Malnutrition probably occurs quite commonly among canine and feline patients with critical illness. Food intake in these animals is often marginal. Canine trauma patients allowed free access to food consumed only one-third the amount consumed by similar patients that were actively encouraged to eat or were hand-fed. Additionally, the physiologic responses to stress and illness may alter nutrient requirements and patterns of fuel utilization.

The normal physiologic responses to starvation, including a shift in substrate utilization and decreased basal metabolism and protein turnover, are significantly compromised when severe trauma or sepsis are present. The response to significant injury involves an early hypermetabolic or "ebb" phase followed by a hypermetabolic "flow" phase. A patient without adequate food intake during the hypermetabolic flow phase likely will experience significant catabolism of body energy and protein reserves, as these are used to provide substrates for stress-induced metabolic processes and to permit healing. It has been suggested, with some support, that at least a portion of the hypermetabolic response is secondary to effects of bacterial translocation and enteral stimulation of the enteroendocrine system. Protecting the gut from atrophy by early enteral feeding after injury helps to decrease both bacterial translocation and the hypermetabolic response.

Protein-energy malnutrition, which results from inadequate intake of protein and calories, can be detected in up to 58% of hospitalized human patients. The frequency may be comparable among critically ill veterinary patients. Severely stressed or injured patients have a relative increase in metabolic rate that is proportional to the severity of their injury. Nitrogen losses are also increased. Fasted dogs hospitalized in an intensive care unit catabolized over 200 grams of lean tissue per day, equivalent to approximately 5 g protein/kg "body weight."

Healthy fasted dogs lost only about 2.6 g protein/kg "body weight per day." High protein intake is necessary to offset the deficit observed in catabolic patients, and it has been suggested that critically ill dogs and cats should receive up to 50% of their total daily calories as protein. The increased need for both amino acids and glucose causes lean body mass to be catabolized at an increased rate. When prolonged catabolism occurs without adequate nutritional support, cardiac, pulmonary, gastrointestinal and immune functions all may be seriously compromised. Regardless of the primary disease process involved, protein-energy malnutrition results in debilitation and eventual death if exogenous nutrients are not provided. Thus, appropriate nutritional support is critical during this time.

Delivering Nutrients: Enteral or Parenteral?

It is obvious that hospitalized patients should receive appropriate nutrition. However, the best route of delivery will depend on the patient's condition and other factors. As previously described, voluntary food intake is reduced in injured patients. Thus, food intake and body weight should be monitored regularly. Patients for whom oral feeding is not contraindicated may respond to or staff encouragement for food intake. When oral intake is inadequate, enteral or parenteral nutritional support should be provided.

Whenever possible, enteral feeding is the preferred route. Enteral feeding is the most physiologic and helps maintain the viability of the gastrointestinal mucosa, discouraging bacterial translocation and reducing infection rates. A word of caution, however. Before initiating any type of oral or enteral nutritional support, it is critical that the animal be properly hydrated and have stable gastrointestinal perfusion. Intestinal hyperperfusion or hypoperfusion can contribute to breakdown in the gut barrier. Feeding stimulates blood flow to the intestine, which could contribute to superinfection injury in a hypovolemic gut. This circumstance can increase the risk for bacterial translocation and septicaemia.

Options for feeding tubes include naso-esophageal, naso-gastric, gastrostomy, jejunostomy, gastrojejunostomy, and, most recently, nasogastric (see the table "Indications for Use of Feeding Tubes," on page 2). Noninvasive nasogastric tubes are the simplest and least invasive to place, requiring no anesthetic other than a drop of lidocaine or similar topical anesthetic. With a little practice, naso-esophageal or gastrostomy tubes can quickly be placed percutaneously, with or without the use of endoscopy. Jejunostomy tubes may be placed surgically, or endoscopically, through a gastrostomy tube. The appropriate selection depends on the site of injury, the status of the patient, the expected delay until oral intake can be resumed, and other factors.

An interesting new approach to the placement of feeding tubes is using magnetic guidance to direct the tube. Using a specially designed tube (Alert Laboratories, Columbus, OH) with a small magnet in the tip, an external hand-held magnet is used to guide the nasointestinal tube through the stomach to the jejunum. This procedure proved highly effective in human subjects under investigation, with 88% of the tubes successfully passed into the small intestine in two separate studies. Once the tube was mastered, it could be performed in awake human patients in about 15 minutes.

References

When oral intake is inadequate, enteral or parenteral nutritional support should be provided.
If enteral feeding is not a viable option, parenteral nutrition should be considered. Total parenteral nutrition (TPN) also involves administering a solution of glucose and amino acids, with or without lipids, via a central venous catheter. However, a recent review of long-term extensive TPN use, as PPN uses solutions of lower osmolality that can be administered through peripheral veins. While it does not provide all calories needed for the parent patient, PPN can reduce the catastrophic effects of malnutrition through parenteral feeding regimens.10,11 TPN solution must contain amino acids. While glucose solutions may provide a small level of protection against protein catabolism, this effect was not noted in otherwise healthy dogs after 4 to 8 days fast.12 However, an infusion of amino acids preserved muscle and protein stores.

An infusion of amino acids preserves whole body and protein stores. All amino acids are essential, meaning they cannot be synthesized by the body and must be provided in the diet. Some essential amino acids are particularly important for recovery from illness or surgery and are often referred to as ‘amino acids of clinical importance’. These include: lysine, tryptophan, threonine, and valine. These amino acids are essential in protein synthesis and support immune function. Threonine and valine are particularly important for tissue repair and recovery during illness. Amino acids not considered essential in the diet are referred to as non-essential amino acids. These are also necessary for proper nutrition, but the body can synthesize them from other amino acids or non-protein sources.

Table 1. Type of Tube Placement

<table>
<thead>
<tr>
<th>Type of Tube Placement</th>
<th>Indications</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nasogastric (NG)</td>
<td>Short-term (≤ 24h) support</td>
<td>Simple placement using small bore tubes</td>
<td>Risk of aspiration, increased risk of infection</td>
</tr>
<tr>
<td>Endotracheal (ET)</td>
<td>Intermediate (1 – 3 days) support with normal GI function</td>
<td>Rapid placement, access to stomach</td>
<td>Risk of trauma, increased risk of aspiration</td>
</tr>
<tr>
<td>Gastrostomy (GS)</td>
<td>Long term (≥ 1 week) support with normal GI function</td>
<td>Long duration of support, reduced risk of aspiration</td>
<td>Risk of complication, increased risk of infection</td>
</tr>
<tr>
<td>Jejunostomy (J)</td>
<td>Short- to long-term nutritional support with partial enteral or parental support</td>
<td>Reduced risk of aspiration and reduced risk of infection</td>
<td>Risk of injury, reduced access to stomach</td>
</tr>
<tr>
<td>Enteral/Perineal (EP)</td>
<td>Short- to long-term nutritional support for patients with partially or completely obstructed proximal GI tract</td>
<td>Limited access to stomach, increased risk of infection</td>
<td>Risk of injury, reduced access to stomach</td>
</tr>
<tr>
<td>Intersurgical (IS)</td>
<td>Short- to long-term nutritional support for patients with advanced cancer or multiple GI or systemic disorders</td>
<td>Limited access to stomach, increased risk of infection</td>
<td>Risk of injury, reduced access to stomach</td>
</tr>
</tbody>
</table>

Intravenous (IV) feeding is a form of parenteral nutrition that involves administering a solution of glucose and amino acids, with or without lipids, via a central venous catheter. However, a recent review of long-term extensive TPN use, as PPN uses solutions of lower osmolality that can be administered through peripheral veins. While it does not provide all calories needed for the parent patient, PPN can reduce the catastrophic effects of malnutrition through parenteral feeding regimens.10,11 TPN solution must contain amino acids. While glucose solutions may provide a small level of protection against protein catabolism, this effect was not noted in otherwise healthy dogs after 4 to 8 days fast.12 However, an infusion of amino acids preserved muscle and protein stores.

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