

Fluid Therapy Made Easy: Calves, Kids, and Lambs

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Overview

Does the thought of calculating a fluid rate make you feel like you are back in vet school about to take an exam? This lecture will review the basic concepts of fluid therapy in calves, including rate calculations and some tips to make fluid therapy easy and affordable for your patients.

Goals of Fluid Therapy in Neonatal Animals

- 1) Correct electrolyte imbalances
- 2) Correct acid-base deficits
- 3) Provide energy

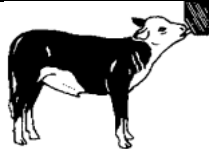
Key Etiologic and Pathophysiologic Points

- **Indications for Fluids in Neonatal Animals**
 - Diarrhea
 - Acidosis
 - +/- hypoglycemia
 - Dehydration/Sepsis
- **Assessment of Dehydration and Acid/Base Status**
 - Mentation
 - Mucous membrane color
 - Pink → Normal
 - Pale → Either Shock or Anemia (check PCV)
 - Bright Pink → Increased capillary circulation
 - Red to Brick Red → Poor capillary perfusion
 - Grey-Blue → Severe shock & cyanosis
 - Tacky or Dry → shock (dehydration)
 - Capillary refill time
 - >2 seconds → shock
 - Pulse quality
 - Heart rate
 - Eyeball recession
 - Losses
 - Diarrhea most commonly in neonatal animals

Guide for estimating dehydration								
% dehydration	0	2	4	6	8	10	12	14
Eyeball recession (mm)	0	1	2	3	4	6	7	8
Skin tent duration (seconds)	2	3	4	5	6	7	8	9

- **Guess and Re-Assess**
 - Initial Plan: Guess
 - % dehydration
 - Maintenance + Ongoing losses
 - Diarrhea
 - Treat Deficit
 - Re-assess

Assessment of Base Deficit Without Bloodwork

Demeanor score	Description		Base deficit of calves $\leq$ 8 days	Base deficit of calves $>$ 8 days
I	Alert, active, normal		0 mmol/L	7 mmol/L
II	Depressed, slow lethargic		5 mmol/L	11 mmol/L
III	Sternal recumbency, suckling reflex absent		12 mmol/L	16mmol/L
IV	Lateral recumbency, suckling reflex absent		13 mmol/L	20 mmol/L

Adapted from: Naylor JM. A retrospective study of the relationship between clinical signs and severity of acidosis in diarrhetic calves. *Can Vet J* 1989;30:577-580.

$$\text{Bicarbonate requirement (mEq)} = \text{body weight (kg)} \times \text{base deficit} \left(\frac{\text{mEq}}{\text{L}} \right) \times 0.6 \left(\frac{\text{L}}{\text{kg}} \right)$$

$$\text{Grams of bicarbonate(mEq)} = \text{mEq bicarbonate} \div 12$$

Rapid Resuscitation

- **IV catheter placement**
 - 14-20g IV catheters (2-5.25 inch)
 - Jugular or auricular
- **Hypertonic Fluids for IV resuscitation**
 - **Rapid effect, low volume**
 - **Hypertonic Sodium Bicarbonate**
 - 8.4% (1mEq/ml)
 - 2000 mOsm/L
 - 5-10mL/kg
 - Follow with isotonic oral or IV fluids
 - **Hypertonic saline**
 - 7.2%
 - 3-5 mL/kg
- **Resuscitation Fluid Rates** → only for rapid resuscitation, not maintenance
 - 30-50cc/kg/hr recommended to avoid overhydration and pulmonary hypertension
 - ~1.2-2L/hr
 - 80ml/kg/hr MAX
 - ~3.2L/hr in a 40lb calf
 - **Equivalent to the blood volume of the animal**
 - **Four ¼ shock boluses**
 - **Add 0 to the BW of the animal in pounds to get ¼ shock bolus**
 - 40lb (88lb) calf = 880ml per ¼ shock bolus

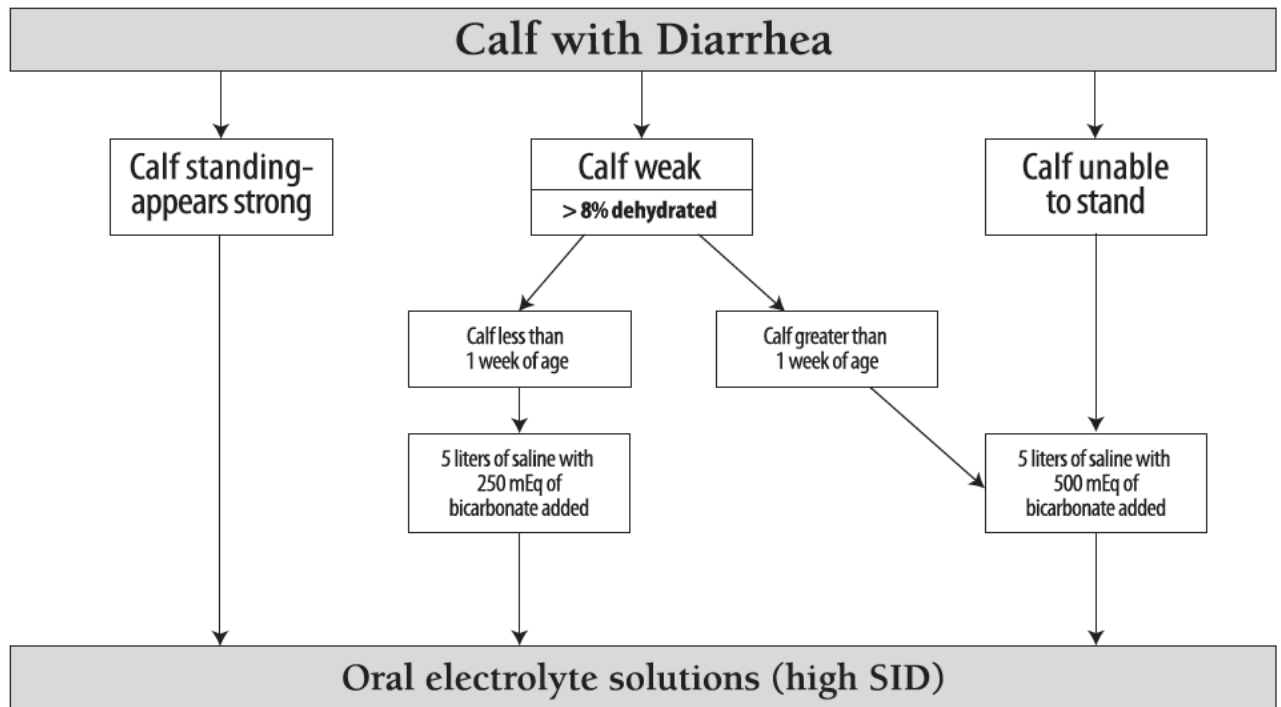
Intravenous Fluids (Maintenance Rate is ~50-100 ml/kg/day or 2-4 ml/kg/hr + ongoing losses)

- **Isotonic sodium bicarbonate (IV)**
 - 1.3%
 - Add 155mEq sodium bicarbonate/liter sterile water
 - Not available commercially
- **0.9% NaCl**
 - Acidifying solution
 - Bicarbonate can be added to provide a slightly hypertonic solution given over several hours

- **LRS**
 - Considered alkalinizing solution as lactate is a metabolizable base
 - Slow action
 - Not recommended in neonates with severe diarrhea
 - D-lactate concentrations may already be increased in these calves
 - Useful for fluid therapy in septic/dehydrated animals
- **Acetated Ringer's**
 - Alkalinizing
 - Quicker action than LRS
 - Does not exacerbate D-lactic acidosis.
- **Dextrose**
 - Add to isotonic fluids @ rate of 50-100mL of 50% dextrose solution to make a slightly hypertonic solution for rehydration
 - This will make a 2.5-5% dextrose solution
 - Plain 5% dextrose (D5W) not sufficient to correct ECF deficits in dehydrated animals

Maintenance Fluids (Oral)

- Oral fluid therapy continues to be extremely important in the treatment of sick neonatal small ruminants due to the fact that it is both inexpensive and easily done on farm.
- Solutions should have high SID and 50-80 mmol/L of an alkalinizing agent (acetate, bicarbonate)
 - **There are many commonly available commercial oral electrolyte solutions for calves**
 - **These solutions may also be fed to small ruminant neonates**
 - **All products are not created equal**
- Feed oral electrolytes as extra meals to calves
 - DO NOT hold calves with diarrhea off feed
 - Even hypertonic oral electrolyte products with high glucose concentrations cannot meet maintenance and growth requirements of a calf
 - If calf refuses to suckle, can hold off for one feeding (12 hours) and replace with an oral electrolyte solution



From: Smith GW, Berchtold J. Fluid therapy in calves. *Vet Clin North Am Food Anim Pract* 2014;30:409-427, vi.

- **Home Brews**
 - Used distilled water for IV use
 - Sterile/non-pyrogenic
 - Weigh out salts and store in zip-loc bags
 - Mix when needed

Component	Amount
NaCl	7g/L
KCl	1.25g/L
CaCl ₂	0.5g/L

- Isotonic Saline (0.9%)
 - Non-Iodized Table Salt
 - 9 g per liter
 - 34 g per gallon
- Hypertonic Saline
 - 72g NaCl per liter
- Isotonic Sodium Bicarbonate (1.3%)
 - Baking Soda (NaHCO₃)

- 13 g (13cc) per liter
 - 50 g (50cc) per gallon
- Potassium Supplementation
 - Animals with diarrhea lose potassium in feces. However, in acute cases of diarrhea, calves may have increased blood potassium concentrations despite a total body deficit. This will correct as dehydration and acidemia are corrected.
 - Additional 10-40 mEq K⁺/L
 - Fluid Rate Dependent
 - **NO MORE THAN 0.5mEq/kg/hr**

Plasma Transfusion

- Failure of Passive Transfer
 - Serum protein <5.2g/dl (plasma <5.8 g/dl)
 - Serum protein < 5.5 g/dl in sick calves
 - 20-40 ml/kg IV for FPT
- Hypoproteinemia
- Sepsis
- DIC
- Rate 5-20 ml/kg/hr
 - Up to 50ml/kg/hr

Whole Blood Transfusion

- Need higher volume than plasma if using to treat FPT

Selected References

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