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Complications of Percutaneous Endoscopic Gastrostomy in Dogs and Cats Receiving Corticosteroid Treatment

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Background: Corticosteroid treatment is commonly required in veterinary patients for treatment of inflammatory, immune-mediated, neurologic, and neoplastic diseases, which also may require assisted enteral nutrition via percutaneous endoscopic gastrostomy (PEG).

Objective: To evaluate complications associated with PEG use in dogs and cats receiving corticosteroid treatment.

Animals: Forty-two animals were included in the study: 12 dogs and 2 cats in the steroid group and 26 dogs and 2 cats in the control group.

Methods: Medical records, between January 2006 and March 2015, were reviewed. Patients were included if the PEG tube was in use for at least 24 hours and if complete medical records were available. Patients were assigned to the control group if they were not treated with corticosteroids during PEG use or to the steroid group if they had received corticosteroids during PEG tube use. Complications were classified as minor, moderate, and major in severity. Maximum severity complication rate was compared between groups.

Results: The general prevalence of complications was found to be similar between groups ($P = .306$), but in the steroid group, 43% of the cases developed a major severity complication compared with 18% of the control group ($P = .054$).

Conclusion and Clinical Importance: Owners of dogs and cats receiving corticosteroids, in which PEG is planned, should be counseled about possible complications beyond those associated with PEG tube usage alone.

Key words: Complications; Corticosteroids; Enteral nutrition; Percutaneous endoscopic gastrostomy tube.

Percutaneous endoscopic gastrostomy (PEG) was first performed in 1979 in a pediatric hospital in Ohio, and it was described in the veterinary field in 1986.[1–3] Today, PEG tube placement is considered the preferred route to provide long-term enteral care for patients that are unable to swallow or have neurologic disorders.[4–6]

In 1990, the technique of PEG tube placement was evaluated in veterinary medicine in 54 dogs and cats, and in 2006, complications associated with PEG tubes were compared with those associated with surgical gastrostomy in dogs and cats[7]. Indications for PEG tube placement included hepatic, oronasal, and esophageal disease; cranial nerve deficits; cranial and tracheal surgery; chronic kidney disease; pancreatitis; vestibular disease; and various neoplastic conditions.[7,8]

Although PEG tube placement is considered a safe technique, many studies in human and veterinary medicine have identified several complications associated with this procedure.[8,9] In a comprehensive clinical literature review, the main complications associated with PEG tube placement in humans between 1980 and 2013, were wound infection, inadvertent PEG tube removal, tube blockage, pneumoperitoneum, gastric outlet obstruction, peritonitis, aspiration pneumonia, hemorrhage, buried bumper syndrome, bowel perforation, necrotizing fasciitis, and metastatic seeding.[10] In veterinary medicine, a few studies have reported complications associated with the placement and management of PEG tubes in dogs and cats.[7,8] The most common complications encountered include stoma site inflammation and infection, pneumoperitoneum, gastric bleeding from the PEG site, splenic or hepatic laceration, vomiting, inadequate gastric emptying, aspiration pneumonia, septic peritonitis, tube dislodgement, tube removal, and fistula formation.[7,8]

Corticosteroid treatment is commonly required in human and veterinary patients, also requiring assisted enteral nutrition via a PEG tube for the treatment of various inflammatory, immune-mediated, neurologic, and neoplastic conditions.[11,12] Corticosteroids impact several steps of the wound-healing process by decreasing the expression of cytokines and therefore suppressing the inflammatory process, attenuating fibroblast proliferation, impairing wound re-epithelialization, and decreasing the stretch ability of the scar.[13]

In 2009, the safety of PEG tubes in human patients receiving corticosteroids was investigated, and it was

Abbreviations:

BCS	body condition score
IBD	inflammatory bowel disease
IMPA	immune-mediated polyarthritis
IQR	interquartile range
PEG	percutaneous endoscopic gastrostomy
SIRS	systemic inflammatory response system

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concluded that this technique was not associated with an increased complication rate in patients receiving acute or chronic corticosteroid treatment.[14] To the authors' knowledge, no studies have investigated the effect of corticosteroid treatment in veterinary patients concomitantly receiving enteral feeding by means of a PEG tube, and this, therefore, was the objective of this study.

Materials and Methods

Case Selection

Medical records from dogs and cats that had PEG performed at a small animal referral teaching hospital between January 2006 and March 2015 were reviewed for this retrospective study. To be included in the study, animals must have had the PEG tube in place for at least 24 hours and complete medical records, including clinical notes from referring veterinarians, kennel sheets, communication records with patients' owners, and notes from PEG tube removal, had to be available.

Cases were assigned to 1 of the following groups: (1) steroid group and (2) control group. To be included in the steroid group, animals had to have received prednisolone, or an equivalent corticosteroid drug, at a dosage ≥1 mg/kg/day. All cases included in the steroid group received corticosteroids for at least 50% of the time of PEG tube use. To be included in the control group, corticosteroids could not have been given up to 48 hours before, during PEG tube placement, or during the time of PEG tube use. Data regarding signalment, year of tube placement, history (including medications before referral), physical examination (including body weight and body condition score [BCS] 1–9), indication for PEG tube placement, treatment, complications associated with PEG, and length of tube use were recorded.

Percutaneous endoscopic gastrostomy was performed using a Fresenius Kabi tube.[a] All animals had PEG performed by a board-certified internist or resident supervised by a board-certified internist. The PEG tube placement was performed in a standard fashion as described previously.[8]

All PEG tubes were used for feeding, which started within the first 12–24 hours after tube placement. Frequency of tube use for feeding was dependent on clinicians' preferences and varied from case to case.

The PEG tube site was checked and aseptically dressed at least once daily during tube use. During hospitalization, notes were made after each change of dressing. Complications that may have occurred after discharge were documented in the communication records with owners and referring veterinarians.

Complications associated with PEG tube placement and use were categorized into 3 severity categories: minor, moderate, and major. Complications were considered of minor severity if they required minimal or no veterinary intervention. Complications were considered of moderate severity if they required veterinary intervention but did not put patients' lives at risk. Complications were classified as major severity if they required immediate veterinary intervention and could have put patients' lives at risk. Inflammation of the stoma site, PEG tube blockage, and serous discharge were classified as minor severity complications. Development of sanguineous discharge, abdominal pain around the stoma site, and chewing of the tube at its tip were considered of moderate severity. Development of purulent discharge around stoma site, PEG tube dislodgement, and chewing of the tube at the stoma site were considered major severity complications.

Stoma site infection was defined by the development of purulent discharge at the stoma site. Culture and sensitivity results were noted if available.

Statistical Analysis

Clinical variables were assessed for normality by visual inspection of histograms and use of the Shapiro-Wilk test. Continuous nonnormally distributed variables (age, year of tube placement, body weight, duration of PEG tube use, time of occurrence of maximum severity complication) were compared between groups using the Mann-Whitney *U*-test and Kruskal-Wallis test, and nonnormally distributed categorical variables (body condition score, sex, and development of complications) were compared between groups using the Pearson chi-square and Fisher's exact test. Maximum complication rate was compared between groups using Kendall's tau-c. Results are presented as median and interquartile range (IQR), unless otherwise stated. Differences in $P < .05$ were considered statistically significant. Statistical analysis was performed using commercially available software.[b,c]

Results

A total of 38 dogs and 4 cats met the inclusion criteria for this study. Twelve dogs and 2 cats were included in the steroid group, and 26 dogs and 2 cats were included in the control group.

The 2 groups were only statistically different regarding the duration of PEG tube use ($P = .043$), with the PEG tube being in use for a longer time period in the steroid group (Table 1). However, when the time of occurrence of the maximum severity complications was

Table 1. Comparison between control and steroid group regarding sex, age, year, body weight, and body condition score at placement of the PEG tube and length of PEG tube use.

Variable	Control Group	Steroid Group	*P* Value
Sex	Entire male (n = 6); neutered male (16); entire female (4); neutered female (5)	Entire male (n = 6); neutered male (1); entire female (1); neutered female (6)	0.005[a]

Variable	Control Group, Median (25th Percentile–75th Percentile)	Steroid Group, Median (25th Percentile–75th Percentile)	*P* Value
Age at placement of PEG tube (years)	5.2 (1.7–9.7)	5.35 (3.5–8)	1[b]
Year of placement of PEG tube	2010 (2007–2013)	2009 (2007–2012)	0.468[b]
Body weight at placement of PEG tube (kg)	18.2 (7.0–29.5)	31.5 (5.7–36.9)	0.198[b]
BCS at placement of PEG tube (1–9)	4 (3–4)	4 (3–5)	0.745[a]
Length of PEG tube use (days)	13.5 (2.2–27.7)	24.5 (8.2–95.2)	0.043[b]

n, number of cases; BCS, body condition score; PEG, percutaneous endoscopic gastrostomy.

[a]Pearson chi-square.

[b]Mann-Whitney *U*-test, significant difference between groups ($P \leq .05$).

compared between groups, no difference was found ($P = .368$; Fig 1).

Sex distribution also was found to be dissimilar between groups ($P = .005$). In the control group, 16 (57%) animals were neutered males, 5 animals (18%) were neutered females, 4 (14%) were intact females, and 3 (11%) were intact males. In the steroid group, 6 animals (43%) were entire males, 6 (43%) were neutered females, 1 (7%) was an intact female, and 1 (7%) was a neutered male. However, no specific sex category was found to be more predisposed for the development of complications ($P = .797$).

In the steroid group, cases received either prednisolone or dexamethasone. Dexamethasone dosages ranged from 0.15 to 0.5 mg/kg/day, whereas prednisolone dosages ranged from 1 to 4 mg/kg/day. Duration of corticosteroid administration ranged from 1 to 172 days.

Reasons for placement of the PEG tube in the steroid group included meningitis, mast cell tumor, esophageal dysmotility, esophageal stricture, oropharyngeal vasculitis (drug reaction), immune-mediated polyarthritis, cricopharyngeal dysphagia, lymphangiectasia, inflammatory bowel disease, and feline dysautonomia.

Regarding reasons for placement of the PEG tube, 24 of the 42 animals (57%) had gastrointestinal disease, 5 (12%) had neurologic conditions, 4 (10%) had inflammatory or infectious diseases, 3 (7%) had neoplastic conditions, 3 (7%) had renal disease, and the 3 (7%) had immune-mediated conditions (Table 2).

The PEG tube complications identified in the study population included serous discharge (n = 17), inflammation of the stoma site (8), sanguineous discharge (7), purulent discharge (7), PEG tube dislodgement (6), stoma site pain (4), tube chewed at the tip (3), PEG tube blockage (2), and tube chewed at the stoma site (1). Complications were classified according to their severity. Inflammation of the stoma site, PEG tube blockage, and serous discharge were classified as minor severity complications. Development of sanguineous discharge, abdominal pain around the stoma site, and tube chewed at its tip were considered of moderate severity. Development of purulent discharge around stoma site, PEG tube dislodgement, and tube chewed at the stoma site were considered major severity complications.

Of the patients included in the study, 15 (36%) had no complications, 8 (19%) developed at least a minor severity complication, 8 (19%) developed at least 1 moderate severity complication, and 11 (26%) developed at least 1 major severity complication. In the control group, 16 (57%) of the 28 patients developed complications, whereas in the steroid group, 11 (78%) of the 14 patients developed a complication.

No association was found between the development of different severity of complications and the BCS of the animals at the time of PEG placement ($P = .164$). Similarly, no association was found between the body weight of the animals at the time of placement of the PEG tube and subsequent development of different severity complications ($P = .136$).

The general prevalence of complications was found to be similar between groups ($P = .306$), but in the steroid group, 43% of the patients developed a major severity

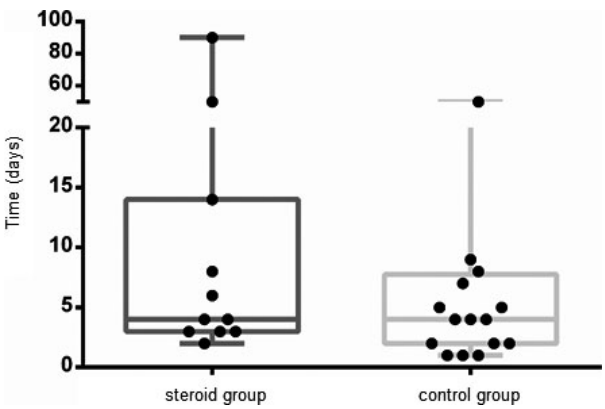

Fig 1. Time of development of maximum severity complications in the steroid and control groups; dots refer to each case of the control and steroid group that developed complications.

Table 2. Indications for placement of the PEG tube in the study population.

Indications for Placement of PEG Tubes	No. of Cases
Gastrointestinal diseases	
Gastrointestinal ulceration	3
Esophageal stricture	3
Pharyngeal dysphagia	3
Megaesophagus	3
Pancreatitis	2
Esophagitis	2
Inflammatory bowel disease (IBD)	2
Oropharyngeal achalasia	1
Esophageal dysmotility	1
Oropharyngeal inflammation	1
Lymphangiectasia	1
Acute gastritis	1
Primary ileus	1
Neurologic diseases	
Dysautonomia	3
Meningitis	1
Trigeminal neuropathy	1
Neoplasia	
Gastrointestinal mast cell tumor	1
Colorectal adenocarcinoma	1
Duodenal lymphoma	1
Renal disease	
Acute kidney disease	3
Inflammatory/infectious	
SIRS	2
Tetanus	2
Immune-mediated diseases	
IMPA	2
Myasthenia gravis	1

SIRS, systemic inflammatory response syndrome; IMPA, immune-mediated polyarthritis; PEG, percutaneous endoscopic gastrostomy.

complication compared with 18% of the control group ($P = .054$, Fig 2).

In the study population, the general prevalence of stoma site infection and PEG tube dislodgement were 17% and 12%, respectively. No statistically significant difference was found between groups in terms of stoma site infection rate ($P = .56$, Fig 3), with 4 (14%) animals in the control group and 3 (21%) animals in the steroid group having infections of the stoma site. Culture and sensitivity results were available for 2 cases. *Klebsiella* sp. sensitive to all antibiotics and *Enterococcus* sp. only sensitive to fluoroquinolones were cultured from 1 dog, which developed a purulent discharge of the stoma site on day 7 after placement of the PEG tube. The other dog, which experienced purulent discharge around the stoma site, yielded a profuse marked *E. coli*, *Streptococcus* sp., and *Enterococcus* sp. sensitive to the majority of antibiotics tested. In terms of occurrence of PEG tube dislodgement, no difference was found between groups ($P = .736$, Fig 4), with 11% of patients in the control group and 14% of patients in the steroid group experiencing tube dislodgement.

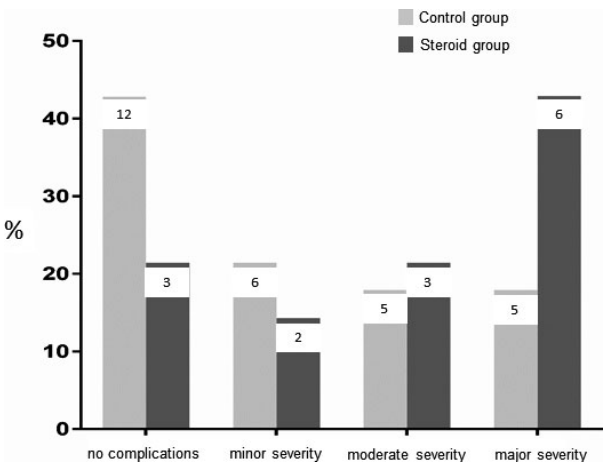

Fig 2. Comparison of different severity complications between groups; the number of cases is indicated in each bar.

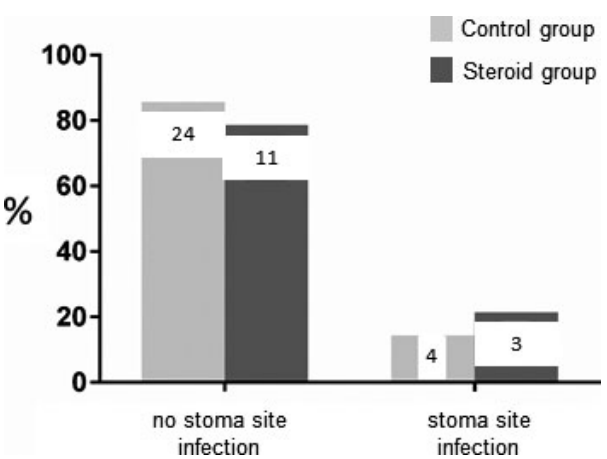

Fig 3. Comparison of stoma site infections between groups; the number of cases is indicated in each bar.

Discussion

To the authors' knowledge, ours is the first study evaluating the effects of corticosteroid treatment on the development of complications in veterinary patients with PEG tubes used for enteral nutrition. We were not able to identify a statistically significant difference between control and steroid groups regarding the development of complications, but we found the development of more major severity complications in the steroid than in the control group. A sample size calculation indicated that we would have required 76 cases in the control group and 38 cases in the steroid group in order to have 80% power to detect a difference between groups in the occurrence of complications, with a significance level of .05. Therefore, it is possible that we were not able to identify a clear difference between groups given the lack of power.

The 2 groups were statistically different regarding the duration of PEG tube use. However, when the time of occurrence of maximum severity complications was compared between groups, no difference was found. However, variable length of time of PEG tube use in the study population is 1 of the limitations of our study, and some patients may not have had time for development of complications and others may have had sufficient time to experience many complications. A prospective, randomized clinical trial in which the length of tube use would be the same between groups would avoid this confounding factor, but would be impracticable and unethical in a clinical setting.

The most common indications for placement of a PEG tube in this study were gastrointestinal disease, dysautonomia, and acute kidney disease, and these reasons were similar to those described in previous studies.[7,8] The complications associated with the PEG tube use encountered in our study also were similar to those

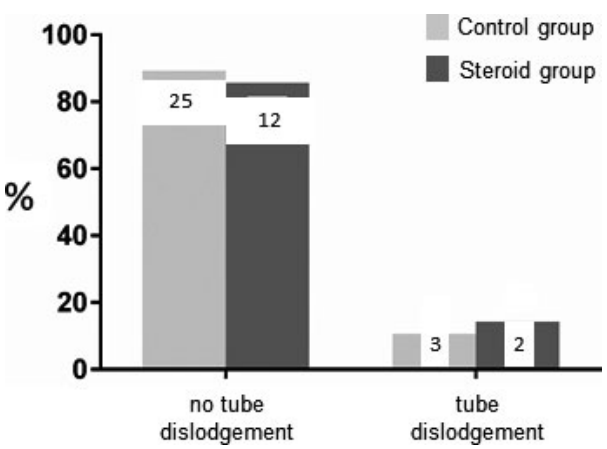

Fig 4. Comparison of percutaneous endoscopic gastrostomy tube dislodgement between groups; the number of cases is indicated in each bar.

reported in previous studies, such as stoma site inflammation and infection, tube dislodgement, and tube removal.[7,8,15,16] The most common complication associated with PEG tube use in our study population was development of serous discharge, a minor severity complication, that in most of the cases was found to be self-limiting after a few sterile dressing changes.

Infection of the stoma site and tube dislodgement were relatively common complications in the study population. The prevalence of stoma site infection reached 17%, which is similar to the prevalence described in human patients (5–25%), where the current recommendation regarding antibiotic prophylaxis is the IV administration of a single dose of cephalosporin in the first hour after PEG tube placement.[10,17] A recent study in human patients explored the option of giving a single dose of co-trimoxazole by the PEG tube shortly after its placement, comparing it to a single IV dose cephalosporin, and there was no significant difference between the infection rates in both groups.[18] The cases included in our study were given cefuroxime or other broad-spectrum antibiotic IV, which had been administered as part of treatment of their underlying medical condition. Higher prevalence of stoma site infections has been reported in dogs and cats with renal failure and was attributed to increased susceptibility to infection and delayed wound healing, associated with uremia and malnutrition.[19] Similarly, in the study population, the administration of immunosuppressive dosages of steroids could have precipitated the development of stoma site infections. The comparison of stoma site infection rate between groups, however, yielded no significant difference between groups.

Tube dislodgement occurs when the apposition between the gastric and abdominal wall is not ideal and the PEG tube is able to move in an out through the stoma site, increasing the risk for development of septic peritonitis if the gastric contents reach the peritoneal cavity.[9,10] In this study, PEG tube dislodgement occurred in 12% of cases, which is similar to the prevalence reported in human medicine (up to 13% of patients).[10] The PEG tube stoma and adhesions between the gastric and abdominal wall begin to mature approximately 7–10 days after tube placement, and this process can take up to 1 month in malnourished and immunosuppressed patients.[9] Therefore, the comparison of PEG tube dislodgement rate between the control and steroid groups yielded no significant difference between groups.

Sanguineous discharge was present in 7 of the patients and pressure bandages were required to stop the hemorrhage. In human medicine, it is recommended to tighten the clip at the stoma site to produce compression of the gastric wall against the abdominal wall for up to 48 hours.[9] Retroperitoneal bleeding is possible in these cases, and monitoring for this complication also is usually recommended in human patients.[10]

Other complications previously described, such as pneumoperitoneum, gastric bleeding from the PEG site, splenic or hepatic laceration, vomiting, inadequate gastric emptying, aspiration pneumonia, and fistula formation, were not found in this study population.[7,8] However, imaging studies were not performed in every case to check for the presence of pneumoperitoneum, and it is, therefore, possible we may have missed the development of this complication. In human medicine, the development of pneumoperitoneum after the placement of a PEG tube is estimated to happen in 50% of the patients and usually is considered self-limiting.[9]

A recent review of the effects of corticosteroids on wound healing concluded that administration of high doses of corticosteroids (equivalent to 1.5 mg/kg of prednisolone) for 10 days had no clinical impact on wound healing, but treatment for at least 30 days before surgery could increase the complication rate up 2- to 5-fold.[13] In this study, animals included in the steroid group received prednisolone, or an equivalent corticosteroid drug, at a dosage $\geq$1 mg/kg/day for at least 50% of the time the PEG tube was in use. However, given the retrospective nature of our study, we included animals that received corticosteroids at different dosages and frequencies of administration, for a variable length of time and at different stages of PEG tube use. Therefore, it is possible that these differences may have affected the results obtained.

The limitations of our study are related to its retrospective nature and the fact that it was highly dependent on the quality of the information recorded by clinicians, nurses, and referring veterinarians. Furthermore, no specific protocol for placement and management of PEG tubes was used, even if the same brand of PEG tube was used throughout the study period. A prospective trial would have been ideal to avoid the introduction of some of the confounding factors of this study. However, in a clinical setting, it would have been unethical to randomize patients to steroid treatment or no steroid treatment because the primary goal was to treat patients' underlying conditions and nutrition was a secondary goal. However, different conditions require different corticosteroid protocols and each treatment plan should be adjusted to patient's needs, based on response to treatment and development of adverse effects. Owners of animals receiving corticosteroids in which PEG is planned should be appraised of possible complications beyond those normally associated with PEG tube usage alone.

Footnotes

[a] Freka® PEG Fresenius Kabi; Cheshire, UK
[b] SPSS 22; IBM, Armonk, NY
[c] GraphPad Prism 6; Software, La Jolla, CA

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