Use of a self-expanding metallic stent to palliate esophageal neoplastic obstruction in a dog

Katherine S. Hansen, DVM; Chick Weisse, VMD, DACVS; Allyson C. Berent, DVM, DACVIM; Marilyn Dunn, DVM, DACVIM; Ana V. Caceres, DVM, DACVR; Kim L. Todd; Jeremy S. Diroff, DVM, DACVIM

Case Description—An 11-year-old spayed female Collie was evaluated because of regurgitation, dysphagia, severe ptyalism, coughing, and weight loss of approximately 12 weeks' duration. Esophageal squamous cell carcinoma had been diagnosed prior to referral on the basis of results of radiographic and endoscopic examination and histologic evaluation of biopsy samples. A percutaneous endoscopically placed gastrostomy (PEG) tube had been inserted 2 weeks prior to referral, and the dog was being treated for infection at the gastrostomy site.

Clinical Findings—Physical examination findings included marked ptyalism, stertor, and inflammation and discharge at the gastrostomy site.

Treatment and Outcome—Surgical options were declined by the owner, and palliative treatment was chosen to alleviate clinical signs and facilitate PEG tube removal. With fluoroscopic guidance, a self-expanding metallic stent was placed in the esophageal lumen at the site of obstruction. Botulinum toxin A was injected into the mandibular salivary glands under ultrasonographic guidance as treatment for severe ptyalism. Following discharge, clinical improvement was reported until euthanasia for unrelated disease 12 weeks after stent placement. Necropsy revealed that the stent had not migrated and had remained patent with some tumor ingrowth but no evidence of stricture or obstruction.

Clinical Relevance—Esophageal stenting effectively treated obstruction and improved clinical signs and may be beneficial for palliative treatment in other animals with malignant esophageal tumors. Although the degree to which botulinum toxin A injection into salivary glands may facilitate PEG tube removal was not addressed, this report demonstrates that esophageal stenting was a safe and effective treatment for severe ptyalism. (J Am Vet Med Assoc 2012;240:1202–1207)

An 11-year-old 28.5-kg (62.7-lb) spayed female Collie was referred to the Veterinary Hospital of the University of Pennsylvania with a history of weight loss, regurgitation, productive cough, severe ptyalism, and stertorous upper airway noise of approximately 12 weeks' duration. The dog also had a chronic history of vesicular lupus erythematosus, signs of lumbosacral pain with weakness of the hind limbs, and hypothyroidism.

Results of esophagoscopy under general anesthesia 2 weeks prior to referral revealed an approximately 5-cm-diameter mass causing partial to complete obstruction of the esophageal lumen; a PEG tube had been placed by the referring veterinarian during the same anesthetic episode. Thoracic radiography was performed 1 day after PEG tube placement because the dog was febrile (body temperature, 39.8°C [103.6°F]). Results revealed osseous metaplasia of the lungs, dilation of the cranial aspect of the thoracic esophagus, and attenuation of the esophagus cranial to the heart base near a broad-based opacity consistent with an esophageal mass. No evidence of pneumonia was detected. A diagnosis of squamous cell carcinoma was made on the basis of histologic evaluation of endoscopic biopsy samples.

The dog was discharged from the referring veterinary hospital, and the owner administered its total caloric energy requirement via the PEG tube. The diet was blended with 90 to 120 mL of water, and 275 mL of the slurry was administered every 12 hours. Six days after the PEG tube was placed, the dog was evaluated by the referring veterinarian because of purulent discharge around the PEG tube site and hind limb weakness attributed to suspected lumbosacral osteoarthritis. Bacterial culture of samples obtained at the PEG tube insertion site revealed infection with multidrug-resistant *Escherichia coli*.

At the time of referral, the patient was receiving sucralfate (35 mg/kg [16 mg/lb], PO, q 12 h), cyclosporine (5.26 mg/kg [2.4 mg/lb], via PEG tube, q 24 h), deacetylcralfate (1.75 mg/kg [0.80 mg/lb], via PEG tube, q 24 h), chloramphenicol (3.5 mg/kg [1.59 mg/lb], via PEG tube, q 12 h), tramadol (1.75 mg/kg, via PEG tube, q 12 h), metoclopramide (0.35 mg/kg [0.16 mg/lb], via PEG tube, q 12 h), levothyroxine (0.007 mg/kg [0.003 mg/lb], via PEG tube, q 12 h), levofloxacin (0.007 mg/kg [0.003 mg/lb], via PEG tube, q 12 h), an omega-3 fatty acid supplement (45.6 mg/kg [20.7 mg/lb], via PEG tube, q 12 h), tacrolimus ointment (applied topically to affected skin, q 12 h), and a nutritional supplement containing a

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<th>ABBREVIATION</th>
<th>PEG Percutaneous endoscopically placed gastrostomy</th>
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A microencapsulated form of *Enterococcus faecium* probiotic (one 30-g packet, via PEG tube, q 24 h in food slurry).

Physical examination findings included marked ptyalism, respiratory stertor suggestive of possible laryngeal paralysis, and inflammation and discharge at the PEG tube site. Results of a CBC revealed leukocytosis (24,000 WBCs/mL; reference range, 4,500 to 15,000 WBCs/mL), neutrophilia with no band cells (20,880 neutrophils/mL; reference range, 2,060 to 10,600 neutrophils/mL), monocytosis (1,200 monocytes/mL; reference range, 0 to 840 monocytes/mL), thrombocytosis (454,000 platelets/mL; reference range, 170,000 to 400,000 platelets/mL), and PCV of 39.6% (reference range, 36% to 60%). Results of serum biochemical analysis revealed a high BUN concentration (47 mg/dL; reference range, 6 to 25 mg/dL), hyperkalemia (5.8 mEq/L; reference range, 3.6 to 5.5 mEq/L), hyperchloremia (122 mEq/L; reference range, 102 to 120 mEq/L), high BUN-to-creatinine concentration ratio (47; reference range, 4 to 27), and a low-normal thyroxine concentration (1.3 mg/dL; reference range, 1.0 to 4.0 mg/dL). Remaining values were within anticipated limits (total protein concentration, 6.0 g/dL; creatinine concentration, 1.0 mg/dL [reference range, 0.5 to 1.6 mg/dL]).

Surgical excision of the mass with esophageal resection and anastomosis was discussed with the owner but was declined. To help alleviate persistent clinical

![Figure 1](image1.png)

**Figure 1**—Lateral fluoroscopic views of the thorax of an 11-year-old Collie with squamous cell carcinoma causing esophageal obstruction. A—A hydrophilic guidewire (arrows) is advanced past the obstructive tumor (asterisk) to facilitate placement of a pigtail marker catheter (arrows) positioned across the obstructed region. C—Contrast agent injected through the marker catheter reveals the extent of the obstructive lesion. Notice the borders of contrast agent within the air-filled esophagus (arrows).

![Figure 2](image2.png)

**Figure 2**—Lateral fluoroscopic views of the thorax of the same dog in Figure 1 undergoing placement of a self-expanding metallic stent. A—The stent delivery system (black arrows) is positioned across the malignant esophageal obstruction. B—Partial deployment of the stent (white arrows) at the aboral aspect of the obstruction is shown; part of the stent remains within the delivery system (black arrows). C—With the stent fully deployed (white arrows), an hourglass shape is evident, with narrowing in the region of the obstruction. D—Contrast agent injected via a pigtail marker catheter immediately following stent deployment reveals restored esophageal patency.
SMALL ANIMALS

and general anesthesia was maintained. Ryngeal paralysis. The dog was intubated, inspiration, confirming the suspected la

lb], IV). A complete laryngeal examina
tion revealed substantially reduced bilateral artenoid cartilage abduction during inspiration, confirming the suspected laryngeal paralysis. The dog was intubated, and general anesthesia was maintained with isoflurane in oxygen. Propofol\(^\text{b} (5 \text{ mg/kg} \ [2.27 \text{ mg/lb}])\) was given via IV bolus administration 3 times during imaging procedures. The dog was placed in left lateral recumbency for the stenting procedure, which was performed with fluoroscopic guidance. A combination 5F pigtail marker catheter\(^\text{a} and 0.035-inch angled hydrophilic guidewire\(^\text{a} were advanced across the malignant obstruction, the wire was removed, and approximately 10 mL of a 1:1 mixture of iohexol and saline (0.9% NaCl) solution was injected through the catheter to define the borders of the esophageal tumor (Figure 1). The esophagus was insufflated with air to help determine diameter of the stent to be used. The marker catheter was removed over a wire and replaced with a 22 X 70-mm, stainless steel mesh, self-expanding metallic stent delivery system.\(^\text{a}

The stent was advanced until it extended past the major malignant obstruction in oral and aboral directions and was deployed (Figure 2). Positive-contrast esophagography was repeated to document patency. Esophagscopy was also performed to confirm stent position and patency. Botulinum toxin A\(^\text{a} was then injected once into each mandibular salivary gland under ultrasonographic guidance at a dose of 30 U/gland. The dog recovered well from anesthesia; total procedural time was approximately 2 hours and 15 minutes. Immediately following anesthetic recovery, ptyalism was subjectively determined to be substantially reduced, according to annotations in the patient’s medical record indicating a marked reduction in the frequency of mouth wiping necessary.

The dog was discharged from the hospital the day after the procedure. The previously described medications were continued, and ranitidine\(^\text{c} (1.3 \text{ mg/kg} \ [0.59 \text{ mg/lb}]), via PEG tube, q 12 h) was additionally prescribed.

At follow-up examination 7 weeks after stent placement, the PEG tube was still in place. Fluoroscopy revealed that the stent was still in place and the esophageal lumen was patent through the stented region (Figure 3).

According to the owner, a veterinarian, the dog had substantial improvement of clinical signs attributable to the esophageal tumor, including regurgitation, dysphagia, and ptyalism, for 12 weeks following stent placement and was able to consume its total caloric energy requirement for target normal weight as a blended, liquid diet fed in an elevated bowl. Medications were continued via the PEG tube. To continue the feedings, the owner reported it was necessary to further dilute the canned diet slurry during the second month after stent placement. The dog’s body weight increased by 6.3 kg (13.9 lb) during the 12 weeks following stent placement.

The patient was euthanized 12 weeks after stent placement because of unacceptable clinical signs of vesicular lupus erythematosus and lumbosacral disease. The patient removed the PEG tube several days prior to euthanasia and the tube was not replaced. Injectable medications were given from that point until euthanasia. At necropsy, the stent was in place with no evidence of migration. Mild tumor ingrowth was detectable within the mesh of the stent, but no overgrowth, obstruction, or stricture was noted at the orad or aborad ends of the stent. A small amount of liquid diet was found within the stent during dissection of the esophagus; however, this was considered a likely postmortem phenomenon. No clinically relevant gross or histopathologic lesions were detected in the mandibular salivary glands.

Discussion

Esophageal cancers comprise <0.5% of cancers in companion animals. Although uncommon, esophageal sarcomas occurring secondary to Spirocerca lupi infection have been reported in small animals in Africa, Israel, and the United States.\(^\text{1} The most common types of esophageal neoplasia include squamous cell carcinoma, leiomyosarcoma, fibrosarcoma, and osteosarco-

Figure 3—Lateral thoracic radiographic views of the same dog in Figure 1. A—Immediately after stent deployment, some narrowing (arrow) of the stent and the esophageal lumen is evident at the tumor site. B—Seven weeks after stent placement, radial widening of the stented esophageal lumen at the tumor site is apparent (arrow). C—Orally administered contrast agent reveals esophageal patency (white arrow); notice contrast agent within the stomach (St) and persistent esophageal dilatation (Eso) cranial to the stent.

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\(\text{a} \) According to the owner, a veterinarian, the dog had substantial improvement of clinical signs attributable to the esophageal tumor, including regurgitation, dysphagia, and ptyalism, for 12 weeks following stent placement.

\(\text{b} \) Botulinum toxin A into the mandibular salivary glands.

\(\text{c} \) Injectable medications were given from that point until euthanasia. At necropsy, the stent was in place with no evidence of migration. Mild tumor ingrowth was detectable within the mesh of the stent, but no overgrowth, obstruction, or stricture was noted at the orad or aborad ends of the stent. A small amount of liquid diet was found within the stent during dissection of the esophagus; however, this was considered a likely postmortem phenomenon. No clinically relevant gross or histopathologic lesions were detected in the mandibular salivary glands.
ma; benign tumors can also occur, and paraesophageal tumors can invade the esophagus from the thymus or heart base. Tumors are most frequently identified in the middle third of the esophagus, complicating treatment options. Common clinical signs in affected animals can include dysphagia, regurgitation, and weight loss. Aspiration pneumonia can also develop when an obstructive mass affects the ability to swallow food, water, and saliva. Examination of standard radiographic views can reveal gas in the esophagus or esophageal dilatation orad of the mass. Endoscopic examination of the esophagus can be used to identify the mass and to facilitate biopsy procedures, and strictures may be detected by use of contrast-enhanced radiography, fluoroscopy, or esophagoscopy.

Prognosis for cure of esophageal cancer in small animals is generally poor, and options for palliation are limited. Esophageal cancers are typically diagnosed at an advanced stage, and ability to perform a complete surgical resection can be limited by poor visibility during surgery and a need to preserve important adjacent anatomic structures. Other potential complications include tension at the anastomosis site after excision of a mass with extensive esophageal involvement and possible reduced healing potential of the esophagus, compared with that of other tissues. In a recent study^7^ of esophageal sarcomas associated with Spirocerca lupi infection, 6 of 17 dogs were treated by means of partial esophagectomy and adjunct chemotherapy with doxorubicin, resulting in a 267-day median survival time. However, complete resection and anastomosis in 2 dogs resulted in a survival time of < 4 days after admission to the hospital for surgery, and dogs that did not undergo surgery survived between 1 and 60 days after the hospital admission date. Chemotherapy has not been attempted routinely, and traditional radiation treatment is difficult because of the sensitivity of surrounding lung parenchyma and heart, if these are within the radiation field. In addition, radiation-induced tumor reduction may take weeks, which can be problematic in patients with complete or nearly complete esophageal obstructions. A PEG tube can be used to provide nutritional support, but complications such as peristomal inflammation, infection, and premature tube removal can occur.

The low likelihood of achieving complete and durable remission in small animal patients with esophageal cancer has encouraged investigation into palliative treatments. Similar difficulties in treating advanced esophageal cancer in humans that are not considered candidates for surgery have led to evaluation of palliative esophageal stent placement to provide an improved quality of life. Dysphagia has a substantial impact on quality of life in patients with esophageal malignancies and, as such, plays a major role in calculating quality-of-life grades in human cancer patients.

Numerous studies^8–11^ have clearly demonstrated the safety and efficacy of palliative esophageal stenting for dysphagia caused by intrinsic or extrinsic esophageal obstruction in humans. There are several types of stents available for use in the esophagus; however, self-expanding metallic stents have largely replaced the previously used plastic stents, and nitinol products may be preferred to those made of stainless steel. Most commonly, a mesh self-expanding metallic stent is used. Advantages of this type of stent include ease of deployment and flexibility; they can be reconstrained and repositioned (or removed) prior to complete deployment. These stents are also available in covered (and removable) versions designed to reduce tumor ingrowth and seal fistulas, although, not surprisingly, covered stents have been reported to have higher migration rates, compared with noncovered stents. Mesh self-expanding metallic stents can shorten over time as they achieve their ultimate diameter. This shortening must be anticipated when choosing an appropriately sized stent. Shortening does not occur with nonmesh laser-cut stents; however, these are more expensive and currently are not routinely available in the lengths and diameters needed for the esophageal applications regardless of patient size. Stent length should be sufficient to allow the device to extend 2 cm beyond the oral and aboral tumor margins. For midesophageal lesions, eccentric stent placement with greater length beyond the oral aspect of the tumor has been recommended to decrease the risk of migration. Standard relative contraindications to esophageal stent placement include inability to place a stent across the full length of the tumor, clinically relevant coagulopathy, or tumor location within 2 to 3 cm of the cricopharyngeus muscle (because of difficulty in placing the stent so that it extends beyond the oral aspect of the tumor).

Stent placement can be performed with fluoroscopic guidance alone, but endoscopy may be considered in more proximal or distal lesions to help avoid stenting of the upper and lower esophageal sphincters, respectively. In 1 report,^10^ procedure times were shorter for fluoroscopically guided stent placement than for endoscopically guided stent placement. It is unclear whether balloon dilation is necessary after a stent is deployed; the type of stent used in the dog of the present report has been reported to expand slowly over 2 to 14 days following placement;^11^ for this reason, balloon dilation was not performed in this dog.

Generally, antimicrobials are not routinely administered following placement of an esophageal stent, although antacids might be helpful, particularly if the stent crosses the lower esophageal sphincter and reflux is anticipated. Postoperative feeding instructions vary among published reports, but it has been recommended that only liquids are ingested for 24 hours and then the normal diet is resumed. Dogs may be encouraged to eat a blended, canned food diet, and warm water can be offered after feedings to help minimize food trapping within the stent. Cola beverages have been recommended in humans with esophageal stents to help clear food from the stent.

Although reported mortality rates associated with esophageal stent placement in humans are low, complication rates of 26% to 52% have been described. Complications can include tumor ingrowth into the stent mesh, overgrowth or granulation tissue at the stent margins, stent migration (especially with covered stents), bleeding, food bolus impaction, and esophageal injury during stent placement. Similar complications were not seen in the dog of the present report.
Although difficult to interpret in dogs, chest pain has also been reported in humans following esophageal stent placement. Potential complications should be discussed with owners, and future studies may help to evaluate the relative risks of stent-related complications in dogs.

Successful palliative stenting procedures for malignant obstructions involving the respiratory, gastrointestinal, urogenital, and cardiovascular systems in dogs and cats have been described. Esophageal stenting for treatment of benign strictures has also been preliminarily investigated in dogs; however, stent migration was a commonly reported occurrence. Because standard treatments were declined by the owner of the dog of this report, and considering the reportedly successful use of palliative stents in human esophageal cancer patients with few serious complications, palliative esophageal stenting was offered as a potential means of improving quality of life.

It remains unclear whether the severe ptyalism observed in the dog of the present report resolved because of stent placement, injections of botulinum toxin A into the mandibular salivary glands, or a combination of the 2 treatments. A botulinum toxin A product was experimentally shown to reduce saliva production from the mandibular salivary glands in healthy dogs by up to 40% when injected into the glands at a 30 U/gland dose; the duration of effect was reportedly < 9 months, and few complications were reported. Saliva production by untreated salivary glands prevents xerostoma. Botulinum toxin A application to the nasal cavity has also been reported to reduce nasal secretions in dogs with experimentally induced rhinorrhea. Injections of botulinum toxin A into the salivary glands have been successfully used to treat human patients with ptyalism and chronic aspiration, and 1 recent report described a > 50% reduction in the total number of hospitalizations and prescriptive aspiration pneumonias in these patients following treatment with botulinum toxin A injections.

Potency units are specific for each botulinum toxin A product preparation and should be noted. In the dog of this report, botulinum toxin A injections were administered under ultrasonographic guidance because this method is typically used in human patients. Potential complications are rare but can include chewing difficulties, dry mouth, dysphagia, facial nerve paralysis, and masseter muscle injections leading to weakened jaw closure. Placement of an esophageal stent in the dog of this report resulted in substantial improvement of clinical signs associated with esophageal squamous cell carcinoma. The degree to which intraglandular injections of botulinum toxin A contributed to alleviation of ptyalism could not be determined; however, ptyalism subjectively appeared to be substantially reduced immediately following anesthetic recovery, and no adverse effects were reported. Stents may be potentially useful as a palliative treatment for animals with obstructive esophageal malignancies when standard treatment options cannot be pursued.

a. Maximum Calorie, Iams Co, Cincinnati, Ohio.

References

18. Freeman, HJ. Endoscopic stenting—where are we now and where can we go? World J Gastro 2008;14:3798–3803.
From this month’s AJVR

Evaluation of intraocular pressure measurements obtained by use of a rebound tonometer and applanation tonometer in dogs before and after elective phacoemulsification

Amy L. Thompson-Hom and Paul A. Gerding Jr

Objective—To determine whether an applanation tonometer and rebound tonometer can be used to detect similar intraocular pressure (IOP) measurements in eyes of dogs undergoing phacoemulsification.

Animals—24 dogs (40 eyes) undergoing elective phacoemulsification.

Procedures—IOP measurements were obtained from each eye by use of both the rebound tonometer and applanation tonometer. Central corneal thickness was measured by use of an ultrasonic pachymeter 3 hours before surgery and 2 and 24 hours after surgery. Statistical analysis was performed by use of paired t tests.

Results—Mean ± SD IOP 3 hours before surgery, 2 hours after surgery, and 24 hours after surgery was 11.9 ± 4.7 mm Hg, 15.5 ± 11.7 mm Hg, and 10.9 ± 6.7 mm Hg, respectively, as measured with the rebound tonometer and 12.2 ± 5.3 mm Hg, 15.7 ± 12.5 mm Hg, and 12.4 ± 5.4 mm Hg, respectively, as measured with the application tonometer. Measured IOP did not differ significantly between the 2 tonometers 3 hours before surgery and 2 hours after surgery, but measured IOP differed significantly between the tonometers 24 hours after surgery.

Conclusions and Clinical Relevance—Use of a rebound tonometer underestimated IOP, relative to results for use of an applanation tonometer, by 1.65 mm Hg in eyes 24 hours after phacoemulsification. Caution should be used when IOP measurements obtained with a rebound tonometer are in the high part of the reference range, and verification of these values with an applanation tonometer would be advised. (Am J Vet Res 2012;73:709–713)

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