ulcers.

a. omeprazole
b. ranitidine
c. sucralfate
d. calcium carbonate

8. Which statement is not an important nutritional guideline for animals with esophagitis?

a. A gastrostomy tube should be placed if an animal is unwilling or unable to eat.
b. Elevated feedings and blenderized food may help prevent regurgitation.
c. Fat may be useful in the diet because it speeds gastric emptying.
d. The diet should be complete with adequate protein and calories.

9. Which statement regarding treatment of strictures is false?

a. Balloon dilation applies only radial forces and bougienage applies radial and shear forces; however, no evidence shows increased complications with one versus the other.
b. Surgery is indicated in cases of esophageal neoplasia, esophageal perforations, or strictures that are unresponsive to medical therapy.
c. The rate of a successful outcome with balloon dilation is greater than 80%.
d. Systemic steroid use has been shown to reduce esophageal scar tissue and improve outcome.

10. The "rule of three" states that

a. if a stricture requires more than three dilation procedures, surgery should be considered.
b. the practitioner should dilate only three sizes (or 3 mm) beyond the first setting at which resistance is felt.
c. repeating procedures at 3-week intervals reduces the complication rate to less than 3%.
d. animals should receive "triple" therapy consisting of sucralfate, an acid reducer such as omeprazole, and a prokinetic agent.