Evaluation of a technique for percutaneous endoscopic gastrostomy tube placement in horses

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**Objective**—To develop and assess the short-term feasibility, maintenance, and complications associated with percutaneous endoscopic gastrostomy (PEG) tube placement in standing horses.

**Animals**—6 adult horses.

**Procedures**—Feasibility of the technique was evaluated in 2 horses. In each of 4 other horses, a PEG tube was maintained for 14 days and used to provide fluid requirements during the latter 7 days, before removal. Following air inflation of the stomach, each PEG tube was placed via a left intercostal approach; proper tube location was ascertained by percutaneous ultrasonography and gastroscopy. The horses underwent physical examinations, CBCs, and peritoneal fluid analyses before and at intervals after tube placement. Seven days after tube removal, horses were euthanized and necropsied.

**Results**—Placement of a PEG tube was feasible in all 6 horses. The 4 horses assessed long term tolerated water administration through the PEG tube and remained clinically stable throughout the 21-day experiment. However, during the period PEG tubes were in place, significant increases in some peritoneal and hematologic variables were detected. Postmortem evaluation revealed localized peritonitis in 1 horse and body wall inflammation along the PEG tube tracks in 3 additional horses.

**Conclusions and Clinical Relevance**—Placement and maintenance of a PEG tube were tolerated well by the study horses, although peritoneal and systemic inflammation were detectable. Fluid requirements were adequately met with this technique, which could provide an alternative method for managing chronically dysphagic horses. Nevertheless, further research is warranted to evaluate the feasibility of enteral feeding by use of this approach in horses. (*Am J Vet Res* 2014;75:354–360)

Dysphagia is the inability to ingest food because of abnormalities in prehension, mastication, or swallowing. In horses, there are 3 types of dysphagia: pain-induced dysphagia, such as that caused by a snake bite or other trauma; obstructive dysphagia, such as that caused by a space-occupying lesion in the pharynx or auditory tube diverticula; and neurologic or neuromuscular dysphagia, such as that which can develop secondary to botulism, temporohyoid osteoarthropathy, or megaesophagus. Regardless of the cause, dysphagia of more than a few days’ duration in horses is difficult to manage and is associated with a high mortality rate. Adult horses can tolerate 3 to 5 days of starvation without major homeostatic disturbances, but young or geriatric horses, horses prone to develop metabolic diseases including hyperlipemia or hepatic lipidosis, and horses with decreased immune function require near-constant caloric support to avoid morbidity.

In horses, dysphagia of <2 weeks’ duration can be managed with minimal morbidity by means of feeding via a nasogastric tube or provision of total parenteral nutrition. However, options for management of long-term dysphagia in horses are associated with a high frequency of complications. Prolonged use of nasogastric tubes can result in necrosis of the nasal passages, pharynx, or esophagus, and these injuries are often severe and life ending.

Surgical cervical esophagostomy has been described as a means of enteral feeding for dysphagic horses, although the procedure can be technically challenging and is associated with high morbidity and mortality rates. Another option for management of dysphagic horses is provision of parenteral nutrition.
although prolonged use is challenging. In adult horses, parenteral nutrition is often cost-prohibitive and is associated with complications including metabolic and electrolyte disturbances, thrombophlebitis, and catheter-induced sepsis. Minimal data are available on the safety of prolonged parenteral nutrition in horses because this approach is usually used for < 2 weeks.

Long-term dysphagia in dogs, cats, and people is often managed by means of PEG tubes. For all of these species, complications of PEG tube placement and maintenance, including infection of the insertion site and peritonitis, have been described, but, in general, the morbidity associated with use of a PEG tube is similar or less than that associated with alternative interventions. With regard to the use of PEG tubes in large animals, it appears to have been described only for swine as an experimental model for human PEG tube investigations. The objective of the study reported here was to develop a technique for PEG tube placement in standing horses and assess the associated short-term feasibility, maintenance, and complications.

Materials and Methods

Horses—The study was approved by the Purdue University Animal Care and Use Committee. Experimental horses were donated to Purdue University for various reasons unrelated to the gastrointestinal tract problems. Horses were excluded if systemic disease was detected on the basis of results of physical examination, a CBC, or measurement of plasma fibrinogen concentration, problems. Horses were excluded if systemic disease was detected on the basis of results of physical examination, a CBC, or measurement of plasma fibrinogen concentration, problems. Horses were excluded if systemic disease was detected on the basis of results of physical examination, a CBC, or measurement of plasma fibrinogen concentration, problems. For all of these species, complications of PEG tube placement and maintenance, including infection of the insertion site and peritonitis, have been described, but, in general, the morbidity associated with use of a PEG tube is similar or less than that associated with alternative interventions. With regard to the use of PEG tubes in large animals, it appears to have been described only for swine as an experimental model for human PEG tube investigations. The objective of the study reported here was to develop a technique for PEG tube placement in standing horses and assess the associated short-term feasibility, maintenance, and complications.

Feasibility of PEG tube placement—Two of the 6 horses (weights, 510 and 535 kg) were used to develop and evaluate the feasibility of the PEG tube insertion technique. Because of the anatomic location of the stomach and its proximity to many vital organs including the liver, spleen, and diaphragm in horses, it was not initially known whether the stomach could be entered for PEG tube placement via the body wall without damaging other structures. In both horses, placement of PEG tubes was successful, and the technique was used for tube placement in the other 4 horses. The 2 horses used to assess technique feasibility were euthanized (with concentrated pentobarbital and phenytoin solution [0.2 mL/kg IV] immediately following PEG tube placement and were not subsequently examined via necropsy.

PEG tube placement—Food was withheld from each horse for 12 to 18 hours prior to the procedure (day 0) to empty the stomach. Each horse was sedated with detomidine (0.01 mg/kg, IV) and butorphanol (0.01 mg/kg, IV). The hair on the left side of the body wall between the 4th and 16th intercostal spaces was clipped, and aseptic preparation of the skin was performed. A 3-m video endoscope was passed through the left or right nostril and into the stomach. The stomach was inflated with air to establish closer proximity of the greater curvature to the body wall. Meanwhile, an ultrasound machine with a variable-band convex array 1- to 8-MHz probe was used to identify the greater curvature of the stomach. An area of the stomach was localized between the liver and spleen between the 8th and 12th intercostal spaces. The skin and soft tissues over the window to the stomach were anesthetized by injection of 10 to 20 mL of 2% lidocaine. Following a stab incision with a No. 15 scalpel blade, a 14-gauge IV catheter was placed aseptically into the stomach with ultrasound guidance (Figure 1). A 4-m-long piece of size 1 monofilament nylon suture was threaded through the catheter into the gastric lumen. The suture was grasped with a biopsy forceps that was inserted through the channel of the endoscope. The suture and the endoscope were then withdrawn through the esophagus, pharynx, and nasal passage. A commercially available 20F, 90-cm-long PEG tube was tied securely to the suture. The PEG tube was covered with water-soluble lubricant and placed in the (right or left) ventral nasal meatus. The operator at the left side of the standing horse slowly pulled the suture with the attached PEG tube through the esophagus, into the stomach, and through the left body wall. The pointed trocar end of the PEG tube facilitates its passage through tissues. Once proper PEG tube placement was ensured (ie, the bell-shaped end of the PEG tube was adjacent to the stomach wall, and the stomach was adjacent to the body wall as determined during ultrasonographic evaluation), the tube was sutured to the horse's body wall with size 0 nylon skin suture in a Chinese fingertrap pattern. A thoracic bandage was applied so that the tube could not be pulled out if the horse rubbed against objects. The end of the tube was capped except during fluid administration.

Maintenance of PEG tubes and care of horses—Each horse was continuously monitored for 1 hour after PEG tube placement to ensure recovery from sedation. Each individual horse was monitored physically every 6 hours for 7 days, then every 12 hours until day 21. If a physical examination variable was determined > 1 time each day, the median value for that variable was used for further statistical evaluation. At each time point until day 21, horses were evaluated for attitude, appetite, heart rate, rectal temperature, appearance of the insertion site, and presence and consistency of manure. Weight was assessed weekly. For the first 14 days after PEG tube placement, horses received flunixin meglumine (1.1 mg/kg, IV, q 12 h); 1 horse was administered oxytetracycline (7 mg/kg, IV, q 12 h) and the other 3 horses were administered penicillin G potassium (22,000 U/kg, IV, q 6 h) and gentamicin sulfate (6.6 mg/kg, IV, q 24 h). All 4 horses also received omeprazole (4 mg/kg, PO, q 24 h) until the PEG tube was removed on day 14. For each horse, the PEG tube insertion site was evaluated daily for swelling, heat, and discharge and the tube was flushed with water to prevent clogging. On days 7 through 14, the horses' water needs were met by continuous-rate instillation of approximately 150% of their fluid requirement (90 mL/kg/d) in the form of tap water directly into the stomach. The water was placed in empty IV fluid bags, and a delivery set was used to administer it by gravity flow. Hydration and perfusion status were assessed via skin...
tenting and measurement of capillary refill time as part of the physical examinations. Except for the period of food withholding immediately preceding PEG tube insertion, mixed grass-alfalfa hay and a salt block were available free-choice to each horse from the time they were enrolled in the study before PEG tube insertion to day 21.

Peritoneal cavity assessment—To monitor cytoLogic changes in peritoneal fluid composition, each of the 4 horses underwent abdominocentesis before PEG tube placement (baseline, day 0) and at days 3, 7, and 14 following PEG tube insertion. Abdominocentesis was performed with a 12-gauge, 6-cm-long, blunted teat cannula. Peritoneal fluid was easily collected from every horse at every time point, but the volume obtained was not recorded. Each peritoneal fluid sample collected underwent cytologic evaluation; if a septic process (ie, observation of extra- or intracellular bacteria, presence of degenerate neutrophils, total nucleated cell count > 10,000 cells/µL, or total protein concentration > 2.5 g/dL) was evident, the fluid underwent bacterial culture.

Assessment of systemic inflammation—For each of the 4 horses, a CBC and assessment of plasma fibrinogen concentration were performed with a commercially available hematology machine and coagulation analyzer before PEG tube placement (baseline, day 0) and at days 3, 7, and 14 following PEG tube insertion. On each occasion, 5 mL of venous blood was collected for analysis. A blood smear was prepared from each sample for routine microscopic evaluation.

PEG tube removal—The PEG tube in each of the 4 horses was removed on day 14 immediately after collection of blood and peritoneal fluid samples. From days 14 to 21, the horses were monitored through physical examinations performed every 12 hours. Blood and peritoneal fluid samples were not collected during this 7-day period.

Figure 1—Photographs to illustrate a technique for PEG tube placement in standing horses. A—Following insertion of a video-endoscope through the right nostril (in this particular horse) into the stomach and inflation of the stomach with air to establish closer proximity of the greater curvature to the body wall, an area of the stomach is localized ultrasonographically between the 8th and 12th intercostal spaces (between the liver and spleen) on the left side of the horse. The skin and soft tissues over the window to the stomach are anesthetized by injection of 10 to 20 mL of 2% lidocaine. A catheter is then inserted into the stomach with ultrasound guidance. B—A 4-m-long piece of suture is threaded through the catheter into the gastric lumen; the suture is grasped with a biopsy forceps that is inserted through the channel of the endoscope. A commercially available 20F, 90-cm-long PEG tube is tied securely to the suture. The PEG tube is covered with water-soluble lubricant and placed in the right ventral nasal meatus. C—The suture and the endoscope are then withdrawn through the esophagus, pharynx, and nasal passage to allow ligation of the suture to the PEG tube guidewire. Suture is attached with a single-throw surgeon’s knot. After PEG tube placement is achieved and the tube is sutured to the body wall, the end (including the wire and suture) is cut off with scissors and a closeable end adaptor is placed on the end of the remaining tube. D—The PEG tube is retracted through the catheter insertion site.
Necropsy—The 4 horses were euthanized via IV administration of a combination of pentobarbital and phenytoin on day 21 of the study (7 days after tube removal). Necropsy was performed according to a standardized protocol that included gross and histologic evaluation of brain, lungs, heart, liver, kidneys, spleen, adrenal glands, thyroid glands, pancreas, stomach, small intestine, large intestine, and urinary bladder. Gross evaluation of the PEG tube tract from the skin to the stomach was performed; select tissues from along the tract were evaluated histologically.

Statistical analysis—Statistical analysis was performed with a commercially available computer program. Physical examination findings (heart rate, respiratory rate, and rectal temperature), hematologic variables (WBC count, neutrophil count, band neutrophil count, and plasma fibrinogen concentration), and peritoneal fluid variables (protein concentration, WBC count, and neutrophil count) were evaluated before (day 0) and at 3, 7, and 14 days following PEG tube insertion. For physical examination findings that were assessed more than 1 time per day, the median value for that day was used for further analysis. The main effects of treatment and time were compared with a 2-way repeated-measures ANOVA with Bonferroni correction. Data are expressed as median and range. A value of $P < 0.05$ was considered significant.

Results

Feasibility of PEG tube placement—On the basis of the initial procedures performed on 2 horses, the technique for PEG tube placement proved feasible. No adaptations were necessary, and the same procedure was subsequently performed in the 4 other horses. The effect of PEG tube placement on physical examination, clinicopathologic, and peritoneal variables was evaluated in these 4 horses.

Physical examination findings and tube maintenance—Each of the 4 horses in which PEG tubes were maintained for 14 days before removal remained bright, alert, and responsive and had a good appetite throughout the 21-day study period. Two horses developed low-grade fevers (rectal temperature, 38.5° to 39.5°C) for the first 3 or 4 days after PEG tube placement; however, these horses responded to the twice-daily administration of flunixin meglumine with their body temperatures returning to baselines values within 4 hours after administration. Despite treatment with flunixin, 2 other horses required additional analgesic treatment (butorphanol, 0.02 mg/kg, IV) on 3 or 4 occasions during the first 48 hours after PEG tube placement. Those horses developed tachycardia and anorexia; however, in both cases, the additional analgesia resolved the problems, which did not reoccur after 48 hours. Rectal temperature ($P = 0.065$), respiratory rate ($P = 0.12$), heart rate ($P = 0.077$), and body weight ($P = 0.175$) did not change significantly during the 21-day study period. In 2 of the 4 horses, the PEG tube site was mildly swollen initially; however, no difficulties with the patency of the tubes were detected at any point. All horses defeated normally throughout the 21-day study period.

CBC findings and plasma fibrinogen concentration—Among the 4 horses, total WBC count ($P = 0.048$) and neutrophil count ($P = 0.034$) increased significantly from baseline during the 14-day tube placement period. Plasma fibrinogen concentration increased significantly ($P < 0.001$) during that period (Table 1).

Peritoneal fluid analyses—Results of the analyses of peritoneal fluid samples collected from the 4 horses indicated that peritoneal total protein concentration ($P = 0.002$), total nucleated cell count ($P = 0.038$), and percentage of neutrophils ($P = 0.006$) increased significantly from baseline during the 14-day tube placement period (Table 2). Bacterial culture of the fluid samples was performed on 8 occasions for 3 horses and did not yield any growth.

Table 1—Median (range) blood WBC, neutrophil, and band neutrophil counts and plasma fibrinogen concentration in 4 horses before PEG tube placement (baseline, day 0) and at days 3, 7, and 14 following PEG tube insertion.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Day</th>
<th>Reference interval</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>WBC count (cells/L)</td>
<td>0</td>
<td>6,200 (5,800–6,700)</td>
<td>0.048</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>6,900 (5,500–8,500)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>9,200 (7,400–11,500)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>9,700 (7,400–11,500)</td>
<td></td>
</tr>
<tr>
<td>Neutrophil count (cells/L)</td>
<td>0</td>
<td>4,400 (3,500–5,000)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>4,300 (3,200–6,600)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>9,300 (6,700–11,500)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>9,900 (7,400–11,500)</td>
<td></td>
</tr>
<tr>
<td>Band neutrophil count (cells/L)</td>
<td>0</td>
<td>0</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Plasma fibrinogen (mg/dL)</td>
<td>0</td>
<td>227 (193–262)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>422 (353–457)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>493 (395–534)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>344 (326–552)</td>
<td></td>
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</tbody>
</table>

The $P$ values were obtained with repeated-measures ANOVA. NA = Not applicable.

Table 2—Median (range) peritoneal fluid protein concentration, WBC count, and percentage of nondegenerate neutrophils in 4 horses before PEG tube placement (baseline, day 0) and at days 3, 7, and 14 following PEG tube insertion.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Day</th>
<th>Reference interval</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein (g/dL)</td>
<td>0</td>
<td>1.4 (1.1–1.8)</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>3.3 (2.2–4.7)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>3.3 (2.2–4.1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>2.8 (2.2–3.9)</td>
<td></td>
</tr>
<tr>
<td>WBC count (cells/L)</td>
<td>0</td>
<td>500,000 (400,000–1,000,000)</td>
<td>0–10,000</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>119,000 (32,000–326,000)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>35,000 (6,100–118,000)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>12,000 (1,000–45,500)</td>
<td></td>
</tr>
<tr>
<td>Nondegenerate neutrophil count (%)</td>
<td>0</td>
<td>15 (11–59)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>88 (15–99)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>87.5 (65–99)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>71 (10–95)</td>
<td></td>
</tr>
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</table>

See Table 1 for key.
has not been described. The apparent lack of descrip-

Discussion

(Figure 2)

body wall, diaphragm, spleen, and gastric wall

had localized nonpurulent inflammation with immature

was isolated. The remaining 3 horses

Streptococcus equi

sub-

sp

zooepidemicus

swab of the exudate in the tract, 

purulent inflammation along the PEG tube tract from the

removal. Granulation tissue had developed along the

body wall. None of the horses appeared to feel the tube

traction on the tube until it pulled out of the horse’s

was removed from each horse by removing the sutures

that attached it to the body wall and applying gentle

fusion through the PEG tube.

PEG tube removal — After 14 days, the PEG tube

was removed from each horse by removing the sutures

that attached it to the body wall and applying gentle

traction on the tube until it pulled out of the horse’s

body wall. None of the horses appeared to feel the tube

removal. Granulation tissue had developed along the

fibrous tract created around the tube in all horses. At

the time of euthanasia 7 days later, the PEG tube site

was epithelialized.

Necropsy results — The first of the 4 horses to un-
dergo postmortem evaluation had a subcutaneous and

body wall abscess at the tube insertion site and localized

purulent inflammation along the PEG tube tract from the

gastric wall through the body wall, involving the spleen,

liver, diaphragm, and left lung. On bacterial culture of a

swab of the exudate in the tract, Streptococcus equi

sub-

sp zooepidemicus was isolated. The remaining 3 horses

had localized nonpurulent inflammation with immature

granulation tissue lining the PEG tube tract, involving the

body wall, diaphragm, spleen, and gastric wall (Figure 2).

Discussion

To our knowledge, PEG tube placement in horses

has not been described. The apparent lack of descrip-
tions of PEG tube placement techniques may be a re-

fection of the relatively small size of the stomach, com-

pared with other portions of the gastrointestinal tract in

horses, which limits possible surgical approaches. The

stomach often cannot be brought to the body wall via a

ventral midline incision in horses.18

In the present study, we developed a technique for use in standing horses that was based on PEG tube

insertion procedures in people19 and companion ani-

mals.21 In those species, the stomach is directly adja-

cent to the body wall and either digital palpation of the

abdominal wall or use of the light source of the gas-

troscopy unit (visible through human skin) enables

identification of the proper location for PEG tube place-

ment. However, because of the anatomic characteristics

of horses, PEG tube insertion is not possible without

ultrasound guidance. Given that the greater curvature

of the equine stomach is approximately 5 to 10 cm me-
dial to the body wall, it is necessary to fully distend the

stomach with air via gastroscopy.20 In a previous study,21
gastric cannulas were placed via ventral midline lapar-

otomy in anesthetized horses. The ability to place PEG

tubes in a minimally invasive way without the use of

anesthesia makes this newly developed procedure at-

tractive as a method of cannula placement for gastric

pH studies in horses.6

Despite the expected clinicopathologic changes, the

4 horses in which PEG tubes were placed main-
tained a good appetite and were bright during the 14-
day tube placement period and the 7-day period after

tube removal. The lack of significant change in body

weight also indicated that the procedure was not as-

associated with major alterations in appetite or gastro-

intestinal tract function. Two horses required ad-

ditional analgesic treatment on 3 and 4 occasions

initially because of intermittent tachycardia and an-

orexia; however, neither horse developed sustained

anorexia or signs of depression and both responded

well to the analgesic treatment. One horse that had ab-

dominal discomfort during water administration was

responsive to temporary slowing of the continuous in-

fusion through the PEG tube.

In 1 of the 4 horses, purulent localized peritonitis

was detected during necropsy, which prompted revision

of the antimicrobial treatment plan. Administration of
cost-effective oxytetracycline was changed to a combi-
nation of penicillin G potassium and gentamicin for the

remaining 3 horses. In those horses, PEG tube place-

ment resulted in localized nonseptic peritonitis that be-
gan to resolve on day 14 of the study. Peritoneal inflam-

mation peaked 3 to 7 days after PEG tube placement as

indicated by results of peritoneal fluid analysis and as-

sessment of plasma fibrinogen concentration. The total

nucleated cell count and protein concentration in the

peritoneal fluid samples increased following PEG tube

placement in all but 1 horse, in which peritoneal fluid

variables remained within reference ranges throughout

the 14-day tube placement period. The detected chang-
es in these peritoneal fluid variables in all other horses

were similar to those reported for ponies in anesthetized horses.18

The procedure was tolerated well throughout the 7-day period, except in 1 horse, in which rapid water admin-

istration was discontinued for 6 hours and later reinstituted at a slower rate. The aim was

to provide 1.5 times the maintenance volume requirement over each 24-hour period; however, on many occasions,
horses received the predetermined amount within 12 to 16 hours. Then the fluid administration rate was slowed

substantially so that no horse received more than twice its maintenance requirements over a 24-hour period. In

the horse that had signs of abdominal discomfort, the rate was slowed sufficiently to administer the predetermined

amount of water during each 24-hour period.

Water administration via PEG tube — On days 7

through 14, horses were administered 90 mL of water/

kg/d as a continuous infusion through the PEG tube.

The procedure was tolerated well throughout the 7-day period, except in 1 horse, in which rapid water admin-

istration resulted in signs of mild abdominal discomfort.

For that horse, water administration was discontinued for

6 hours and later reinstituted at a slower rate. The aim was

to provide 1.5 times the maintenance volume requirement

ever each 24-hour period; however, on many occasions,
horses received the predetermined amount within 12 to

16 hours. Then the fluid administration rate was slowed

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the horse that had signs of abdominal discomfort, the rate

was slowed sufficiently to administer the predetermined

amount of water during each 24-hour period.

Figure 2—Postmortem photograph of the abdomen of 1 of 4

horses that was euthanized 7 days after PEG tube removal; the

PEG tube had been maintained for 14 days. Notice the fibrous

tract formed around the PEG tube (arrow). The tract formation is

considered normal and was expected on the basis of reports of

findings in other species following PEG tube placement.
in 10 ponies. Initial baseline peritoneal fluid variables were within reference limits; however, the total leukocyte count and total protein concentration in peritoneal fluid samples increased and remained high until termination of the study. Another study evaluated bilateral laparoscopic and natural orifice transluminal endoscopic ovariectomy in horses with repeated analyses for 2 weeks. Abdominocentesis revealed increases in peritoneal nucleated cell count and total protein concentration for up to 14 days following the procedure.

In the present study, based on the leukograms and plasma fibrinogen concentration data, the horses developed mild to moderate systemic inflammation during the PEG tube placement period as evidenced by neutrophilia with concurrent high fibrinogen concentration. A previous report describes a mild inflammatory leukogram and peak mean plasma fibrinogen concentration by day 4 following laparotomy in ponies. In the horses in the present study, the extent of systemic inflammation was not overwhelming as represented by the lack of detectable band neutrophilia at any time when a blood sample was collected. Because the peritoneal fluid changes observed in this study were similar to those previously reported, and the fact that PEG tube insertion would be reserved for horses with chronic dysphagia (a condition that has a high mortality rate), these changes were considered acceptable. Inflammatory signs markedly abated by 14 days in all but the 1 horse treated with oxytetracycline; that horse developed a subcutaneous and body wall abscess at the tube insertion site.

In a study evaluating surgically versus endoscopically placed gastrostomy tubes in 73 dogs and cats, 42 (57.5%) animals had no complications, 5 (6.8%) had minor complications, 19 (26.0%) had moderate complications, and 7 (9.6%) had severe complications. In that study, minor complications were classified as those not requiring medical attention (eg, peristomal inflammation), moderate complications were classified as those that posed a non–life-threatening health risk (eg, peristomal infection or fistula formation after tube removal), and severe complications were classified as those that posed a life-threatening health risk (eg, inadvertent tube removal resulting in septic peritonitis). By use of this classification scheme, the complication rate among the 4 horses in the present study appeared very similar to that among dogs and cats: 2 horses had no complication, 1 had moderate complications, and 1 had minor complications; no horse developed severe complications. However, conclusions based on this between-study comparison cannot be substantiated because the other study evaluated long-term maintenance, used the tubes for assisted enteral feeding, and had a larger sample size.

Antimicrobial prophylaxis resulted in a relative risk reduction of 64% for infections in people with PEG tubes in a meta-analysis of 10 randomized clinical trials (1,059 cases). In the present study, horses were treated systemically with antimicrobials during the 14-day tube placement period to prevent septic complications of PEG tube and IV catheter maintenance. Even so, the horse treated with oxytetracycline developed fever, a subcutaneous and body wall abscess, and localized purulent peritonitis. One of 3 horses that were administered a penicillin-gentamicin combination developed low-grade fever during the first 3 to 4 days of the study. However, because of the low number of horses in this study, conclusions regarding the most suitable antimicrobial selection and regimen cannot be drawn. Nevertheless, it is our impression that horses should be maintained on potent broad-spectrum antimicrobial treatment until the fibrous tract around the PEG tube forms; however, most dysphagic horses require antimicrobial treatment to treat or prevent aspiration pneumonia.

With regard to PEG tube placement in horses, it must be emphasized that nonseptic peritonitis and body wall abscess development are important complications. However, PEG tube placement is reserved for horses with prolonged (>2 weeks’ duration) dysphagia, for which the prognosis would be poor without this intervention or esophagostomy. The high morbidity and mortality rates associated with either repeated nasogastric tube insertion or esophagostomy must be weighed against the potential complications of PEG tube placement. It must again be highlighted that although gastric adhesion to the body wall has been reported as early as 3 days after gastrostomy in healthy animals, it could take longer in immunosuppressed or debilitated patients. Therefore, PEG tubes should only be considered for prolonged (>14 days’ duration) provision of assisted enteral nutrition and should not be removed until a gastric adhesion to the body wall has formed, usually at least 10 days after placement.

Major limitations of the study reported here included the small sample size and lack of long-term follow-up. However, the aims of the present study were to develop and assess the short-term feasibility, maintenance, and complications associated with a technique for PEG tube placement in standing horses.

Although further experimental and clinical studies are warranted to evaluate the validity of provision of liquid enteral nutrition with this versus other assisted feeding approaches, results of the present study have indicated that PEG tube placement in standing horses is possible with complication rates similar to those in small animals undergoing the procedure. Furthermore, fluid administration and maintenance requirements could be met with this technique. Thus, we propose PEG tube placement as a potential candidate for further evaluation as an alternative method for long-term nutritional management of chronically dysphagic horses.

References