


## STANDARD ARTICLE

# Esophagostomy tube complications in dogs and cats: Retrospective review of 225 cases

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**Abstract**

**Background:** Esophagostomy feeding tubes (E-tubes) are an essential tool for management of hyporexic patients' acute and chronic nutritional requirements. Despite their routine use, limited information is available regarding E-tube complications, especially in the recent veterinary literature.

**Objective:** To provide an updated descriptive account of E-tube complications in cats and dogs, and to evaluate potential prognostic factors to determine if certain patients are at increased risk for complications.

**Animals:** One hundred two dogs and 123 cats.

**Methods:** Retrospective study evaluating patients that had E-tubes placed between March 2014 and March 2017.

**Results:** One hundred patients (44.4%) experienced a complication related to tube placement, with a similar complication rate among dogs (43.1%) and cats (45.5%). Twenty-two cats (17.8%) and 14 dogs (13.7%) developed signs of infection at the E-tube site, with 5 cats (22.7%) and 5 dogs (35.7%) requiring surgical debridement. Regurgitation of food through the E-tube stoma was noted in 7 dogs and 1 cat. Three patients were euthanized as a result of tube-related complications.

**Conclusions and Clinical Importance:** We have provided an updated descriptive review of complications associated with E-tube placement in a large population of dogs and cats at a tertiary referral center. Although E-tubes are essential tools that generally are safe and well tolerated, several complications can occur. We did not identify any specific factors that increase patient risk for these complications, and therefore it is important that all patients are closely monitored and clients are educated to pursue prompt veterinary assessment when such complications arise.

**KEYWORDS**

cachexia, canine, critical care, enteral nutrition, feline, nutrition

**Abbreviations:** E-tube(s), esophagostomy tube(s); PEG, percutaneous endoscopic gastrostomy.

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## 1 | INTRODUCTION

Esophagostomy feeding tubes (E-tubes) are an essential tool for management of hyporexic patients' acute and chronic nutritional requirements, as well as a method for provision of medications and supplemental free water in patients intolerant of IV fluid support. Despite their common use, limited information is available regarding E-tube complications, especially in the recent veterinary literature. Previous studies have reported complication rates ranging from 13 to 71%, with major complications being far less common.<sup>1-3</sup> The most common complications reported with E-tube placement included vomiting, patient removal of the tube, mechanical difficulties (eg, tube obstruction, tube nozzle dislodgement), and vomiting of the tube. Peristomal inflammation, infection and abscess formation, and necrotic tissue were noted to be less common (13%-25%). In most cases, infections were associated with poor at-home stoma care and were easily manageable.<sup>1-3</sup>

In a retrospective study of cats undergoing E-tube placement, 19/52 (36.5%) cats experienced a complication after the procedure.<sup>3</sup> Of these 19 cases, 13 were characterized as mild and did not require any adjustments to treatment. Of the more severe complications, 4 cats developed abscesses that required treatment, with 3 of these cats treated successfully with modifications to home care, cleansing in-clinic, and antibiotics. One of the cats' abscesses was characterized as more severe and required hospitalization to manage the infection and salvage the tube.

Another retrospective study compared complications associated with esophagostomy vs percutaneous endoscopic gastrostomy (PEG) feeding tubes and found a complication rate of 71.7% in cats with E-tubes, with 39% of these being classified as minor and 61% moderate in severity.<sup>2</sup> No statistical difference was found between PEG tubes and E-tubes with regard to complications.

More recent veterinary literature has focused on procedural descriptions<sup>4,5</sup> and novel uses of E-tubes, such as indwelling esophageal balloon dilatation for esophageal strictures<sup>6</sup> and continuous suctioning for long-term management of megaesophagus.<sup>7</sup> However, limited information regarding complications associated with E-tubes has been published in the past decade.<sup>1-3</sup>

The objectives of our retrospective study were to provide an updated descriptive account of E-tube complications and to investigate novel aspects of E-tube management, including time to institution of feeding and bacterial isolates causing E-tube site infections.

## 2 | MATERIALS AND METHODS

Medical records of dogs and cats that had E-tubes placed between March 2014 and March 2017 at the investigators' tertiary referral center were retrospectively reviewed. Dogs and cats were included if they had an E-tube placed and maintained for at least 24 hours.

For dogs and cats that met the initial inclusion criteria, medical records were reviewed for patient and E-tube placement data, as well as complications documented while in hospital and during follow-up

visits. Patient data included signalment, clinicopathologic abnormalities, primary disease processes, and comorbidities (including immunosuppressive conditions). Placement data included tube size, mode of confirmation, procedural complications, anesthesia data, and concurrent procedures. Records were reviewed for daily observations and changes in management of E-tube sites (if applicable). If aerobic culture and sensitivity were performed, the results were recorded. Cultures were obtained using skin swabs and placed in a sterile culture tube in all cases. Follow-up visits, surgical reports, and anesthetic records also were reviewed. Primary care veterinarians were contacted for follow-up data after discharge. Reason for removal, infection outcome, duration of time the tube was in place, and euthanasia (if applicable) were recorded.

### 2.1 | Statistical analysis

All statistical analyses were performed using standard statistical software (Stata 15MP, StataCorp, College Station, Texas), with a *P* value <.05 as the criterion for statistical significance. For each continuous variable, a Shapiro-Wilks test for normality was performed. Descriptive analyses included computation of medians, ranges of continuous variables, and frequencies as percentages for categorical data. Exploratory statistical analysis was conducted by Spearman correlation to determine if an association existed between independent variables and the outcome of interest. A *P* value <0.2 was considered significant for data to be included in subsequent inference statistical analysis. Univariate binary logistic regression was performed to assess the association of variables with outcomes of interest, including complications as a whole, as well as individual complications. Chi-squared analysis, Firth logistic regression, and pair-wise comparisons were utilized to compare risk factors and outcomes of interest among dogs and cats.

## 3 | RESULTS

### 3.1 | Sample population and clinical data

During the 3-year study period, 250 patients met the initial criteria. Fifteen were excluded because of incomplete records. An additional 10 were removed from analysis because the E-tube was in place for <24 hours, resulting in 225 cases for inclusion in the final analysis. Of these 225 cases, 102 were dogs and 123 were cats.

The median age of cats was 8 years (range, 1-6 years) and median weight was 4.4 kg (range, 1.75-10.9 kg). One hundred twelve cats had tube size reported, all of which had a 14-French (Fr) E-tube placed. The primary disease process was recorded for all cats, with renal disease being most common (52 total, with 11 receiving intermittent hemodialysis). The other patients were being managed for hepatic disease (23), gastrointestinal disease (14), pancreatitis (10), respiratory disease (7), trauma (6), orofacial disease (5), infectious disease (2), diabetes mellitus (1), and neurologic disease (1). In terms of concurrent immunosuppressive conditions, in addition to the 1 patient with diabetes mellitus, 12 cats

were diagnosed with neoplasia. Nine patients were receiving systemic immunosuppressive drugs, including corticosteroids and chemotherapeutic agents. Ninety-three cats had received PO antibiotics during or after hospitalization. Twenty-two patients were hypoalbuminemic (1.4-2.4 g/dL), 31 had a leukocytosis (16 790-39 680/ $\mu$ L), 2 were leukopenic (1000-5060/ $\mu$ L), and 7 had a left shift noted on CBC.

Eighty-three cats had concurrent anesthetic procedures at the time of E-tube placement, including 4 laparoscopic procedures (liver or intestinal biopsies or both), 26 laparotomies (ureteral surgery or stent placement or both in 21 and exploratory laparotomy in 5), 12 endoscopic procedures, 3 wound treatments, 8 dental procedures, 11 dialysis catheter placements, and 17 other procedures performed (head or nasal computed tomography [CT] in 3, ultrasound-guided aspirates in 3, pyelogram in 3, endotracheal wash in 2, and 1 of each of the following: rhinotomy, manual relief of obstipation, cholecystocentesis, endotracheal wash, ultrasound-guided renal biopsy, and nasal irrigation). Median anesthesia time was 120 minutes (range, 20-450 minutes). One hundred twenty cats had mode of tube placement confirmation recorded; 41 patients had tube placement confirmed by radiography (34.2%), 42 by endoscopy (35%), and 37 by fluoroscopy (30%). Feeding was initiated at a median of 14 hours after E-tube placement (range, 2-144 hours).

The median age of dogs was 8 years (range, 1.5 months to 15 years) and median weight was 14.2 kg (range, 1.7-57.8 kg). Sixty-seven dogs had tube size recorded, with 14 Fr in 32 patients, 18 Fr in 27, and 8 Fr E-tube in 8 patients. Renal disease was the most common primary disease process (59 patients, 18 of which were receiving intermittent hemodialysis). The other patients were being managed for hepatic disease (21), gastrointestinal disease (12), pancreatitis (10), trauma (6), infectious disease (3), neoplasia (1), orofacial disease (1), or immune-mediated disease (1).

Several dogs had multiple comorbidities, including immunosuppressive conditions such as diabetes mellitus (3), hyperadrenocorticism (3), and neoplasia (8). Seventeen patients were receiving systemic immunosuppressive drugs including corticosteroids, cyclosporine, mycophenolate, and chemotherapeutic agents (vincristine and cyclophosphamide). Eighty-one patients were treated with PO antibiotics during or after hospitalization. Forty-nine patients were hypoalbuminemic (1.3-2.4 g/dL), 48 had leukocytosis (11 520-53 568/ $\mu$ L), 1 was leukopenic (1771/ $\mu$ L), and 22 had a left shift noted on CBC.

Fifty-eight dogs had concurrent anesthetic procedures at the time of E-tube placement, including 17 dialysis catheter placements, 11 laparotomies (exploratory laparotomy in 7, biliary surgery in 2, splenectomy in 1, and inguinal hernia repair in 1), 7 laparoscopic liver biopsies, 5 endoscopic procedures, 4 renal biopsies, 3 wound treatments, 3 dental procedures, and 5 other procedures (including, head CT in 2, anthrocentesis in 1, buccal mucosal bleeding time in 1, and radiographs in 1). Median anesthesia time was 92.5 minutes (range, 30-480 minutes). Mode of tube placement confirmation was recorded in 101 dogs; 49 had tube placement confirmed by radiography (48.5%), 35 by endoscopy (34.6%), and 17 by fluoroscopy (16.8%). Feeding was initiated a median of 12 hours after E-tube placement (range, 2-48 hours).

## 3.2 | Complications

Of the 225 cases, 100 (44.4%) experienced a complication, with a similar complication rate among dogs (44 total, 43.1%) and cats (56 total, 45.5%). Complications were recorded during initial hospitalization as well as during follow-up visits. Six cats (4.8%) and 4 dogs (3.9%) had erythema noted around the stoma in hospital, whereas 14 cats (11.3%) and 13 dogs (12.7%) were noted to have erythema at follow-up. Nine cats (7.3%) and 14 dogs (13.7%) were noted to have inflammation around the stoma in hospital and 19 cats (15.4%) and 14 dogs (13.7%) at follow-up. Fifteen cats (12.2%) and 12 dogs (11.7%) had active mucoid, mucopurulent, or purulent discharge around the stoma in hospital and 28 cats (22.7%) and 20 dogs (19.6%) had discharge noted at follow-up.

Seventeen cats (13.8%) and 10 dogs (9.8%) had loose sutures noted at follow-up, requiring resuturing of the site. Two cats (1.6%) and 2 dogs (1.9%) were evaluated for vomiting of the tube. Two cats (1.6%) and 5 dogs (4.9%) required tube readjustment based on radiographs because of tube migration, and 7 cats (5.6%) and 7 dogs (6.8%) required replacement with a new tube because of dislodgement. Two cats (1.6%) and 1 dog (0.9%) were reported to have discomfort on examination, and 1 cat (0.8%) presented for an obstructed tube requiring removal.

One cat (0.8%) and 7 dogs (6.8%) had evidence of food coming through the stoma. Dogs were significantly more likely to develop this complication, compared to cats ( $P = .02$ ). Three of the dogs (42.8%) with this complication were dialysis patients. Four patients (including the 3 dialysis patients) were >20 kg. Tube size was not recorded in these specific cases. One of these patients was under anesthesia for 450 minutes, which was the longest anesthetic event for all dogs. Two of these dogs were hypoalbuminemic (1.7 g/dL and 2.3 g/dL), both of which also had evidence of leukocytosis (19 608/ $\mu$ L without a left shift and 48 960/ $\mu$ L with a concurrent left shift). Five of these patients were receiving antimicrobials; none were receiving immunosuppressive drugs.

Twenty-two cats (17.8%) and 14 dogs (13.7%) developed clinical signs consistent with infection, with 5 cats (4%) and 4 dogs (3.9%) developing signs during hospitalization and 17 cats (13.8%) and 10 dogs (9.8%) having signs noted at follow-up. Presumed infections were noted to occur at a median of 7 days after tube placement in both cats and dogs (range, 2-195 days). Six cats (4.8%) and 1 dog (0.9%) developed necrotic skin around the stoma that was noted at follow-up visits, ranging from 2 to 22 days after initial placement.

## 3.3 | Surgical intervention and outcomes

Ten patients with stoma site infections (4.4%) required surgical debridement, including 5 cats (22.7%) and 5 dogs (35.7%). Of the dogs that required surgical debridement, 6 procedures were performed during initial hospitalization and 2 at a later date. Both cats had surgical debridement performed after hospital discharge. Two dogs required 2 surgical procedures for ongoing stoma site infection, 3 and 4 days apart, respectively. One of these patients was hypoalbuminemic

(2.4 g/dL) and receiving IV dexamethasone at an immunosuppressive dosage. The other had a mild inflammatory leukogram, normal serum albumin concentration, and no immunosuppressive conditions or treatments. The remainder of the patients with signs of stoma site infection (20 cats and 6 dogs) did not require surgery, and their infections resolved with systemic or topical antimicrobial treatment or both. Two patients received topical treatment alone. Four infections resolved after removal of the tube.

Esophagostomy tubes were kept in place for a median of 19 days in both cats and dogs (range, 1-283 days for dogs, 2-609 days for cats). Four cats (3.2%) and 8 dogs (7.8%) had their E-tubes removed because of tube-related complications, and 1 cat (0.8%) and 2 dogs (1.9%) were euthanized because of tube-related complications. The cat developed signs of septic shock and necropsy confirmed an abscess at the esophagostomy site, with no other source of sepsis identified. One of the dogs developed severe regurgitation and aspiration pneumonia 24 hours after tube placement whereas the other was euthanized because of recurrent regurgitation through the stoma and lack of response to surgical and medical management. This patient had mild leukocytosis. No other distinguishing features were noted in these 3 cases.

One dog experienced an esophageal tear, leading to premature removal of the tube (after being in place for 3 days). The esophageal tear was managed medically. Another dog experienced severe hemorrhage after trauma to a suspected anomalous arterial vessel during tube placement, requiring surgical intervention.

### 3.4 | Bacterial culture results

Twenty-five patients with signs consistent with infection or discharge at the stoma had aerobic cultures performed. Three patients had a negative culture, but all 3 were on systemic antimicrobial treatment at the time the culture was collected. The results of the positive cultures are presented in Table 1. Fifteen (68%) of these culture results were polymicrobial and 10 (45%) had evidence of either methicillin resistance or multidrug resistant patterns.

### 3.5 | Prognostic factors and associations

No statistically significant associations were found between any variables of interest (patient weight, age, hypoalbuminemia, leukocytosis, leukopenia, use of antimicrobial or immunosuppressive drugs, concurrent disease processes, time to initiation of feeding, duration tube was in place, size of tube, and method of confirmation of placement) and risk of developing an E-tube complication or infection in the cats and dogs in this study ( $P \geq .09$ ).

## 4 | DISCUSSION

Our study provides an updated descriptive review of complications associated with E-tube placement in a large population of dogs and cats at a tertiary referral center. The overall incidence of

**TABLE 1** Summary of bacterial culture results in 25 cases of E-tube stoma site infection

Culture result	Number of cases
<i>Enterococcus faecium</i>	10
<i>Escherichia coli</i>	9
<i>Staphylococcus pseudintermedius</i>	4
<i>Enterobacter cloacae</i>	3
<i>Pasteurella multocida</i>	3
<i>Staphylococcus aureus</i>	3
<i>Staphylococcus epidermidis</i>	1
<i>Staphylococcus schleiferi</i>	1
<i>Klebsiella pneumoniae</i>	2
<i>Pseudomonas aeruginosa</i>	1
<i>Proteus mirabilis</i>	1
<i>Neisseria animaloris</i>	1
<i>Neisseria zoodegmatis</i>	1
Beta-hemolytic <i>streptococcus</i> spp.	1
<i>Morganella morganii</i>	1

complications was comparable to that of previous studies,<sup>1-3</sup> with the majority of complications being minor and easily manageable. However, 16% of patients developed infection at the site and 3 patients were euthanized because of tube-related complications.

Although most of the reported complications in our study have been noted previously, to our knowledge, regurgitation of food through the stoma has not been previously reported. Eight patients had evidence of food coming through the stoma, with dogs being more likely to experience this complication. The E-tubes were removed in 2 patients because of this complication; 1 patient was euthanized because of this recurrent complication and the need for repeated surgical intervention.

One limitation of the medical records system at our institution is that 30 Fr E-tubes have an ambiguous charge code that did not permit notation of patients in which this size of E-tube was utilized. Of the 8 patients that regurgitated food through their stoma, 4 patients did not have tube size recorded because of this fact. It is possible that these 4 patients (being larger dogs and having the ambiguous charge code) had a 30 Fr E-tube in place. Given this limitation, we are unable to draw any conclusions regarding larger tube sizes and the possible associated risk of developing a complication. At our institution, 30 Fr tubes have been used only infrequently in the last few years because they are anecdotally associated with more complications, such as infection or swelling at the site. Future prospective studies may be useful to investigate this specific variable.

Ours is the first study to evaluate bacterial isolates from E-tube site infections. Thirty-six patients developed clinical signs of infection, with aerobic cultures performed in 25 (69%). The 2 most common pathogens isolated were *Enterococcus* spp. and *Escherichia coli*. This result is in contrast to previous studies evaluating surgical site skin

infections that have found *Staphylococcal* spp. to be the most common organism cultured.<sup>8,9</sup> This finding may indicate that the agents responsible for E-tube site infections are enteric in origin, rather than skin commensals. Many (45%) of the bacterial organisms isolated in our study were methicillin resistant or had multidrug resistance patterns. Despite this, the majority of cases experienced resolution with topical antimicrobial treatment alone or a combination of topical and systemic antimicrobial treatment without utilizing second- or third-tier antimicrobial agents. Antibiotic escalation was rarely indicated clinically. This observation serves as a reminder that culture and sensitivity information must always be interpreted with the complete clinical picture in mind and topical treatments often can result in sufficient concentrations of antimicrobial to overcome reported resistance patterns.

At this time, no consensus exists regarding when feeding should be initiated in patients with E-tubes. Tube feeding was initiated anywhere from 2 to 144 hours after placement, with a median of 12 hours in dogs and 14 hours in cats in our study. The ideal time to institute E-tube feedings is not established, and it is unknown whether time to initiate feeding relates to risk of complication, particularly with regard to regurgitation of food through a healing stoma. In our study, no association was found between time to institute feeding and risk of developing a complication. However, it is possible that, despite large study numbers, our study was underpowered to detect such a difference. Patient factors, such as anesthetic recovery, gastrointestinal ileus, and nausea, as well as convenience factors, such as nursing availability and owner schedules often are considered. Future studies are needed to provide additional insight into this particular feature of nutritional management with feeding tubes.

The major limitation of our study was its retrospective nature. Although patients were excluded if their medical records were incomplete, the details recorded for a given patient's tube site assessment were variable and clinician- or nurse-dependent. It is possible that mild complications such as slight erythema or inflammation at the site may have been overlooked. Not all E-tube sites were thoroughly evaluated daily, and it is possible that some observations were not consistently recorded. Follow-up was limited in some cases, and although primary care veterinarians were contacted for additional follow-up data, mild complications again may have been overlooked. Major complications such as those that required surgical debridement were more likely to be recorded in detail and less likely to be disregarded, therefore providing a more accurate representation of major complication rate.

Despite the relatively large case numbers included in our study, we were unable to identify any statistically significant risk factors or draw any conclusions about which patients, if any, might be predisposed to E-tube complications. It is possible that our study was underpowered to detect such differences, but it also may indicate that development of complications is a result of at-home management factors, rather than patient-specific or hospital-related factors. Based on our findings, there is no evidence that patients with hypoalbuminemia, those on immunosuppressive drugs, and

those receiving hemodialysis treatment, are more at risk for infection. At the same time, our results suggest that even the most stable patient without complicating factors is at a similar risk for developing a complication and, as such, thorough follow-up and monitoring remain necessary.

Esophagostomy tubes are a beneficial tool to provide nutrition to hyporexic patients, but they are not without risk. Severe complications were rare in our study, which is in accordance with earlier studies. However, despite their limited occurrence, when these severe complications occurred, clinically important consequences ensued, with 10 requiring surgical intervention and 3 patients euthanized because of tube-related complications. Our study provides updated information regarding possible complications associated with E-tube placement and management. A prospective study evaluating patient-specific variables and procedural factors may be helpful to determine if there are any predictive factors that increase a given patient's risk of complications.

#### CONFLICT OF INTEREST DECLARATION

Authors declare no conflict of interest.

#### OFF-LABEL ANTIMICROBIAL DECLARATION

Authors declare no off-label use of antimicrobials.

#### INSTITUTIONAL ANIMAL CARE AND USE COMMITTEE (IACUC) OR OTHER APPROVAL DECLARATION

Authors declare no IACUC or other approval was needed.

#### HUMAN ETHICS APPROVAL DECLARATION

Authors declare human ethics approval was not needed for this study.

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