Retrospective Study

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Continuous versus intermittent delivery of nutrition via nasoenteric feeding tubes in hospitalized canine and feline patients: 91 patients (2002–2007)

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Abstract

Objective – To compare continuous to intermittent feeding at delivering prescribed nutrition in hospitalized canine and feline patients.
Design – Retrospective clinical study.
Setting – University teaching hospital.
Animals – Fifty-four cats and 37 dogs.
Measurements and Main Results – Twenty-four-hour periods of prescribed and delivered nutrition (kcal) were recorded, and the percentage of prescribed nutrition delivered (PPND) was calculated. If the patient received nasoenteric feeding for >1 day, then the average PPND per day was calculated. Frequency of gastrointestinal complications (vomiting, diarrhea, and regurgitation) was calculated per patient for each group. The PPND was not significantly different between patients fed continuously (99.0%) and patients fed intermittently (92.9%). Vomiting affected 29% of patients (26/91), diarrhea affected 26% of patients (24/91), and regurgitation affected 5% of patients (5/91). There was no significant difference in incidence of gastrointestinal complications between the patients fed continuously and the patients fed intermittently. There was a significantly higher incidence of diarrhea and regurgitation in dogs than in cats.
Conclusions – PPND was not significantly different for continuous versus intermittent feeding via nasoenteric tubes. Frequencies of gastrointestinal complications were not significantly different between patients fed continuously and patients fed intermittently. Enterally fed dogs had a significantly higher frequency of regurgitation and diarrhea than enterally fed cats. Prospective studies are warranted to investigate causes for these potential inter-species differences.

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Introduction

Nutrition is a fundamental component of the optimal care of hospitalized patients. Enterally delivered nutrition is generally preferred over parenteral nutrition due to evidence from human clinical trials and animal models that enteral nutrition may preserve gut integrity, minimize bacterial translocation, improve the immune response, and attenuate the release of inflammatory mediators.[1–4] Nasoesophageal and nasogastric tubes are feeding devices used to deliver enteral nutrition in both human and veterinary medicine. They can be placed noninvasively with minimal need for sedation.[5–7]

Studies in human and veterinary patients have shown a discrepancy between the amount of nutrition prescribed by the clinician, and the amount actually delivered to the patient.[1,2,6,8] Identification of causes for this discrepancy has been the focus of multiple studies.[1,2,4,6,8–12] In both veterinary and human studies, cessation of feeding during diagnostic or therapeutic procedures was a common

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barrier to nutrient delivery.[1,2,6,8,12] Vomiting was the most common gastrointestinal cause for interruption of nutrition delivery in 1 veterinary study.[8] In human patients, a high gastric residual volume has been shown to result in decreased nutrient delivery, because feedings are withheld if gastric residual volumes are above a certain limit set by the clinician.[2,6]

Human clinical trials that have compared complication rates and effectiveness of nutrient delivery between continuous and bolus methods of feeding yield conflicting results.[4,9–12] One of these trials found that the nutritional goal was reached faster with continuous feeding.[10] Conversely, another human study revealed that bolus administration of enteral nutrition was more effective at delivering nutrition than continuous infusion, which the authors attributed to fewer interruptions in the feeding schedule for diagnostic or therapeutic procedures.[12] A third study found no significant difference between delivery methods at delivering prescribed nutrition.[4] Two studies have shown an increased rate of diarrhea in intermittently fed patients, but this has not been demonstrated in other studies.[9–12] The only study in veterinary medicine that compared continuous to intermittent feeding used healthy research dogs, and found no difference between groups with respect to nutrition delivered or complication rates.[13]

The primary aim of this retrospective study was to compare continuous to intermittent feeding at delivering prescribed nutrition in hospitalized canine and feline patients. Because intermittent feedings allow for fewer interruptions of nutrition due to diagnostic and therapeutic procedures, our hypothesis was that intermittent feeding would result in a greater delivery of prescribed nutrition than continuous feeding. If true, this difference could alter the way clinicians prescribe feedings to their patients. The secondary aim was to determine the frequency of gastrointestinal complications associated with enteral nutritional support.

Materials and Methods

The medical records database at the Michigan State University Veterinary Teaching Hospital was searched for all dogs and cats with nasoesophageal or nasogastric feeding tubes placed during hospitalization from January 1, 2002 to December 31, 2007. Patients were included in the study if nasoenteric feeding tube placement was documented in the medical record and the tube was used for enteral nutrition for a minimum of 24 hours. Twenty-four-hour periods of nutrition were recorded for each patient. Twenty-four-hour periods in which the patient voluntarily ate, received concurrent parenteral nutrition, or received both intermittent and continuous feeding, were excluded.

Other types of feeding tubes (esophagostomy, gastrostomy, nasojejunal) were excluded because the caloric content of the food delivered through these tubes was often impossible to determine from retrospective review of the medical records. All patients received a 1 kcal/mL veterinary liquid diet[a] through the nasoenteric tube.

Data recorded included species, age, total days in hospital, total days of enteral nutrition provided via nasoenteric tube, intermittent or continuous method of feeding, and frequency of gastrointestinal complications (vomiting, diarrhea, and regurgitation). The number of calories prescribed for each 24-hour period and number of calories delivered for each 24-hour period were calculated from the medical record. Any explanation for interruption or discontinuation of enteral nutrition was also recorded.

The percentage of prescribed nutrition delivered (PPND) was calculated as the number of calories delivered in a 24-hour period divided by calories prescribed. If the patient received nasoenteric feeding for >1 day, then the mean PPND per day was calculated on a per patient basis. The number of 24-hour periods in which PPND equaled 100% (the patient received all of their prescribed nutrition for that day) was also recorded. Frequency of gastrointestinal complications (vomiting, diarrhea, and regurgitation) was calculated on a per patient basis.

Statistical Methods

PPND were compared between groups using a Mann-Whitney *U*-test. Normality of data were assessed using the Shapiro-Wilk test. Data are reported as median and range. Frequency of gastrointestinal adverse effects was compared by χ^2 or Fisher's exact test (for sample size <5) and are reported as a percentage. Statistical analyses were performed using statistical software.[b] Statistical significance was set at $P<0.05$.

Results

Ninety-one animals met the study inclusion criteria, representing 205 days (24-h periods) of nasoenteric feeding. Thirty-seven of 91 cases (40.7%) were dogs and 54 of 91 cases (59.3%) were cats. Thirty cases were excluded entirely because the patient was eating during all 24-hour periods of nasoenteric feeding. Eighteen cases were excluded due to concurrent TPN on all days of nutrition. Thirty-six cases were excluded because enteral nutrition was provided for <24 hours, and 2 cases were excluded because the patient received both continuous and bolus methods of feeding. Dogs ranged in age from 2 months to 14 years, with a median age of

8 years. Cats ranged from 1 year to 16 years, with a median age of 8.5 years.

Median number of total days in hospital for all patients was 8 days (3–21 d). Median number of 24-hour periods of enteral nutrition was 2 (1–7). For some patients included in the study, additional days of nasoenteric feeding were excluded from analysis because the patient was concurrently eating, receiving TPN or because they received a combination of continuous and intermittent feeding for that 24-hour period. For patients included in the study, the total number of days (24-h periods) that were excluded due to patients eating was 33, the number of days that were excluded due to concurrent TPN was 3, and the number of days excluded due to the patient receiving a combination of intermittent and continuous feeding was 1.

Fifty-six of 91 patients (61.5%) were fed continuously and 35 of 91 patients (38.5%) were fed intermittently. When patients were grouped according to species and feeding method, 23 of 37 dogs were fed continuously, 14 of 37 dogs were fed intermittently, 33 of 54 cats were fed continuously, and 21 of 54 cats were fed intermittently.

For all subjects, median PPND was 97.2% (4.2–133.1%). The median PPND was not significantly different between patients fed continuously (99.0%, range 4.2–100.0%) and patients fed intermittently (92.9%, range 33.3–133.1%) ($P = 0.72$). Feline patients received a median PPND of 100.0% (range 47.9–133.1%) and canine patients received a median PPND of 91.7% (range 4.2–100.0%) ($P = 0.10$). Feeding methods were not significantly different within species. Continuously fed dogs received 98.1% (4.2–100.0%) of prescribed nutrition and intermittently fed dogs received 91.7% (33.3–100.0%) of prescribed nutrition ($P = 0.35$). Continuously fed cats received 100.0% (47.9–100.0%) of prescribed nutrition and intermittently fed cats received 100.0% (62.5–133.1%) of prescribed nutrition ($P = 0.73$).

Continuously fed animals received 100% of their prescribed nutrition on 82 of 118 days (69.5%) of enteral nutrition, which was not significantly different from intermittently fed animals, who received 100% of their prescribed nutrition on 51 out of 87 days (58.6%) of nutrition ($P = 0.10$).

Twenty-nine percent of patients (26/91) vomited during enteral nutrition, 26% of patients (24/91) had diarrhea, and 5% of patients (5/91) regurgitated. Eight of the 26 patients (30.7%) who experienced vomiting during enteral nutrition were vomiting in the 24 hours before starting enteral nutrition. Likewise, 12 of 24 patients (50%) with diarrhea recorded during enteral nutrition had diarrhea in the 24 hours before starting nutrition. No patients with regurgitation during enteral nutrition had regurgitation prior.

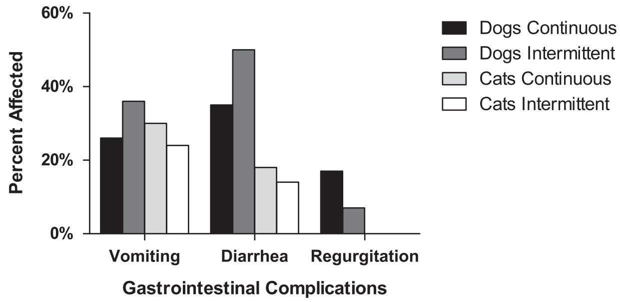

Figure 1: Frequency of gastrointestinal complications by group.

The frequency of gastrointestinal complications in each group (species and method) was not significantly different (Figure 1). There was no significant difference in frequency of gastrointestinal complications between the patients fed continuously and the patients fed intermittently. Both groups had a 28.6% frequency of vomiting ($P = 1.0$). The continuously fed group had 25% of patients experience diarrhea and the intermittently fed group had 28.6% of patients experience diarrhea ($P = 0.71$); 7.1% of patients fed continuously experienced regurgitation and 2.9% of intermittently fed patients experienced regurgitation ($P = 0.38$).

In dogs, there was a significantly higher frequency of diarrhea (15/37, [40.5%]) and regurgitation (5/37, [13.5%]) than in cats (9/54 [16.7%] and 0/54 [0%], respectively, $P < 0.05$) (Figure 2). All 5 patients who experienced regurgitation were dogs.

The medical records were reviewed for specific reasons that enteral nutrition was stopped (either a feeding was skipped during bolus feeding or enteral nutrition stopped altogether). Out of all 205 days of enteral nutrition, the delivery of nutrition was stopped 26 times due to vomiting. Regurgitation interrupted feeding twice and diarrhea was cited once. Reasons for cessa-

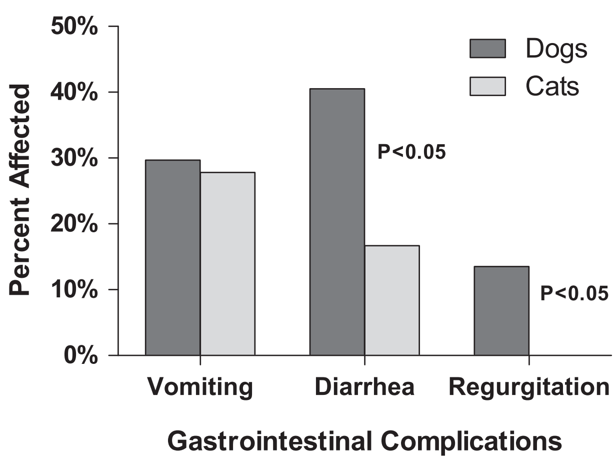

Figure 2: Gastrointestinal complications in dogs versus cats.

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tion of feeding other than the recorded gastrointestinal complications included the following: dislodgement of the nasoenteric tube ($n = 9$), surgical procedures ($n = 5$), diagnostic procedures ($n = 4$), high gastric residual volumes ($n = 3$), clogged tubes ($n = 2$), blood transfusion ($n = 1$), dyspnea ($n = 1$), and hypersalivation ($n = 1$). These are the only instances where a specific note was made in the medical record indicating a reason for stopping nutrition. Other instances of vomiting, diarrhea, or regurgitation were recorded without cessation of feeding. Further, feeding was stopped in 7 other instances without a specific reason noted. In 2 continuously fed dogs, the amount of prescribed nutrition was decreased after episodes of vomiting.

Discussion

Results of the present study appear to suggest that the method of nutrition delivery via nasoenteric tubes does not affect the PPND to veterinary patients. In this study, subjects received a median of 97% of prescribed calories regardless of feeding method used. This percentage is similar to that found in one other veterinary study, which documented a median PPND of 91%.[8] PPND in veterinary patients appears to be higher than that documented in studies of human patients, in which PPND ranges from 60% to 78%.[1,2,4,6,12]

One study that observed human patients over 3 days reported an equal delivery of nutrition with both continuous and intermittent feeding methods.[4] A second study in human patients found that patients fed intermittently reach goal feeds faster and had a higher probability of being at goal feeds by day 7 of enteral nutrition than continuously fed patients. The authors attributed this difference to more frequent interruptions in feeding for procedures in continuously fed patients.[12] The retrospective nature of our study precluded identification of the frequency with which feedings were stopped for procedures. However, 9 patients' medical records indicated cessation of feeding for a procedure. Of these 9 patients, 6 were fed continuously and 3 were fed intermittently.

No differences in gastrointestinal complication rates were found between patients fed continuously and patients fed intermittently in this study. This is in agreement with the results of several studies of human critical care patients that failed to detect a difference in complication rates between methods of nutrition administration.[4,11,12]

In the present study, dogs had a significantly higher frequency of regurgitation and diarrhea than cats. No feline patient had an episode of regurgitation documented in the medical record. This may be an indication that cats tolerate nasoenteric feeding better than dogs. Alternatively, this difference in frequency of regurgitation may be due to the small sample size of the study or lack of accurate medical record keeping.

Data on gastrointestinal adverse effects must be interpreted with caution. Because some patients were vomiting, regurgitating, or having diarrhea before initiation of enteral nutrition, it is impossible to know if these clinical problems occurred due to the underlying disease process or the administration of enteral nutrition. Further, high gastric residual volumes have been cited as a reason for cessation of feeding in human patients, but were not evaluated in this study because they were infrequently recorded in the medical record. Prospective studies are warranted to determine if the difference in frequency of regurgitation and diarrhea between cats and dogs affects the delivery of enteral nutrition in these species.

The retrospective nature of this study precludes making conclusions regarding the cause for discrepancy between prescribed and delivered nutrition. While in many instances the medical record indicated a close association between a gastrointestinal complication or diagnostic procedure and the cessation of nutrition delivery, one cannot assume that the given complication or procedure was the direct cause unless specified as such in the record. Further, in 7 instances, no documentation was made in the medical record to indicate a reason for cessation of feeding.

Another limitation of the study is that the prescribed number of calories for each patient was not determined using a consistent algorithm. Because the caloric requirement for individual patients remains a controversial topic, no attempt was made to retrospectively compare the number of calories prescribed for each patient to a calculated target energy requirement. An inappropriately high or inappropriately low prescription may have affected the number of calories delivered to that patient or the complications experienced by that patient. Further, the type of feeding method (intermittent versus continuous), and tube type (nasogastric versus nasoesophageal) was chosen at the discretion of the attending clinician. The effectiveness of nutrition delivery may have been biased by the clinician's perceived idea of which method would work better for an individual patient. Finally, the lack of difference in PPND between intermittent and continuous delivery of nutrition may have been due to a type II statistical error from small sample size.

In conclusion, in this study, the PPND was not significantly different for continuous versus intermittent feeding via nasoenteric tubes. The frequency of gastrointestinal complications was not significantly different between patients fed continuously and patients fed intermittently. Enterally fed dogs had a significantly higher frequency of regurgitation and diarrhea than enterally fed cats. The results of this study indicate that delivery of prescribed nutrition in patients with nasoenteric tubes does not appear to be affected by the method of feeding; however, the retrospective nature of the study imposes limitations on the findings. Prospective studies are warranted to confirm the findings of this retrospective study.

Footnotes

[a] Clinicare Canine/Feline Liquid Diet & Clinicare RF Liquid Diet, Abbott Laboratories, Abbott Park, IL.

[b] SAS Statistical Software, Version 9.1, SAS Institute, Cary, NC.

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