FEEDING TUBES FOR ENTERAL NUTRITION

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Metabolism of the Traumatized Patient

Tissue trauma, sepsis, burns and major surgery all induce major metabolic changes within the small animal patient. With each of these stresses the animal’s basic metabolic rate is accelerated and protein catabolism occurs leading to a potential state of negative nitrogen balance. The metabolic response to injury is an adaptive mechanism whereby the body mobilizes and accelerates immune defense and wound repair mechanisms in the face of little or no nutritional intake. This metabolic response to injury is in contrast to starvation whereby the body lowers its metabolic rate and nitrogen loss to conserve body resources. Protein-calorie malnutrition (PCM) occurs when the metabolic response to injury becomes prolonged due to the severity of the injury or because of a hypermetabolic state such as that caused by sepsis. When protein-calorie malnutrition is present cell mediated immunity is impaired, there is a higher risk of infection, wound healing may be impaired, anemia and hypoproteinemia may occur, generalized muscle weakness may be present and multiple organ dysfunction leading to death may occur. It may take only 5-10 days of anorexia to compromise the immune system and deplete the body’s muscular glycogen stores. Without adequate nutrition, during this period humoral and cellular immunodeficiency occurs and animals frequently die despite the use of aggressive antibiotic therapy.

Most anorexic animals that are too weak or sick to eat still have a GI tract which is capable of sufficient digestion and absorption of nutrients. This is especially true in the small intestine. Enteral alimentation offers the clinician an alternative to parenteral (intravenous) nutrition when normal ingestion of food is not possible. Enteral nutrition is both practical and easy to perform and not fraught with the expense and serious complications often seen with parenteral nutrition. The goal of enteral alimentation is to provide calories and protein sufficient to achieve a positive calorie and nitrogen balance in a safe and convenient manner.

Indications

Enteral feeding is indicated in those patients where anorexia is present and evidence of protein energy malnutrition is present prior to surgery. In animals where the stomach is functioning, feeding can be accomplished through the use of nasogastric, esophagostomy, pharyngostomy, or gastrostomy tubes. Nasogastric tubes are small bore (3.5-8 Fr) usually necessitating a liquid diet whereas esophagus or gastrostomy tubes are often larger (14-20 Fr) and a blended gruel of the animal's regular food can often be fed through the tube. It is, however, important to strain the food prior to injecting it, since one small clump of food may plug the system. With the pharyngostomy or gastric tube the animal's daily caloric needs can usually be met by dividing the feedings into 2-6 hour intervals. It is especially important to feed slowly through a pharyngostomy tube, since the possibility for regurgitation and aspiration does exist. In those patients where the stomach is not functioning or needs to be
bypassed after surgery, the use of enterostomy tubes or needle catheter jejunostomy is an effective way of feeding. Fluids, electrolytes and oral medications can also be administered through these tubes if necessary.

Placement of enterostomy catheters should be considered in those patients 1) that have an acute weight loss of 10% BW or chronic weight loss of 15-20% BW, 2) are hypoproteinemic, 3) are septic, 4) in gastric or pyloric resections, 5) in extra hepatic biliary diversions, 6) in multiple enterotomy or massive intestinal resections, 7) in any condition where chronic cachexia may adversely affect wound healing or 8) animals with unresponsive pancreatitis. Studies show that immunocompetence returns within as little as 48 hours after hyperalimentation. If the surgeon anticipates that oral feeding might be delayed or that hypermetabolic complications might be present, the tube should be placed at the time of surgery. These tubes are easily removed but difficult to place after surgery.

Surgical Techniques

Nasoesophageal Tube - This method of feeding is commonly used in cats and will also be tolerated by dogs. Lidocaine 2% is instilled down the nostril and a lubricated 3.5-5.0 Fr (cats) or 8 Fr (dogs) polyvinyl feeding tube is passed in a ventromedial direction through the ventral meatus of the nose. The tip of the tube is passed into the distal esophagus. Passage into the stomach may result in reflux esophagitis. Radiographs can be taken to determine the tube location. The end of the tube is then affixed to the cat's face with sutures. An Elizabethan collar is applied. The tube is capped. Feeding can be performed through intermittent bolus injections of 10/ml/kg or using a slow infusion of 2-4 mg/kg/hr.

Pharyngostomy Tube - The original technique suggested that the tube be placed rostral to the hyoid apparatus but aspiration pneumonia and airway obstruction resulted because of interference with the glottis, particularly in cats. Now it is recommended that the tube be introduced distal to the hyoid apparatus. A 10-16 Fr tube can be used in cats and a 16-24 Fr tube for dogs. Recently pharyngostomy tubes have fallen out of favor because of more complications in comparison to esophagostomy tubes.

Esophagostomy Tube - This method has been recently described and apparently eliminates much of the potential for airway obstruction and aspiration pneumonia. The tube is inserted using a curved Carmalt or Mixter right angle forceps. The forceps are advanced 3-4 cm past the larynx and then a stab incision is made over the intranasal. The tip of the catheter is then advanced into the lumen of the esophagus and either normograded directly down the esophagus or pulled back into the mouth, reversed and then inserted down the esophagus. The tube should be premeasured up to the level of the 10th rib to make sure it does not enter the stomach. A 14-16 Fr catheter is commonly used in cats and 18-20 Fr for dogs.

Gastrostomy Tubes can be placed through an open operative technique or via a percutaneous technique using either an endoscope (PEG tube) or nonendoscopic method using an Eld cannula (PNG tube). With the open technique a ventral midline approach is made and the stomach is exteriorized. A double pursestring suture is placed and a 16-22 Fr Foley catheter is introduced through the left flank and placed into the stomach lumen. The pursestring sutures are tightened and invert the stomach around the tube. Four simple interrupted preplaced sutures are used to draw the stomach to the oblique muscles and the balloon is inflated. With slight traction on the catheter, the sutures are tied. Omentum is wrapped around the gastrostomy site. The subcutis and skin are closed and the catheter is fixed to the skin using a Chinese finger snare suture.

With the percutaneous endoscopic gastrostomy (PEG) the patient is positioned with the left side up and the stomach is insufflated. A Bard or Pezar mushroom-tipped catheter is drawn "inside-out" by tying it to a piece of suture material which has been passed into the stomach
lumen percutaneously through an IV catheter and retrieved using an endoscope. Traction is placed on the catheter to keep the stomach wall against the peritoneum and prevent leakage. With the percutaneous nonendoscopic gastrostomy an Eld cannula is inserted through the oral cavity and into the stomach. The curved portion of the cannula is tipped up against the left body wall behind the 13th rib and the sharp stylet is pushed through the stomach and body wall. A piece of suture material is tied through the hole in the stylet and the cannula is retrieved out through the oral cavity. The mushroom catheter is then affixed to the suture and the remainder of the procedure is exactly like the PEG tube placement.

**Low Profile Gastrostomy Button**

Some patients require long-term or even permanent gastrotomy tube placement for conditions such as esophageal neoplasia, strictures, megaesophagus or as an aid to malnutrition caused by cancer or chronic renal failure. These patients may benefit greatly from the use of commercial low profile feeding devices such as the Passport (Passport-Wilson-Cook Medical, Winston Salem, NC 27105 (800-245-4717)) or Surgitek One Step Button (One Step - Surgitek - Racine, WI 53404 (800-558-9494)). The Passport button has a one way valve that is convenient to use. It is made to be used as a replacement unit for a standard mushroom catheter. When the old mushroom catheter is pulled, the new unit is put in its place by merely collapsing the mushroom of the new unit with a stylet and gently inserting it into the old stoma. The one step button is placed exactly like a mushroom PEG tube, but once the unit is in place an outer wrapper comes off the guide tube and two side flanges, one with an attached stopper plug is left. The disadvantage of the Surgitek button is there is no valve and food spillage is more common.

**Jejunostomy Tube**

A loop of distal duodenum or proximal jejunum distal to the surgery site is isolated and a pursestring suture using 3-0 or 4-0 suture material is placed on the antimesenteric border. A commercially available jejunostomy tube, a 3-5 Fr vinyl feeding tube (introduced through a 12-14 gauge needle) or a 16 gauge through the needle polyvinyl catheter (Intra Cath, CR Bard Inc.) is passed through the abdominal wall 4-5 cm from the midline. The needle is then inserted through the intestinal pursestring suture and tunneled subserosally 1-2 cm before entering the intestinal lumen. The catheter is advanced aborally in the lumen for a distance of 20-25 cm, the needle is withdrawn, and the pursestring suture tied. The enterostomy site is then fixed to the abdominal wall using 4-6 preplaced sutures or a simple continuous pattern of 4-0 monofilament suture material. The catheter is then fixed to the skin using a finger trap suture or tape. An extension tube is attached and abdominal dressings are applied.

**Caloric Requirements**

The following chart describes the formula used by the author for estimating caloric needs. It must be remembered that basal caloric requirements increase by 50-150% depending on the degree of hypermetabolism.

**Caloric Needs Estimation Chart**

<table>
<thead>
<tr>
<th></th>
<th>Basal Needs</th>
<th>Major Surgery</th>
<th>Polytrauma/Burns-/Sepsis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cat</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-10 kg Dog</td>
<td>75 kcal/kg</td>
<td>110 kcal/kg</td>
<td>150-190 kcal/kg</td>
</tr>
<tr>
<td>10-20 kg Dog</td>
<td>70-80 kcal/kg</td>
<td>100-120 kcal/kg</td>
<td>160-200 kcal/kg</td>
</tr>
<tr>
<td>&gt; 20 kg Dog</td>
<td>60-70 kcal/kg</td>
<td>90-110 kcal/kg</td>
<td>140-180 kcal/kg</td>
</tr>
<tr>
<td></td>
<td>50-60 kcal/kg</td>
<td>75-90 kcal/kg</td>
<td>120-160 kcal/kg</td>
</tr>
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</table>
Protein requirements are estimated at 4.4-8.8 gm/kg BW for dogs and are probably slightly higher for cats. The protein content of most commercial liquid diets ranges from 16-20%. This is based on a current recommendation for people that 16% of available calories be provided by protein. This value is probably lower than ideal for use in dogs and cats.

**Diets**

There are two basic types of diets available for enteral tube feeding, polymeric and monomeric. **Polymeric** diets are composed primarily of polypeptides and polysaccharides (starches). They require digestion as well as absorption. The advantage of these diets is that they have low osmolality (350-450 mOsm/L) and therefore are less likely to promote osmotic diarrhea. Polymeric diets are cost effective and are good for use in most standard enteral hyperalimentation regimes. Polymeric diets used at the University of Florida include Isocal (Mead Johnson), Ensure (Ross Labs) and Pulmocare (Ross Labs). These diets have low osmolality and contain approximately 16% protein. Ensure and Isocal has a caloric density of 1 Kcal/ml while Pulmocare has a density of 1.5 Kcal/ml. Diet higher in protein are the Clinicare Diets produced by Ag Vet. These liquid diets are specifically formulated for dog (24%) and cat (28%) protein needs.

**Monomeric** are elemental diets composed of amino acids and monosaccharides with a minimal amount of fat content. The diets require minimal to no digestion and are absorbed over as little as 100 cm of bowel. They are hypoallergenic and have a low residue. Unfortunately, they are hyperosmolar (600-800 mOsm/L) and often cause diarrhea. Additionally they are relatively expensive. Monomeric diets are usually reserved for use in patients with significant intestinal tract disease. They are indicated for use in malabsorption syndromes or when short bowel disease is present. Examples of monomeric diets are Vital (Ross Labs) and Vivonex (Norwich Eaton). These diets are approximately 16% protein and have a caloric density of 1 Kcal/ml.

**Administration and Complications**

With esophagostomy or gastrostomy tubes feed no more than 30 ml/kg of body weight with each feeding. The liquid diets can be divided and injected in bolus form every 6 hours or they can be given at a slow continuous infusion of 5-10 ml/kg/hr. The main complications associated with enteral hyper alimentation are osmotic diarrhea and hyperglycemia. Osmotic diarrhea can usually be avoided by diluting the liquid diet with water by 50% on the first day and feeding only 2 the calculated volume. The concentrations and volumes are then gradually increased to that by day 4 or 5 the concentrated diet at full volume can be fed. Hyperglycemia can often be controlled by slowing the diet administration rate.

An example of a starting regimen may be as follows:

<table>
<thead>
<tr>
<th>Day</th>
<th>Volume</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>2</td>
<td>75%</td>
<td>50%</td>
</tr>
<tr>
<td>3</td>
<td>75%</td>
<td>75%</td>
</tr>
<tr>
<td>4</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Contraindications to the use of enteral hyper alimentation include adynamic ileus of the intestinal tract and persistent diarrhea which is not controlled by administration rate or drugs.