Nutritional Support of Hospitalized Patients

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Introduction

Anorexia, or reduced food intake are common findings in sick and hospitalized patients in our small animal clinics. Left untreated, reduced caloric intake is very serious.

Why?

Every cell, and hence every organ within our body depends on an adequate supply of nutrients in order to function normally – meaning if we don't feed our patients adequately, cell and organ function deteriorate. Sadly, malnutrition of protein and energy are known to occur in 25-60% of hospitalized human patients, and is associated with increased patient morbidity and mortality. How our veterinary patients fare is not known, but is estimated to be very similar to the figures for humans in hospital!

As mentioned above, nutritional deprivation has adverse effects on the structure and function of nearly all the organs and systems of the body. A brief overview of these effects is outlined below

1. **Decreased protein production in the body**. This can result in poor circulation, and bleeding problems due to lack of albumin and blood clotting factors.
2. **Gastrointestinal tract** - gastric emptying is delayed, gut transit times are prolonged, and the intestine loses much of the surface area it needs to digest and absorb nutrients. Diarrhea, vomiting and anorexia follow. Bacteria from the gut more readily cross into the bloodstream.
3. **Kidney** – blood flow to the kidney reduces, and the kidney becomes less able to excrete body wastes. Kidney failure may result.
4. **Immune System** function is decreased – white blood cells respond to infection poorly, making these patients more susceptible to infection.
5. **Pulmonary system** – Respiratory effort and rate are reduced. In addition, the respiratory secretions become thicker, and less mobile. These things mean the lungs do not function as well, and are at increased risk of getting infected.
6. **Cardiac function** – The heart muscle mass reduces, and the strength of heart muscle contraction reduces – the heart becomes less able to pump blood around the body.
7. **Skeletal muscle** - depressed synthesis and increased degradation of skeletal muscle.

8. **Bone** - osteoporosis, spontaneous fractures.
9. **Wound healing** - decreased rate of wound healing. Decreased neovascularization; decreased collagen synthesis; decreased wound re-modeling; decreased healing in tissues, edema.
10. **Haemopoietic system** - development of anemia, thrombocytopenia, leukopenia.

What a list! Let's all eat something – NOW!

If we were healthy, and sitting, or lying down, while we were being deprived of nutrition, our body metabolism would gradually slow down, so that we could preserve as many of these body functions for as long as possible. Eventually, however, the malnutrition would become so severe, that all the things outlined above progressed to the point that we died.
However, the situation with our hospitalized patients sitting in our vet clinics is very different! The problem is that our patients in our vet clinics very rarely stop eating unless they are sick! This means that the most common thing that happens to the metabolism of sick patients is NOT a slowing down of metabolism (as would be the case if the animal had a simple case of starvation), but an INCREASE in metabolic rate! Here's a reminder of what an increased metabolic rate due to the stress of illness causes -

- Increased heart rate, blood pressure, and workload on the heart.
- A decrease in the storage of glucose, and an increase in the breakdown of body proteins, fats and carbohydrates for energy production – i.e. an INCREASED metabolic rate.
- Increased body tissue inflammation.

These things cause the rapid development of malnutrition and impaired organ function – often within a couple of days of a reduced appetite beginning! Very rapidly, the immune system becomes overwhelmed, and the gut, urinary tract, respiratory tract, and any wounds become very susceptible to infection.

The Role of Early Enteral Nutritional Support in Critical Care Patients

The response of the body in states of injury and disease demands that nutritional support be initiated early to avoid excessive breakdown of body tissues, improve the rate of wound healing, to help maintain normal organ function, and prevent life-threatening infection. Both animal and human studies demonstrate that early feeding improves survival, reduces hospital stay, and reduces organ damage – that is – your patients have a better chance of surviving their illness - just because you feed them!

Let's take a look at what will happen to our sick hospitalized patients if we feed them EARLY in the course of their disease, or hospitalization…

Gut Function – early nutrition reduces the movement of bacterial from the gut into the blood stream, and improves gut health.

Renal Blood Flow – animals receiving enteral nutrition have significantly better renal blood flow, glomerular filtration rates, and survival rates following acute renal damage.

Wound Healing – in a study of colonic anastomosis in dogs, dogs fed enteral nutrition immediately after surgery had better anastomotic bursting pressure and wound collagen synthesis following surgery than unfed controls.

Cell Membrane Integrity – fasting prior to stressful or traumatic episodes such as trauma, surgery or anesthesia has been shown to significantly increase the degree of cell membrane damage, by reducing production of, and/or activity of cellular anti-oxidant systems.

85% of studies demonstrate an improvement in outcome in at least one study criteria, including complications, infections, length of hospital stay, and survival, when nutritional support was not delayed.

Treatment and Prevention of Protein-Calorie Malnutrition

Treatment and prevention of protein-calorie malnutrition is dependent on the veterinarian and the veterinary nurse paying attention to three (3) important clinical choices - selection of patients for nutritional support, establishing a route and method of administration for nutritional support, and determining the appropriate diet for feeding based on patient protein and caloric needs. Let's have a look at these in a bit more detail…

Selection of Patients for Nutritional Support

Unfortunately, there are no specific tests available that will consistently identify patients likely to benefit from nutritional supplementation. However, **patients with ONE or more of the following should receive nutritional support.**

- Anorexia, or decreased food intake for 3 days.
- Anticipated anorexia or decreased food intake for 3 days.
- Loss of 10% of body-mass not related to hydration status. This relies on accurate bodyweights being recorded during routine clinical examinations.
- Hypoalbuminaemia.
- Inadequate muscle mass, scaly skin, decubital ulcers (bed-sores), joint swelling or pain.
- Patients with diseases associated with high metabolic demands.
- Recent trauma or surgery.
- Infusion of simple electrolyte solutions, such as lactated Ringer's solutions for more than 2-3 days, in the absence of feeding.
- Increased caloric losses due to vomiting, diarrhea, abscesses, burns, wounds.
- Use of anti-nutrient or catabolic drugs - corticosteroids, immunosuppressive therapy, antibiotics.
- Cancer, organ dysfunction/failure, such as liver disease, kidney disease, pancreatitis, pneumonia etc.

Using these criteria, ***any patient suffering from illness, trauma, surgery, infection or neoplasia will require nutritional support***. This should be considered an essential part of the patient's treatment regime on presentation to the clinic, and should remain so during the course of the illness.

Selection of a Route for Nutritional Support

The accepted rule to follow when one chooses between enteral and parenteral nutritional support is that "if the gut works, use it". Enterocytes – the cells lining the gastrointestinal tract - rely on luminal substrates for at least 40% of their nutrition, and rapidly atrophy without this nutritional support. Enteral nutrition is physiologically superior to intravenous or parenteral nutrition. Total parenteral (intravenous) nutrition results in reduced liver function in comparison to patients fed enteral nutrition. In addition, the sepsis rate is 2-3 times higher in critical patients fed with total parenteral nutrition (TPN), and the rate of infection in trauma patients is 2-3 times higher in patients fed with TPN, when compared to those fed by the enteral route.

The type and route of enteral nutrition are assessed based on the following:

- Patients clinical and nutritional status.
- Degree of anorexia.
- Anticipated duration of nutritional support.
- Patients ability to protect its airway against aspiration.
- Patients ability to tolerate anesthesia.
- Patients ability to tolerate the method of feeding.
- The need for abdominal surgery due to the primary disease process.
- The requirement that the feeding tube be placed based on functional status of the gastro-intestinal tract e.g. megaoesophagus, esophageal trauma. Placement of the feeding tube is most commonly required distal to the site of the disease.
- Cost considerations.

Let's have a look now at the various routes and methods of providing nutritional support. Appendix 1 details the placement of each of the feeding tubes mentioned below.

1. **Repeated orogastric intubation (including syringe feeding and force feeding)**
    a. May cause significant stress to the patient.
    b. Orogastric intubation provides an increased chance of incorrect tube placement, esophageal trauma, and aspiration pneumonia.
    c. Do not use in long-term nutritional management of anorexia.
2. **Nasogastric tubes**
    a. Easy to place and generally well tolerated.
    b. Small tube diameter (usually only size 6-8 Fr tubes can be placed because of the narrow diameter of the nasal passages) means that these tubes are really only useful for feeding liquid diet formulations. Currently in Australia and New Zealand, there are no completely liquid, animal-specific liquid diets available. Semi-liquid diets such as a/d or nutritional recovery formula frequently clog nasogastric tubes, rendering them un-usable. There are, however, some human liquid formulations that can be used, including Vital HN, Ensure, Glucerna, Jevity and others. Because these diets are human diets, they are useful only for short-term (1-2 days) use before supplementation or weaning is required.
    c. If the tube is placed in the stomach, a reflux esophagitis may result.
    d. Complications of tube placement include aspiration pneumonia, vomiting, tube migration, esophageal irritation, inflammation and scarring, tube clogging (due to small tube diameter), and epistaxis (bleeding from the nose).

3. **Oesophagostomy tubes**
    a. Provide a good alternative to nasogastric tube placement.
    b. Allows feeding of larger volumes of food compared to nasogastric tubes. In addition, blenderized canned diets can be fed.
    c. These tubes should be avoided if the patient has a megaoesophagus (snake envenomation, myasthenia gravis etc.)
    d. Complications of tube placement include aspiration pneumonia, vomiting, tube migration, oesophageal irritation and inflammation, tube clogging (although the incidence is much reduced compared to nasogastric tubes), and skin infections about the tube insertion site in the neck.
4. **Gastrostomy tubes**
    a. Require a general anesthetic to place. These tubes may be placed via endoscope, percutaneously or via laparotomy.
    b. The tube must be left in place for at least 7-10 days to allow a fibrin seal to form between the stomach and abdominal wall.
    c. Complications of tube placement include vomiting, tube migration, tube clogging, peri-stoma infections, splenic laceration (percutaneous placement), pneumo-peritoneum, and gastric haemorrhage.
5. **Jejunostomy tubes**
    a. Bypasses the upper portion of the gastrointestinal tract. They may be useful in animals with conditions affecting the stomach and upper small intestine, such as neoplasia, major surgery, pancreatic diseases (pancreatitis, abscesses, neoplasia), and in patients with persistent regurgitation.
    b. These tubes require abdominal surgery (laparotomy) to place.
    c. Because these tubes are small (similar size to nasogastric tubes) the type of diet fed must be liquid only. Small frequent or (ideally) continuous feeding required in order to prevent intestinal distension around the tube, and patient discomfort.
    d. Complications include tube migration, tube clogging, peri-stoma infections, and diarrhea and vomiting from inappropriate feeding techniques, hyperglycemia and electrolyte disturbances, and hypo-glycaemia (if feeding abruptly stopped). Very occasionally, the tip of the tube can perforate the small intestine, and result in leakage of intestinal fluid into the abdominal cavity, causing severe peritonitis.

Determine the Appropriate Diet

Determining the appropriate diet to feed a patient in hospital is one of the most important decisions you and your vets have to make for your patients. Choosing the wrong diet can result in vomiting, diarrhea, anorexia, and further weight loss – all of which can delay recovery from illness, disease and surgery. So, it is worthwhile taking some time to decide on the most appropriate diet for the patient, and frequently reassessing this choice, to make sure the chosen diet remains an effective one for the patient. It is not unusual for most patients that are treated in hospital to have one or two changes in the diet they receive during a hospital stay.

In general, it is best to start feeding a sick patient with a glucose and electrolyte solution to begin with (lectade, vytrate or similar solutions are best). These solutions provide cells lining the gut with energy in a readily usable form, and prepare the gut for subsequent, more complex diets.

Below are some recommendations for "ideal" diets in four critical groups of patients – those with severe injury (SIRS or Sepsis), those with pancreatitis, acute renal failure and lung injury – including pulmonary contusions, pneumonia, chest wall injury or respiratory muscle paralysis.

Systemic Inflammatory Response Syndrome (SIRS)

In patients with sepsis or SIRS resulting from trauma (dog bite, hunting injury, road traffic trauma etc.), burn injury, or systemic inflammation, the following has been found

- Enteral nutrition is associated with decreases in infectious complications
- Feeding of diets enriched in omega-3 fatty acids, and arginine have been associated with shorter hospital stays, and reduced complications arising from infections
- Feeding of so-called immune-enhancing diets improves outcome

Acute Pancreatitis

In acute pancreatitis, the following may occur:

- Oral nutrition may be prohibited by many factors, including abdominal pain, nausea, vomiting, gastric atony, and partial duodenal obstruction caused by pancreatic swelling and enlargement.
- Decreases in luminal pancreatic enzymes may cause maldigestion and malabsorbtion of ingested nutrients.
- Inflammation of the pancreas and abdominal cavity may produce excessive protein loss.
- Energy expenditure is increased in as many as 50% of patients (the remainder of the patients have normal energy expenditure (40%), or are hypometabolic (10%)).
- Impaired production of insulin, together with stress results in an increase in the glucagon: insulin ratio, and increased gluconeogenesis.
- Fat metabolism is altered in favor of increasing lipolysis and lipid oxidation, resulting in hyperlipidemia.

- Protein catabolism and protein loss is accelerated.
- Micronutrient losses occur commonly, particularly with calcium, magnesium, zinc, thiamine, and Folate.
- Negative energy balance occurs due to reduce nutrient intake, and is associated with increasing mortality.

Nutritional management of pancreatitis has included pancreatic rest – the withholding of enteral nutrition in an effort to reduce pancreatic secretions, and the stimulus for ongoing release of pancreatic enzymes into the abdominal cavity. Traditional recommendations for nutrition of patients with pancreatitis have centered about providing parenteral nutrition. Parenteral nutrition in patients with pancreatitis produces longer hospital stays, higher rates of infections, and has been compared to giving no nutrition at all. The provision of parenteral nutrition in patients with pancreatitis has no benefit.
Provision of early enteral nutrition in patients with pancreatitis shortens hospital stay, results in lower incidence of sepsis and infection, and a more rapid resolution of elevated markers of inflammation. The optimal route for nutritional support in patients with pancreatitis is via the jejunum, followed by the duodenum, and the stomach. Nutritional support should begin within 12-24 hrs of presentation to the ICU.

Acute Renal Failure

Many patients with acute renal failure are hyper-catabolic, owing to concurrent disease processes, the loss of nutrients such as amino acids through diuresis and peritoneal dialysis. Protein loss may be significant in patients with acute renal failure who have sustained trauma, surgery, or burns or multisystem injury. Patients who are receiving peritoneal dialysis may lose between 1 and 4 grams of amino acids per day, and this needs to be replaced in the diet.
Patients in oliguric or anuric renal failure frequently have increased levels of potassium, phosphorus, and magnesium. Enteral diets containing relatively smaller amounts of fluid and electrolytes may be useful in these patients.

Lung Disease

Patients with pulmonary disease such as pneumonia, or chest wall disease, pulmonary contusions etc. or in patients with impaired respiratory function (such as those with tick paralysis and snake bite in Australia), the feeding of diets high in fat content liberate less carbon dioxide per kilocalorie of energy released from the diet, when compared to diets high in protein or carbohydrate. Following initiation of nutritional support with micro-enteral nutrition, and intestinal support diets, these patients may benefit from feeding a high fat diet, as because less carbon dioxide produced, the work of breathing is also reduced.

Feeding the Patient

Step 1: Micro-enteral Nutrition

Term micro-enteral nutrition was developed to define the delivery of small amounts of water, electrolytes, and readily absorbed nutrients (glucose, amino acids, and small peptides) directly to the gastrointestinal tract. These nutrients may be given as a bolus infusion every 1-2 hours or as a constant rate infusion directly into the esophagus and stomach, duodenum, or jejunum via a feeding tube. Why do we give micro-enteral nutrition? – To improve blood flow to the gut, improve gut function, and to improve the tolerance to more complex diets when we begin feeding them.

Protocol for Micro-enteral Nutrition

- Begin within 2-12 hours of admission to the hospital.
- Solution - lectade, vytrate, gastrolyte, OR 0.45% NaCl + 2.5% dextrose solution.
- Additives:
    - Potassium chloride- 20 mEq/L.
    - Amino acids - 3% amino-acid solution. Addition of amino acids promotes a protein-sparing effect in critically ill patients. Amino acids should not be supplemented in micro-enteral formulations for use in patients with pancreatitis.
    - Glycine hastens the resolution of diarrhea, improves intestinal morphologic characteristics in patients with diarrhea, and enhances the uptake of glucose.
    - Glutamine is the preferred energy source of rapidly dividing cells (GUT cells, lymphocytes, and fibroblasts). Glutamine plays a role in the maintenance of the integrity of the GI mucosal barrier and preventing bacterial translocation.
- Rate of administration:
    - CRI rate of 0.05 - 0.2 ml/kg/hr.
    - Bolus infusion of 1-4 ml/kg every 4 hours.
    - Increase volume administered 2-5 ml/kg/hr every 8-12 hours if patient is tolerating the solution.
- Begin feeding a commercial liquid diet if micro-enteral nutrition solution is being tolerated after 12-18 hours.

Step 2: The Nutrition Formula – Beyond Micro-enteral Nutrition

When formulating a diet for the patient, the following are taken into consideration:

Fluid Requirements - normal patient's fluid requirements are between 60 and 80 ml/kg/day. Frequently, in sick hospitalized patients, this requirement is being met by the use of intravenous fluid therapy. However, it is important to remember, especially during the phase of hospitalization when patients are being weaned from intravenous fluid therapy.

Energy Requirements - the energy requirements of critically ill animals and humans rarely approach normal maintenance requirements, due to a reduction in physical activity associated with illness. There are numerous methods and recommendations for estimating patient caloric needs during illness - none of which has been validated. Current practice is to feed critically ill patients between one and 1.4 times their resting energy requirements (RER)

RER = Bodyweight (kg) x 30 + 70 (dog > 2kg)
RER = Bodyweight (kg) x 70 (dog <2kg)
RER = Bodyweight (kg) x 40 (cat)
RER = Bodyweight (kg) $^{0.75}$

Protein Requirements - protein requirements during illness vary. Proteins are used for energy production, enzyme systems, wound healing, acute phase protein synthesis, and growth. Because utilization of proteins is not completely efficient, nitrogen is constantly being lost from the body. During states of anorexia, these losses are not replaced, leading to progressive protein and nitrogen malnutrition.

Current recommendations are as follows:

- Dogs - require in illness 16% dietary calories as protein (4g/100 kcal). Dogs with hepatic failure, or hepatic encephalopathy require 5-10% dietary calories as protein (1.5-2.5g/100 kcal).
- Cats - require in illness 24% dietary calories as protein (6g/100kcal).

Step 3: Feeding the Patient

Enteral feeding should be initiated within 12-24hrs of admission to the ICU. If oral feeding is not possible or feasible, a gastric feeding tube (nasogastric, oesophagostomy, or gastrostomy tube) should be placed. Feeding may be by bolus feeding, or by constant rate infusion. The residual gastric volume should be monitored, and the feeding regime adjusted as outlined below. In all cases, the target energy and protein requirements for the patient should be met by the third day of feeding. If the protein content cannot be obtained by this time, a diet containing higher protein content should be fed.

Bolus Feeding Protocol for Gastrostomy, Oesophagostomy, or Nasogastric Tubes

If patient has had prolonged anorexia (2-3 days) use the following feeding protocol:

- Day 1 = feed 1/4 - 1/3 of daily feed requirement in several small feeds
- Day 2 = feed 1/2 - 2/3 of daily feed requirements in several small feeds
- Day 3-4 = feed entire feed requirements in several small feeds

NB - if feeding via Gastrostomy tube, Oesophagostomy tube, or nasogastric tube, suction the tube first - if you suction a volume greater than 1/3 of the previous volume of feed given, delay the next feed for 2-3 hours, and feed 1/3 - 1/2 the volume of the last feed. Consider the presence of intestinal ileus, and manage with metoclopramide and/or butorphanol.

Note that following administration of the diet through the feeding tube, the tube MUST be flushed with between 5 and 20 ml of water (depending on the size of the patient, and the volume of the tube). This allows food to be flushed from the tube, which can help prevent food sediment from blocking the tube!

Continuous Feeding Schedule for Enterostomy Tubes

Determine ml of diet to administer over 24 hour period. Divide this number by 24 to determine the number of ml/hr
Day 1 = administer half of this volume; dilute the diet to half strength
Day 2 = administer at the required hourly rate, but keep diet at half strength
Day 3 = administer at required hourly rate, and use diet at full strength

Suction enterostomy tube every 4 hours - if the volume suctioned is less than twice the volume infused per hour (dog) or less than half the volume infused per hour (cats), and then continue feeding.

Care of the Feeding Tube

Feeding tubes require proper care if they are to remain patent, and in order to prevent infection from developing at the site of insertion. The following are a few brief guidelines for tube care:

1. Skin wound care
   a. For oesophagostomy, gastrostomy and Jejunostomy tubes, the skin should be well clipped and have received a surgical preparation prior to tube placement. Following tube placement, a clean, non-adherent contact bandage layer, such as Melolin or Allevyn should be placed around the tube insertion site. If desired, antiseptic ointment such as Silvazine (Smith and Nephew) or a wound gel such as Solosite (Smith and Nephew) can be placed about the tube insertion site through the skin, to maintain a moist wound environment underneath the contact bandage layer. The insertion site should then be wrapped circumferentially around the patient with a self-adhesive bandage such as vetrap (3M).
   b. The wound site should be unwrapped each day, and the skin wound evaluated and cleaned with sterile saline-soaked swabs, and the bandage re-applied as described above.
2. Preventing Tube Blockage
   a. Flush the tube with 1-5 ml water prior to food administration to ensure the tube is patent.
   b. At the conclusion of feeding, flush the tube with between 5 and 20 ml of water to flush food residue from the tube.
3. Checking Tube Placement
   a. Nasogastric and oesophagostomy tubes – these tubes, if placed in the oesophagus, can be regurgitated and aspirated in the airways (trachea and bronchi). Tube placement may be simply checked by aspirating with negative pressure using a syringe. If air is obtained in large volumes (greater than about 3-5 ml), the tube position is in doubt, and should be checked by radiographing the thorax.
   b. Gastrostomy tubes – these tubes sit in the stomach. If the tube is in the stomach, negative suction on the tube applied by a syringe should ALWAYS result in fluid or air draw-back into the syringe. If there is no air or fluid draw-back, the tube may have migrated out of the stomach. Feeding should not commence until tube placement has been confirmed with your veterinarian.
   c. Jejunostomy tubes – these tubes sit in the small intestine. If properly placed, they seldom migrate. However, application of negative pressure on the tube using a 3 ml syringe should result in a small amount (perhaps less than 0.5 ml) fluid being withdrawn. Again, if no negative suction is obtained, the tube should be evaluated with your veterinarian before feeding continues.

Conclusion

Nearly every major study conducted in human and veterinary literature supports the importance of beginning early nutritional support in hospitalized patients, regardless of their illness. The most important things to remember about nutritional support are firstly, to begin nutritional support early, using micro-enteral nutrition, and to follow this up with the feeding of a diet that is appropriate to the animals' condition, beginning with small volumes, increasing to meet the animal's dietary requirements within 3 days of hospitalization. Failure to attempt to do these things results in poorer outcomes for the patient. In addition, pharmacological and fluid support of the gut will improve tolerance to feeding, and improve patient comfort.