

Proceeding of the NAVC
North American Veterinary Conference
Jan. 8-12, 2005, Orlando, Florida



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FLUID THERAPY IN ADULT CATTLE

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INTRODUCTION

Fluid therapy in adult ruminants is often difficult to accomplish because large volumes are needed, animals must be restrained, proper therapy can be very time consuming, and monitoring is often impossible. For these reasons, fluid therapy is often avoided in adult ruminants, however there are clinical situations where either oral or intravenous fluids are necessary and cannot be avoided.

INDICATIONS FOR AND PRINCIPLES OF FLUID THERAPY IN ADULT RUMINANTS

Obviously the most common indication for fluid therapy in adult ruminants is to correct dehydration that can occur as a sequella to any number of primary conditions. However accurately predicting the degree of dehydration in adult ruminants is often difficult. A well designed study has been published demonstrating the eyeball recession and skin tent duration are the most accurate indicators of dehydration in neonatal calves and provides validation for estimating the percent dehydration based on extent of eyeball recession or duration of skin tent.² Unfortunately this type of study does not exist in adult ruminants and therefore we can only roughly estimate the extent of dehydration as follows:

Mild dehydration (6-8%)	slight eyeball recession, skin tent slightly prolonged (2-4 seconds), mucous membranes moist
Moderate dehydration (8-10%)	eyes obviously sunken, skin tent obviously prolonged (4-8 seconds), mucous membranes tacky
Severe dehydration (10-12%)	eyes severely sunken into orbits, skin remains tented indefinitely, mucous membranes dry

When treating dehydrated cattle, the practitioner must not focus solely on correcting the degree of dehydration, but must also consider the animal's maintenance fluid requirements. Non-lactating cattle require at least 50 ml/kg of water per day for maintenance and lactation adds to the requirement depending on the cow's production level.⁶

We must also remember that adult ruminants rarely develop metabolic acidosis. In a study of over 500 cattle older than 1 month of age, blood gas and serum electrolyte analyses determined that 60% of dehydrated animals had a normal blood pH with most of the remaining cattle exhibiting a metabolic alkalosis.⁵ Therefore alkalinizing fluids (such as lactated Ringer's or sodium bicarbonate) or oral electrolyte solutions containing alkalinizing agents (bicarbonate) are rarely indicated in adult ruminants except in cases of grain overload, hepatic lipidosis, and in occasional cases of choke (excessive salivation leads to bicarbonate loss) and severe gastrointestinal disease (small intestinal strangulation, mesenteric torsion, etc).

ORAL FLUIDS

Oral electrolyte solutions have classically been used to replace fluid losses and correct electrolyte abnormalities in adult ruminants because they are cheap and easy to administer on-farm. Since most dehydrated cattle have a metabolic alkalosis, it is important to use a non-alkalinizing oral electrolyte solution that does not contain bicarbonate, acetate, or propionate. We generally don't attempt to correct an alkalosis by administering acid, instead our goal is to provide extracellular anions in relative excess to cations.⁶ In practice, this is accomplished with chloride-rich, high potassium solutions. By simply adding NaCl (7 grams/L), KCl (1.25 grams/L) and CaCl₂ (0.5 grams/L) to a liter of water (or 140 grams NaCl, 25 grams KCl, and 10 grams CaCl₂ in 20 liters or roughly 5 gallons of water), a non-alkalinizing oral electrolyte solution for adult ruminants can be created that will effectively rehydrate animals without alkalinizing the blood pH. Most of the commercial oral electrolyte solutions made for cattle are designed for dehydrated calves which typically have a metabolic acidosis. The majority of these products contain bicarbonate and are not indicated for use in adult ruminants.

INTRAVENOUS FLUID THERAPY

In cases of moderate to severe dehydration or with specific electrolyte abnormalities, intravenous fluid therapy is indicated. Although it is frequently avoided in adult ruminants due to reasons listed above, there are certain clinical situations for which there is no substitute. Fluid types commonly used in adult ruminants include:

1) Saline or Ringer's solution - In cases of severe dehydration, these isotonic, non-alkalinizing solutions are generally recommended for replacement of large fluid volumes in adult ruminants.⁶

If mild to moderate hypokalemia is present, potassium chloride can be added at a rate of 20 to 40 mEq/L during routine fluid administration (1 gram of KCl contains 14 mEq of K⁺)

If mild to moderate hypocalcemia is suspected, a 500 ml bottle of calcium gluconate can be added to 20 liters of fluids intended for intravenous administration.

2) Hypertonic saline - Saline - Over the past 10 years we have discovered that hypertonic saline (2400 mOsm/L) can be used to rapidly expand plasma volume in a severely dehydrated animals. When combined with oral electrolyte solutions or oral water (without added electrolytes), this approach can be extremely effective in rehydrating dehydrated cattle and is much easier to administer than volumes of isotonic fluids. Adult ruminants have a large water reservoir (rumen) that enables the animal to go without water for days and then rapidly rehydrate without any negative effects.³ The main force for water movement across the rumen wall is the gradient of osmolality between ruminal fluid (which is normally isotonic to plasma) and blood perfusing ruminal epithelium.¹ This is the basic principle of hypertonic saline. Basically we increase plasma osmolality in adult ruminants with the administration of hypertonic saline while simultaneously decreasing rumen osmolality through oral administration of water of a hypotonic oral electrolyte solution containing sodium. The increase in osmolar gradient across the rumen wall following this combined treatment will cause a large movement of water from the rumen into the extracellularspace, thereby expanding the plasma volume and correcting dehydration.³

Hypertonic saline solutions can be purchased commercially in 1000 ml containers and should be given to ruminants at 4 to 5 ml/kg administered slowly over a 4 minute period (approximately 2 liters for an adult cow). Cattle should be immediately given a supply of fresh water after treatment and most animals will drink 5-10 gallons over the next 10 minutes. Cattle that do not drink water within 10 minutes of hypertonic saline should have 5 gallons of water pumped into their rumen. Hypertonic saline should never be given alone without providing the animal fresh water to drink or ororumenal administration of water. This protocol has been shown to be safe and effective for the correction of dehydration in adult cattle.^{5,8,9}

3) Dextrose - Often indicated for cattle in early lactation with severe ketosis, hepatic lipidosis, or hypoglycemia. Glucose as a 5% solution can be administered at a slow rate for several days, however this delivers free water and can cause dilution of serum electrolytes. In general, it is preferable to add 2.5 to 5% glucose to a non-alkalinizing fluid type (ie. Ringer's) and administer a slightly hypertonic solution than to administer isotonic dextrose by itself.

4) Isotonic potassium chloride - Only used for severe hypokalemia in cattle (serum K⁺ concentration <2.3 mEq/L) with severe muscle weakness or recumbency. This is usually seen in dairy cattle following the administration of isoflupredone acetate (Predef[®]), a corticosteroid used to treat ketosis in lactating cows. Isoflupredone acetate has been shown to have mineralocorticoid activity and has been associated with severe hypokalemia in cattle following multiple or higher than recommended doses.⁷ Recommended treatments involve the intravenous administration of isotonic potassium chloride (11.5 grams of potassium chloride per liter of sterile water) at a rate of 4 ml/kg/hour. Combined with large doses of oral potassium salts (ie. 200 grams of KCl per day), the hypokalemia can be rapidly corrected.

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