Subcutaneous emphysema, pneumoperitoneum, and pneumoretroperitoneum after gastrostomy tube placement in a cat

Nicola J. Mason, BVetMed, DACVIM, and Kathryn E. Michel, DVM, MS, DACVIM

Pneumoperitoneum is a common complication of percutaneous endoscopic gastrostomy tube placement in humans and does not necessitate immediate laparotomy unless concurrent signs of peritonitis develop. Subcutaneous emphysema and pneumoretroperitoneum after gastrostomy tube placement is rare. Pneumoretroperitoneum is usually treated conservatively with broad-spectrum antimicrobials.

A 17-year-old spayed female domestic shorthair was referred for palliative radiation treatment of an oral squamous cell carcinoma. The cat had been examined by the referring veterinarian for lethargy, intermittent anorexia, weight loss, dysphagia, and ptyalism of 1 month’s duration. Clinical evaluation had revealed cachexia, mild dehydration, moderate gingivitis, and a large (2 cm \( \times \) 4 cm) erythematous mass that originated from the base of the tongue and the medial surface of the body of the right mandible. Signs of pain were elicited by manipulation of the mandible. Serum biochemical analyses revealed slightly increased creatinine concentration (2.2 mg/dl; reference range, 0.5 to 2.0 mg/dl) and mild hyperglobulinemia (5.6 g/dl; reference range, 2.1 to 4.3 g/dl). Results of CBC were unremarkable. Enzyme-linked immunosorbert assays for FeLV antigen and feline immunodeficiency virus antibody yielded negative results. Radiography revealed extensive subcutaneous emphysema and mild pneumoperitoneum that worsened with attempts to maintain gastric insufflation developed almost immediately at the point of catheter entry and spread rapidly to the thoracic inlet, dorsally over the spinous processes to the right thoracic wall and right abdominal wall, and caudally to the sacral region. The procedure was aborted.

Thoracic and abdominal radiographs revealed obvious subcutaneous emphysema and mild pneumoperitoneum and pneumoretroperitoneum (Fig 1). Exploratory laparotomy was performed 3 hours later, to investigate the possibility of gastric rupture and to place a gastrostomy tube. A 2- to 3-mm perforation was detected in the gastric fundus, with 3 pinpoint areas of serosal hemorrhage surrounding the perforation. A 2-cm diameter area of discolored serosa on the greater curvature of the stomach at the junction of the cardia and fundus was also observed. Additional intestinal perforations were not detected. Approximately 20 ml of a serosanguineous peritoneal effusion was collected and submitted for bacteriologic culture. Cytologic examination of the peritoneal effusion was not performed. Additional findings included a small pancreatic cyst-like structure, prominent mesenteric lymph nodes, and a small left kidney. Biopsy specimens from the stomach wall and mesenteric lymph node were taken, and 3 ml of brown fluid was aspirated from the pancreatic cyst. A gastrostomy tube was placed, and a gastropexy was performed. The abdomen was flushed with 2 L of warm saline (0.9% NaCl) solution and closed in a routine manner. The cat received an analgesic (butorphanol, 0.1 mg/kg, IV, q 4 h) as required, broad spectrum antibiotics (ampicillin, 11 mg/kg [5 mg/lb], IV, q 6 h), meropenem (50 mg/kg [22.7 mg/lb], IV, q 6 h), and metoclopra-mide (1 mg/kg [0.45 mg/lb], IV, q 24 h) as a constant rate infusion, sucralfate (0.25 gm, administered via gastrostomy tube, q 6 h), and cimetidine (5 mg/kg [2.27 mg/lb], IV, q 8 h) for treatment of suspected gastritis. Radiation treatment was not performed.

From the Department of Clinical Studies, School of Veterinary Medicine, University of Pennsylvania, Philadelphia, PA 19104-6010.
of long-term management. Clinical signs of gastritis were never reported, and complications associated with the gastrostomy tube did not develop. Because of progression of the oral squamous cell carcinoma and the associated discomfort, euthanasia was recommended. The owner declined this option, and the cat was lost to follow-up.

Percutaneous endoscopic gastrostomy tube placement is widely accepted in human and veterinary medicine as a rapid, simple, and cost effective technique that allows permanent or temporary gastric access for patients rendered anorexic by physical, neurologic, or metabolic disorders.²,³ Complications associated with PEG tubes and their placement are documented in the human literature, and the incidence of serious complications is generally low.⁴,⁵ In the veterinary literature, complications of PEG tube placement and management are uncommonly reported and are usually of minor consequence.⁶,⁷

The technique of PEG tube placement described by Gauderer and Ponsky⁸ and adapted for use in dogs by Mathews and Binington⁹ requires maximal insufflation of the stomach to place the greater curvature of the fundus against the left lateral abdominal wall; this reduces the incidence of splenic laceration or intestinal perforation during gastric puncture. Over-insufflation of the stomach leading to gastric rupture is rare during endoscopy and is usually accompanied by autonomic changes such as bradycardia and hypotension.¹⁰ Serosal tearing and mucosal and submucosal prolapse usually precede rupture. In the cat of this report, continuous cardiac and Doppler blood pressure monitoring indicated that bradycardia and hypotension did not develop during the endoscopy procedure. In addition, the gastric perforation was consistent with that made by a cannula and not with over-insufflation, particularly because serosal tearing and mucosal prolapse were not evident. Thus, over-insufflation of the stomach did not apparently contribute to the gastric perforation.

Intraluminal pressures > 70 mm Hg (95 cm water) can be achieved with air insufflation via a flexible endoscope, producing a considerable pressure gradient between the gastric lumen and the surrounding tissues, where the pressure is approximately 5 mm Hg.¹¹ Subsequently, after needle puncture of the abdominal wall and stomach during PEG tube placement, an opportunity arises for air to enter the peritoneal cavity and surrounding tissues. Results of prospective and retrospective studies indicate that pneumoperitoneum is a common development after PEG tube placement in humans and does not necessitate immediate laparotomy unless concurrent signs of peritonitis develop.²,⁷,¹²-¹⁴ It is unknown whether pneumoperitoneum develops as a common complication of PEG tube placement in cats. In the cat of this report, the pneumoperitoneum was mild, and on its own, may not have necessitated exploratory surgery.

Pneumoretroperitoneum following PEG tube placement in humans is usually treated conservatively with broad-spectrum antimicrobials.²,²,² In the cat of this report, the detection of Pasteurella multocida and Enterobacter spp, commensal organisms of the oral cavity and stomach of cats, respectively, in the peritoneal effusion, was strongly suggestive of leakage of gastric contents from the perforation site. Classification of the
fluid type and cytologic evaluation would have aided in further identifying the cause of the effusion. Further investigative procedures such as diagnostic peritoneal lavage have not been documented in humans with pneumoperitoneum following PEG tube placement, so it remains unknown whether leakage of gastric contents occurs simultaneously with pneumoperitoneum, and whether prophylactic administration of broad-spectrum antimicrobials is necessary in such cases. Resolution of pneumoperitoneum usually develops within 1 week, but sporadic cases of prolonged pneumoperitoneum have been reported in humans.15,16

Reports of subcutaneous emphysema and pneumoretroperitoneum following PEG tube placement in humans are rare, although subcutaneous emphysema and pneumoretroperitoneum did develop within hours of PEG tube placement in one instance.19 To the authors’ knowledge, however, this complication has not been reported in the veterinary literature. In the cat of this report, it is most likely that underlying gastric damage predisposed to air leakage into the peritoneal cavity after gastric puncture. Subcutaneous emphysema and pneumoretroperitoneum developed when the air dissected through the subcutaneous tissues around the point of catheter entry and along fascial planes into the retroperitoneum. Interestingly, pneumoretroperitoneum has not been reported with pneumoperitoneum or subcutaneous emphysema after PEG tube placement in humans. Two reports of retroperitoneal, mediastinal, and subcutaneous emphysema that developed secondary to endoscopy of the upper portion of the gastrointestinal tract, without evidence of gastric perforation, are documented in the human literature.15,20 Such reports are believed to support the theory that, during insufflation, air may enter damaged areas of the gastric mucosa and pass along perivascular and perineural tissues to reach the peritoneal, retroperitoneal, thoracic, and subcutaneous tissues, resulting in disseminated emphysema. It is possible that such a mechanism contributed to the development of disseminated emphysema seen in the cat of this report. However, because microscopic evidence of mucosal and submucosal emphysema was not detected in the gastric tissues, this cause seems less likely.

Positive pressure ventilation has been reported to cause subcutaneous emphysema, pneumomediastinum, pneumomediastinum, and pneumopericardium in a cat.21 In that situation it is believed that air passes across the wall of the pulmonary alveoli and along the connective tissue surrounding the pulmonary blood vessels into the mediastinum.22 However, positive pressure ventilation was not used in the cat of this report, and thoracic disease was not identified by radiography. It is of interest that the pneumomediastinum was mild, as determined by the abdominal radiographs. This may indicate that the pneumoretroperitoneum developed secondary to air dissection along fascial planes or that the subcutaneous emphysema was so extensive that it may have resulted in retrograde air movement from the subcutis into the retroperitoneal space.

Studies performed to determine predictors of outcome in human patients with PEG tubes have found a strong association between mortality and increasing age, low serum albumin concentration, decreased body mass index, and obstructive malignancies.1 In the cat of this report, low serum albumin concentration was considered to be secondary to malnutrition and, possibly, overhydration, and may have contributed to the complications that developed. However, wound healing after surgery was not compromised, and complications associated with the PEG tube were not detected. After PEG tube feeding for 2 weeks, the serum albumin concentration returned to reference range. It is arguable that hypoalbuminemia reflects the degree of malnutrition and general debility and as such may indicate an unsuitable candidate for PEG tube placement until the patient’s condition is improved. Unlike the situation in humans, age-related microscopic changes in the gastric wall have not been documented in cats. It may be speculated that age-related gastric mucosal atrophy may predispose to PEG tube complications, but evidence of such a relationship has not yet been detected in animals.

References

17. Hirsch DC. Microbiology of the gastrointestinal tract: