

Fluid Therapy in Calves

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KEYWORDS

• Fluid therapy • Calves • Diarrhea • Strong ion acidosis

KEY POINTS

- Early and aggressive fluid therapy is critical in correcting the metabolic complications associated with calf diarrhea in order to avoid deaths.
- Oral electrolyte therapy can be used with success in calves, but careful consideration should be given to the type of oral electrolyte used.
- Electrolyte solutions with high osmolalities (>650 mOsm/L) have been shown to significantly slow abomasal emptying and can be a risk factor for abomasal bloat in calves.
- Milk should not be withheld from calves with diarrhea for more than 12 to 24 hours.
- Hypertonic saline and hypertonic sodium bicarbonate can be used effectively for intravenous fluid therapy on farms when intravenous catheterization is not possible.
- A simplified fluid therapy protocol using only 5-L bags of saline and 8.4% hypertonic sodium bicarbonate provides optimal resuscitation for both beef and dairy calves with diarrhea, dehydration, and moderate to severe acidosis.

Neonatal diarrhea remains the most common cause of death in both beef and dairy calves. Despite significant progress in understanding the pathophysiology of neonatal diarrhea, it continues to be a major cause of economic loss to the cattle industry. A complete review of the pathophysiology of diarrhea is beyond the scope of this article and has recently been covered elsewhere in the literature.¹ Some pathogens cause secretory diarrhea, causing the small intestine to move from a net absorption of fluid to a net secretion of chloride, sodium, and water into the intestinal lumen. This increase in secretion overwhelms the absorptive capacity of the large intestine, resulting in diarrhea. Other pathogens damage the small intestinal villi, which results in failure to absorb electrolytes and water (malabsorptive diarrhea). However, regardless of the pathogen or the mechanism involved, diarrhea increases the loss of electrolytes and water in the feces of calves and often decreases milk intake. This process results in dehydration, strong ion acidosis, electrolyte abnormalities (usually decreased sodium and increased or decreased potassium), increased D-lactate concentrations,

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and a negative energy balance (from anorexia and malabsorption of nutrients). Therefore diarrhea is by far the most common indication for fluid therapy in neonatal calves. The primary goals of treating calf diarrhea are as follows:

1. Correct free water and electrolyte abnormalities
2. Correct acid-base deficits (acidemia)
3. Provide nutritional support
4. Eliminate and/or prevent *Escherichia coli* bacteremia.

Three of these 4 goals can be met with fluid therapy. This article provides an overview of fluid therapy in calves with particular emphasis on treating diarrhea. Practical options for fluid therapy that can be performed on the farm are emphasized.

ORAL ELECTROLYTE THERAPY

According to the World Health Organization (WHO), the development of oral rehydration therapy was one of the most significant advances in human medicine of twentieth century. Oral electrolyte solutions also continue to serve as the backbone of treatment protocols for diarrhea in neonatal calves because they are cheap and easy to administer on farms. Oral electrolyte solutions are indicated in any diarrheic calf that has at least a partially functional gastrointestinal tract. If oral electrolyte solutions are administered to a calf with ileus, the fluid pools in the forestomach, resulting in bloat and rumen acidosis. In general, a calf with any sort of suckle reflex or that shows any chewing action can be considered to safely tolerate oral fluids.

Oral electrolyte therapy in calves was thoroughly reviewed in a previous issue of *Veterinary Clinics of North America: Food Animal Practice*²; however, a brief overview is warranted here. Oral electrolyte solutions were originally developed in human medicine for treatment of diarrhea associated with cholera infection, with the original WHO electrolyte formulation based on the following main principles³:

1. It was an isotonic solution that contained an approximately equimolar mixture of sodium (90 mM/L) and glucose (2%).
2. It contained potassium because of the severe potassium depletion associated with diarrhea and anorexia.
3. It contained glycine to facilitate absorption of sodium, glucose, and water.
4. It contained bicarbonate to correct the metabolic acidosis associated with diarrhea.

Although much research has been done on oral fluid therapy since that time, little progress has been made from the original principles of the 1960s.

Considerable variability exists in the quality of commercial oral electrolyte solutions that are currently available (**Table 1**) and practitioners must put some thought into the product they choose to use in practice. As was eloquently stated in a previous article by Michell and colleagues,⁴ simply recommending oral electrolyte rehydration in this decade is as imprecise as advocating antibiotics would be without considering the drug or condition being treated. There are several important factors to consider when deciding on a product. Current knowledge indicates that an oral electrolyte solution must satisfy the following 4 requirements: (1) supply sufficient sodium to normalize the extracellular fluid (ECF) volume; (2) provide agents (glucose, citrate, acetate, propionate, or glycine) that facilitate absorption of sodium and water from the intestine; (3) provide an alkalinizing agent (acetate, propionate, or bicarbonate) to correct the acidosis usually present in calves with diarrhea; and (4) provide energy, because most calves with diarrhea are in a state of negative energy balance.² A brief discussion of factors to consider when choosing an oral electrolyte solution is warranted.

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