Parenteral Nutrition in Cattle

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Summary

The use of parenatal nutrition was studied in 32 calves suffering from calfhood diseases that required nutritional support. The most frequent clinical condition requiring parenteral nutrition was a chronic diarrhea and wasting syndrome seen in 20 of the calves. An amino acid-dextrose solution (Formula 1) was administered to 27 calves and an amino acid-dextrose-lipid solution (Formula II) was administered to 5 calves. Enteral feeding was limited to less than one-half of the normal requirements for the sick calves. The combination of limited milk and parenteral nutrition using Formula I or II supplied more than 100 percent of the energy and protein requirements for a healthy calf.

Introduction

Parenteral nutrition (PN) has been advance in human medicine over the past 15 years to the point where nutritional integrity can be maintained regardless of the severity of the illness or organ failure (1). The reported use of total parenteral nutrition in cattle has been limited to 5 normal calves and 1 calf with atresia coli (2). The calves were able to maintain their original weight but had no gain after 12 days of therapy. Herein, we report on the use of partial parenteral nutrition in 32 calves with illnesses requiring intensive medical treatment and/or surgical intervention.

Materials and Methods

Animals and Illness

Since 1983, 32 calves (2 days-14 weeks of age) have received PH for 3 days or more (range 3 to 13 days). The total days on PN for the 32 calves was 207 days. Twenty of the calves received PH because of chronic diarrhea and catabolism. Other illnesses are listed in Fig. 1. Abnormally low concentrations of plasma protein and creatinine, along with the frequent finding of hypoglycemia (80 mg/dl) supported a diagnosis of nutritional deficiency in most of the calves with chronic diarrhea. Six of the calves with diarrhea and emaciation could not stand on hospital admission. Sixteen of the 20 calves with chronic diarrhea and emaciation had clinically detectable pneumonia. The 12 other calves that received PH also had detectable areas of sepsis (peritonitis, salmonellosis, meningitis or primary pneumonia) at the time of hospital admission.

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Product

Formula I used to provide PN in 27 of the calves consisted of 400 ml 50% dextrose 750 ml 5% crystalline amino acid solution. The caloric to nitrogen ratio of this solution is 112:1. The calves were administered the solution at the rate of 1.54-2.2 ml/kg/hr. Five additional calves in the study received both Formula IIa and Formula IIb. Formula IIa was made by adding 375 ml 50% dextrose and 500 ml of 8.5% crystalline amino acid solution (Travasol @ - Traveno Laboratories, Deerfield, IL). The 5 calves received this formula at a rate of 1.5-1.9 ml/kg/hr on hospital day 1 only. Formula IIb, which was administered on the following days at the rate of 2.2-2.5 ml/kg/hr, consisted of 500 ml 50% dextrose, 750 ml 8.5% amino acids. Concurrent with the administration of Formula IIa and IIb was the administration of 1 gm/kg bw/day and 2-3 gm/kg bw/day, respectively, of a 10% lipid emulsion. The caloric to nitrogen ratio of IIa and IIb were 117:1 and 140:1, respectively (including lipids). To Formula I, IIa and IIb were added 24 mEq/L sodium bicarbonate, 40 mEq/L potassium chloride and 1 ml/L multiple B vitamins.

The PN was administered in the jugular vein via 16 g 3-½" or 14 g 5-¼" angiocath. A catheter was replaced every 3 to 5 days. During the continuous administration of the PN, calves were housed either outdoors in 6' x 6' pens or inside a 6' x 10' stall. The calves were allowed free movement in the stall during the continuous gravity flow administration. Urine and blood samples were intermittently collected to determine the presence of glucosuria and hyperglycemia. Plasma samples were evaluated twice daily for evidence of gross lipemia. Adjustments in flow rates of Formula I, IIa, IIb or lipids were

FIGURE 1. Illness in Calves on Parenteral Nutrition and Outcome.

	Number of Calves	Died	Survived
Chronic diarrhea	20	4	16
Abdominal surgery	4	0	4
Acute salmonellosis	3	0	3
Bacterial meningitis	3	2	1
Severe pneumonia	2	1	1

made accordingly. The clinical condition and/or poor appetite of the calves limited the amount of milk fed (avg. 2.2 L/day). The fed milk provided approximately 46% of the energy requirement and 52% of the nitrogen requirements for a normal 42 kg calf. The average weight of the 31 milk fed calves (1 calf was a ruminant at the time of the illness) was approximately 42 kg. The combination of limited milk and PN using Formula I provided 106% of the energy requirements and 105% of the nitrogen requirements of a normal 42 kg calf. The 4 milk fed calves receiving limited milk and formula II received 146% of the energy requirements and 148% of the nitrogen requirements of a normal calf 42 kg. Parenteral nutrition was supplemented with intravenous polyionic solutions as needed for dehydration and electrolyte disturbances.

Complications

There were no serious complications noted in the calves that could be associated with the administration of the PN. Most of the calves developed nonpainful thickening of the jugular veins, but only 2 veins in this study were believed to be thrombosed. None of the calves on formula II had thrombosed veins. Septic thrombophlebitis was not found in any calf. Most calves on PH had fevers, but these were thought to be associated with foci of sepsis (lungs, abdomen, etc.) present at the time of hospital admission.

Results

The survival rate in the calves with the various illnesses and receiving PN was as shown in Fig. 1. Calves tended to maintain their weight in spite of their severe illnesses. Eight of the calves with chronic diarrhea and emaciation actually gained weight while on the PN (avg. .22 kg/day).

Discussion

We believe the administration of PN enabled several of the calves in this study to survive that would not have lived otherwise. We also are of the opinion that parenteral nutrition in calves is best used in combination with enteral feeding. Calves with chronic diarrhea and emaciation, acute salmonellosis and those undergoing abdominal surgery would be most likely to benefit from PN. There are many oral electrolyte and fluid volume replacement solutions commercially available that have been recommended as a partial replacement for the milk in calves with gastrointestinal disease. Aggressive therapy with these solutions and fluid replacements has usually been effective in normalizing body fluid volume and electrolytes, but will not prevent life threatening catabolism in the presence of persistent diarrhea (3). An emaciated condition can develop within a period of days in neonatal calves with increased catabolic demand (diarrhea, fever, surgery) and deficient nutrient intake. Emaciated calves suffering from chronic diarrhea, salmonellosis, peritonitis, etc., and/or which will not drink milk or cannot tolerate sufficient milk feedings may in some cases only be saved by PN. In postoperative human patients, PN was as efficient in supplying calories and protein as was forced enteral feeding (4). The combination of both parenteral and enteral (limited milk) feeding in the calves in this study provided over 100% of the daily requirements of both energy and protein needed for growth in a normal calf. This did not take into consideration any increase in nutrient demand associated with the fever, sepsis, diarrhea, surgery, etc. The additional utilization of IV lipids increases caloric density and permits the addition of a higher protein (8.5%) concentration to the stock solution yet still maintains a caloric to nitrogen ratio close to the value recommended for humans (approx. 100-200:1) (5,6). A step-wise increase in both nitrogen and energy was utilized in the 5 calves receiving Formula II (a and b) so that changes in metabolism of amino acids, lipids and dextrose would be gradual.

The administration of PN as described is both practical and safe for use in bovine clinical practice. The administration of the hypertonic stock solution (osmolality = 1,629 mOsm/L) into the jugular vein seems acceptable although a certain degree of phlebitis is to be expected. The concurrent administration of lipids with the formulas will not only enhance caloric density but will lower the osmolality of the solution and may decrease the degree of phlebitis. The osmolality of the lipid solution is approximately 310 mOsm/L. The PN solution may be administered to calves without any special restraint of the animal. Long term administration of total parenteral nutritient has resulted in vitamin and micronutrient imbalances in children (7). We believe this should not be a significant problem in calves since the parenteral administration will usually be of short duration (days) and some enteral feeding will be continued in most instances. The major limitation for the use of PN in cattle is not safety, efficacy or ease of administration, but expense. The products, as they are not marketed, are cost acceptable to the owners of valuable calves. We believe PN will become a meaningful therapeutic regimen for certain patients.

References

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