How to Perform an Equine Esophagram

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1. Introduction

Esophageal disorders occur with relative frequency in equine practice, the most common being esophageal obstructions. While most esophageal obstructions are transient and require no imaging diagnostics, in cases with a history of dysphagia, recurrent esophageal obstruction, or other esophageal disease, an esophagram may provide important diagnostic information. Esophagrams are particularly indicated in cases of recurrent obstruction since these are more frequently associated with underlying morphological or functional esophageal disturbances. These may include, but are not limited to, stricture formation, diverticula, and motility disturbances. Less frequently, obstruction can result from extra-esophageal sources such as neoplastic masses and abscesses. Clinical signs of esophageal disease may include nasal discharge containing saliva/food, signs of dysphagia such as quidding/dropping food and delayed eating, gagging, and coughing, although more vague presentations such as anxiety and anorexia may also be seen. Esophageal perforation and rupture secondary to both intraluminal obstruction and external trauma have also been reported within the literature. Indicators of esophageal rupture can include a painful ventral cervical swelling with associated crepitus, cellulitis, and potential drainage. Cases of esophageal perforation may present with colic signs and pleural effusion, and this should always be considered as a differential diagnosis for such cases.

An esophagram can be performed safely and effectively and can often be acquired using portable x-ray equipment. It allows assessment of esophageal integrity and morphology and is a helpful complement to esophagoscopy in the investigation of equine esophageal disorders. Although fluoroscopic dynamic esophagrams are reported within the literature, because fluoroscopy is not available for most practitioners, this article will focus on the acquisition of a static radiographic esophagram.

2. Materials and Methods

Timing

Passage of a nasoesophageal tube and/or endoscope can cause esophageal dilation and optimally would not be performed immediately prior to the exam. If chemical restraint was used to facilitate prior nasoesophageal tube placement, the interval before the esophagram should be at least 30 minutes.

Sedation

If possible, sedation of the patient for radiograph acquisition should be avoided due to reported effects on esophageal motility. If sedation is required, the authors have used low-dose xylazine (0.2–0.4 mg/kg) to safely acquire diagnostic images.
Survey Radiographs
Prior to contrast administration, standing right-to-left laterolateral radiographs should be obtained. A complete radiographic examination of the esophagus should include the pharynx, cervical, thoracic, and abdominal esophagus. Images should be centered on the cranial esophagus caudal to the mandible, mid-esophagus ventral to the cervical spine, thoracic inlet, thoracic esophagus dorsal to the heart, and abdominal esophagus at the level of the dorsal diaphragm (Fig. 1). For radiography of the esophagus in an adult horse, exposures in the region of 80 to 120 kVp and 4 to 60 mAs are required, dependent on the radiographic system used. Due to the dorsal position of the esophagus within the thorax, it is usually possible to perform diagnostic studies with portable radiographic systems. Acquisition of survey radiographs is important, first, since they may themselves reveal esophageal abnormalities including any pre-existing gas or fluid dilation and, second, because they enable practitioners to optimize radiographic technique before contrast administration.

Foals may be radiographed in left lateral recumbency for ease of restraint, although in such cases, contrast medium should be limited to barium paste to reduce the risk of aspiration (Fig. 2).9

Contrast Selection
Liquid barium is the most frequently used contrast agent for esophagrams. In the majority of cases at the authors’ institution, 60% w/v barium suspension is utilized. However, in cases where esophageal perforation is suspected, nonionic iodinated contrast media should be used in place of barium since the latter has been associated with mediastinitis. If liquid barium does not identify a lesion consistent with the clinical suspicion, or in horses in which failure of patient compliance precludes intubation, barium may be mixed with feed and offered to the horse. A slurry/mash can be made of pelleted feed and 350 mL 60% w/v barium suspension.

Contrast Administration
Liquid contrast can be administered via 60-mL oral dosing syringe or via nasogastric tube. The syringe method requires multiple administrations, often gets a smaller bolus, and can be particularly messy. In most cases, the nasogastric tube is the preferred route unless a very cranial abnormality is suspected. Radiography may be performed with the tube in situ to confirm tube location prior to contrast administration. Careful intubation is important since manipulation of the tube has been shown to induce esophageal dilation.6 Once the tube has successfully been positioned in the cranial esophagus, a bolus of 350 to 500 mL of barium is administered under gravity. As the barium is being delivered, personnel should position the x-ray machine and plate appropriately to acquire images in a timely manner.

Image Acquisition
Radiographs are obtained immediately following barium administration. The decision on where to begin radiograph acquisition may depend in part on the suspected lesion location—it is recommended to focus on this region initially to ensure that barium passage through this area is adequately demonstrated. If no specific lesion location is suspected, begin caudally and move cranially. Radiographs may be repeated every 1 to 2 minutes until the contrast medium has disappeared completely. This usually occurs within a few minutes.10 Repeat boluses may be administered if required. In one study, two boluses of barium suspension, each of 2.5 mL/kg, were administered without associated signs of patient discomfort.10
Follow Up

If an intraluminal obstruction is visualized via esophagram as failure of passage of the barium bolus, it is recommended to repeat the study following clearance of the obstruction to ensure that no underlying esophageal lesion such as a diverticulum or mass is present. It may also be desirable to perform thoracic radiographs in the few days following clearance of esophageal obstruction to look for evidence of aspiration pneumonia. This secondary complication has been seen in up to 44% of horses presenting with esophageal obstruction. Thoracic radiographs may be particularly valuable in horses with a longer duration of clinical signs since these cases have been shown to be more likely to develop aspiration pneumonia. Thoracic ultrasound should also be performed in suspect aspiration pneumonia cases.

3. Results

At the authors’ institution, over a 10-year period (2010–2020), 18 positive-contrast esophagrams were performed. For many of these studies (n = 8), multiple (> 2) sequential 350-mL boluses of 60% w/v barium were administered via nasoesophageal tube. For three studies, the patient consumed barium-impregnated feed; in two cases, barium was administered per os via dosing syringe; in one case, barium administration was via both dosing syringe and nasoesophageal tube; and in one, both barium-coated feed and nasoesophageal intubation were utilized. Information regarding route of barium administration was not available for three cases. The normal passage of the esophagus is outlined in Figure 1.

On precontrast survey radiographs, the normal esophagus is difficult to discern since it does not contain air. Occasionally, a contrast bolus may persist within the normal esophagus until a second peristaltic wave completes passage into the stomach, particularly if a nasoesophageal tube is in place. Common locations for this temporary bolus retention are the thoracic inlet, just cranial to the cardiac silhouette, and at the cardia. In one study, disappearance of a barium bolus at the thoracic inlet by 2.5 minutes following administration was seen in 80% of normal horses, and bolus disappearance in the thoracic esophagus occurred in less than 2 minutes in 90% of horses. If material persists in these locations for multiple sequential radiographs and beyond these time limits, esophageal dysfunction may be suspected. In a normal esophagus, small volumes of residual contrast medium may be seen outlining the longitudinal mucosal folds after the passage of the bolus (Fig. 3). Several studies, and a number of cases at the authors’ institution, demonstrated a roughly U-shaped conformation of the caudal cervical esophagus in some normal horses; therefore, this should not be overinterpreted as a diverticulum (Fig. 4). The esophagus was deemed to be radiographically normal in six of the esophagrams performed within the study period.

In two of the horses examined within the study period, generalized esophageal dilation was seen as a wide, gas-filled viscus in the region of the esophagus on plain films (Fig. 5) and as static contrast material within the dilated esophagus on sequential radiographs as part of the esophagram (Fig. 6). It is
particularly important to perform concurrent or sub-
sequent thoracic radiographs on cases of generalized
megaesophagus since these horses are at higher risk
of aspiration pneumonia (Fig. 7).13

Peri-esophageal abscesses, tumors, or cysts may be
appreciable as soft-tissue masses that might cause
deviation of the esophagus and/or trachea. Figure 8
demonstrates a case of peri-esophageal abscess seen
within the study period. Where esophageal perfora-
tion is suspected, secondary to either chronic obstruc-
tion with intraluminal necrosis or external trauma, gas
and/or feed material may be seen within the peri-
esophageal soft tissues. Intraluminal obstruction
with radio-opaque food material may appear as an
ovoid heterogeneous mottled gas and soft-tissue opac-
ity, often located at the thoracic inlet, heart base, or
cardia. If the obstruction is well visualized on survey
radiographs, it may be prudent to forgo contrast
administration due to the risk of reflux and aspiration
of barium. No cases of either simple esophageal
obstruction or perforation were seen within the study
period at the authors’ institution, and food material
was only seen within diverticula. Strictures resulting
from intramural scarring secondary to previous
obstruction or other esophageal trauma may be visual-
ized as a smooth narrowing of the esophageal lumen
with contrast retention oral to this region (Fig.
9).9 This abnormality should be demonstrated to per-
sist over sequential radiographs so as to differentiate it
from a normal peristaltic contraction or esophageal
spasm.9 Strictures were suspected radiographically
in four horses in the study period.

Finally, esophageal diverticula are visible as out-
pouchings of the esophagus in which contrast material
will usually accumulate (Fig. 10). It can be difficult
to distinguish a true diverticulum from focal dilata-
tion radiographically. Diverticula may be classi-
ﬁed as pulsion, in which herniation of mucosa
occurs secondary to muscularis injury—usually
as a result of chronic impaction—or traction,
resulting from periesophageal scarring. It is reported
in the literature that traction diverticula are spherical
with a wide neck, whereas pulsion diverticula have a
ﬂask-like shape on esophagrams.14 In addition to
contrast, food material and gas may be seen within
the diverticula. Diverticula were detected radiog-
raphically in eight horses within the study period.

Two horses within the study period were suspected
of having a functional esophageal abnormality based
upon delayed passage of contrast medium. Several
horses had multiple concurrent esophageal abnormal-
ities, such as stricture with oral diverticulum (Fig. 9).

In one esophagram performed during the study pe-
riod, it was recommended to repeat the study due to
ingestion of an inadequate volume of barium-coated
feed. The only other reported complication associ-
ated with esophagram radiography was a single

Fig. 5. Megaesophagus. Diffuse gas distension of the esophagus, most pronounced in the thorax (arrows). Cranial is to the
left of the image.

Fig. 6. Barium pooling in caudal esophagus (arrows) over sequential radiographs obtained several minutes apart. Moderate-
marked ventral spondylosis of multiple thoracic vertebrae is seen as an incidental finding (arrowheads). Cranial is to the left of the
image.
instance of liquid barium aspiration in a 2-month-old foal (Fig. 2). In this case, barium administration via nasoesophageal tube was performed; however, the presence of a congenital stricture likely resulted in reflux and aspiration of contrast material. The foal was treated for pre-existing aspiration pneumonia and made a full recovery with apparent stricture resolution.

4. Discussion

Contrast radiography can help to distinguish between generalized megaesophagus and focal esophageal dilatations and their possible causes. Generalized megaesophagus usually reflects a functional abnormality and has been reported secondary to gastroduodenal ulceration, gastroesophageal reflux, cardiac sphincter anomaly, grass sickness (United Kingdom), congenital esophageal neural deficits, and a hereditary condition associated with muscular hypertrophy of the distal esophagus in Friesian horses. Focal esophageal dilatation and associated contrast accumulation may be secondary to either intra- or extraluminal obstructions, including foreign bodies, extraluminal masses, vascular ring anomaly, or stricture, or may indicate diverticula.

On consultation with radiologists at other referral hospitals, variations in preferred esophagram technique are apparent. Two institutions utilize a 1:1 dilution of barium suspension (60–105% w/v) with water administered via nasogastric tube. This information is valuable since it indicates that a smaller barium dose can be used in a similar bolus volume to successfully demonstrate esophageal abnormalities, thus reducing cost. Opinions regarding the success of barium-coated feed ingestion vary, with some individuals citing a frequent failure to tempt the horse to eat and others advocating for barium-impregnated mash as the primary technique utilized. At one institution, the favored approach is to begin with ingestion of a liquid slurry/mash and follow with increasingly dense barium-coated feed material to assess esophageal function with a variety of media. Where the administration of barium-coated feed has been attempted within the authors’
institution, a variety of coated feed types have been offered in order to maximize the chances of success, with the addition of sweet feed, treats, or cookies providing additional incentive. Fasting the horse prior to the study can also help encourage voluntary ingestion of barium. If it is possible to tempt the horse to eat the barium product, this does have the advantages of, first, avoiding the challenge of intubating a horse without sedation and, second, enabling visualization of bolus manipulation and swallowing in cases of dysphagia. In these patients, it is particularly important to assess for evidence of barium dorsal to the soft palate, or within the larynx or trachea, indicating pharyngeal dysfunction. Abnormal esophagram findings have been reported in cases of congenital anomalies such as cleft palate and postsurgically in cases of laryngeal hemiplegia.

No cases of simple obstruction were seen at the authors’ institution. This likely reflects the study population of a referral hospital, with most simple obstructions resolved in the field prior to or without need for referral. In cases that presented to the hospital with clinical suspicion of obstruction, these were either cleared before the esophagram was performed or identified as being secondary to diverticula on radiography.

Soft-tissue masses, whether extraluminal or within the wall of the esophagus, may cause compression or displacement of the esophagus, which will be readily visible on contrast studies. Ultrasonographic evaluation of the cervical esophagus/thoracic inlet and additional diagnostic procedures may be required to help differentiate abscesses, neoplasia, cysts, or other soft-tissue masses. Abscesses of the esophageal wall may be associated with irregularity of the mucosal surface since these may originate from internal trauma. Esophagoscopy is a useful adjunct to esophageal radiography and can be used in combination with esophagrams to provide the most comprehensive clinical picture to facilitate accurate diagnosis, implement successful treatment regimens, and assist with prognostication. Esophagoscopy provides important information regarding the gross appearance and integrity of the esophageal mucosa, which may not be apparent radiographically.

Management and treatment of esophageal disorders identified on esophagram vary depending on the specific lesion type. Medical management of esophageal obstructions is common, and these cases, if isolated incidents without associated aspiration pneumonia, typically have a favorable outcome. Recurrent obstruction is more likely to be associated with an underlying morphological or functional abnormality, which may carry with it a poorer prognosis. Standing endoscopic balloon dilation of esophageal strictures has been reported with a long-term survival rate of 56%. Options for surgical correction of strictures include esophagomyotomy, resection and anastomosis, creation of a traction diverticulum, or patch grafting. Interventions for treatment of stricture should be delayed for 60 days after the original presentation since some studies have demonstrated an increase in luminal diameter over this time period following the inciting incident. Traction diverticula infrequently produce clinical signs requiring medical intervention; however, pulsion diverticula may undergo progressive enlargement, predisposing to recurrent obstruction and esophageal rupture, and may require surgical repair. Medical management is the only option for generalized megaesophagus due to congenital or acquired esophageal dysfunction.

In conclusion, the esophagram is a valuable tool for diagnosis and characterization of functional and morphological esophageal abnormalities in horses and can be readily performed with infrequent complications by the well-prepared equine practitioner.

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Declaration of Ethics
Retrospective case series (level-4 evidence-based medicine) performed in adherence with the Principles of Veterinary Medical Ethics of the AVMA.

Conflict of Interest
The Authors have no conflicts of interest.

References