AN INEXPENSIVE, PRACTICAL, AND EFFECTIVE METHOD FOR RAPID RESUSCITATION OF SEVERELY DEHYDRATED DIARRHEIC CALVES

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TAKE HOME MESSAGES

♦ The combination of intravenous hypertonic saline-dextran with oral electrolyte solution is an inexpensive, practical, and effective method for rapid resuscitation of severely dehydrated diarrheic calves.

♦ The new resuscitation method does not require intravenous catheterization or periodic monitoring, and is therefore suitable for use in the field.

INTRODUCTION

Diarrhea in neonatal calves is a continuing problem and source of economic loss to the cattle industry. The United States Department of Agriculture estimates that 6.6 percent of the annual dairy heifer calf crop dies as a result of diarrhea, with diarrhea being the leading cause of death in unweaned dairy heifers. Financial losses occur not only from calf mortality, but also from the cost of medication and labor needed to treat sick calves.

Intravenous fluid therapy is a fundamental requirement for treating severely dehydrated diarrheic calves; however fluid administration is difficult and expensive to accomplish in the field, requiring IV catheterization, delivery apparatus, and periodic monitoring. Traditional methods for fluid administration in neonatal calves requires large volume isotonic fluids such as Lactated Ringers, which is impractical in a field setting. A practical and effective method for IV fluid administration combined with oral electrolytes would therefore be extremely advantageous.

Hypertonic saline solution induces a rapid increase in plasma volume, cardiac output, and mean arterial pressure. This solution can be useful to veterinary practitioners and cattle producers because it provides a rapid, inexpensive and practical technique for the initial resuscitation of dehydrated diarrheic calves. The volume expansion that occurs due to osmotically drawing the intracellular and interstitial water into the vascular space is approximately 3 mL for every 1 mL of hypertonic saline infused. The duration of the effect of hypertonic saline can be prolonged by adding dextran-70, which increases the plasma colloidal pressure and maintains the mobilized intracellular and interstitial fluid in the intravascular space. The superior results of hypertonic saline dextran (HSD), compared to hypertonic saline has been demonstrated by previous investigators, who suggested that HSD solutions be used for the resuscitation of dehydrated patients in the field. Small volume hypertonic saline solution (2400 mOsm/L NaCl, 4 mL/kg, IV over 4 minutes) is successful in treating endotoxic shock in cattle and pigs, and hemorrhagic shock in dogs, cats, sheep, pigs, and horses. We have previously shown that IV administration of
HSD solution, combined with oral fluid administration, was effective in resuscitating dehydrated diarrheic calves. The goals of this study were to determine whether the rapid IV administration of HSD solution combined with oral electrolyte therapy is effective in resuscitating dehydrated diarrheic calves and to compare the resuscitative response of HSD solution to that produced by conventional IV fluid therapy using Lactated Ringers solution.

MATERIALS AND METHODS

Fifteen healthy male dairy calves, 2 to 7 days old, were instrumented to permit measurement of cardiac output and to obtain blood for analysis. After instrumentation and recording baseline data, osmotic diarrhea and dehydration were induced by administering milk replacer and oral sucrose solution plus three different diuretic agents every 8 hours, for 48 hours. At the end of 48 hours, milk replacer feeding and diuretic agents were discontinued and calves received only oral sucrose solution during the 24 h treatment phase. Calves were randomly allocated to one of three groups, 5 calves per group. Group C (control), an untreated control group. Group HSD (hypertonic saline-dextran) received hypertonic saline (7.2 percent, 2400 mOsm/L) and 6 percent dextran-70 once at a dose rate of 4 mL/kg over 4 minutes intravenously plus an oral isotonic alkalinizing electrolyte solution at 60 mL/kg at 0 h, 8 h, and 16 h. Group LRS (Lactated Ringers) received isotonic lactated Ringers solution at an aggressive shock resuscitation rate (80 mL/kg/h) for one hour continued at a maintenance fluid rate (4 mL/kg/h) for the next 7 hours. Intravenous fluid administration was discontinued at 8 h, and oral isotonic alkalinizing electrolyte solution (same as above, 40 mL/kg) administered at 8 h and 16 h (3.6 mM Na/kg at each feeding).

Cardiac output, heart rate, respiratory rate, mixed venous blood gas tension and blood pH; hematocrit; plasma lactate; serum biochemical analysis; fetlock and blood temperature; urine volume; mean central venous pressure; clinical hydration; and depression status were determined before induction of diarrhea (baseline), when severely dehydrated (t=0), and at 15, 30 minutes, 1 hour, 8 hours, and 24 hours after treatment. Plasma volume, extravascular space and body weight were determined at baseline, t=0, and 24 hours after treatment.

RESULTS AND DISCUSSION

Clinical changes in calves after 48 hours of osmotic diarrhea were severe watery diarrhea, profound depression, and marked dehydration (mean, 14 percent body weight). Cardiac output decreased from 8.8 to 3.9 L/min, plasma volume decreased from 3.4 to 2.5 L, serum potassium concentration increased from 4.8 to 6.4 mEq/L and plasma lactate concentration increased from 1.1 to 2.8 mEq/L. Fetlock temperature decreased from 34 C to 27 C. Calves in the control group remained depressed and dehydrated during the 24 h treatment phase. Group HSD had an 84 percent increase in cardiac output, 27 percent increase in plasma volume and a decrease in serum potassium concentration. Group LRS had an 61 percent increase in cardiac output, 15 percent increase in plasma volume and a response similar to HSD in serum potassium concentration. Although a positive response was seen in both groups, the response was more sustained in the HSD group.