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Original Research

Enteral Electrolyte Solutions With Different Osmolarities: Clinical and Laboratory Assessment in Equines

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ABSTRACT

This study assessed and compared the effects of enteral electrolyte solutions with different osmolarities, administered using a nasoesophageal probe of small caliber with continuous flow, on clinical and laboratory parameters in healthy equines. Six adult females were used in two simultaneous 6 × 3 Latin squares with a mixed model. The animals were divided into three groups and submitted to each of the following treatments: SEDext: 5-g NaCl, 0.5-g KCl, 200-mg magnesium pidolate, 1-g calcium gluconate, and 10-g dextrose, dissolved in 1,000-mL water (osmolarity measured: 228 mmol/L); SEMalt: 5-g NaCl, 0.5-g KCl, 200-mg magnesium pidolate, 1-g calcium gluconate, and 10-g maltodextrin dissolved in 1,000 mL water (osmolarity measured: 181 mmol/L); SEProp: 5-g NaCl, 0.5-g KCl, 200-mg magnesium pidolate, and 10-g calcium propionate, dissolved in 1,000-mL water (osmolarity measured: 282 mmol/L). The electrolyte solution was administered in a dose of 15 mL/kg/h for 12 hours with continuous flux using a nasoesophageal probe, with food and water restriction. SEMalt and SEDext were effective in expanding blood volume, increasing intestinal motility, and decreasing urine density, whereas the SEProp caused abdominal distention, discomfort, and diarrhea in 50% of the animals, in addition to promoting less effect on the expansion of plasma volume and intestinal motility.

1. Introduction

Dehydration is a clinical sign that usually accompanies most diseases that affect equines. Owing to this fact, hydration is an important therapeutic resource used daily in medical practice. Administration of large volumes of fluids via a nasogastric tube in horses has shown to be effective to maintain vascular volume, cardiovascular performance, and perfusion and oxygenation of the tissues, as well as to correct electrolytic and acid–base imbalances [1]. For this reason, hydration is considered useful and its lack can determine the boundary between the maintenance of life and death [2].

Sometimes, the diseases determine the emergence of inappetence and anorexia or, in some cases, the patient needs to remain without food intake for a certain period, which can cause hypoglycemia. In such cases, it becomes appropriate to add energy precursor substances to electrolyte solutions [3].

The use of hypotonic electrolyte solutions associated with enteral hydration in equines is still little studied. In Brazil, there are some commercial veterinary products of electrolyte solutions for enteral use, and few of them are recommended for equines. It is worth noting that most of these products have not been tested experimentally in

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animals of this species. However, recently, a study conducted by Ribeiro Filho et al [4] demonstrated that the use of hypotonic enteral electrolyte solutions associated with energy sources in horses is safe and effective.

Given the great importance of this therapeutic modality, the development of electrolyte solutions with different osmolarities and energy sources that reverse electrolyte and hypoglycemia imbalance will be of great value, without causing the emergence of adverse effects. The goal of this study was to evaluate systemic, enteric, and renal effects of enteral electrolyte solutions with different osmolarities and energy sources administered with continuous flow using nasoesophageal probes of small caliber in healthy equines.

2. Materials and Methods

This experimental design was submitted to the Ethics Committee of the Veterinary Department at the Federal University of Viçosa, and it was approved under protocol no. 05/2010.

Six healthy equines were used in the study. They were crossbred nonpregnant females aged 1.5 to 2.5 years, with good body score [5], and mean body weight was 290.5 kg (range, 258–330 kg). The animals had been free of illness in the last 6 months before the study. The control of ectoparasites (0.025% deltamethrin) and endoparasites (praziquantel + ivermectin) was performed one week before the experiment after clinical and laboratory assessment. The equines were housed in individual box stalls for adaptation to a diet with water and coastcross hay (*Cynodon dactylon*) and received commercial concentrated ration in the proportion of 1% of body weight twice a day and 50 g/day of mineral supplement. During the experimental phase, the average temperature had been 26°C and the relative humidity was 72%.

The animals were randomly distributed into three groups, each with six animals. A 6 × 3 cross-over design was carried out (six animals × three treatments). The interval between periods of treatment was 7 days (Table 1). The treatments were established as follows: the SEDext group was treated with electrolyte solution containing 5-g NaCl, 0.5-g KCl, 200-mg magnesium pidolate, 1-g calcium gluconate, and 10-g dextrose, dissolved in 1,000-mL water (osmolarity measured: 228 mmol/L); the SEMalt group received electrolyte solution containing 5-g NaCl, 0.5-g KCl, 200-mg magnesium pidolate, 1-g calcium gluconate, and 10-g maltodextrin, dissolved in 1,000-mL water (osmolarity measured: 181 mmol/L); and the SEProp group received electrolyte solution consisting of 5-g NaCl, 0.5-g KCl, 200-mg of magnesium pidolate, and 10-g calcium propionate, dissolved in 1,000-mL water (osmolarity measured: 282 mmol/L). The enteral electrolyte solutions were administered at a dose of 15 mL/kg/h using a nasoesophageal probe of small caliber with continuous flow.

Table 1
Distribution of the animals in each treatment.

Period	Animals	Treatments
First period	1 and 2	SEDext
First period	3 and 4	SEMalt
First period	5 and 6	SEProp
7-Day interval		
Second period	5 and 6	SEDext
Second period	1 and 2	SEMalt
Second period	3 and 4	SEProp
7-Day interval		
Third period	3 and 4	SEDext
Third period	5 and 6	SEMalt
Third period	1 and 2	SEProp

For the laboratory tests, the blood was collected after antisepsis through jugular venipuncture, using needles and vacutainer tubes with EDTA to measure total plasma protein and hematocrit. The total plasma protein was determined using the refractometry technique, whereas the hematocrit was determined by microhematocrit method. The feces were collected from the rectal ampoule. Subsequently, they were weighed, placed in aluminum trays, and placed in an oven at 60°C for dehydration. The feces were then weighed daily until there were no changes in their weight. The moisture content of the feces was calculated by the formula: moisture (%) = [(fresh weight − dry weight)/fresh weight] × 100.

Urine samples were collected in 60-mL collector bottles using a Foley (No. 32 Foley probe; Rusch Inc, Malaysia) probe introduced into the bladder through the urethra and analyzed immediately. A refractometer (Cat No. 315, Atago Urine Specific Gravity Refractometer; Atago Co., Ltd, Japan) was used to determine the urine density, whereas the pH was measured by pH meter (pH Calibration; Hanna Instruments Brasil, São Paulo, Brasil) and the urinary glucose was determined using a reagent strip (reagent tape for urinalysis; Combina 115, Human, Wiesbaden, Germany). The clinical assessment included the following: rectal temperature (°C); heart rate, measured with a stethoscope during 1 minute (beats per minute); respiratory rate, assessed by observing the movements of the abdomen during 1 minute (movements per minute); capillary filling time, obtained by counting seconds, observing the total filling of the gingival mucosa above the upper incisor teeth, immediately after the mucosa received a digital pressure; abdominal contour, measured with a tape adjusted to the perimeter of the paralumbar fossa region; body weight (Búffalus; Balanças do Brasil [Brazilian scales], Londrina, Paraná, Brazil), measured using a scale with a weighing capacity of 1,000 kg; and intestinal motility, assessed with the stethoscope in the upper and lower abdominal flanks, observing the intensity and frequency of borborygmus, classified into the following scores: atony (0); hypomotility (1); normal motility (2); and hypermotility (3).

Clinical and laboratory assessments were always performed at the following intervals: T0 hours (7:00 AM)—immediately before hydration; T6 hours (1:00 PM)—6 hours of hydration; T12 hours (7:00 PM)—12 hours and termination of hydration; and T24 hours (7:00 AM)—12 hours after the end of hydration.

The analysis of variance based on planning of repeated measures was used to assess the effect of the treatments, that is, each treatment was assessed in several monitoring times. The influence of time and the interaction between treatment and time were assessed. Tukey's test was used [6] when the assessments were significant to one or more