Clostridial abomasitis and bloating in calves

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Clostridium spp. are anaerobic bacteria
- They are everywhere.
- They grow and cause problems when their environment switches from an oxygen-rich to an oxygen-deficient environment.

Clostridial spores = Survival state when Clostridium sp. reside in oxygen
**Clostridial abomasitis and bloating in calves**

- Abomasum is the “true” stomach of cattle and is similar to the human stomach.
- Abomasitis is the term used to describe an infected abomasum.
- Infected abomasum are often ulcerated.

**Clostridial abomasitis and bloating in calves**

- Bloat is excessive distention of a stomach with gas.
- Rumen bloating is more common than abomasal bloating, but **rumen bloat IS NOT abomasal bloating**.
- Rumen bloat can sometimes be relieved by passing a tube
- Abomasal bloat should not be relieved by passing a tube
- Abomasal bloat can rupture = peritonitis = death
Better titles:
Bacterial stomach infections and excessive stomach gas in calves
Or..
Food poisoning in calves

Normal bovine abomasum
Normal calf abomasum: Normal milk clots and whey

7-day-old calf: Found dead
10-day-old calf: Bloated and died overnight

Infected stomach wall - Abomasitis
Normal bovine abomasum

Abomasal (stomach) contents
What exactly is this??
New disease?....Unlikely.

- *Clostridium perfringens* type A is found in the intestines of nearly all warm-blooded healthy and sick animals.
- *Clostridium perfringes* type A is found in soil, dust, contaminated feeds, etc.
- Experimental reproduction of the disease is difficult and inconsistent.
  - Feeding high levels of *Clostridium perfringes* to healthy calves doesn’t cause disease.

What to do??...Treatment?

- Antibiotics
  - Oral Penicillin
- Relieve gas
  - Oral tube won’t get to the abomasum
- Vaccinate?
- Clean, clean, clean?
- Blame ‘management’?
The goal of Clostridial vaccination is to have the animal to produce and immune response and make antibodies that neutralize (bind) the bacterial toxins.

- Generally speaking, this works well.
- Clostridial vaccines WILL NOT
  - Prevent livestock from consuming Colostral spores
  - Prevent the creation of an anaerobic (Clostridial) environment
  - Prevent Clostridium from growing in the anaerobic environment
  - Prevent Clostridial gas production and bloating
- Vaccines are good at targeting the toxin.

**Clostridium perfringens**

<table>
<thead>
<tr>
<th>Type</th>
<th>Major Toxin</th>
<th>Disease of....</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type A</td>
<td>Alpha</td>
<td>Stomach and intestines, “food poison”</td>
<td>The bacteria is widespread. Toxic effects of alpha toxin are inconsistent</td>
</tr>
<tr>
<td>Type B</td>
<td>Alpha, Beta &amp; Epsilon</td>
<td>Intestines of lambs, calves and foals</td>
<td>The beta toxin is consistently lethal</td>
</tr>
<tr>
<td>Type C</td>
<td>Alpha &amp; Beta</td>
<td>Intestines of pigs, birds, lambs, calves, goats and foals</td>
<td>Well controlled in sheep with “C + D vaccines.” Occasionally diagnosed in pigs. Rare in cattle</td>
</tr>
<tr>
<td>Type D</td>
<td>Alpha &amp; Epsilon</td>
<td>Intestines of lambs and goats</td>
<td>“Pulpy kidney” in lambs, well controlled by vaccination. The epsilon toxin is lethal</td>
</tr>
</tbody>
</table>
**Clostridium perfringens type A and the alpha toxin**

- Alpha toxin
  - When the alpha toxin is injected in to mice, it’s not always lethal
  - Mild when compared to beta and epsilon toxin
- Beta and Epsilon toxin
  - Much more lethal than the alpha toxin
  - Well controlled by vaccination (C and D) vaccines in sheep
  - Rarely diagnosed in cattle
- Upon examination, calves ultimately die of **bloat**, **ulceration**, **septicemia** and and/or **abomasal perforation** associated with the retention of “bacterial soup” and not alpha toxin damage.

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**What to do??...Consult the List**

**One, or more, are potential causes...**
1. Contaminated colostrum and/or milk (*Bacterial soup*)
2. Improperly mixed (hyperconcentrated) milk replacer
4. Improperly mixed (hyperconcentrated) electrolytes
5. Excessive oral supplements, probiotics, & antibiotics
6. Heat-damaged milk from pasteurization
7. Poorly digestible, plant-based milk replacers
8. Erratic feeding schedules (9 AM and 4 PM)
#1: Contaminated colostrum, milk or milk replacer

- Newborn calves make little stomach acids to kill bacteria.
- Colostrum and milk are an ideal media for bacteria.
- If calves are dying in the first 5 days, I usually suspect failure of passive transfer and/or consumption of contaminated colostrum or milk ("bacterial soup")
- CALVES CAN NOT VOMIT, if they could, they would.

#2 – Improperly mixed milk replacers.

- Calves need water to digest milk solids
  - ↑Water = ↑oxygen = ↑digestion = ↓no Clostridium
  - ↓Water = ↓no oxygen = ↑Clostridial digestion
  - In the absence of water (and oxygen)
  - Clostridium sp. digest the milk, then the abomasum = infection = bloat/perforation = dead.
Whole milk vs. 20:20 vs. Accelerated

<table>
<thead>
<tr>
<th>BF %</th>
<th>Pro</th>
<th>O/S</th>
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<tr>
<td>3.89</td>
<td>3.01</td>
<td>5.77</td>
</tr>
<tr>
<td>3.85</td>
<td>3.04</td>
<td>5.77</td>
</tr>
<tr>
<td>3.85</td>
<td>3.03</td>
<td>5.76</td>
</tr>
</tbody>
</table>

- Bulk tank milk
  - 3.0 % Protein
  - 3.8 % Fat
  - 5.75 % Other solids
  - **12.55 % Solids**
- Already mixed, the ratios remain the same

- 20:20 Replacer
  - 2.1 % Protein
  - 2.1 % Fat
  - 6.3% % Other solids
  - **10.5 % Solids**
  - 8 oz. of powder in **2 quarts** of water

- 26:18 Accelerated
  - 3.6 % Protein
  - 2.3 % Fat
  - 7.0 % Other solids
  - **13.0 % Solids**
  - 14.4 oz. of powder in **3 quarts** of water

Considerations when increasing calories.

- Feed more, properly mixed milk replacer
- Replace your 2 quart nipple bottles with 3 quart bottles
- Add digestible fat to increase calories without increasing the osmolarity
  - Fat does NOT need extra water (and oxygen) for digestion
  - Fat is 2.5X more energy dense that sugars and proteins
  - Generally speaking, *Clostridium sp.* do not digest fats
#3: Water problems

- Offering free-choice water might not resolve the problem.
  - Water freezes
  - Small calves may not reach the water in the bucket.
    - 24 inches from the ground to top of bucket to bottom of bucket.
  - Are calves smart? Do they know they should drink water?
    - Make the decision for them and put the water with the replacer.

#4: Electrolytes

- Electrolytes are “salts”
  - Sodium, chloride, potassium, etc.
- Wherever salts go, water follows
- The “saltyness” of a solution is measured and reported as Osmolarity.
- Osmolarity of various fluids.
  - Milk ~ 300 mOsm/L
  - Gatorade ~ 300 mOsm/L
  - Blood serum ~ 300 mOsm/L
  - Sea water ~ 800 mOsm/L
- **Sugars** and **Protein** also act like **Salts** and “pull fluids”
  - Sugar on strawberries = juice
- **Fat** does **not** act like a salt and does not “pull fluids”
Osmolarity or “saltyness” of these electrolytes ranges from 245 to 739 mOsm/L (If they are mixed with the proper amount of water as directed on the label).

Osmolarity and abomasitis

- Excessive osmolarity (or saltiness) of oral fluids can quickly dehydrate a young calf
  - Salty fluids pull water and can cause diarrhea.
  - Dehydration is a loss of water, electrolytes, and oxygen
  - ↓ of Water = ↓ of oxygen = ↑ risk of Clostridial growth
- Excessive osmolarity can also slow the GI flow and “stall” the movement of nutrients in the intestines.
#5: Excessive oral supplements, probiotics & antibiotics

- Anything added to milk and milk replacer has the potential to increase the osmolarity.
- Excessive oral, and extralabel, antibiotics can
  - Increase the osmolarity
  - Disrupt the normal bacterial flora
  - In some cases, lead to fungal stomach infections.
- Example:
  - Electrolyte (Entrolyte H E) + Antibiotic (Baytril*) = Osmolarity 913
  *Extra-label use of Baytril is prohibited
  - Similar problems have been seen with excessive amounts of oral tetracyclines.

#6. Heat-damaged milk from pasteurization

#7. Poorly digestible, plant-based milk replacers

- If a calf can’t digest the proteins and sugars, Clostridium sp. might
- Feed an all-milk replacer for at least 2 weeks.
Quick On-Farm “Fix”

- Calf heath problems?
  - Feed 3 quarts/feeding of whole milk from a healthy cow.
  - Add a colostrum cube from a rota/corona vaccinated cows to control viruses
  - Discontinue all supplements...simple is good
- Scared? Try it bull calves.

Still Having Problems?

- Create sentinel calves.
  - Sentinel – A calf the you are OK to sacrifice for testing
- Do not treat and have the vet euthanize, necropsy and submit a full set of tissues to the lab.
  - Alternatively, drive the live calf to the D-lab.
Summary

- *Clostridium* spp. bacteria are commonly isolated from the stomachs of calves with abomasal bloat.
- *Clostridium* spp. appear to thrive because we’ve created an enviroment for anaerobic growth
  - No water = no oxygen = Clostridial growth
- Calf bloating and death is a syndrome with multiple potential causes, **consult the list of 8.**
- If changes don’t resolve the problem
  - Consider feeding whole cows milk and colostrum cubes
  - Consider sacrificing sentinel calves for diagnostic tests

References:

2. Songer JG, Miskimins DW; *Clostridial abomasitis in calves: Case report and review of the literature*. Anaerobe. 2005 11, 290-294
3. Daly R; *Clostridium perfringens infections in baby calves*. SDSU Extension Extra 11022. 2007
4. Britt J; *They were killing their calves*. Minnesota Dairy Health Conference Proceedings, 2006