Improving patient outcomes with early nutritional support

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A common approach to critical care nutrition is to delay feeding until the patient's appetite or willingness to eat returns. It is well documented, however, that early nutritional support of hospitalised dogs and cats improves recovery from illness, reduces mortality and improves response to trauma and stress.[1] While not usually detrimental to healthy dogs and cats, a few days of fasting can have significant negative effects in hospitalised patients.

Although few animals present with the primary diagnosis of starvation illness, medical procedures often result in anorexia or fasting. Fasting dogs can lose 1 to 3% of their body weight per day; anorexia in cats may lead to hepatic lipidosis.[2] The detrimental effects of delayed or inadequate nutritional support in hospitalised patients include poor wound healing, increased risk of infection, muscle wasting, breakdown of the gut barrier and increased mortality.[3] Conversely, optimal nutrition allows the immune system to respond adequately, so that medications and other treatment modalities can be effective.[3]

Nutritional support of hospitalised animals should be viewed as an extension of the care and treatment for their primary illness or trauma. To this end, patients should be fed the correct therapeutic diet for their respective conditions while in hospital. The cost of this diet could be factored in to the initial quote and unfinished bags or tins sent home with the patient as part of their overall medical management.

Effects of illness on energy needs

The metabolism of a fasting sick or injured animal differs dramatically from that of a normal, healthy fasting animal. Surgery, fractures, serious infections, burns, trauma and head injuries all affect an animal's total energy and protein requirements. The normal fasting animal uses carbohydrate stores in the form of glycogen as its primary source of energy, followed by use of stored fat deposits, enabling it to preserve lean muscle tissue when deprived of food. In contrast, the sick or injured fasting animal is unable to properly metabolise carbohydrates, and is forced to use its own body protein as an energy source. The resulting depletion of lean muscle mass and preservation of stored fat deposits is termed 'hypermetabolism' and is characterised by marked loss of protein from the animal's tissues. A hypermetabolic animal is also unable to dispose of glucose effectively, is 'resistant' to the effect of insulin and develops 'stress diabetes'.[3] Feeding large amounts of carbohydrate is therefore contra-indicated, and fat and protein should be used as the primary dietary energy sources. The cumulative drain of hypermetabolism on tissues may continue for weeks, necessitating appropriate nutritional support for weeks after the animal leaves hospital.

Developing a nutritional plan

The first step towards incorporating dietary support into your treatment protocols is to determine which patients require nutritional intervention. This can be achieved by routinely completing a nutritional assessment for every patient at every visit, using information gained from the animal's history, physical examination and laboratory tests.

The dietary history should include information on the previous diet (for example, premium commercial pet food or unbalanced human food), the amount consumed as a percentage of normal intake, how long the intake has been reduced and whether there have been any additional losses from vomiting or diarrhoea. If the patient has been completely anorectic for 2 days, or intake has been only 25% of normal resting energy intake over 3 days, the animal is likely to be suffering protein-calorie malnutrition and require nutritional intervention. The patient's activity level should also be determined - bedridden people are more likely to be malnourished,[4] and the same may also be true for animals sitting in cages. Weight changes should be considered carefully in the assessment, while factoring in confounding effects such as changes in hydration status. Specifically, we need to know what percentage of total body weight has been lost, the rate at which the weight loss occurred (over days, weeks or months), and whether the weight change was acute or chronic. An acute weight loss of 6-10% body weight in the absence of dehydration indicates possible malnutrition and any animal with 10% or more weight loss is likely to be malnourished.

Clinical findings such as decreased subcutaneous fat stores, muscle wasting or loss of lean body mass, ascites or limb oedema, poor hair coat, pressure sores or other signs of general debilitation should be regarded as significant. Disease related factors such as the hypermetabolism of trauma or sepsis, effects of treatment (e.g. chemotherapy) or increased nutrient losses (e.g. malabsorption or protracted vomiting/diarrhoea) should also be determined and weighted heavily in a patient's nutritional assessment. Abnormal laboratory findings are not generally specific to malnutrition. They are usually seen later in the disease process and are thus weighted less heavily. These may include hypoalbuminaemia, lymphopenia or non-regenerative anaemia.

Once the evaluation is complete, a subjective assessment rating should be assigned to the patient. The most emphasis should be placed on the findings of poor nutritional intake, significant weight loss, and loss of subcutaneous fat and lean body mass. The ratings are

1. Severely and obviously malnourished. Aggressive nutritional intervention is required.
2. Moderately malnourished or suspected to be malnourished. Needs a caloric assessment and encouragement to eat.
3. Well nourished. No nutritional intervention required at present.

Patients can move from one category to another quite quickly and a daily nutritional assessment should be incorporated into your daily physical examination.

What to feed?

Options include

1. Regular pet food
2. Human liquid enteral diets
3. Specialised recovery foods
4. Therapeutic diets
5. Parenteral nutrition.

The best nutritional support for animals is provided by specialised recovery formulas and therapeutic diets formulated for specific disease conditions.

Supermarket pet foods. Maintenance-type pet foods seldom meet the needs of hospitalised dogs and cats. They usually contain large amounts of carbohydrates in the form of cereals, and are therefore contraindicated for most ill animals. While blending these pet foods or even home cooked foods may appear to be a cheaper option, there are likely to be problems with viscosity, bacterial growth, settling of solid components and inconsistency of nutritional composition.

Liquid diets. Commercially available liquid enteral diets designed for tube feeding are manufactured for human use. They tend to be extremely expensive and although not nutritionally adequate for dogs and cats, short-term use (< 1 week) is possible. The formulations are classified as elemental or polymeric. Elemental liquid diets consist of small hydrolysed nutrients and can be used if the animal's digestive capabilities are compromised (e.g. severe pancreatitis or severe enteritis). However, they can cause diarrhoea and abdominal cramping, especially if administered too rapidly. Examples include Vital® (Ross) or Criticare® (Mead Johnson). Polymeric liquid diets contain more complex nutrients and require normal digestive processes. Polymeric diets are sufficient for most veterinary applications if a small feeding tube is placed or drip-feeding is required. The most common example of this type of diet is CliniCare® (Abbott), however to the author's knowledge, this is not available in Australia. Ensure HN® (Ross) or Pulmocare® (Ross) are available for use in Australia. Both need additional supplementation with protein, as well as arginine and taurine, if they are to be used in cats.

Parenteral nutrition. Parenteral nutrition is the provision of all (Total Parenteral Nutrition [TPN]) or part (Partial Parenteral Nutrition [PPN]) of the patients' energy and protein needs intravenously. TPN solutions are generally administered via a central vein to prevent peripheral vein thrombosis. The disadvantages of using TPN include cost, the need to place and maintain a central venous catheter, the risk of central vein thrombosis or infection and metabolic disturbances. In contrast PPN can be delivered using a standard intravenous catheter via a peripheral vein. Often, however, only part of an animal's nutritional requirements can be met in this manner due to the lower caloric density of the solutions that can be used. Another disadvantage of the exclusive use of parental nutrition is that it fails to support or maintain intestinal cells or mucosal barrier function and thus is not recommended in the long-term unless gastrointestinal function is severely compromised. Such

conditions may include protracted vomiting and diarrhoea, severe maldigestion or pancreatitis, and postoperatively for some surgeries. It should be noted that microenteral nutrition can be used in conjunction with parenteral nutrition to help maintain intestinal health.

Specialised recovery formulas. Hill's™ Prescription Diet™ a/d™ Canine/Feline is a registered therapeutic diet (by the Australian Veterinary Medicines Authority) and is available in Australia. This food is formulated and balanced specifically for the needs of recovering dogs and cats, and provides concentrated levels of energy, protein and fat. It is enriched with glutamine, which is a major source of energy for the intestinal cells. Levels of arginine, branched chain amino acids, omega-3 fatty acids, zinc, potassium, B complex vitamins, vitamin E and selenium are also increased. These nutrients aid with wound healing, tissue synthesis and immune function.[3] Hill's™ Prescription Diet™ a/d™ Canine/Feline is thixotropic, meaning the more it is stirred, the more liquid it becomes. This allows the options of dish, syringe and tube feeding. Recovery formulas may need to be diluted by blending with water, straining and re-blending the lumps to pass through a smaller feeding tube. Correct flushing procedure is essential. A major benefit of this type of food is that it can be fed orally after the tube is removed without necessitating a change of diet.

Therapeutic diets. The nutritional requirements of an animal are determined by its primary disease, as well as by its species and metabolic state. For example animals which are hospitalised for severe kidney or liver disease may need a restricted protein diet. As a general rule, the food should be selected on the basis of the animal's most important medical issue.

Preparing slurries and gruels

To prepare a slurry, a specific amount of canned formulation is blended with a measured amount of water. The larger particles can then be strained out. Remember that adding water dilutes the food's caloric density and a larger volume will be required to meet the animal's energy and nutrient needs.

If using Hill's™ Prescription Diet™ a/d™ Canine/Feline, for example, blend one can of food (weighing 150 g and containing 180 kcal per can) with 150 mL of water. The number of calories per mL fed is calculated as follows:

150 + 150 = 300
300 mL now contains 180 kcal
Thus, the slurry contains 180/300 or 0.6 kcal per mL

If using a prescription/therapeutic diet that is not intended for tube feeding, the food is prepared by blending approximately 400 g of moist food with 1.5 to 2 cups of water at high speed for 60 seconds. Strain, then re-blend any lumps with a small volume of the strained formula. Strain again and then combine the formulations and mix well, discarding any remaining lumps. The caloric content of the liquid is calculated in the same way as in the example above.

How much to feed?

The daily food intake offered initially should supply the calories determined for cage-rest. Approximate caloric needs are therefore initially calculated as the resting energy requirement (RER) from one of the following equations.

1. RER (kcal) = 70 x (Current Bodyweight)$^{0.75}$

This can be calculated simply by multiplying the animal's current body weight three times (e.g. for a 10 kg dog = 10 x 10 x 10), then taking the square root twice.

2. The simplified calculation

RER (kcal) = [30 x BW (kg)] + 70

can only be used if the patient weighs between 2 kg and 45 kg.

For example, the RER of a 10 kg dog hospitalised post-operatively is approximately 370 kcal (30 x 10 kg +70).

Previously, some clinicians multiplied the RER by an illness energy requirement (IER) to account for the hypermetabolism associated with injury and illness, and the presumption of increased caloric requirements. However, when caloric requirements were determined using indirect calorimetry in hospitalised dogs, most were close to the RER. The current approach in human patients is to estimate caloric needs as being at or near the RER, with an adjustment based on clinical assessment. Using the RER alone as the caloric goal for hospitalised animals is a reasonable and safe approach for veterinary patients. It is widely used and avoids the risk of overfeeding.

Regardless of how daily energy requirements are calculated, it is essential that monitoring is continued and the nutritional plan adjusted to provide optimal nutritional support.

In patients that have not been eating for several days, supplementation should not be started at the full RER. Only 1/3 of the estimated energy requirement can be given on the first day, divided into several small meals or boluses. If this is well tolerated, the amount can be increased to 2/3 on the second day, and the entire amount can be given on the third day.

As a general rule, once feeding is established, regular feeding of two main meals per day, at least 6 hours apart, is recommended for hospitalised patients. However, the frequency of meals can range from 2 to 12 feeds per day depending on the severity of illness, diet, route of delivery and availability of nursing care. For instance, intensive care cases may need feeding every 2 hours, moderately ill animals 4 hourly and mildly ill animals can usually be fed their total daily intake in two or three meals. Increasing the number of meals without changing the total amount fed daily

optimises digestion. If sufficient food is not consumed throughout the day, the animal requires a more specific plan of nutritional support.

It is essential to carefully monitor the amount of food or calories actually consumed by the animal over the day. Daily maintenance fluid requirements not met by diet must be supplemented enterally, subcutaneously or intravenously.

How to feed?

'If the gut works, use it!' Feeding via the enteral route is preferred in the presence of a functioning gastro-intestinal tract. Gut cells receive approximately 40% of their nutrition from digesta in the lumen of the gastrointestinal tract. Therefore, when patients are not fed enterally, loss of mucosal cell mass occurs and gastrointestinal function is impaired, rendering the gut more susceptible to damage and bacterial translocation.

Food for voluntary consumption should be offered before enteral feeds in selected patients. Food and calorie intake must be monitored, along with body weight, and if energy and nutrient requirements are not being met, another route should be selected.

Syringe feeding of blended slurries may work, but it requires repeated handling and manipulation of the animal, and risks aspiration and a grumpy patient! It is critical that stress be minimised in ill animals - the method of feeding selected should be the one that causes the least discomfort. This may mean feeding by an indwelling tube rather than force feeding boluses, syringe feeding or repeated intubations.

Tube feeding includes nasoesophageal and nasogastric tubes, or surgically placed tubes such as oesophagostomy, gastrostomy and jejunostomy tubes. Nasoesophageal tubes are commonly used for nutritional support lasting 4 to 7 days whereas gastrostomy tubes are used for long-term support for weeks to months (e.g. cats with hepatic lipidosis).

Generally, meal or bolus feeding is better tolerated than constant infusions. Tube feeding allows bolus or meal-type feeding schedules as the stomach acts as a food reservoir. However, some animals cannot tolerate bolus feeds without vomiting, and require slow continuous drip administration of liquid diets with a pump or gravity-flow device.

Principals of tube feeding

- Food should be refrigerated but warmed to room temperature in a bowl or jug of hot water before feeding. Heating in a microwave oven is not recommended due to possible uneven heating of the food.
- The bolus should be infused slowly over 1 minute to allow the stomach to expand.
- The daily volume should be split into several smaller meals, the volume depending on the stomach capacity.

- The stomach capacity of cats and dogs is initially 5 to 10 mL per kg but can increase to 45 mL per kg (cats weighing 4-6 kg) and 90 mL per kg (dogs) once the feeding regimen is established.
- Salivating, gulping, retching or vomiting may indicate that too large a volume has been infused, or it has been infused too quickly. It also may mean that the tube is displaced so tube placement should be checked.
- Feeds should be stopped at the first sign of salivating, gulping, retching or vomiting. The meal size should be decreased by 50% for 24 hours, and then gradually increased by 25% daily.
- Follow all infusions with a water flush of the tube volume only. Ensure the animal's requirements for water are met.
- Blocked feeding tubes may be cleared by filling the tube with water or a carbonated drink and allowing time for the food plug to dissolve, or inserting a stiff urinary catheter into the feeding tube.

Transition from tube feeding to voluntary feeding

As patients respond to treatment and improve they should be offered small amounts of food orally before the feeding tube is removed. Even dogs and cats with nasogastric tubes can eat voluntarily. Tubes should be left in place until the animal voluntarily consumes its daily caloric needs. Clients can tube feed at home in addition to voluntary feeding, thus ensuring optimal daily caloric intake.

Transition to home feeding

Counselling the client at discharge is essential to ensure that optimal nutritional support continues at home. Clients must be counselled about what to feed, how much to feed, how often to feed and, importantly, what not to feed. Compliance can be enhanced by offering clients access to direct technical support from the manufacturer of the recommended diet.

Each animal should be provided with an appropriate therapeutic diet at discharge as an important part of the total medication required. In general, discontinuation of nutritional support tends to be too abrupt. As a general guide, nutritional support should be continued for 2 weeks after uncomplicated surgeries, 2 to 4 weeks after uncomplicated trauma cases, at least 6 weeks after neglect, starvation or any other hypermetabolic states, and up to 12 weeks after severe trauma.

Ideally the animal should be fed the same diet at home as it was in hospital to avoid digestive upsets and palatability issues. If this is not possible, the diet transition should be made very slowly. Once the period of nutritional support is over, the dog or cat should return gradually to its former diet. Each change of diet should be made in a series of partial replacement steps and take 7 days for simple cases and up to 10 to 14 days for serious gastrointestinal disease.

Summary
Sick or traumatised animals are less adaptable and have reduced physiological reserves to withstand changes in their environment, including nutrition. Intervention should be early, within 24-48 hours of the injury or illness.

It is essential to: -

- Assess the animal's nutritional needs using recent dietary history, physical examination, body weight and condition changes, and laboratory tests.
- Assign the patient a subjective assessment rating and reassess this every 24 hours.
- Calculate the patients RER and use as daily caloric goal.
- If the gut works, use it! This includes tube feeding if indicated.
- All foods should be stored in the refrigerator but fed at or just below body temperature.
- Choose a formula based on the animal's medical condition.
- Give frequent feeds of high calorie foods.
- Ensure adequate water intake.
- Carefully monitor the actual amount of food and calories consumed.
- Weigh the animal daily.
- Evaluate and modify the plan as needed.
- Transition to home feeding.
- Counsel clients on what to feed, how much to feed, how to feed and how long to feed. Offer practical tips such as hand-feeding, and warming or moistening foods to increase palatability.

APPENDIX 1.

Notes on Hill's™ Prescription Diet™ Canine/Feline a/d™

- 1 can a/d™ = 180 kcal or 150 mL
- a/d™ contains 76.5% moisture and 1.2 kcal per mL
- 1 mL of water is required per 1 kcal energy per day thus an additional 0.44 mL of water is required per mL of a/d™ (more if increased losses due to the disease process).

Chart for use of Hill's™ Prescription Diet™ Canine/Feline a/d™

Blended for 60 seconds but not strained.

	Caloric density kcal/mL	Tube Size – French gauge				
		5	8	10	12	14
Can a/d™	1.2	no	no	no	maybe	maybe
2 cans + 50mL water	1.0	no	no	maybe	yes	++
2 cans + 100 mL water	0.9	no	maybe	yes	++	++
2 cans + 150 mL water	0.8	no	yes	++	+++	+++
1 can + 150 mL water	0.6	yes	yes	++	+++	+++

No = excessive pressure, really hard push, can still flow but too hard
Maybe = high pressure, hard to push but will flow
Yes = high pressure, hard push, will flow
++ = good flow, acceptable pressure, medium push
+++ = good flow, low pressure, easy push

Note – need to strain if tube size < 12 gauge

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