General principles of parenteral nutrition

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Parenteral nutrition provides nutrition intravenously. Due to greater number of potential complications associated with parenteral nutrition, its use is restricted to animals that do not tolerate enteral nutrition. Parenteral nutrition can be used to provide complete caloric intake (total parenteral nutrition) or a proportion of the caloric and protein intake (partial parenteral nutrition).

Total parenteral nutrition (TPN)

Total PN is indicated in debilitated animals where the gastro-intestinal tract (GIT) is not functional. This includes animals with intractable vomiting and/or diarrhea, severe malassimilation or prolonged ileus (Chandler et al 2000). The main objective of TPN is to prevent further weight loss and maintain lean body mass. It is preferred, that restoration of body weight is not performed until enteral nutrition is able to be re-commenced.

Disadvantages

The use of TPN in absence of enteral or micro-ental nutrition predisposes to decreased integrity and function of gastrointestinal tract and liver. Due to the high osmolarity ( > 800 mosm/l), it essential that TPN be administered via a central vein. TPN is also associated with the risk of infection, central vein thrombosis and metabolic disturbances. (Chandler et al 200, Crabb et al 2006)

Formulation:

Parenteral nutrition solutions are composed of 50% glucose, 20% lipids and 8.5% amino acid solutions. Resting energy requirements (RER) are calculated from the current body weight using the following formula:- RER (kCal/day) = 70 x bodyweight^0.75. The required protein component is then calculated as 4-5 g/100kCal for dogs and 6 g/100kcal for cats. Lower supplementation is recommended in renal or hepatic insufficiency, higher supplementation may be required in animals with high ongoing protein loss (Freeman and Chan 2006).

It is currently recommended that non-protein calories are calculated by subtracting protein calories (4 kcal/g protein) from the RER. The glucose and lipid components are then calculated as a percentage of the non-protein calories. Typically 50% of non-protein calories are provided by glucose and 50% by lipid. For diabetes, greater % of calories should be provided by lipid and protein. In contrast for animals with hypertriglyceridaemia, less/no calories are provided by lipid (Freeman and Chan 2006).

Partial (or Peripheral) Parenteral nutrition (PPN)

The main objective of PPN is to prevent protein catabolism. Partial PN is indicated in non debilitated animals requiring IV nutrition for < 7 days, in situations
where a central catheter can not be placed and as adjunctive nutrition in animals that are only able to tolerate partial caloric requirements enterally (Chandler et al 2000; Chan et al 2002).

**Advantages:**

Partial PN solutions are lower in osmolarity and thus can be administered via a peripheral vein. Furthermore when compared with TPN, PPN is associated with lower incidence of metabolic complications (Chan et al 2002). However this may simply reflect less severe illness in these animals (Chandler et al 2000)

**Disadvantages:**

The relatively greater volume of solution required to be administered may predispose to volume overload. Thus use of PPN should be used cautiously in animals with heart disease or oliguric/anuric renal failure.

**Formulation:**

Partial PN solutions are composed of 5% glucose, 20% lipid and 8.5% amino acid solutions. Initially the % of RER to be provided by PPN solution is calculated. The relative proportion of calories to be provided by glucose, amino acids and lipids are then calculated. Worksheets for calculating relative components can be found in standard textbooks (Freeman and Chan 2006)

**Complications of parenteral nutrition**

Complications of parenteral nutrition can be divided into metabolic, mechanical and septic complications. Metabolic complications are the most common followed by mechanical and septic complications.

**Metabolic complications:**

Hyperglycaemia is the most commonly reported metabolic complication associated with parenteral nutrition. It is also reported to be more common in cats than dogs (Chan et al 2002). In most cases hyperglycaemia is found to be mild and transient. However in critically ill animals with marked and/or persistent increases in glucose, administration of insulin may be required to prevent potentially adverse effect of hyperglycaemia on mortality (Crabb et al 2006; Pyle et al 2004). Adjustment of RER by an illness factor may increase the risk of hyperglycaemia, thus it is currently recommended that RER is not adjusted.

Refeeding syndrome is another metabolic complications observed with PN. Classically this syndrome is associated with the development of low phosphate (PO4) in animals that have been inappetant for prolonged periods. However this syndrome also includes abnormalities in magnesium (Mg), and potassium (K). Overfeeding increases the risk of refeeding syndrome. Thus to prevent overfeeding it is recommended that current body weight is used for calculation of RER. It is also recommended that RER is not adjusted for an illness factor and that feeding is commenced at 1/3 daily requirement and gradually increased. Pre-existing abnormalities in electrolyte and fluid balance must be corrected before commencing parenteral nutrition.
Mechanical complications

Mechanical complications are the next most frequently reported complication of PN, with a higher incidence in dogs than cats, presumably reflecting differences in behaviour (Chan et al 2002). Mechanical complications include catheter dislodgement, disconnection, occlusion, and chewed lines.

Septic complications

Septic complications include infection of catheter site or systemic infection (Chan et al 2002; Crabb et al 2006; Pyle et al 2004). Prevention of sepsis requires strict aseptic technique during preparation of solutions, placement of catheters and handling of the catheter and administration set. The solution and administration set should be changed every 24 hours. In addition, a dedicated catheter port should be used for the administration of TPN. Infection should be suspected in any animal receiving TPN that develops neutrophilia or pyrexia not consistent with the underlying disease.

Sepsis may also occur secondary to breakdown of the mucosal barrier and bacterial translocation (Freeman and Chan 2006). To minimize the risk of mucosal breakdown it is essential that enteral feeding be resumed as soon as possible. Micro-enteral nutrition should also be considered to provide the essential nutrients directly to GIT mucosa and thus prevent loss of cell integrity.

References


