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
<table>
<thead>
<tr>
<th>% dehydration</th>
<th>0</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
<th>12</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eyeball recession (mm)</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Skin tent duration (seconds)</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
</tbody>
</table>

**Guide for estimating dehydration**

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

**Assessment of Base Deficit Without Bloodwork**

<table>
<thead>
<tr>
<th>Demeanor score</th>
<th>Description</th>
<th>Base deficit of calves ≤ 8 days</th>
<th>Base deficit of calves &gt; 8 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Alert, active, normal</td>
<td>0 mmol/L</td>
<td>7 mmol/L</td>
</tr>
<tr>
<td>II</td>
<td>Depressed, slow lethargic</td>
<td>5 mmol/L</td>
<td>11 mmol/L</td>
</tr>
<tr>
<td>III</td>
<td>Sternal recumbency, suckling reflex absent</td>
<td>12 mmol/L</td>
<td>16 mmol/L</td>
</tr>
<tr>
<td>IV</td>
<td>Lateral recumbency, suckling reflex absent</td>
<td>13 mmol/L</td>
<td>20 mmol/L</td>
</tr>
</tbody>
</table>

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

**Grams of bicarbonate (mEq) = mEq bicarbonate ÷ 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
  o 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
  o Useful for fluid therapy in septic/dehydrated animals
• Acetated Ringer’s
  o Alkalinizing
    ▪ Quicker action than LRS
  o Does not exacerbate D-lactic acidosis.
• Dextrose
  o 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 and 50-80 mmol/L of an alkalinizing agent (acetate,
  bicarbonate)
  o 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
  o 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
Calf with Diarrhea

Calf standing-appears strong

Calf weak >8% dehydrated

Calf unable to stand

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

<table>
<thead>
<tr>
<th>Component</th>
<th>Amount</th>
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<tbody>
<tr>
<td>NaCl</td>
<td>7g/L</td>
</tr>
<tr>
<td>KCl</td>
<td>1.25g/L</td>
</tr>
<tr>
<td>CaCl₂</td>
<td>0.5g/L</td>
</tr>
</tbody>
</table>

- 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