



To Feed or Not to Feed?

CONTROVERSIES IN THE NUTRITIONAL MANAGEMENT OF PANCREATITIS

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- Advance the specialty area of veterinary nutrition
- Increase the competence of those practicing in this field
- Establish requirements for certification in

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- Encourage continuing education for both specialists and general practitioners
- Promote evidence-based research
- Enhance dissemination of the latest veterinary nutrition knowledge.

The ACVN achieves these objectives in many ways, including designating specialists in animal nutrition, providing continuing education through several media, supporting veterinary nutrition residency programs, and offering a wide array of resources related to veterinary nutrition, such as this column.



Pancreatitis is a common clinical condition of both dogs and cats (**Figure 1**), and significant research has been devoted to improved diagnostic identification of the disease.¹⁻³

However, nutritional management of pancreatitis continues to be guided primarily by the human literature and clinical experience due to lack of controlled clinical trials. Any nutritional intervention in the treatment of pancreatitis is predicated on the practitioner distinguishing acute or chronic pancreatitis from other causes of gastrointestinal signs.

RISK FACTORS

In most patients, the definitive cause of pancreatitis is unknown. Published risk factors for pancreatitis are extensive and include endocrine disease, obesity, breed, and others.¹⁻⁶ The nutritional factors that are anecdotally reported to precede episodes in dogs include dietary indiscretion and consumption of more dietary fat than normal for a particular dog.

In a single retrospective study that interviewed owners of dogs affected by pancreatitis and those

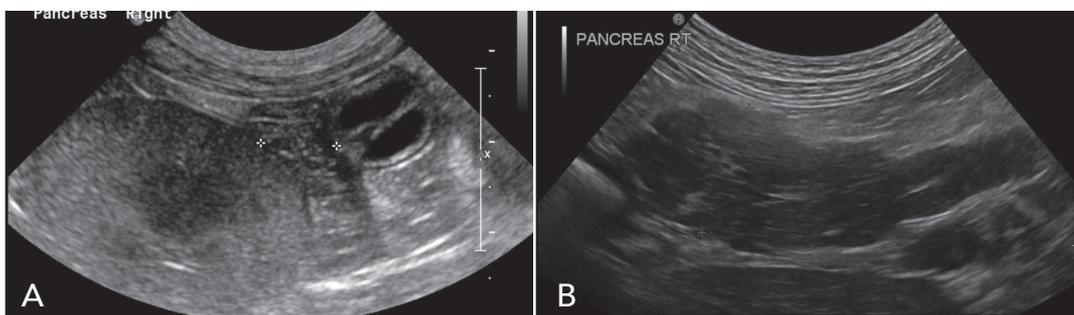


FIGURE 1. Ultrasound images of pancreatitis demonstrating (A) heterogeneous echogenicity in the pancreas of a dog affected by chronic pancreatitis and (B) significant pancreatic enlargement, hypochoic regions in the pancreas, and adjacent hyperechoic peripancreatic fat in a dog with acute pancreatitis.



Learn More

For more information on acute pancreatitis in dogs and cats, read the following articles from *Today's Veterinary Practice*, available at tvjournal.com:

A Case of Canine Acute Pancreatitis: From Diagnosis to Treatment
(September/October 2016)

Feline Pancreatitis: Current Concepts in Diagnosis & Therapy
(January/February 2015)

presenting with renal disease, factors that were more prevalent in the pancreatitis group included:⁵

- Dietary indiscretion of items in the trash, which conferred greatest risk (13× more likely)
- Unusual food items consumed prior to presentation (4×–6× more likely)
- Table scraps given in the preceding week or generally (2× more likely)
- Obesity (2.6× more likely).

CLINICAL SIGNS

Cranial abdominal pain and nausea are thought to be characteristic of acute pancreatitis in dogs.¹⁻³

Dogs with chronic pancreatitis may display vague signs of anorexia, hyporexia, lethargy, or behavioral changes, and an acute trigger may not be immediately identified in these patients.

Cats commonly present with nonspecific signs of anorexia and lethargy for both acute and chronic disease, which makes detection more challenging.⁴

CANINE ACUTE PANCREATITIS

To feed or not to feed?

No objective information is available to determine whether fasting is associated with beneficial or poor outcomes in dogs with pancreatitis.

- Fasting was, and continues to be, a mainstay of acute pancreatitis treatment by many veterinarians.²
- The premise for this approach is to avoid both pancreatic stimulation and premature activation of zymogens, but these effects have not been demonstrated in clinical patients receiving nutritional support.
- Many veterinarians relate personal observations that early feeding is associated with increased nausea or morbidity, especially in the presence of abdominal pain or severe gastrointestinal signs prior to feeding.

Some practitioners, nutritionists, and internists advocate early enteral nutrition in dogs with acute episodes of pancreatitis because:

1. A large body of evidence from human critical care medicine supports decreased morbidity and mortality associated with early enteral nutrition
2. While evidence for early enteral nutrition in dogs is comparatively sparse:
 - Early enteral nutrition accelerated recovery in dogs with parvoviral enteritis, with food administered by nasogastric tube irrespective of whether dogs were vomiting or regurgitating;⁷ however, the significance to older dogs and those with pancreatitis remains unclear.

- Enteral nutrition by jejunostomy tube maintained intestinal villous height and mucosal thickness better than parenteral nutrition in dogs with experimentally induced pancreatitis.^{8,9} However, this information may not be relevant to most practitioners, who will choose between fasting or enteral support, rather than intravenous nutrition.

3. Feeding during illness helps provide essential nutrients that affect cellular function. However,
 - Many of these nutrients are present in reserve, and dogs are more resistant to starvation than humans, with higher rates of fat oxidation at rest.¹⁰
 - Protein catabolism may occur in critical illness despite the presence of adequate caloric intake due to increased protein requirements.¹¹

This increased interest in early enteral nutrition is challenged by some who routinely fast animals with acute pancreatitis. These clinicians argue that there is no evidence—in naturally occurring pancreatitis in companion animals—that shows a favorable effect of nutrition and that assistive enteral feeding, when necessary, adds risk and cost to treatment of a patient with pancreatitis. It is important to consider, however, that:

- If enteral tubes are placed inappropriately, aspiration may be a risk, but aspiration due to placement errors is rare and risk is mitigated by documenting negative pressure in a feeding

KEY POINT: Short-term fasting has not been associated with poorer outcome in dogs with pancreatitis, and the benefits of feeding require additional validation in dogs with naturally-occurring pancreatitis.

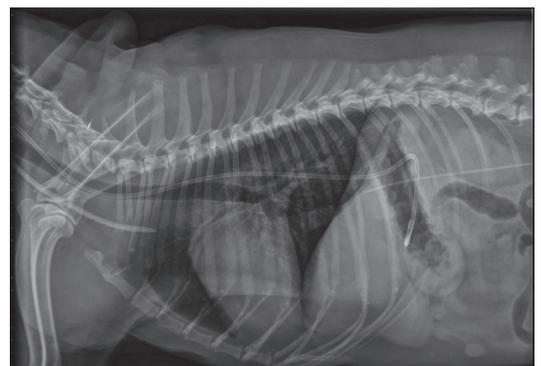


FIGURE 2. Radiographs should confirm placement of nasoenteral tubes; this lateral radiograph shows a nasogastric tube placed in a cat with the distal tip clearly evident in the stomach.

tube, absence of a cough when sterile saline is given via the tube, radiographic confirmation (**Figure 2**) of correct placement, or even capnography.¹²

- The expense of feeding dogs with severe acute pancreatitis amounts to a small fraction of the overall care (< 5%), but these costs could be significant if the owner's budget is limited.

In the absence of evidence specific to canine pancreatitis, practitioners should evaluate the risks of enteral feeding in the context of the patient's overall clinical picture. Dogs with intractable vomiting or regurgitation, in normal body condition, or those with owners who have financial limitations may tolerate a period of fasting without any clinically relevant adverse effects.

KEY POINT: Maintenance of enteral nutrition appears beneficial in humans with critical illness and is likely worth the time and effort of intervention—when risks of feeding the patient are low—until additional studies are performed.

Enteral or parenteral feeding?

Enteral nutrition in humans with pancreatitis may prevent bacterial translocation, metabolic and electrolyte complications of parenteral feeding, immune system impairment, villous atrophy, and reduced mortality.¹³ However, human guidelines also suggest that parenteral nutrition should be considered:

- If nutrition is indicated due to prolonged or anticipated anorexia
- When enteral nutrition is either contraindicated or not well tolerated.¹⁴

The optimal route of enteral nutrition has not been defined in humans or animals.¹⁵ While veterinary guidelines for parenteral nutrition have been extrapolated from human guidelines, the pathophysiology of small animal pancreatitis cases may be quite different, as well as prognosis and response to parenteral nutrition.¹⁶

KEY POINT: Enteral nutrition is generally associated with more favorable outcomes in humans and possibly in dogs when compared with parenteral nutrition.

How much is too much?

Dogs with pancreatitis should eventually achieve their estimated resting energy expenditure when feeding is appropriate and elected.

Resting energy requirement (RER) can be estimated in 2 ways:

1. $70 \times (BW_{\text{kg}})^{0.75} = \text{RER (kcal/day)}$
2. $[30 \times (BW_{\text{kg}})] + 70 = \text{RER (kcal/day)}$

The first formula is the more accurate of the 2 equations, while the second is an approximation of RER for dogs weighing 5 to 25 kg. Body weight should always be entered in kg.

If partial intolerance to enteral nutrition is present, it is likely that a lesser amount provides some benefit in maintaining absorptive surface area of the intestines. Illness factors, which increase calculated RER, should not be used as the available literature suggests that such values overestimate calories needed in hospitalized patients.¹⁷

Animals may require assistive enteral feeding.

- Syringe feeding is not recommended due to the practical inability to deliver full nutrient requirements with this method and the risk of food aversion and aspiration.
- Nasoesophageal and nasogastric tubes are often used in management of canine and feline pancreatitis.
- Esophagostomy tubes are generally reserved for severe chronic pancreatitis in dogs, or in cats with concurrent morbidities that make the need for continued supportive feeding likely.

What should the patient be fed?

Commercially available low fat enteral diets (**Table 1**) may best be reserved for patients that have been discharged from the hospital or those that are severely hyperlipidemic.

TABLE 1.

Fat Content (g/1000 kcal) of Veterinary Therapeutic Diets Labeled for Management of Pancreatitis

DIET	DRY	CANNED
Low Fat Kangaroo Maintenance (raynenutrition.com)	22	24
Prescription Diet i/d Low Fat (hillspet.com)	20	23
Veterinary Diet Gastrointestinal Low Fat (royalcanin.com)	19	18
Veterinary Diets EN Gastroenteric (proplanveterinarydiets.com)	31	44
Veterinary Diets HA Hydrolyzed (Vegetarian/Chicken) (proplanveterinarydiets.com)	26/32	n/a
Veterinary Formula Intestinal Plus Low-Residue (iams.com)	29	45

TABLE 2.
Fat Content & Energy Density of Selected Liquid Diets

DIET	FAT (g/1000 kcal)	PROTEIN (g/1000 kcal)	KCAL/ML
CliniCare Liquid Diet (abbottnutrition.com)	≥ 50 ^a	≥ 80 ^a	1
Ensure Plus (abbottnutrition.com)	31	37	1.5
Intensive Care HDN (emeraid.com)	48	85	≤ 1.36
Rebound Liquid Diet^b (virbacvet.com)	≥ 60 ^a	≥ 60 ^a	0.84
Sustain HDN (emeraid.com)	61	73	≤ 1.34
Vivonex Elemental Formula (nestlehealthscience.us)	7	42	1

a. Estimated from guaranteed analysis

b. Manufacturer does not recommend for constant rate infusion

- Initiation of therapeutic diets during acute illness has been hypothesized to risk food aversion to the diet offered, and only a limited number of fat-restricted diets are available on the market.

- Dogs fed a fraction of normal maintenance energy requirements tolerate a moderate fat “sacrificial” maintenance diet during hospitalization, in my experience.

Liquid veterinary-specific enteral diets are available (**Table 2**):

- Veterinary-specific diets are usually higher in fat than human formulas but are complete and balanced.
- Human enteral diets may be used for short-term feeding as they are lower in fat but are generally also lower in protein and essential nutrients, making them inappropriate for long-term use without detailed analysis.
- Liquid diets are generally required for nasoenteral tubes.

Elemental diets are liquid diets designed for humans. The name “elemental” refers to a basic mixture of simple nutrients, such as free amino acids or small peptides, simple sugars, and low amounts of dietary fat. These diets tend to be more expensive per calorie than all other common diets, and are not complete and balanced for long-term feeding. However, they may be beneficial if an animal has concurrent food hypersensitivity.

Standard parenteral nutrition solutions can be given in the event of severe acute pancreatitis.

- There is no evidence parenteral lipid emulsions increase pancreatic release of proteases or worsen prognosis.

- Similar outcomes have been reported in dogs receiving parenteral nutrition for acute pancreatitis and in those receiving early enteral nutrition, but dogs fed parenterally had increased catheter complications.¹⁸
- The provision of complete parenteral nutrition solutions is often difficult in practices not equipped with a fully staffed emergency and/or critical care unit or in those without previous experience with these formulations.

Long-term Nutritional Assessment & Recommendations

Dogs with acute pancreatitis may fully recover, and may not display any histologic features or clinical signs of chronic disease. In such cases, a diet otherwise optimal for the pet’s age and health can eventually be fed.

Once the patient is discharged:

- If the patient received a low fat diet during hospitalization, slowly transition the animal to the previous or intended maintenance diet.
- Do not make this transition until the owner has verified the patient is eating well and clinically stable after discharge. There are often no contraindications to extended administration of a low fat diet.
- Discontinue food transition and reevaluate recommendations if there is any evidence of lethargy, hyporexia, or abdominal pain.
- Owners should be counseled to avoid the risk factors highlighted at the beginning of this article (eg, significant abrupt food changes, ingestion of trash, table scraps, obesity).

CANINE CHRONIC PANCREATITIS

Low fat, no fat, or normal fat?

The evidence for dietary fat restriction in chronic canine pancreatitis is based on clinical impression and the published management of relatively few cases. The lack of prospective controlled clinical trials assessing fat tolerances in dogs with acute or chronic pancreatitis has resulted in a range of recommendations.

TABLE 3.
Published Maximal Dietary Fat Concentrations Suggested for Use in Dogs with Pancreatitis

Villaverde C 2012²⁰	<i>All dogs: 24 grams fat per 1000 kcal</i>
Hand M et al 2011²¹	<i>Obese dogs: 25 grams fat per 1000 kcal^{a,b} Non-obese dogs: 38 grams of fat per 1000 kcal^a</i>
Xenoulis PG et al²	<i>All dogs: 25 grams fats per 1000 kcal^a</i>

a. As estimated from dry matter percentage given

b. Obese dogs = BCS ≥ 7/9

Some specialists generically advise that a low fat diet be given,^{1,19} while others provide specific empirical maxima (**Table 3**). None of the values has a primary basis in scientific experimentation and as such should be interpreted cautiously. Moreover, the diets marketed and labeled for management of pancreatitis vary widely in nutrient composition (**Table 1**).

The precise fat content tolerated is likely patient-specific. Human patients with chronic pancreatitis eating high fat diets had increased abdominal pain but fat intake was not associated with increased disease severity or complications.²²

KEY POINT: Based on available evidence, it is prudent to feed lower fat diets (< 30 grams per 1000 kcal) in order to assess an individual dog's response. Diets with higher fat contents may be tolerated by some dogs as precise data are unavailable.

Nutritionally responsive hyperlipidemic dogs should consume no more fat than necessary to maintain serum triglycerides in a normal range. These dogs should, however, minimally receive their recommended allowance of 14 grams of fat per 1000 calories, assuming a normal intake of food.¹⁰ Fat free diets are not appropriate because minimum intake of dietary fat is needed for absorption of fat-soluble vitamins and provision of essential fatty acids.

What type of fat?

The type of fat consumed may influence a dog's response to a particular diet. Dietary fat may be saturated or unsaturated and have different lengths of fatty acid chains. For a further discussion on dietary fat, read **Role of Dietary Fatty Acids in Dogs & Cats** (September/October 2016), available at tvjournal.com.

In vitro studies have suggested that acinar cells are differentially sensitive to the types of dietary fat to which they are exposed, with saturated fats the most lipotoxic, polyunsaturated fats less so, and monounsaturated fats protective.²³ Such studies have not been performed in veterinary patients or cell lines.

Oral or parenteral omega-3 fatty acids (eg, docosahexaenoic acid [DHA], alpha-linolenic acid [ALA], eicosapentaenoic acid [EPA]) may reduce pancreatic inflammation and prevent apoptosis of acinar cells.²³⁻²⁵

- Efficacy and dosing in dogs has not been established; however, other omega-3

responsive conditions typically require 1 to 3 mg of combined EPA and DHA per kcal, or approximately 1 to 3 standard fish oil capsules (containing 300 mg EPA and DHA) per 10 pounds of body weight.²⁶

- Each capsule adds 1 gram of fat to a dog's intake; therefore, omega-3 fatty acids should be used judiciously while monitoring clinical signs.
- Extended administration is required and, therefore, is only likely to be beneficial in patients with chronic pancreatitis.

Oxidized or rancid fats should be avoided. While avoiding improper food storage is important for all dogs, it is especially important for those predisposed to pancreatitis because:

- Oxidative stress may be a component of the pathophysiology of pancreatitis
- Oxidized lipids may activate inflammatory cells.^{27,28}

A protein problem?

Published anecdotal recommendations have suggested restriction of dietary protein to less than 75 grams per 1000 kcal for dogs based on the stimulation of pancreatic enzyme secretion in response to amino acids and protein.²¹ However, there is no evidence that such a maximum is beneficial or necessary.

Critically ill dogs may have increased protein requirements, as in humans, due to the systemic inflammatory response; changes in plasma amino acids of dogs with pancreatitis have been documented.²⁹

KEY POINT: In the absence of definitive data regarding dietary protein, nutritional plans for dogs with pancreatitis should ensure that patients receive at least the recommended daily allowance of protein (3.3 grams per [BW_{kg}]^{0.75}).¹⁰

FELINE PANCREATITIS

In most cats, the underlying inciting cause of pancreatitis is not identified. It commonly occurs as a co-morbidity with other conditions, including those affecting the small intestine and liver. This so-called *triaditis* may occur in a majority of cats diagnosed with pancreatitis.

Feline pancreatitis is histologically consistent with the chronic form in 2/3 of affected cats.³⁰ Cats with suspected acute or chronic pancreatitis should be carefully screened for cholangiohepatitis, inflammatory hepatic disease, inflammatory bowel disease, and bacterial infections of the pancreas.^{4,30}

KEY POINT: Feline pancreatitis is not the same as pancreatitis in a small dog, and dietary fat restriction is generally not required in cats.

The nutritional treatment of feline pancreatitis and associated conditions is centered on provision of adequate caloric intake for both short- and long-term feeding. Most cats require between 200 to 250 kcal daily during hospitalization and in their home environment.

There is no evidence that dietary fat restriction is warranted in feline pancreatitis, whether acute or chronic. Therefore, higher fat recovery diets can be fed if palatable and available.^{4,16}

Anecdotally cats require increased time and treatment to begin eating compared with dogs. If a patient has a history of significant weight loss or a protracted period of anorexia, feeding tubes should be considered.

- Esophagostomy tubes (**Figure 3**) should be placed in cats with hepatic lipidosis or other co-morbidities and when a protracted recovery is expected.
- Short-term enteral feeding is typically best achieved by nasoesophageal tube placement; cats should not be given human enteral formulas during hospitalization as most formulas do not meet the unique nutritional requirements of cats.¹⁶
- Appetite stimulant drugs are unreliable in many cases.



FIGURE 3. Esophagostomy tubes help facilitate nutritional management of acute and chronic pancreatitis characterized by hyporexia.

Cats may benefit from parenteral vitamin B₁₂ (cobalamin) supplementation given that the absorptive cofactor necessary for B₁₂ absorption, known as the *intrinsic factor*, is produced only in the pancreas of cats (as opposed to the pancreas and stomach in dogs).³¹

SECONDARY EFFECTS OF PANCREATITIS

Severe pancreatitis may be associated with diabetes mellitus and exocrine pancreatic insufficiency (EPI). These occur more frequently in dogs than in cats, but have been reported in both species.^{2,32}

- EPI can be managed with a variety of different dietary strategies but relies on exogenous pancreatic enzyme powders to aid in normal digestion.
- Pancreatitis is documented in a number of diabetic dogs (> 1/3), and may have a causal role.³²
- The relationship between pancreatitis and diabetes in cats is less clear, with insulin resistance secondary to increased adiposity being the primary risk factor. Cats with diabetes mellitus benefit from weight loss and, possibly, a low carbohydrate, high protein diet; neither would be detrimental to managing concurrent pancreatitis based on available knowledge.

IN SUMMARY

Small animals with pancreatitis should receive an assessment of their dietary history and nutritional status. Unfortunately, current knowledge is inadequate to provide a strong evidence-based



Decoding the Label: Assessing Commercial Diets for Fat Content

Dietary nutrient comparisons are best performed on a caloric basis (see **Beyond the Guaranteed Analysis: Comparing Pet Foods**, available at tvjournal.com under Clinical Resources).

Ideally, the amount of fat in grams per 1000 calories would be obtained directly from the manufacturer. In the absence of such information, the dietary fat content can be estimated:

1. Add 1% to the guaranteed analysis fat minimum on the label to estimate the actual or typical content.³³
2. Divide the as-fed caloric density (kcal/kg) on the label by 10,000.
3. Divide the number from Step 1 by the number from Step 2.

If evaluating a dry diet with a caloric density of 4000 kcal/kg and fat content of 15%, the equation would be:

$$(15+1) / (4000/10,000) = 40 \text{ grams of fat (estimated) for every 1000 kcal fed}$$

The National Research Council's recommended allowance for fat content (g/1000 kcal) in canine diets is 13.8; less than 30 is considered low fat, 30 to 50 is considered moderate fat, and greater than 50 is considered high fat by the author.

recommendation on when and how to feed many patients.

Dietary fat restriction appears to be a critical part of successful management of chronic disease in dogs, but its role in acute pancreatitis is less clear, and is generally unnecessary in cats. The definition of a *low fat diet* for patients with pancreatitis is not well established but may be less than 30 grams per 1000 kcal. Hyperlipidemic animals may benefit from restricted intake of fat to achieve lower serum triglycerides and cholesterol, but all animals require sufficient fat intake to ensure fat soluble vitamin absorption and to meet essential fatty acid requirements.

When nutrition is elected for acute or severely affected patients, assistive feeding may be required. Current evidence suggests that enteral nutrition is preferred over parenteral nutrition unless there is a contraindication to luminal nutrition.

ALA = alpha-linolenic acid; BW_{kg} = body weight in kilograms; DHA = docosahexaenoic acid; EPA = eicosapentaenoic acid; EPI = exocrine pancreatic insufficiency; kcal = kilocalorie; RER = resting energy requirement

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