Nutritional Support: Tubes, Tubes, Tubes

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Why is nutrition support important in the critically ill or injured patient?
Adequate nutrient intake is necessary to provide energy for cellular function, substrates for protein synthesis and, vitamins and minerals for daily metabolic processes and maintenance of homeostasis. Hypermetabolism is characteristic of the acute illness or injury and a catabolic state rapidly develops. Anorexia associated with severe injury or sepsis has been shown to lead to: glycogen depletion within 8 to 12 hours leading to muscle weakness, substantially decreased fibronectin levels within 48 hours of anorexia contributing to immune dysfunction, and decreased protein synthesis. The deleterious effects of malnutrition are more pronounced in the acutely ill or injured patient due to the higher metabolic rate necessary to increase liver and immune function as well as provide substrates for wound healing. Experimental and clinical research has emphasized the importance of beginning enteral nutritional support as early as possible to prevent immune system depression, serum albumin decreases, muscle weakness, bacterial translocation, infection, major organ failure, and death.

How do I decide to feed enterally or parenterally?
Enteral feeding is preferred over parenteral feeding whenever possible as it is more physiologic. It is also less expensive than total parenteral nutrition and it avoids the risk of catheter-related sepsis. When compared with total parenteral nutrition, enteral feeding has been shown to maintain gut mucosal integrity thus decreasing bacterial translocation, improve lymphocyte function, improve wound healing and improve survival from peritonitis. The adage of "if the gut works use it" should be followed as much as possible. During severe injury or infection gut perfusion may be inadequate and the gut mucosal barrier may become compromised leading to bacterial translocation. Lack of luminal nutrients leads to mucosal atrophy and destruction of the gut barrier. Early enteral feeding has been found to blunt the release of stress hormones thus reducing the elevation in metabolic rate. Parenteral nutrition should only be used if the gut is not accessible or is not functioning adequately. This includes patients with GI obstruction, peritonitis, intractable vomiting, acute pancreatitis, short bowel syndrome and ileus. Parenteral therapy has no beneficial effects on the course of inflammatory bowel disease or pancreatitis and enteral feeding should be considered as a first line of therapy.

What is meant by parenteral nutrition and how is it administered?
Parenteral nutrition is comprised of total parenteral nutrition (TPN) and partial parenteral nutrition (PPN). PPN provides a 3% amino acid solution and is usually supplemented with carbohydrate source (glycerol, dextrose) to prevent all the amino acids from being used as a glucose source. It may also contain lipid.It should be kept in mind that amino acids and glycerol are bacteriostatic, but lipid and dextrose are not. TPN provides amino acids, glucose and fat. Both solutions can be given by peripheral intravenous lines; however, central lines are preferred for TPN and in both cases lines should be kept dedicated.

What are the disadvantages to TPN?
Complications of TPN include catheter-related sepsis, metabolic abnormalities and gut atrophy. Hepatic cholestasis also occurs as does pancreatic atrophy. Parenteral feeding is associated with higher rates of mortality in infected animals, and higher rates of sepsis in human trauma patients than those fed enterally.

Why should a feeding tube be placed?
Many ill or injured patients are unwilling or unable to eat; yet the gastrointestinal tract is still able to digest and absorb nutrients. By providing a more palatable diet, the anorectic animal may be encouraged to eat. By utilizing tube feeding the problems associated with anorexia can be avoided.

What types of tubes exist?
Tube enteral nutrition in the ICU is provided primarily via nasoesophageal, nasogastric, esophagostomy, and gastrostomy tubes. Nasal tubes can be placed under local anesthesia. Occasionally mild sedation will be required. All other tubes require general anesthesia.

What are these feeding tubes used for?
In general the tubes are used for enteral feeding but they can be used to deliver electrolyte infusions and water. Radiographs should always be taken of nasal and esophageal tubes to confirm their location prior to use. All tubes can be used for suctioning, which is important in the immediate postoperative period to remove gas and fluid from the esophagus and stomach to help prevent ileus. Decompression is also essential in conditions such as acute megaesophagus and post gastric dilatation-volvulus surgery. Suction can be done intermittently with a syringe or continuously with a thermotic pump. Radiographs are also recommended if the animal vomits, if the tube appears obstructed, or if suctioning is producing much lower volumes of gas or air than expected.

How do I decide what kind of tube to place?
Often the type of tube placed is determined by the patient's underlying disease, whether or not anesthesia is an option and whether or not abdominal surgery is being performed. Nasal tubes are typically used for short term feeding. Esophagostomy tubes are used for long term feeding. In the author's opinion gastrostomy tubes have no benefit over esophagostomy tubes except in rare situations and they have the potential to lead to lifethreatening complications.

How do I take care of these tubes?
All ostomy and incision sites must be examined on a daily basis while the patient is in hospital. Any dressing must be changed as soon as it gets wet and a minimum of every 72 hours. If the bandage is still clean and dry this can be done through a window cut in the bandage - creating a 'trap door' that can be replaced when the old dressing is removed. When removing the bandage it is extremely easy to cut the tube, therefore the bandage should be removed slowly and layer by layer. An indelible marker can be used on the bandage to denote the approximate location of the tube to facilitate removal of the dressing. In general the tube should be looped up over the back of the patient, taking care not to kink the tube at the ostomy site. If a small bore tube is cut it can often be salvaged by placing a hypodermic needle into the cut end after using hemostats or needle holders to break off the needle tip with a bending motion. The needle is taped carefully into the tube and an extension set attached to the hub.

The ostomy site should be cleaned with an antibacterial solution and examined closely for signs of discharge or inflammation. The area around the tube should be thoroughly palpated to check for any signs of swelling or crepitus. Antibacterial ointment should be placed over the ostomy site and the bandage replaced.

When do feedings start?
Early enteral feeding has been shown to be very beneficial in the trauma patient and should start as soon as the patient is resuscitated. The patient should have full control of its airway before feeding is started. Feeding into the stomach should be done cautiously postoperatively as gastric motility often does not return to normal for at least 1-2 days.

What should I feed?
Only liquid diets can be fed through small bore tubes (less than approximately 10 French). Blenderized canned foods can be fed through larger bore tubes; however, it is recommended that liquid be used initially until it has been determined that the patient is tolerating the food. The choice of diet may depend on the patient's underlying disease but in most cases feeding the patient is more important than what is being fed.

How fast should the liquid be delivered?
Initially the delivery rate should be 0.1-0.25 ml/kg/hr. This can be used in all patients including those who have had gastrointestinal surgery. These rates may even be too fast for those patients who have had massive bowel resection, pancreatitis or prolonged anorexia. If the patient is tolerating the rate of delivery the rate can be increased as frequently as every 12 hours by increments of 30% until 100% of the required volume is being delivered. Rates should be increased no faster than every 24 hours in patients with a history of prolonged anorexia or severe bowel disease. The volume of feeding required is calculated using the basal energy requirement (BER) in kcal for the weight of the animal and knowledge of the caloric density of the food. A commonly used linear formula for BER for adult dogs is 30 x kg + 70. BER does not need to be multiplied by stress factors as this is more likely to lead to overfeeding in animals in a cage. Overfeeding has been shown to have more negative consequences than permissive underfeeding. Intravenous fluid rates should be decreased in proportion to the amount being delivered enterally. Cats often will not tolerate greater than 20 ml/kg per feeding when being fed intragastrically.

What are the exceptions to the above delivery rates?
If a patient has been anorectic for longer than a few days the lower rate of 0.1 ml/kg/hr may be better tolerated as the stomach, duodenal and pancreatic atrophy that may have occurred during this time can be significant. The atrophy is associated with down regulation of the digestive enzyme systems and decreased absorptive surface area in the small intestine. The length of time the bowel takes to return to normal will vary depending on how long the patient has been anorectic. If a large percentage of the small bowel (generally greater than 80% of the small intestine) was removed at surgery the animal may suffer from "short bowel syndrome" and increases in rates may need to be adjusted even further as the absorptive surface area will have been significantly reduced.

What about microenteral nutrition?
Microenteral nutrition is the delivery of small amounts of 0.1 to 0.25 ml/kg/hr of a glucose and electrolyte solution into the gut. This is provided for the patient who is fairly intolerant of oral nutrition e.g. the vomiting patient who is continuing to vomit intermittently, pancreatitis patients who are no longer vomiting, the patient with severe esophageal injury and patients with short bowel syndrome. This form of nutritional support will hopefully help 'feed the gut", and "wake it up" functionally and help prevent further down regulation of the enzyme systems.

What do I feed?
Both monomeric and polymeric diets are used. Monomeric diets are elemental diets that require no digestion prior to absorption. These include amino acid diets and peptide based diets. Amino acid-based diets require active absorptive processes whereas di- and tri-peptide-based diets can be passively absorbed and are preferred. In general monomeric diets are reserved for patients who have had large amounts of their bowel removed, have malabsorptive or maldigestive problems or have pancreatitis. In all other patients polymeric diets should be able to be used. These are also less expensive and generally have a much better taste if forced oral feedings are used.

What concentration of diet should be delivered?
If the gastrointestinal tract is functioning then full strength polymeric diets should be tolerated right from the start. In the case of GI dysfunction, short bowel syndrome or pancreatitis, polymeric diets at 30-50% concentration or elemental diets should be used. In these cases the osmolality should not be greater than 300 mOsm. If there is serious concern regarding GI function, enteral administration of water, glucose and electrolyte-based oral rehydrating solutions or intravenous fluid solutions can be used. If there are problems maintaining an intravenous catheter an enteral feeding tube can be used to deliver replacement or maintenance crystalloid solutions. If a diluted diet is being used the concentration of the diet should not be increased until full volumes (see under delivery rate) are being delivered.

Note: In some cases the patient may be volume restricted and more concentrated diets may be required i.e. cardiac cachexia, chronic starvation. In these patients administration of full volumes may either never be possible or may

take more than a few days to achieve. Special attention should be paid to fluid balance in these patients.

What should I use to dilute the diet?
Water should be used to dilute the diet unless there is a specific reason for using another fluid.

How do I deliver the feedings?
All diets should be fed at room temperature. Most patients tolerate a constant rate infusion much better than bolus feedings. Constant rate infusions may alter homeostasis and fuel use as it does not allow for the normal cascade and feedback mechanisms to occur. Enteral feeding pumps are available although some of the diets can also be given via the regular fluid infusion pumps. If a diet is being delivered as a constant rate infusion no more than eight hours of diet is hung at any one time. All patients should have their tubes flushed with 2 to 5 ml of warm water (depending on the size of the tube) every 6 hours. If the patient is going to be tube fed at home a gradual switch to bolus feedings must be done, ideally over a period of 2 to 3 days. The first day the hourly feedings are delivered over 5 minutes. If this is being tolerated then the amount of the feeding can be doubled in 12 hours and the feeding given every 2 hours. The second day the amount is increased and the frequency decreased to every 3 to 4 hours. (Due to volume restrictions it is rare to be able to deliver the required number of calories in fewer than 6 to 8 feedings per day if total caloric requirements are being met by tubes requiring liquid diets.) Bolus feedings should always be given over at least 5 minutes. After a bolus feeding an attempt should be made to hold a column of water in the tube. This is done by flushing the tube and clamping the tube by kinking it prior to removing the syringe. The syringe is removed and the cap placed prior to unkinking the tube. Hypodermic needle caps make excellent caps for most larger bore feeding tubes.

How do I tell if the diet is not being tolerated?
If the patient starts coughing discontinue feeding, administer oxygen if required and take a chest radiograph. The patient may show signs of abdominal discomfort, nausea, hypersalivation, vomiting or diarrhea. On occasion gastric feedings will reflux into the esophagus and jejunal feedings will reflux into the stomach and be subsequently vomited. Gastrointestinal motility modifying drugs may be required (i.e., metoclopramide). If none of these signs discussed is observed then the patient is believed to be tolerating the administration well.

What about enteral feeding in the face of pancreatitis?
Traditionally TPN was used for feeding patients with pancreatitis. A number of studies have looked at enteral feeding in the face of pancreatitis and have shown that outcome is improved as long as the feeding is tolerated. The presence or absence of ileus is a good predictor of tolerance for enteral nutrition.

What are the complications and how do I prevent them?
1. Kinking: This usually only happens with small diameter tubes and is the first thing that should be checked if the feeding solution is not flowing. Careful looping of the tube when bandaging usually prevents this problem. On occasion suture material is tightened too much around the tube creating an obstruction.

2. Clogging: When blenderizing diets the consistency should flush easily through a tube of similar diameter. All tubes being used for continuous rate infusions should be flushed every 6 hours with warm water to prevent buildup of the diet on the sides of the tube. If clogging does occur tubes can be usually be unclogged using water, Diet Coke, or meat tenderizer. A tube declogger is available commercially. Flushing with small syringes (tuberculin) builds up higher pressure than larger syringes and is usually more successful. On rare occasions the passage of an angiographic wire down the lumen is needed to unclog the tube. If infusion of the diet is still not possible radiographs should be taken to check for internal kinking of the tube.

3. Infection: Signs of inflammation with or without discharge or fever may indicate an early wound infection. This must be differentiated from fasciitis since a simple wound infection can usually be treated locally with gentle cleaning with an antibacterial solution, use of topical antibacterial ointments and more frequent dressing changes. The application of warm compresses three times daily may also be recommended. The systemic administration of

antibiotics should be reserved for patients with systemic signs of infection.

4. Necrotizing fasciitis: This potentially fatal complication, where the bacterial infection travels along fascial planes, is possible with any of the surgically placed gastric or jejunal tubes. Early warning signs include swelling and inflammation around the tube and in dependent areas near the tube, fluid or crepitus under the skin, and fever with no identifiable source. Fasciitis requires immediate aggressive surgical debridement. The condition should be considered to be similar to gas gangrene and treated appropriately.

5. Tube dislodgement: This is most common with nasal tubes. An Elizabethan collar may be required. Nasal or esophageal tubes that pass through the lower esophageal sphincter in cats are more likely to trigger vomiting and should be backed out to just caudal to the base of the heart (about the ninth intercostal space.) Surgically placed tubes should be covered with a light bandage to prevent the animal from scratching or chewing at the tube. Gastric tubes that are dislodged prior to a seal forming at the ostomy site can cause peritonitis. If this occurs the possibility of peritonitis should be aggressively investigated.

6. Metabolic complications: Disorders of electrolytes and glucose are possible - these parameters should be monitored daily while the patient is stabilizing.

7. Aspiration: This is the most common complication in humans being fed into the stomach; the incidence in animals is unknown. The aspiration is often silent, in other words, the event cannot be detected by simple observation. Signs of possible aspiration include moist lung sounds, areas of dullness on auscultation or percussion of the lungs, coughing or fever. Feeding should be discontinued, oxygen given as required and chest radiographs taken.

8. Vomiting: This can occur with any of the tubes and can be related to the placement of the tube, the feeding process, or the underlying disease. Nasal and esophageal tubes should not pass into the stomach unless specifically indicate. Diets should be fed at room temperature and should not be given too rapidly. If the underlying disease if the problem antiemetics may be required.

9. Diarrhea: Studies in human medicine have shown diarrhea to be a major complication often necessitating discontinuing enteral feedings. Diarrhea is usually defined as the presence of 3 or more liquid bowel movements per day. The incidence of diarrhea in human patients is decreased if the diet fed is isotonic, lactose free and is delivered by a constant infusion rather than bolus feedings. Feeding through acute diarrhea in people has shown better maintenance of mucosal barrier. Rice based oral rehydration solutions decrease stool volume relative to glucose based oral rehydration solutions as the glucose and peptides in rice provide the substrates for electrolyte pumps thus improving water absorption. The true incidence of diarrhea in veterinary patients is unknown.

10. Refeeding syndrome: The refeeding syndrome is usually thought of as the severe hypophosphatemia and its associated complications that occurs in malnourished patients receiving aggressive nutritional support. It is characterized by acute cardiopulmonary decompensation leading to death. Refeeding leads to fluid retention, increases in heart rate and blood pressure and oxygen consumption that may cause the demands on the heart to exceed supply, increased carbon dioxide production leading to respiratory distress, Central nervous system dysfunction including seizures, diarrhea, red blood cell dysfunction and leukocyte dysfunction. The rapid hypophosphatemia is in response to a rapid intracellular shift due to the demands for phosphorylated compounds and increased insulin activity, which promotes uptake of phosphorus.

Remember no critical animal has ever benefited from acute malnutrition - only the opposite - therefore, feed early, and increase gradually, and most nutritionally related complications will be avoided.

References available on request.