MVDL Bovine Updates 2014

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Four topics

• Hemorrhagic Bowel Syndrome (HBS)
• Protein, Albumin and Cow Health
• Non-hardware, chronic fibrous epicarditis in dairy cows
• Updates on Bovine Coronavirus.
Hemorrhagic Bowel Syndrome

HBS Background

- Sporadic intestinal disease of milking cow also known as “bloody gut” and “jejunal hemorrhagic syndrome.”
  - Reported as far back as 1966.
- Blood clots obstruct and enlarge the intestines
  - Serum chemistry is consistent with obstruction: High glucose, high magnesium, low sodium, low potassium and low chloride.
  - Fatality rate ~85%
Clostridium perfringens type A

- *Clostridium perfringens* type A was isolated in 85% of HBS cases (Dennison, JAVMA, 2002)
  - Don’t know if the organism is involved in the primary disease process or if it proliferates as a secondary response
- Other proposed risk factors are (APHIS Dairy 2002)
  - Increasing milk production
  - High-energy TMR
  - Decreasing dietary fiber
HBS cases by herd size and milk production

VDL observations in cattle with HBS

• In 4 of the last 6 cows I posted with HBS I could physically feel gravel and dirt in the feces.
  – Upon analysis, ash content of the feces was >20%.
  – 10% fecal ash is ‘normal.’
• Other cows had no feces, just blood clots.
• Excessive dirt consumption can result in a wide range of stomach and intestinal problems. Not all cows with “dirtosis” develop HBS, but excessive dirt consumption appears to be an additional risk factor.
HBS and Dirt (Dirtosis?)
Dairyland Labs data 2013

<table>
<thead>
<tr>
<th>Feed</th>
<th>Total Ash Range</th>
<th>Mean Ash</th>
<th>Ca, K, Phos, etc.</th>
<th>Dirt?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa haylage</td>
<td>8-14%</td>
<td>11%</td>
<td>5.5%</td>
<td>6%</td>
</tr>
<tr>
<td>Corn silage</td>
<td>1-7%</td>
<td>4%</td>
<td>2.2%</td>
<td>1.8%</td>
</tr>
<tr>
<td>Grass hay</td>
<td>5-15%</td>
<td>10%</td>
<td>3.3%</td>
<td>7%</td>
</tr>
</tbody>
</table>

The amount of soil and dirt included in these feeds ranged from 2 – 13%

Sources of excessive dirt

- Haylage harvest. Wet heavy windrows that lie on wet soil will collect dirt. Short stubble and merging windows will compound the problem.
- Mud and dirt tracks from tractor tires and the feed wagon that is pushed into the feed bunk during push-up.
- Dirt, clay and gravel from bunker floors and walls that gets mixed into the feed.
- Dirt and gravel from under Ag Bags.
- Lodged, or silt-covered flooded corn that is chopped for silage.
- Empty bunk syndrome. Hungry, aggressive cows that eat sand from freestalls.
Dirt in hay and haylage: Wheel rakes.....aka “dirt” rakes

Windrow mergers: Better than wheel rakes, but the final windrow is big, heavy and pushed between the stuble and sticking to the ground
Dirt and gravel from tire tracks pushing into the feed during push-up.

Earthen bunkers, enough said.
Gravel and dirt mixed into the feed from under Ag Bags

Empty Bunk Syndrome

Producers have observed cows eating sand from free stalls. “Empty bunk syndrome” is noted when pens are overstocked, or during high feed prices when there is little tolerance for refusals (weighbacks). Other causes of pica remain elusive.
Rumen content
Daughter’s 4-H heifer
Abomasum containing gravel

Gravel cuts the pyloric mucosa

Cattle intestines are long. 17 times longer than their body length (>70 feet). Predispose to obstruction?
HBS comparative pathology

• In poultry, consumption of hard-wood shavings is a risk of developing Clostridial enteritis. The mechanism is thought to revolve around trauma to the intestinal lining (‘cut gut’) facilitating Clostridial growth.
• In swine, carbohydrate engorgement after a feed outage (empty feeders) is a risk factor for bloody gut in pigs.
• In lambs, excessive starch consumption is a risk reproducible factor of over-eating disease.

HBS summary

• The etiology of HBS remains elusive, but the following appear to be risk factors.
  – Excessive starch consumption initiated by incomplete mixing, poor formulation and/or sorting.
  – Molds with, or without, mycotoxins
  – Excessive amounts of soil, sand, gravel or dirt mixed in the feed.
    • Gravel and rocks with sharp edges appear problematic
  – Others? Genetics? Breed?
Protein, Albumin & Cow Health

Current Feed Protein Status

- Soybean meal and soybean bi-products have remained expensive.
- Alfalfa hay is expensive or not available.
- Will we have “winter kill” of alfalfa fields?
- Non-traditional by-pass protein sources (RUP) should not expected to fully compensate for degradable (RDP) and rumen microbial protein production.
Ruminant Protein Metabolism 101

- A dairy cow diet is about 16-17% protein
- Approximately 2/3 of the consumed protein is rumen degradable (RDP).
- Approximately 1/3 of consumed protein is bypass, or undegradable (RUP)
- RDP (alfalfa, etc.) → ammonia/urea → microbial “true” protein → SI digestion → albumin production in the liver

What is albumin and why should we care?
**Albumin**

- A large blood protein produced by the liver
- Albumin regulates intravascular and extravascular hydration (oncotic pressure)
  - Low albumin = generalized edema
- Albumin is the “portable liver” and scavenges free radicals preventing tissue and organ damage
- Albumin transports nutrients, vitamins, trace minerals, hormones and fatty acids
- Albumin binds and transports cortisol

**Low albumin (hypoalbuminemia)**

**How bad is bad? (human reference)**

- In humans, low serum albumin levels are an important predictor of morbidity and mortality.
- A meta-analysis of cohort studies found that...
  - A 1.0 g/dL decrease in serum albumin...
    - Mortality was increased by 137%
    - Morbidity increased by 89%.
- Patients with serum albumin levels of less than 3.5 g/dL at 3 months following discharge from the hospital have a 2.6 times greater 5-year mortality than those with a serum albumin levels greater than 4.0 g/dL. (www.emedicine.com)
How does hypoalbuminemia happen?

• Decreased albumin production
  – Primary liver disease involving > 2/3 of liver
  – Malnutrition, lack of dietary protein
    • Slow process. The liver has a about 30 days of reserve.
  – Chronic inflammation

• Increased albumin loss
  – Protein-losing nephropathy
    • Kidney disease, amyloidosis, A/G ratios below 0.5
  – Protein-losing enteropathy
    • Johne’s disease, GI parasitism, Salmonellosis

How do we measure albumin?
Measuring Albumin = Serum chemistry

- Serum chemistry. Marshfield labs does a bovine serum chemistry, including albumin, for $15 per sample.
- Are there clinical signs associated with hypoalbuminemia?
  - “Stocked up” or “puffy” legs (usually all four legs)
  - Edematous brisket
- A refractometer is a poor choice for measuring albumin because it measures both albumin and globulin. If albumin is low and globulin is high, then the total protein will report “normal.”

Case 1: Molds, mycotoxins and hypoalbuminemia
Forages

- Corn silage bunker (35% of the diet)
  - Marginally packed (<15 lb DM per ft²)
  - No “facer”
  - No inoculant
  - Earthen walls
  - Mold crusts were not removed

- Mycotoxin analysis
  - Zearalenone (0.6 ppm), Vomitoxin (0.8 ppm) & Aflatoxin (0.05 ppm) detected in silage

- Mold and Yeast counts not done

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Case 1: Dairy herd feeding moldy corn silage with mycotoxins

<table>
<thead>
<tr>
<th>Clinical App</th>
<th>SDH</th>
<th>AST</th>
<th>GGT</th>
<th>Albumin</th>
<th>Globulin</th>
<th>A/G ratio</th>
<th>BUN</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Normal</td>
<td>89</td>
<td>187</td>
<td>62</td>
<td>3.3</td>
<td>4.1</td>
<td>0.80</td>
<td>12</td>
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<td>20</td>
<td>107</td>
<td>28</td>
<td>3.4</td>
<td>3.5</td>
<td>0.97</td>
<td>8</td>
</tr>
<tr>
<td>3 Normal</td>
<td>38</td>
<td>95</td>
<td>26</td>
<td>3.2</td>
<td>5.3</td>
<td>0.60</td>
<td>13</td>
</tr>
<tr>
<td>4 Normal</td>
<td>11</td>
<td>77</td>
<td>17</td>
<td>3.4</td>
<td>3.1</td>
<td>&gt;1</td>
<td>12</td>
</tr>
<tr>
<td>5 Normal</td>
<td>36</td>
<td>96</td>
<td>43</td>
<td>3</td>
<td>5.1</td>
<td>0.60</td>
<td>9</td>
</tr>
<tr>
<td>6 Normal</td>
<td>41</td>
<td>77</td>
<td>42</td>
<td>3.3</td>
<td>3.6</td>
<td>0.91</td>
<td>9</td>
</tr>
<tr>
<td>7 Normal</td>
<td>41</td>
<td>85</td>
<td>42</td>
<td>3</td>
<td>4.6</td>
<td>0.65</td>
<td>10</td>
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<tr>
<td>8 Normal</td>
<td>26</td>
<td>71</td>
<td>23</td>
<td>3.3</td>
<td>4.3</td>
<td>0.77</td>
<td>12</td>
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<tr>
<td>9 Normal</td>
<td>21</td>
<td>81</td>
<td>29</td>
<td>3.5</td>
<td>3.5</td>
<td>1.00</td>
<td>13</td>
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<tr>
<td>10 Normal</td>
<td>38</td>
<td>149</td>
<td>39</td>
<td>3.6</td>
<td>4</td>
<td>0.90</td>
<td>9</td>
</tr>
<tr>
<td>11 Pneumonia</td>
<td>10</td>
<td>220</td>
<td>18</td>
<td>2.5</td>
<td>4.1</td>
<td>0.61</td>
<td>11</td>
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<tr>
<td>12 Pneumonia</td>
<td>50</td>
<td>148</td>
<td>38</td>
<td>2.8</td>
<td>5.2</td>
<td>0.54</td>
<td>10</td>
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<tr>
<td>13 RDA</td>
<td>45</td>
<td>97</td>
<td>29</td>
<td>2.7</td>
<td>4.1</td>
<td>0.66</td>
<td>16</td>
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</table>

Ref range: 7-23 U/L 48-127 U/L 3-38 U/L 3.2-4.0 g/dL 3.1-5.6 g/dL 0.84-0.94 10-24 mg/dL
Case 2: Neighboring dairy farm feeding moldy haylage.

No mycotoxins were detected. Liver enzymes (GGT and SDH) were normal

<table>
<thead>
<tr>
<th>Cow ID</th>
<th>Clinical Signs</th>
<th>Albumin</th>
<th>Globulin</th>
<th>A/G ratio</th>
<th>BUN</th>
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<tbody>
<tr>
<td>767</td>
<td>Brisket and peripheral edema</td>
<td>3</td>
<td>5</td>
<td>0.60</td>
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<td>757</td>
<td>Poor performance</td>
<td>2.4</td>
<td>5.7</td>
<td>0.42</td>
<td>15 mg/dL</td>
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<td>807</td>
<td>DA cow</td>
<td>2.2</td>
<td>6.4</td>
<td>0.34</td>
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<td>204</td>
<td>Fresh cow</td>
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<td>4.5</td>
<td>0.60</td>
<td>10 mg/dL</td>
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<tr>
<td>737</td>
<td>Fresh cow</td>
<td>2.8</td>
<td>4.7</td>
<td>0.60</td>
<td>10 mg/dL</td>
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</tbody>
</table>

Cases 1 and 2: Summary

- Farmers— Had a hard time linking the brisket edema, swollen legs and poor health to moldy feeds.
- Nutritionist – Recognized mold problems and appreciated the link between haylage and marginal production and feet and leg health.
- Improved haylage quality slowly improved cow health.
Case 3:

- Calf raiser calls and complains of poor health. Total protein in live calves reveals failure of passive transfer.
- The dairy farm that produces calves confirms failure of passive transfer because *cows are not producing colostrum.*
- The dairy farm has zero tolerance for udder edema and **does not feed salt to dry cows??**
- Even after excluding salt, the farm still complains of udder and vulva edema in fresh cows.
- An assumption was made that failed colostrum production was due to molds and mycotoxins. That assumption was followed by a suggestion to add a mold and mycotoxin binder to the feed.
- **Diagnostic questions.** Is the udder edema a low albumin problem? Are liver enzymes elevated suggesting mycotoxin exposure?

<table>
<thead>
<tr>
<th>Stage</th>
<th>Dry cow</th>
<th>Dry cow</th>
<th>Fresh cow</th>
<th>Fresh cow</th>
<th>Fresh cow</th>
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<td>ID</td>
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<td>3192</td>
<td>3736</td>
<td>3701</td>
<td>3725</td>
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<td>Clincal sign</td>
<td>Normal</td>
<td>Normal</td>
<td>Udder edema</td>
<td>Udder edema</td>
<td>Udder edema</td>
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<tr>
<td>Glucose</td>
<td>70</td>
<td>64</td>
<td>59</td>
<td>55</td>
<td>77 H</td>
</tr>
<tr>
<td>AST (GOT)</td>
<td>63</td>
<td>64</td>
<td>64</td>
<td>73</td>
<td>69</td>
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<tr>
<td>SDH</td>
<td>11.8</td>
<td>11.8</td>
<td>16.1</td>
<td>9.5</td>
<td>9.3</td>
</tr>
<tr>
<td>Tot Bili</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0</td>
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<tr>
<td>Cholesterol</td>
<td>101 L</td>
<td>200</td>
<td>56 L</td>
<td>104 L</td>
<td>56 L</td>
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<tr>
<td>Total Protein</td>
<td>6.9</td>
<td>8.1 H</td>
<td>6.3</td>
<td>7.2</td>
<td>5.5 L</td>
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<tr>
<td>Albumin</td>
<td>3.9</td>
<td>3.6</td>
<td>3.7</td>
<td>4.1</td>
<td>3.7</td>
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<tr>
<td>Blood Urea N</td>
<td>11</td>
<td>16</td>
<td>11</td>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>Creatine</td>
<td>0.5</td>
<td>0.7</td>
<td>0.7</td>
<td>0.9 H</td>
<td>0.6</td>
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<td>Phosphorus</td>
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<td>6.9</td>
<td>4.3</td>
<td>4 L</td>
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<tr>
<td>Calcium</td>
<td>9.2</td>
<td>9.6</td>
<td>9.8</td>
<td>10.2</td>
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<td>Sodium</td>
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<td>Potassium</td>
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<td>5.9 H</td>
<td>5.7 H</td>
<td>5.8 H</td>
<td>5.2</td>
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<tr>
<td>Chloride</td>
<td>104</td>
<td>99 L</td>
<td>104</td>
<td>99 L</td>
<td>106</td>
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<td>24</td>
<td>29</td>
<td>29</td>
<td>30 H</td>
<td>26</td>
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<tr>
<td>CK</td>
<td>88</td>
<td>122</td>
<td>73</td>
<td>88</td>
<td>308 H</td>
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<tr>
<td>GGT</td>
<td>26</td>
<td>20</td>
<td>17</td>
<td>18</td>
<td>12</td>
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<tr>
<td>Anion Gap</td>
<td>16</td>
<td>17</td>
<td>16</td>
<td>16</td>
<td>14</td>
</tr>
<tr>
<td>Globulin</td>
<td>3</td>
<td>4.5 H</td>
<td>2.6</td>
<td>3.1</td>
<td>1.8 L</td>
</tr>
<tr>
<td>A/G ratio</td>
<td>1.3</td>
<td>0.8</td>
<td>1.4</td>
<td>1.3</td>
<td>2.1</td>
</tr>
<tr>
<td>Urea/Creat</td>
<td>22</td>
<td>23</td>
<td>16</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>Na/K ratio</td>
<td>27</td>
<td>24</td>
<td>25</td>
<td>24</td>
<td>27</td>
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</table>
Case 3: Comments & Summary

- Albumin and liver enzymes were normal
- Potassium was high in three cows
- Chloride was slightly low in two cows
- There was no evidence of hypoalbuminemia
- No evidence of elevated liver enzymes

Case 4:

Poor reproduction. Some cows fail to get pregnant and fail to remain pregnant. Many pregnancies are lost between 40 and 100 days.
Case 4

- Stanchion barn
- Component fed corn silage, dry corn and dry alfalfa hay
- Serology detected high BVDV titers.
- All cows were ear notch and tested PI negative.

Case 4: Serum chemistries on 4 cows and 2 heifers

<table>
<thead>
<tr>
<th></th>
<th>SDH</th>
<th>GGT</th>
<th>ALBUMIN</th>
<th>BUN</th>
<th>CK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cow 68</td>
<td>59</td>
<td>0</td>
<td>4.1</td>
<td>14</td>
<td>351</td>
</tr>
<tr>
<td>Cow B6</td>
<td>40</td>
<td>17</td>
<td>3.6</td>
<td>15</td>
<td>424</td>
</tr>
<tr>
<td>Cow 146</td>
<td>37</td>
<td>27</td>
<td>3.8</td>
<td>13</td>
<td>1345</td>
</tr>
<tr>
<td>Cow 11</td>
<td>126</td>
<td>28</td>
<td>3.7</td>
<td>15</td>
<td>133</td>
</tr>
<tr>
<td>Heifer 5</td>
<td>21</td>
<td>16</td>
<td>3.8</td>
<td>10</td>
<td>506</td>
</tr>
<tr>
<td>Heifer 7</td>
<td>23</td>
<td>18</td>
<td>3.9</td>
<td>11</td>
<td>94</td>
</tr>
</tbody>
</table>

Ref Range: 6-38 U/L 4-42 U/L 3.1-4.3 g/dL 8-22 mg/dL 50-271 U/L
Case 4:

The farmer mentioned that one of the air bags in the Harvstore silo was torn.

Protein, Albumin and Cow health:

Summary

• Adequate albumin in critically important for cow health.
• Albumin and multiple other elements and enzymes can be easily measured with a serum sample for about $15 per cow.
• WATCH BULK TANK MILK UREA NITROGEN (MUN).
  – Single digit MUNs (<10) is not necessary good. MUNs in the teens is consistent with wastage, so 10, 11 and 12 appears to be the homeostatic reference range.
  – Some herd have added urea and have observed increased milk production and NO CHANGE in MUN, suggesting nearly total utilization of urea without an increase in MUN.
• Indirect indicator of insufficient urea.
Non-Hardware Chronic Fibrous Epicarditis in Dairy Cows
Enlarged liver from passive congestion due to heart failure
Cross section of plant debris
(circular brown structure in middle)

Irregular pieces of plant debris surrounded by scar tissue
Decomposing “rod-like” plant debris (blue circle) adhered to scar tissue

“Spear-like” piece of plant debris
Plant debris attached to scar tissue (brown structure in blue circle)

Mineralized debris / ash (dark purple debris) surrounded by bacteria and neutrophils
Small piece of plant debris surrounded by scar tissue

NOT FROM THE COW. This is *rumen* lining from a 6-week-old calf bedded on wheat straw. The circular structure is believed to be an awn.
Small grain awns are designed to burrow into the ground by wind...they can also burrow into tissue by repeated side-to-side manipulation.

Comparative pathology: Foxtail grasses and awns can be lethal to dogs.
Awns in dogs


Updates on Bovine Coronavirus
Interesting BoCV Case 1

- Beef calf developed summer pneumonia and died.
- Trachea →
- BoCV was found on a nasal swab, in the sinus cavity, facial nerve, retropharyngeal & submandibular lymph nodes, salivary gland and olfactory (smell) nerve

Interesting Case 2

- Two dairy calves die of respiratory disease.
- The frontal sinus cavity contained pus (sinus infection).
- BoCV was found in the sinus cavity, lymph nodes, salivary gland and inner ear.
Interesting case 3

- Jersey calves develop diarrhea. Rotavirus, coronavirus and Cryptosporidium sp. were detected.
- All three heads were examined and BoCV was found in the following head tissues.

Nasal swab (2 calves) > Lung (1) > Inner ear (2) > Frontal sinus cavity (2) > Retropharyngeal lymph node (2) > Salivary gland > Facial nerve (1) and Trigeminal nerve (1)

Bovine coronavirus nerve involvement

<table>
<thead>
<tr>
<th>Group</th>
<th>Host</th>
<th>Virus</th>
<th>Cellular Receptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1a</td>
<td>Cat</td>
<td>BCoV, FoV, FIPV</td>
<td>Unknown</td>
</tr>
<tr>
<td>Group 1b</td>
<td>Human</td>
<td>HCoV-229E, HCoV-NL63</td>
<td>APN (ACE2)</td>
</tr>
<tr>
<td>Group 1b</td>
<td>Pig</td>
<td>PEDV, RBCoV</td>
<td>Unknown</td>
</tr>
<tr>
<td>Group 1b</td>
<td>Rabbit</td>
<td>BCoV, BCoV-related viruses</td>
<td>Unknown</td>
</tr>
<tr>
<td>Group 2a</td>
<td>Cattle, llama, alpaca</td>
<td>BCoV, HCoV-HKU1, HCoV-OC43</td>
<td>Unknown</td>
</tr>
<tr>
<td>Group 2a</td>
<td>Dog</td>
<td>BCoV, HCoV-HKU1</td>
<td>Unknown</td>
</tr>
<tr>
<td>Group 2a</td>
<td>Human</td>
<td>BCoV, HCoV-OC43</td>
<td>Unknown</td>
</tr>
<tr>
<td>Group 2a</td>
<td>Mouse</td>
<td>MHV</td>
<td>Carcinoembryonic antigen family molecule 1 (CEACAM1a)</td>
</tr>
<tr>
<td>Group 2a</td>
<td>Pig</td>
<td>PHEV</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

BoCV attaches to receptors on nerves, gut cells and red blood cells. Demyelination is a consequence.
Updated vaccine study

• Bull calves are vaccinated 3 weeks prior to grouping while in calf huts.
• The farm has tried a variety of intranasal, IM killed and IM modified-live.
• IM modified-live (Calf Guard) consistently works the best.

Updated vaccine study

• <5% morbidity
• No mortalities
• Weighed at 5 months
• IM Mod LV BoCV = 425 lbs.
• SQ Killed BoCV = 399 lbs.
• IN Mod LV BoCV= 385 lbs
• Neg controls = 373 lb
Day 5 BoCV Ab titer of fatal pneumonia cases and asymptomatic cohorts

(Storz, Journal of Clinical Microbiology, 2000)

Red circles = Mortalities
These cattle died and had very low / absent BCoV antibody titers on day 5

Asymptomatic = These cattle were 18 normal controls that remained clinically healthy and did not nasally shed BCoV

- Fatality
- Asymptomatic

BoCV summary

- BoCV has been repeatedly detected in the head nerves of calves with BRDC and viral enteritis.
- Mild demyelination of these nerves can set cattle up for other health problems.
- Intramuscular modified-live vaccination appears to have the largest positive impact in Holstein bull calves.
- A high serum antibody titer appears important for nerve protection and it’s unlikely to get a high serum titer with an intranasal vaccination.