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Research Paper

Postoperative Nutritional Intervention by Enteral Feeding in Dogs: a Review

Veterinary

KEYWORDS : postoperative, nutritional intervention, enteral feeding, dogs, canines

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ABSTRACT

During postoperative condition, nutritional intervention by enteral feeding is considered to be an essential tool in supporting both acute as well as chronically ill patients. For fast recovery, it is important that critically ill dogs start to eat and drink as soon as possible during the first two days after any surgery or trauma. Nutritional support early during the postoperative stage reduces catabolic stress, improves immune response, minimizes mortality rate and shortens the duration of hospitalization. Different enteral interventions depend on different clinical conditions and underlying cause of the disease. Though several nutrients are found to be beneficial during healing and recovery, further studies are required to certify the effects of these nutrients in critically ill patients. In this review, an attempt has been made to bring forth the different benefits of enteral feeding in critically ill canines

Introduction

Postoperative stage is associated with changes in body condition, energy requirements, declining organ function with immune status and other metabolic alterations. After any surgery or trauma, survival rate of the nutritionally depleted patients may depend on the timing and extent of postoperative nutritional support. The calorie requirements usually vary with the magnitude of the surgical procedure and various outcomes of postoperative complications. Nutrition plays an important role in delaying such deteriorative alterations by preventing them. In case of critically ill dogs, there is every chance of progressive malnutrition (Serón-Arbeloa, C. et. al., 2011; Chambrier, C. and Sztark, F., 2012). Food intake provides nutrients mostly in the form of glucose, amino acids, fatty acids, vitamins, and minerals that help to optimize tissue repair and immune response as well as the metabolism of administered medications (Liu, D.T., et. al., 2012). During postoperative stage dogs usually refuse to eat, which occurs due to catabolic stress. Almost all hospitalized animals have a negative energy balance and almost half of the patients have that negative energy balance due to food refusal (Remillard, L., 2002). Animals in negative energy balance have a shortfall of essential nutrients. Hence, palatability of nutritional products fed to the patients must be good because the appetite is dramatically reduced during postoperative stage (Verbrugghe, A., et. al., 2012).In addition, a properly functioning immune system is crucial for recovery from illness and after any surgery and trauma. It has been estimated that greater part of the immune system of dogs is in the intestines; hence, the intestinal mucosa must remain intact for proper immune response (Okuma, T., 2007). The first two weeks are extremely important, especially for the ingestion of fluids and essential nutrients through enteral intervention. As such, nutrients ingested during this period promote optimal gastrointestinal tract function. The intact small intestinal mucosa of the postoperative patient can facilitate absorption of sufficient water, electrolytes and nutrient solutions to support the daily requirements in the early phase of recovery. The different complications associated with prolonged parenteral infusion can be avoided if the need for nutritional support is anticipated. Nutritional intervention by enteral feeding can provide nutritional support and may also serve as an alternative to the prolonged use of parenteral medium.

The objective of this review is to discuss about the current knowledge regarding importance of enteral intervention to improve the condition of impaired food absorption after surgery or during any serious illness.

Different feeding methods

It is important to provide nutrients through the most natural route. However, when spontaneous food intake through natural route is not successfully stimulated, tube feeding or parenteral nutrition should be initiated immediately. Nutritional support should be given in accordance to the resting energy requirement of the animal on basis of the present body weight. The volume of food should be maintained gradually over a period of 2 to 4 days. Due to inappetence, if an animal avoids voluntary intake of the required volume of food, enteral/tube feeding should be initiated. In critically ill patients, nutrients via enteral medium is often preferred to parenteral medium (Okuma, T., 2007).

Enteral feeding vs parenteral feeding

Parenteral feeding is indicated for a nonfunctional gastrointestinal tract, associated with excessive vomiting. Parenteral feeding requires an intensive care setup facilitated with preparation and handling of products used for parenteral feed, performed under strict aseptic conditions. Additional information regarding comparative enteral and parenteral feeding techniques have been reported in many current research works (Saker, K.E. and Remillard, R.L., 2010; Hand, M.S., et. al., 2011; Larsen, J.A., 2012). Many comparative studies in human medicine that failed to show different benefits of enteral feeding over parenteral feeding could not demonstrate any negative effects but also revealed no differences between treatments. Recent literature reviews have analyzed the evidence from these comparative studies and found that enteral feeding is more cost effective that showed an overall significant decrease in complications with more positive outcomes (Gramlich et al. 2004;McClave, S. A., et. al., 2006; Jeejeebhoy, K. N. (2007). In the field of veterinary medicine, it has been reported in dogs with induced pancreatitis that parenteral nutrition has a negative impact on gut barrier function when compared to enteral nutrition. The parenteral nutrition was associated with reduced height in intestinal villi, mucosal thickness, total protein and nucleoside content, which occurs within a week of post-operative stage (Qin, H. L., et. al., 2007). It seems clear that the provision of adequate nutrition, when administered enterally wherever possible, can be a powerful tool in the management of hospitalized dogs under several disease conditions.

Importance of enteral feeding

Many articles have mentioned techniques for successfully providing enteral nutrition in veterinary patients (Marks 1998; Daye et al. 1999; Stevenson et al. 2000; Von Werthern and Wess 2001). Despite these references, one study found that negative energy balance was very common in a population of hospitalized dogs (Remillard, L., 2002). This study also reported a significant and positive correlation between calorie intake and outcome. Reasons for failure to provide adequate nutritional support included inadequate feeding technique by the clinician and patient's refusal to eat. There are evidences that animals with diseases that have been traditionally managed may actually benefit from early enteral feeding (Mohr et. al., 2003; Qin, H. L., et. al., 2007). There are different ways to accomplish enteral feeding, including voluntary intake. If an animal will eat adequate amounts of an appropriate diet for any disease states that may be present, intervention is not required. Voluntary intake can be encouraged with the utilization of various measures of altering diet palatability as well as managing the hospital environment (Delaney, S. J., 2006). While there are several appetite stimulants such as benzodiazapines, cyproheptidine, dronabinol, megesterol acetate, mirtazapine, prednisone, propofol, etc. have been utilized with varied success rate for short term in canine patients. But these measures are not to be practiced on long term basis as they usually do not result in the consumption of adequate amounts of calories on a sustained basis. For partially or fully anorexic patients, options include forced feeding with syringe or other method, or placement of an enteral feeding device. The placement and use of an enteral feeding device is the preferred method of providing adequate amounts of an appropriate diet, and it can be accomplished on a long term basis with many tube types. Nutritional support should be provided as soon as malnutrition is recognized or anticipated to occur. Regardless, intervention is indicated if anorexia has been documented for longer than 3 to 5 days or if a patient is not expected to eat within 2 to 3 days (such as those with significant oro-facial trauma or in need of extensive oro-facial surgery). Additionally, feeding tube placement can facilitate the administration of extra fluids as well as medications without oral feeding. Although it is clear that providing adequate nutritional support and administering it enterally if possible is of benefit in managing many cases, most enteral feeding devices are contraindicated in patients with an increased risk of aspiration. However, accomplishing enteral feeding with devices that terminate in the jejunum is a viable option for those with increased risk of aspiration (Heyland, D. K., et. al, 2002). It is also important to consider whether frequent anesthesia or sedation may be necessary due to bandage change or other procedures. In this case, consideration should be given to using an enteral feeding technique that facilitates meal feeding and allows evaluation of gastric residuals that terminates in the jejunum.

Enteral feeding devices

Enteral feeding devices include tubes that pass through the nares and end anywhere from the esophageal lumen to the jejunum. These can be classified on the basis of their utility into hospital care and home care (Kondrup, J., et. al., 2003).

In hospital care, the tubes include nasoesophageal tubes, nasogastric tubes and tubes with post-pyloric options like duodenostomy tubes and jejunostomy tubes. Enteral tubes at home care include esophageal tubes and gastrostomy tubes. Placement of any of these tubes requires the ability to confirm correct placement into the appropriate location in the gastrointestinal tract instead of the airway, peritoneum or subcutaneous space. No method is feasible for confirming correct placement in the long term. However, with experience and the use of multiple confirmatory methods, the risks of feeding through an incorrectly placed device can be reduced. Radiography can be useful; other methods to determine correct tube placement into the esophagus or stomach rather than the bronchus include the injection of air or sterile water while observing for coughing or auscultation. A feeding tube needs some maintenance once it is planted in the patient's body. It should be kept clean by flushing it after feeding to prevent blockage. If it gets blocked, flush it with warm water. Depending on the type of tube used, it can remain in place for a few weeks or even several months. In some cases, dogs and cats need to wear an Elizabeth collar all the time to keep the tube in the place and prevent any displacement.

Calculation of energy requirement for enteral feeding

Comparatively, surgically treated and ill patients have higher requirements for energy and other nutrients. Physiological stress from surgical trauma and sickness increases muscular breakdown (Hasselgren and Fischer 2001). It has been demonstrated that critically ill dogs catabolize significant amounts of endogenous body protein (Michel, K.E., et al. 1997; Chan, D. L., and Freeman, L.M., 2006). As a result of this, the patients that are anorexic during postoperative stage are likely to become malnourished to a greater extent in a very shorter span of time. Although illness factors have been used in the past to account for these increased demand, it is now recognized that such factors may overestimate the requirements of inactive, convalescing and recumbent veterinary patients (Chan 2004). There are potentially adverse consequences to overfeeding and there is general agreement that this should be avoided in canine patients despite few published scientific reports. One study showed similar outcomes in hospitalized dogs that were provided higher amounts of energy compared to approximately basal requirements (Brunetto et al. 2010). According to the European Society for Clinical Nutrition and Metabolism Guidelines on Enteral Nutrition advises against providing more than approximately basal energy requirements, especially in the acute phase of critical illness (Kreymann et al. 2006). On the contrary, in another study (Krishnan et al. 2003) reports reveal that caloric intakes below the calculated values may improve recovery in some patients. The true metabolic energy requirement (MER) of veterinary patients is often not known, so the calculated demands can over- or underestimate actual requirements.

MER is usually calculated by first calculating the resting energy requirement (RER): (Weight in kg0.75 × 70), then multiplying by a factor depending on the species. To avoid overfeeding hospitalized patients with potentially wide variations in true MER, it is best to begin with RER, monitor body weight and adjust the amount fed, if necessary. This approach allows for any necessary adjustments while preventing potentially adverse effects of hyper alimentation (Chan 2004).

An example to show how to calculate feed and water requirement for a canine patient

1) Calculation of dietary requirement for a 20 kg dog with an esophagostomy tube

The resting energy requirement (RER) for a 20 kg canine patient with esophagostomy tube

RER = $20^{0.75 \times 70 = 662 \text{ kcal per day}}$

Desired diet provides 1.25 kcal per ml when adequately blended for tube feeding

Quantity of feed to be fed at full RER: 662 kcal per day/1.25 kcal per ml = 530 ml per day

Quantity per meal when fed four meals per day: 530 ml per day/4 meals per day = 133 ml per meal

Days	*Energy requirement*	*Feeding practice*
Day 1	*Start at 25% of RER (166 kcal)*	*Feed 33 ml per meal over 4 meals for a total of 133 ml per day*
Day 2	*Increase to 50% of RER (331 kcal)*	*Feed 66 ml per meal over 4 meals for a total of 266 ml per day*
Day 3	*Increase to 75% of RER (497 kcal)*	*Feed 99 ml per meal over 4 meals for a total of 398 ml per day*
Day 4	*Increase to 100% of RER (662 kcal)*	*Feed 133 ml per meal over 4 meals for a total of 530 ml per day*

The body weight is monitored and amount of feed is adjusted as per the nutrient requirement to achieve the target condition.

2) Calculation of water requirement if patient cannot consume water voluntarily

Water sources are included to diet for uniform mixing of the feed and flushing the tube. A hospitalized dog requires 662 ml water per day for maintenance requirements, (estimated using RER equation: $20^{0.75 \times 70} = 662$ ml per day)

The diet fed in the example is having 80% moisture and provides 1,500 kcal per kg as fed.

662 kcal per day/1,500 kcal per kg = 0.441 kg per day

The dog requires 441 grams as fed per day to meet energy requirements

441 grams of diet provides 353 grams (353 ml) of water 441 grams * 80% = 353 grams = 353 ml

For uniform mixing, 25 ml water per 441 grams is added to the diet.

For tube flushing, 10 ml water is used after each feeding.

Water from diet (353 ml + 25 ml per day) + water from flushing (40 ml per day) = 418 ml per day

Deficit of 244 ml per day (662 ml – 418 ml) must be provided through the tube.

Similarly the hydration status is also monitored by checking the urine specific gravity, skin turgor, and mucus membrane status, and adjusted as per the need.

Once the nutrient requirements are calculated, the critically ill dog is started on progressively increasing concentration of balanced diet? dissolved in water and the amounts and concentration of jejunal feeding are adjusted depending on the patient's response (Table 1). A relatively constant rate of nutrient infusion is also important to prevent abdominal distention and to assure that satisfactory volumes of jejunal feeding were administered.

Table 1. Feed concentration and feeding rate in postoperative jejunal diet

Day	Quantity of water (litre)	Diet (gram)	Calories	Carbohydrates (gram)	Protein (Nitrogen) (gram)
1st	2	160	600	126.2	4
2nd	3	320	1200	252.4	8
3rd	3	480	1800	378.6	12
4th	3	720	2700	567.9	18
5th	3	800	3000	631.0	20

Diet selection for enteral feeding

There is no such best diet for use with enteral feeding devices, yet there are many options available in the market. The factors to be considered while choosing a diet include not only tube size but also ingredients, particle size, caloric density, macronutrient distribution, osmolality, cost and availability (Schafer, L., et. al., 2009). It is also important to consider the expected period of feeding and whether the diet chosen is nutritionally complete and balanced for the individual patient. For many patients, the underlying disease will limit the choices to diets that incorporate specific, appropriate modifications. In some cases, tube size will limit diet choices to those of a particular viscosity (i.e., liquid diets for enterostomy and nasoenteric tubes). If possible, providing a nutritionally balanced commercial diet is preferable. This includes slurries of semi moist, canned or dry diets; however, both commercially available and home-prepared diets can be used. A wide range of both canned and dry foods can be fed enterally. For slurries of commercially available diets, it may be necessary to experiment with different water ratios to achieve the desired consistency that will easily flow through the selected tube. This will facilitate to avoid tube obstructions and aid in calculation of caloric density of specific diet slurries. It is best to uniformly mix the slurry for sufficient time to achieve a smooth consistency. It is helpful for the clinician to have a basic understanding of the characteristics of a range of different prescription diets. For example, knowing which renal therapeutic or uncommon antigen diets are lowest in fat can be useful. The pet food manufacturers are usually ignorant about the clinical conditions. They frequently introduce new products by modifying the formulations of existing diets, and it may be difficult for most practitioners to remain up-to-date on current information. In general, an appropriate diet may be chosen on the basis of the caloric distribution (per cent of calories from carbohydrate, fat and protein), micronutrient levels from vitamins and minerals, and ingredient source. Hence it is better to consider commercially available pet food options and human enteral formulas as well as homemade diets. For fat-intolerant animals, cooked rice with skimmed milk slurries are useful for tube feeding, and can be supplemented with a linoleic acid source and micronutrients for longer term feeding. Liquid diets are available in the market that can be used both for human and animal patients. The liquid diets are the only option for patients with small diameter feeding tubes (nasoenteric and jejunal tubes). Such diets are generally well tolerated and can provide requisite nutrients to provide weight maintenance in hospitalized conditions. These diets tend to be expensive, especially in larger patients and it is important to note that most commonly used liquid diets do not meet every currently known nutrient requirement of dogs and cats. In order to improve the caloric density, liquid diets are generally supplemented with fat. But high-fat diets are contraindicated in some clinical conditions like pancreatitis, lymphangectasia and other intestinal diseases.

From enteral feeding to voluntary intake

While some patients will require enteral feeding on a long term basis but others need them only on temporary basis once recovered. But in certain clinical conditions such as those with severe and permanent oro-facial or esophageal disease or with chronic kidney disease, enteral feeding is practiced for whole life. At this point, the patient can be offered the diet before scheduled feedings when they should be hungry. Transitioning away from tube feeding is often successful with this strategy, and is beneficial when the enteral diet includes a low fat based, home-cooked diet slurry for dogs with adverse food reaction and pancreatitis. Other patients will have alternative options for longer term diets, as there are many products with similar nutritional profiles are available. In these cases, a different diet other than the one routinely fed through the tube may be accepted voluntarily, especially if food aversion occurred. But, in many situations, the diet choice will be driven by the needs of the specific patient. For instance, animals with fiber-responsive diarrhea, chronic pancreatitis, adverse food reactions, or other conditions will require diets with specific modifications. Ultimately, options for long-term diets and transition to voluntary intake will vary according to the underlying clinical conditions and is dependent on the individual patient.

Conclusion

After any surgery, trauma or during serious illness, several metabolic alterations in the patient's body disturb the nutritional entity resulting in malnutrition and delayed recovery. There is evidence that nutritional intervention early during the postoperative period or after onset of illness decreases the death rate and shortens the duration of hospitalization in critically ill dogs. The preferred feeding route will depend on the condition of the patient. In case there are no clinical contraindications, patients

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should receive nutritional support, at least consistent with the resting energy requirement. Whereas the addition of food supplements containing nutrients may be beneficial during healing and recovery from illness or surgery. Further studies are needed to be conducted on canines to certify the favorable effects of these nutritional interventions during postoperative stage.

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