

## Intermittent and Continuous Enteral Nutrition in Critically Ill Dogs: A Prospective Randomized Trial

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**Background:** Malnutrition is a common problem in critically ill dogs and is associated with increased morbidity and mortality in human medicine. Enteral nutrition (EN) delivery methods have been evaluated in humans to determine which is most effective in achieving caloric goals.

**Objectives:** To compare continuous infusion and intermittent bolus feeding of EN in dogs admitted to a critical care unit.

**Animals:** Fifty-four dogs admitted to the critical care unit and requiring nutritional support with a nasogastric feeding tube.

**Methods:** Prospective randomized clinical trial. Dogs were randomized to receive either continuous infusion (Group C) or intermittent bolus feeding (Group I) of liquid EN. The percentage of prescribed nutrition delivered (PPND) was calculated every 24 hours. Frequencies of gastrointestinal (GI), mechanical, and technical complications were recorded and gastric residual volumes (GRVs) were measured.

**Results:** PPND was significantly lower in Group C (98.4%) than Group I (100%). There was no significant difference in GI or mechanical complications, although Group C had a significantly higher rate of technical complications. GRVs did not differ significantly between Group C (3.1 mL/kg) and Group I (6.3 mL/kg) and were not correlated with the incidence of vomiting or regurgitation.

**Conclusions and Clinical Importance:** There was a statistically significant difference in the PPND between continuously and intermittently fed dogs, but this difference is unlikely to be clinically relevant. Critically ill dogs can be successfully supported with either continuous infusion or intermittent bolus feeding of EN with few complications. Increased GRVs may not warrant termination of enteral feeding.

**Key words:** Clinical trials; Gastric residual volumes; Intensive care medicine; Nasogastric feeding tubes.

- Objective: Compare continuous infusion vs intermittent bolus of EN (2 got RF) to dogs in CCU
  - critically ill patients with impaired GI motility may tolerate CRI nutrition better
  - intermittent bolus feeding represents a more physiologic method of providing calories
  - hypothesis: no difference in attainment of daily caloric goals or frequency of complications in dogs receiving EN support by either CRI or intermittent bolus
- N = 54 all with either NE (11) or NG (43) tube
  - exclusion criteria: no owner consent, > 50% intestine resected, placement of feeding tube contraindicated, enteric tube already in place, EN delivered > 24 hours
- Prospective randomized clinical trial (MSU)
  - continuous infusion OR intermittent bolus
- PPND (percentage of prescribed nutrition delivered) calculated every 24 hours
  - $RER = 70 \times BW(kg)^{0.75}$
  - Clinicare or Clinicare renal formula (both 1 kcal/mL)
  - Total prescribed calories = 1/3 RER, then increased by 1/3 increments every 24 hours over 72 hours and continued on full RER if hospitalization continued
  - GRVs recorded q4hrs
  - intermittent bolus over 30 minutes q4hrs
  - CRI volume confirmed and recorded q4hrs
  - % PPND = # calories administered over 24 hours / calories prescribed according to feeding protocol, then converted to % (if > 24 hours the mean was taken)
- frequencies of GI, mechanical, technical complications recorded and GRVs measured
- Rescue protocol in place - only 1/9 needed alternative method
  - if vomited or regurgitated twice over 24 hours period

- enteral feedings stopped for 12 hours then resumed at last recorded volume and rate
- if vomit/regurgitation again, stop for another 12 hours, then start at lowest rate (1/3 RER)
- if 24 hours protocol failed EN d/c
- all patients requiring rescue were included in data analysis

#### Findings:

- PPN significantly lower in Group C than Group I, but not clinically relevant (98.4% vs 100%)
- GRVs did not statistically significantly differ ( C: 3.1 mL/kg and I: 6.3 mL/kg)
- No correlation with incidence of vomiting or regurgitation
- No difference in GI or mechanical complications
  - mechanical complications: regurgitation or vomiting the tube, occlusion of the tube, inadvertent tube removal
- CRI had more technical difficulties
  - technical complications: feeding off schedule, treatment/procedure, owner visit, walk outside > 10 minutes, operator error, equipment malfunction

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## **Retrospective Evaluation of Partial Parenteral Nutrition in Dogs and Cats**

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The purpose of this retrospective study was to evaluate the use of partial parenteral nutrition (PPN) in dogs and cats. The medical records of all dogs and cats receiving PPN between 1994 and 1999 were reviewed to determine signalment, reasons for use of PPN, duration of PPN administration, duration of hospitalization, complications, and mortality. Complications were classified as metabolic, mechanical, or septic. One hundred twenty-seven animals (80 dogs and 47 cats) were included in the study, accounting for 443 patient days of PPN. The most common underlying diseases were pancreatitis (n = 41), gastrointestinal disease (n = 33), and hepatic disease (n = 23). Median time of hospitalization before initiation of PPN was 2.8 days (range, 0.2–10.7 days). Median duration of PPN administration was 3.0 days (range, 0.3–8.8 days). Median duration of hospitalization was 7 days (range, 2–20 days). In the 127 animals receiving PPN, 72 complications occurred. These included metabolic (n = 43), mechanical (n = 25), and septic (n = 4) complications. The most common metabolic complication was hyperglycemia (n = 19), followed by lipemia (n = 17) and hyperbilirubinemia (n = 6). Most complications were mild and did not require discontinuation of PPN. Ninety-three (73.2%) of the 127 patients were discharged. All 4 animals with septic complications were discharged from the hospital. The presence, type, and number of complications did not impact the duration of hospitalization or outcome. However, animals that received supplemental enteral nutrition survived more often than those receiving PPN exclusively. Although PPN seems to be a relatively safe method of providing nutritional support, future studies are warranted to determine its efficacy.

**Key words:** Cat; Dog; Intravenous feeding; Nutritional support.

- retrospective study between 1994-1999
  - medical records of all dogs and cats receiving PPN between 1994 and 1999 were reviewed to determine signalment, reasons for use, duration of administration/hospitalization, complications (metabolic/mechanical/septic), mortality.
  - 127 animals, 80 dogs and 47 cats
    - 443 patient days of PPN (253 dogs and 181 cats)
  - exclusions,
    - no medical record

- could not have cyclic PPN (12 hour cycles)
- supplemental enteral nutrition OK
- procedures
  - dedicated parenteral nutrition catheter (external jugular, lateral saphenous, femoral, cephalic)
  - bags and lines changes q24hrs
  - 1.2 um filter
  - RER = 70 x BW(kg)<sup>0.75</sup> or RER = 30 x (body weight in kg) + 70
  - illness energy requirement (IER) = 1.0-1.5 multiplier of RER
  - partial energy requirement (PER) = 50% x IER
    - 5% dextrose, 8.5% amino acids, 20% lipids
    - final calculated osmolality < 750 mosm/L
  - categorized on maximal % IER provided by enteral nutrition while receiving PPN
    - 1-25% (n=15)
    - 26-50% (n=6)
    - 51-75% (n=4)
    - 76-100% (n=4)
  - some patients (hepatic failure, severe hypoproteinemia) received a customized formulation

**Table 1.** Partial parenteral nutrition (PPN) formulations used based on body weight. Some animals received a customized PPN formulation.

Body Weight (kg)	Percent of Calories from each Component			Formulation	n <sup>a</sup>
	5% Dextrose	8.5% Amino Acids	20% Lipid		
3-10	25	25	50	A	52
10-25	33	33	33	B	19
<25	50	25	25	C	23
Custom <sup>b</sup>	Variable	Variable	Variable	D	19

<sup>a</sup> The specific formula was not available in the medical record for 14 animals.

<sup>b</sup> These formulas ranged from 15 to 85% of calories from dextrose, 8 to 33% of calories from amino acids, and 0 to 48% of calories from lipid.

- why PPN
  - short term nutritional support in non-debilitated patients (no obvious signs of malnutrition)
  - nutritional support in patients in which central jugular catheter placement is contraindicated)
  - supplement enteral feeding when it is insufficient to meet the full nutritional needs of the patient)

### Findings

- 72 complications
  - metabolic (43)
    - hyperglycemia, lipemia, hyperbilirubinemia

- increase in serum glucose, triglyceride, bilirubin, urea nitrogen, Na, Cl, Ca, phosphorous concentrations after PPN administration in a pat with a measurement initially WNL
  - animals receiving formulation A were more likely to have metabolic complications than other formulations
- mechanical (25)
  - thrombophlebitis, catheter occlusions, disconnected lines, other technical problems interfering with administration of PPN.
- septic (4)
  - clinical suspicion of sepsis and a positive catheter tip culture
  - also recorded new febrile episodes during PPN administration not attributable to underlying disease
- pancreatitis most common reason for PPN (GI and hepatobiliary also common), many patients had more than 1 reason
- Before PPN mean days no food PO 5.3 +/- 2.7 days (0.2-10.7 days in hospital prior to PPN)
  - shorter hospitalization before starting PPN in cats than in dogs
  - dogs lost significantly more weight than cats
  - no difference on total hospital stay in dogs vs cats
  - overall hospitalization time was positively correlated with the length of hospitalization prior to starting PPN
- overall mortality rates for PPN patients were 31% for dogs and 19% for cats
- more animals that received some enteral nutrition during PPN administration survived (26/29) compared to animals not receiving any enteral nutrition (67/98)
- cats more likely than dogs to have metabolic complications
- no difference in mechanical, metabolic, or septic complications were found between animals with central s peripheral catheters
- no association between outcome and species, age, complication, change in body weight, illness factor used, duration of hospitalization or length of hospitalization before starting PPN