CASE REPORT

Total Parenteral Nutrition in a Premature Rhinoceros Calf

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ABSTRACT: A female black rhinoceros calf developed significant hypoglycemia (blood glucose, 30 mg/dL) and hypothermia (97°F) within 48 hours of birth and refused to nurse. Normal gestation of the black rhinoceros is 15 months, but elongated hoof slippers and low birth weight (30 kg) suggested prematurity in this calf. Clinical symptoms of neonatal sepsis including lassitude and poor sucking continued in spite of the aggressive use of antibiotics, and the calf required mechanical ventilatory support on day 7. Nutritional support including enteral gavage feedings (Pedialyte/4 ounces of SMA [Wyeth Ayerst] with sucraflox) had been instituted and was supplemented with total parenteral nutrition on day 5. Central venous access was obtained via a jugular cutdown. The total parenteral nutrition included appropriate electrolytes and vitamins for the neonatal calf but did not include trace elements. The use of total parenteral nutrition by our zoos for therapeutic purposes is increasing. Experience with total parenteral nutrition in exotic animals such as the black rhinoceros is limited, yet this may be an important therapeutic modality in these animals, particularly those in danger of extinction.

CASE REPORT

A female black rhinoceros calf was born on January 5, 1990, at the St. Louis Zoo (Fig 1). Low birth weight (30 kg) and elongated hoof slippers suggested prematurity. On the morning of birth, the calf was unable to stand and, by the afternoon, was hypothermic with continued weakness. The calf was given vitamin E-selenium, as well as saline and warmed formula orally. The calf was normothermic and more active on day 2 and was reintroduced to the dam. On day 3, the calf was observed to nurse early in the morning but later fell into the water trough and became very excited. Hypoglycemia (blood glucose, 30 mg/dL) was noted. The calf refused to nurse, and peripheral access was very difficult. Consequently, intraperitoneal lactated Ringer's and glucose solution was given as well as intravenous corticosteroids (Solu-Delta-Cortef). Hypothermia and weakness continued, and on day 4, the calf was tube fed with artificial maternal rhinoceros' milk, providing 35 kcal/L. A medial limb forearm cutdown was performed, and both colostrum and plasma were taken from the dam for administration to her calf. Penicillin (700,000 units intravenously four times a day) and amikacin (210 mg intravenously three times a day) were also started. Although the blood sugar stabilized, the forearm cutdown was pulled out on day 5, necessitating an internal jugular venous cutdown which was performed under general anesthesia. Total parenteral nutrition (TPN) was initiated by using foal guidelines. The TPN included 50% dextrose (600 mL), 10% fat emulsion (300 mL), and 10% amino acids (600 mL). This formula provided 1392

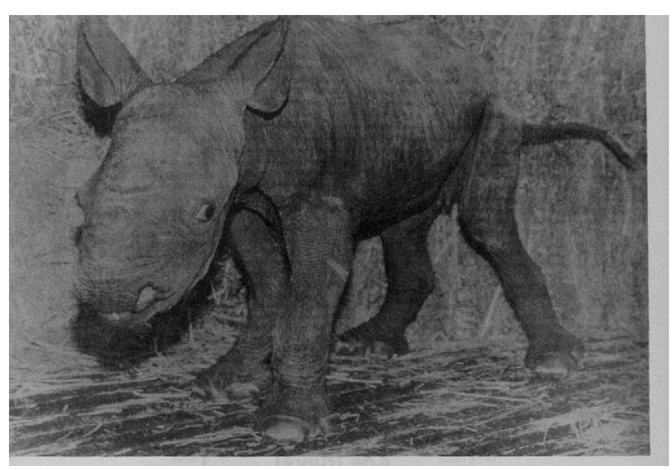

Figure 1. Premature black rhinoceros calf.

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nonprotein calories and 60 g of protein in a total volume of 1580 mL. Multivitamins and electrolytes were added along with supplemental magnesium. Pulmonary edema developed in the evening of day 5 and improved with intravenous furosemide and corticosteroids, although hypokalemia ensued.

Disseminated intravascular coagulopathy developed with decreasing platelets and packed cell volume (Fig 2), as well as decreasing white blood cells (Fig 3). Both maternal and matched whole blood transfusions were given. A sling was fashioned on day 7, and the neonate was placed in the sling for pulmonary support. In spite of these measures, arterial blood gases remained poor (pH 6.9; O_2 saturation, 39%) and a chest film showed ventral lung consolidation (Fig 4). Oxygen had been delivered by face mask, but at this point, the rhinoceros was intubated with an oral tracheal tube and mechanically ventilated (MA-1 respirator) with positive end expiratory pressure. Hypoxia worsened in spite of an increasing fraction of inspired oxygen (FiO_2) (Fig 5) and intravenous aminophylline and steroid therapy.

Generalized seizures were treated with intravenous diazepam. TPN was continued throughout this critical period. Despite aggressive respiratory support, the calf suffered a cardiac arrest and died in the evening of day 8.

A necropsy was performed, confirming *Escherichia coli* sepsis with pneumonia and respiratory failure as the cause of death. Bacterial leptomeningitis was described with hemorrhage noted around the spinal cord and the base of the brain. Fibrinous pericarditis was present. The lungs were stiff and showed bilateral pneumonia with extensive consolidation and hemorrhage. Multiple gastric ulcers were also seen.

DISCUSSION

The black rhinoceros is an exotic animal that is highly prized for its horns, which are used in Asian

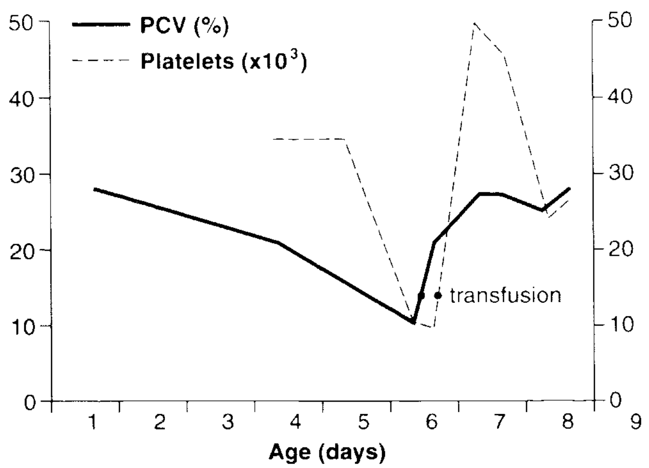

Figure 2. Platelet count and packed red cell volume (PCV).

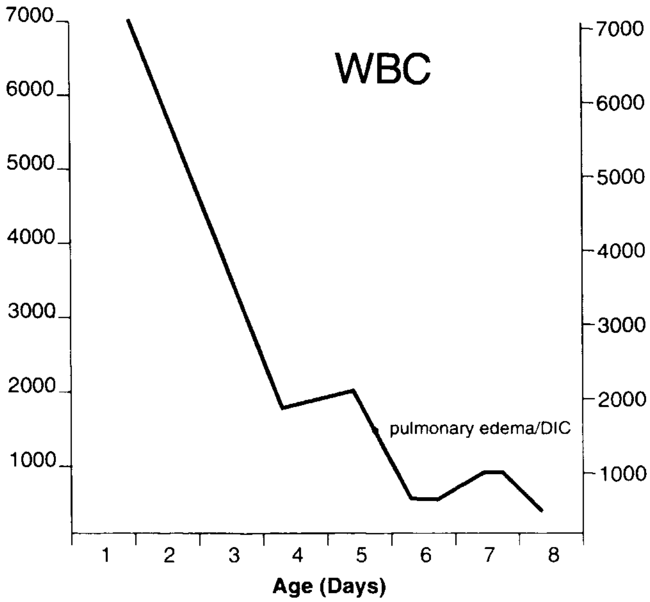

Figure 3. White blood cell (WBC) count.

medicines and for making dagger handles. Extensive poaching in Africa and Asia has rendered this species in severe danger of extinction. Currently, there are approximately 80 black rhinoceros in captivity in North America. The birth of a black rhinoceros in captivity is a rare zoological event, and every effort is extended to ensure the safe and healthy delivery as well as perinatal care for these endangered animals.[1] TPN has not been used extensively in exotic species and, before this case, had not been used at the St. Louis Zoo.

The use of TPN in human neonatology has markedly and favorably altered mortality in this group of patients. Neonatal animals are as fragile as humans, if not more so, and mortality in this group is higher in the perinatal period than in any subsequent period in the animal's life.[2] Although TPN has been extensively used in humans, its use in veterinary medicine has been limited. Most of the experience in critical care medicine, to include specialized nutritional support in animals, has been extrapolated from experience in humans.[1, 3, 4]

Reports of parenteral nutrition in large exotic animals are relatively scarce. Much of the work in intravenous nutrition has been accomplished in foals,[1, 4-6] and our review of the literature yielded few references regarding nutritional support in other large animals, particularly ungulates. Neonatal ungulates are extremely sensitive to metabolic disturbances and alterations, and premature ungulates are even more difficult to manage. Providing adequate nutritional support to the unstable neonate is obviously an important priority. Factors such as stress and sepsis may increase caloric and protein requirements dramatically, making delivery of nutritional support difficult. Our review of

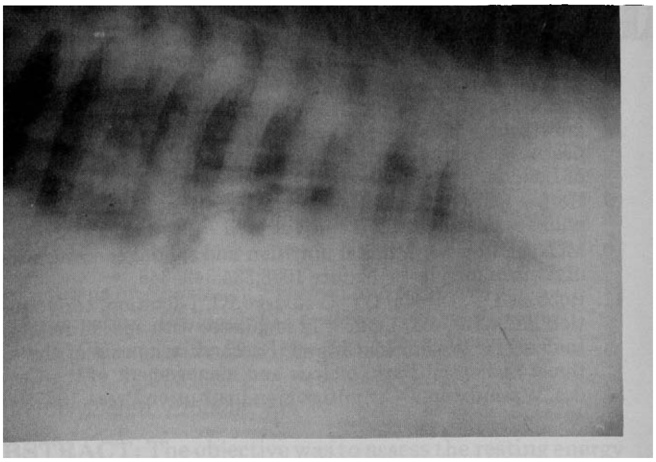

Figure 4. Ventral lung consolidation noted on chest roentgenogram.

the literature yielded several studies of nutritional support in larger animals.

Catheter sepsis and thrombophlebitis are major complications of parenteral feeding in animals and generally relate to the duration of the catheter. Infection or sepsis is the most common cause of mortality in neonatal animals; therefore, strict adherence to aseptic technique and the management of TPN catheters is essential in these animals.[4]

Hovda et al discussed the use of TPN to treat a full-term neonatal llama with severe diarrhea.[7] Daily TPN for the llama maximally provided 66.2 kcal/kg (nonprotein calorie-to-nitrogen ratio of 165:1 to 205:1) through a jugular venous cutdown. The solution contained dextrose, crystalline amino acids, and soybean fat emulsion and provided 65% of nonprotein calories as dextrose and 36% as fat. Electrolytes from fat and multivitamins were added, but trace elements were not added because the llama was on TPN for less than 2 weeks and began taking small amounts of goat's milk orally.

Kirkwood and associates describe the management of a full-term but low-birth-weight (18 kg) female rhinoceros born at the Zoological Society of London in 1988.[8] This animal, however, did not require TPN, was always able to tolerate enteral feedings with milk formulas, grew well, and survived. The milk of the black rhinoceros is of low kilocalorie density (0.35 kcal/mL) and contains considerably less protein (16%) and fat (2%) than does that of other species.

Hoffsis et al delivered TPN to five normal calves and one calf with atresia coli.[9] The calves were maintained on TPN for 8 to 14 days, with three calves developing fever (two of these with pneumonia). One calf developed occlusive phlebothrombosis, and all survived the TPN period with maintenance of their starting weights.

Metabolic disturbances particular to neonatal ungulates further complicate the delivery of TPN.[10] Selenium deficiency has been reported in numerous exotic neonatal ungulates, and early selenium injections or supplementation are generally recommended for these animals in the neonate period.[11] Various electrolyte deficiencies were observed in our rhinoceros calf as well, including hypokalemia, hypomagnesemia, and hypoglycemia. The rhinoceros calf in this report received a supplemental vitamin E-selenium preparation, as well as added potassium and magnesium, to correct deficits.

Energy requirements in large neonatal animals such as the rhinoceros usually approach 125 kcal/kg/day[2]; however, amino acid requirements in large exotic animals are not well established. The protein requirements for calves have been estimated at 3.75 g of protein/kg/day (0.6 g of nitrogen/kg/day).[4,7] The use of fat emulsions in TPN for the large veterinary patient has not been well documented, but limited and preliminary experience indicates that fat emulsions may be safely administered to these animals.[3]

The immune status of our rhinoceros calf may have been compromised by the inability of the animal to suck from her mother, as the maternal colostrum may provide important immunoglobulins for the neonate.

With increasing evidence of the gut as the origin of the septic state, enteral feeding may be an important method of nutritional support for these animals. More aggressive enteral feeding, particularly in the neonatal animal, might decrease the incidence of the septic state and minimize morbidity. Bacterial translocation has been well described in smaller animals, as has the protective effect of enteral feeding in minimizing this phenomenon.

It is likely that further investigation and experience with both enteral and parenteral nutrition in large exotic animals may be rewarded with improved survival in this group, many of which are endangered species.

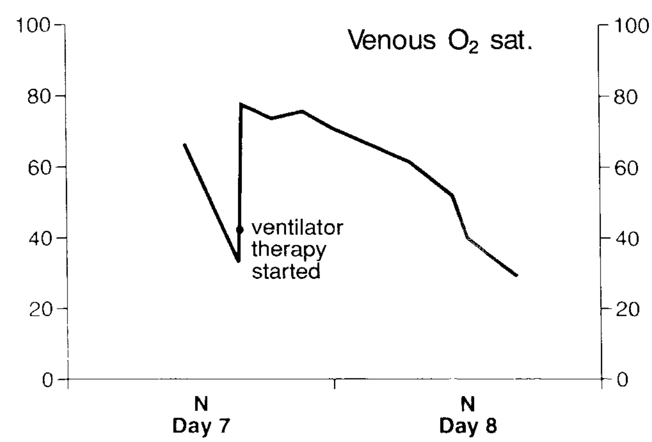

Figure 5. Venous oxygen saturation (sat).

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