BVDV eradication, ‘Canadian’ perspective or...let’s get moving...

USAHA 2019
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SAVE THE DATE: 16-17-18 JUNE 2020
CALGARY, AB

8th BVDV SYMPOSIUM COMBINED WITH THE UCVM BEEF CATTLE CONFERENCE

‘BVDV, is there a limit to our tolerance?’
The virus, BVD pathogenesis and a pathway to eradication.
In Providence?

Crossing the species barrier

BVDV PI lambs: Hairy shakers
Beef and dairy production in Canada
In Alberta cattle feeding generated a production value of $1 billion. This represents a $355 million contribution to provincial GDP.
A long history of talking about BVD control/eradication

AN APPARENTLY NEW TRANSMISSIBLE DISEASE OF CATTLE

BY PETER OLAFSON,** A. D. MccALLUM,** AND F. H. FOX†

New York State Veterinary College, Ithaca, N. Y.
The first report of BVDV in the Canada

X Disease of Cattle — Saskatchewan

BY T. Childs *

The following notes cover personal observations of cattle affected with what is, as yet, a disease of unknown origin, and are assembled from data secured in the Province of Saskatchewan during the months of July and August, 1946.

With the advances in virology, the disease has been present in the Western Provinces for years but, owing to its insidious and unspectacular nature, has not received much attention heretofore.

The disease has been observed in acute and sub-acute forms, young cattle being most commonly affected. One or two animals in a herd may be affected and die, and there may not be further casualties for several weeks. However, over a period of six or eight months, losses among young cattle, from the acute form of the disease, can be serious.

Acute Form

Canadian Journal of Comparative Medicine 1946

Getting Serious About BVD

Bovine viral diarrhea is one of the most costly diseases of cattle, and most U.S. cow herds are at risk for infection. Now it’s attracting more industry attention.

Clint Pickering Editor | Apr 15, 2003
746 market-derived mixed-breed beef calves
mean arrival weight 712 lbs.
548 (73.45%) calves pulled within 35 days on feed

**IDEXX Herdcheck BVBVAb**

- **Interpretation S/P value**
  - <0.2 = negative
  - 0.2-0.3 = suspect
  - ≥ 0.3 = positive

  **Results:**
  - 506 (67.83%) negative
  - 76 (10.19%) suspect
  - 164 (21.98%) positive

**IDEXX Herdcheck* IBRgB**

- **Interpretation blocking %:**
  - <45% = negative
  - 45-55 = suspect
  - ≥ 55 = positive

  **Results:**
  - 398 (53.35%) negative
  - 52 (6.97%) suspect
  - 296 (39.68 %) positive

Courtesy of Barbara Wolfler and Karin Orsel used with permission
BVDV eradication still a North American pipe dream

By Dr. Ron Clarke Ph.D.

Reading Time: 3 minutes

BVDV eradication still a North American pipe dream

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BVD costs U.S. cattle producers millions

By Barbara Backworth

Published: April 1, 2016

BVD costs U.S. cattle producers millions

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Eradication efforts of BVDV in North America
In Michigan: Twenty-two of the 140 (16%) survey respondents did not participate in the project.

“Project would be too much work,” “Do not believe BVDV is a problem,” “Did not know about the project,” “Did not understand the project,” and “Other”

<table>
<thead>
<tr>
<th>Eradication efforts in the US</th>
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<td><strong>Table 6. Comparison of four regional control programs in the U.S.</strong></td>
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<td>Program</td>
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<tr>
<td>Washington State BVD Control and Eradication Project</td>
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<td>2006–2008</td>
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<td>Mexico BVD-PI Herd Biosecurity Project</td>
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<td>2006–2008</td>
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<tr>
<td>Alabama Voluntary BVDV Control Program</td>
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<td>2006–2008</td>
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<tr>
<td>Michigan Upper Peninsula BVDV Eradication Project</td>
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<td>2008–2011</td>
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</table>

Lessons learned:

1. Target an entire region at one time in order to capitalize on the enthusiasm and interest of a new disease management program. Interest seems to wane in the ensuing years of a program.
2. Ensure that adequate manpower is available to manage the workload.
3. Create a written plan detailing required resources and manpower with a realistic time line.
4. There must be a marketing and communication plan for the entire length of the project.

A lesson learned from all four projects is that BVDV control programs are as much about working with people as they are about the technical aspects of detection, vaccination and biosecurity.
BVD screening in Saskatchewan

“We have found that this program is underutilized, when we compare the tests requested at PDS versus those paid through our program.”

Will it be continued?

Heart, lung, liver, kidney, spleen, duodenum, muscle, mes Lnn, lung Lnn, urine bladder, gall bladder, bile, feces, urine, ovary/testicle, obex, jejunum, ileum, milk udder tissue, colon, caecum, skin (=ear), nasal swab, tonsil, esophagus, serum, white blood cells (PBL)

And the same from the fetus (if present and possible)

Everything PCR positive except bile and feces
Canadian beef production: Challenges for disease control

Disease status of calves for finishing difficult to control
- The Canadian beef industry ships to 56 countries but is reliant on the U.S. for 74 per cent of all beef exports
- Influx of US calves in the fall
- Long distance transport of calves within Canada
- Limited Identification and Registration
- Disease status of calves at market is not known

Dairy production, challenges and opportunities

- Supply management
  - Relatively small family farms (especially in the east)
  - Higher milk prices for farmers (price/L Ca$ 0.75)
  - Quota have to be filled
  - Quotum changes create animal dynamics on farm (culling, purchasing)
  - Limits initiative for production of yoghurt/cheese etc
  - Highly educated producers
  - ProAction initiated by Dairy Farmers of Canada
  - Influx of untested US dairy cows when large herd expansions take place
  - I&R is well organized
ProAction initiated by farmers

What is ProAction?

To offer the best and most efficient dairy production in Canada, dairy farmers in Nova Scotia and farmers initiated the development of ProAction to help farmers to reduce costs, improve productivity, and improve animal health and welfare as well as environmental stewardship.

Alberta: 28.4% BVDV1 and 8.9% BVDV2; herd-level 53.4% and 19.7%

Saskatchewan: 28.1% BVDV+; herd level 48.7%

Manitoba: 16.4% BVDV+; herd level 32.0%

Table 1: Bulk Tank Milk test results for 619 dairy herds in Atlantic Canada in 2016

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<thead>
<tr>
<th>Herd</th>
<th>PEI</th>
<th>NS</th>
<th>NB</th>
<th>NL</th>
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<td>BTV ELISA</td>
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<td>Herds Suspect</td>
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BVDV in Canadian dairy herds

Among unvaccinated dairy heifers, seroprevalence

“During recent decades, BVD control approaches in various European countries and regions have clearly demonstrated that measures on a voluntary basis are inadequate to achieving freedom from the disease.”

Fig. 1. The monthly proportions of newborn calves that were born BVDV-positive (with 95% confidence interval) during the Swiss BVD eradication campaign up to September 2010. The duration of the different phases of the eradication programme is displayed in the graph.

### Table 5. Development of PI and certified herds from 2005 to 2008 in Lower Austria.

<table>
<thead>
<tr>
<th>Year</th>
<th>Herds</th>
<th>Herds with PI</th>
<th>PI</th>
<th>Certified herds</th>
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<td>n</td>
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<td>2005</td>
<td>13,382</td>
<td>248</td>
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<td>511</td>
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<td>2006</td>
<td>12,857</td>
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<td>2007</td>
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<td>2008 (until 31 August)</td>
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<td>20</td>
<td>0.16</td>
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</table>
#1 motivator, it must be financially worth the effort...

But often we do not have a clue how much it all cost

What are the losses due to BVDV in dairy production?

- Losses in dairy herds are 20% higher than beef herds
- Overall (the western world) average direct losses were 199.50 US$/naïve cow (vs. 174.60 US$ beef)
- Only a few papers assessed the economic impact of immune suppression
- Canada:
  - Carman 1998: CAD 40,000.00-100,000.00/herd for the acute BVDV infection
  - Chi 2002:~CAD 47.30/dairy cow in an infected herd

Richter et al. The Veterinary Journal 220 (2017): 80-87
What is the most economical option to control BVDV

“We need more studies to demonstrate that the implementation and inherent costs of BVDV prevention and/or mitigation activities are justified”

“There is a lack of studies relating to efficiency calculations, in particular at national and regional level”

Is intervention A more cost effective than B?

Canada: 1 paper
— Chi et al. 2002
We have the tools and the knowledge

Strategy towards eradication? Kill the PI’s!

- Finding PI’s where to start?
  - Serological evaluation of oldest non-vaccinated animals
  - Bulk tank PCR

  Using DHI milk samples, producers have the ability to:
  1. Screen adult milking herd with the sensitive PCR test, through pooled samples
     - DHI lab will sub-sample cows into Group pools (up to 250 cows maximum)
     - The Group pool(s) will be tested by PCR. If positive, customers will be notified immediately and provided the option to test individual cows by ELISA

- Individual animal assessment
  - Ear notch
  - Blood
  - Milk

  2. Test selected cows with the cost-effective ELISA antigen test using the regular DHI sample (cows only need to be tested once in their lifetime). Possibilities include:
     - All cows when PCR group screening result is positive
     - Purchased cows

“Despite progress in the development of BVD vaccines, the assessment of the effect of widespread vaccination against BVD over several decades is disappointing. Vaccination has not changed BVD prevalence over time”

How different are 1b and 2 from PI209_1a?

>90% of cow calf producers in Western Canada vaccinate their cows and >95% their replacement heifers against BVDV

(Survey of 93 herds)

Waldner et al. CVJ / VOL 60 / APRIL 2019
Wrecks on cow/calf Ranches.
If it goes wrong....it goes very wrong

- Unvaccinated herds, new introduction of virus
- Synchronized breeding (all fetuses approx. the same age)
- All (or almost all) calves become PI.
- Usefull as research material: influence of ‘host’ on virus evolution/adaptation

Performance, survival, necropsy, and virological findings from calves persistently infected with the bovine viral diarrhea virus originating from a single Saskatchewan beef herd

Lee F. Taylor, Eugene D. Janzen, John A. Ellis, Jan V. van den Hurk, Pearse Ward

Persistently infected calves were "poor doers" and had poor survivability, with only 4 persistently infected calves surviving to 1 year of age.

51 (+20) calves out of 652 cows were PI and part of the study

Can Vet J 1997; 38: 29-37
Table 2. Distribution of lesions in necropsied calves that died of bovine viral diarrhea virus (BVDV)-related disease during 1992 and 1993. Viralological findings from these calves are also summarized for comparison.

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<thead>
<tr>
<th>Calf ID</th>
<th>Date of Death</th>
<th>Age</th>
<th>Ursinella ulcerum</th>
<th>Ureaplasma urealyticum</th>
<th>Revetremor Topostoma</th>
<th>Lymphoadenopathy</th>
<th>Renal infarction</th>
<th>Surgical lesions</th>
<th>BVDV virus</th>
<th>BVDV virus</th>
<th>Gross diagnosis</th>
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No MLV vaccine provided

South Dakota 2004

<table>
<thead>
<tr>
<th>Age</th>
<th>BVDV test status</th>
<th>Mean weight (kg)</th>
<th>Mean weight increase (kg (%))</th>
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<tbody>
<tr>
<td>Birth</td>
<td>Positive</td>
<td>35.0*</td>
<td>—</td>
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<tr>
<td>7 weeks</td>
<td>Negative</td>
<td>42.4</td>
<td>—</td>
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<tr>
<td>14 weeks</td>
<td>Positive</td>
<td>84.0*</td>
<td>47.6 (141.0)</td>
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<td>Negative</td>
<td>108.8</td>
<td>66.3 (159.1)</td>
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<tr>
<td></td>
<td>Positive</td>
<td>127.9*</td>
<td>42.8 (50.7)</td>
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<tr>
<td></td>
<td>Negative</td>
<td>167.5</td>
<td>58.8 (55.1)</td>
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Calves were tested for the presence of BVDV antigen by immunohistochemical staining of ear notch specimens. At each age, the weight of each calf was obtained and the mean was calculated for each group. Similarly, the amount and percentage of weight gained between measurements was determined for each calf, and the respective mean weight increases were calculated. — Not applicable. *Value is significantly (P < 0.05) less than the corresponding value for the BVDV test-negative calves.
“Vaccinate the PI’s out of the herd”

- Vaccine induced MD
- Delayed onset postvaccinal mucosal disease
- Recognized very early in vaccine evaluation (cBVDV was used)
- How many PI’s will you remove?
- It is possible to create MD with heterologous vaccine, but not so efficient
- 1a PI will develop MD due to 1a cBVDV vaccine, 1b PI’s probably will just mount an antibody response

- My guess: <25% of the PI’s will succumb to MD following vaccination with MLV cBVDV vaccine

Examples: 13 PI’s, 3 MD cases

- At processing, animals received the following: unique individual animal identification tag; a modified-live infectious bovine rhinotracheitis virus (IBRV) and BVDV (both type I and type II viruses) vaccine;

- Death occurred prior to harvest in 8/13 (61.5%) PI animals: 3 were diagnosed with mucosal disease, 1 was diagnosed with peritonitis, and 4 were diagnosed with BRD.

Example 2: 10 PI’s none died

- all cattle received a modified-live virus vaccine against BVDV,
- Ear notches from 10 of 5,041 (0.2%) calves yielded positive results for BVDV

- No MD cases
Ongoing BVDV research in Calgary

There are 3 BVDV researchers left in Canada (as far as I know)

Diversity of BVDV 1a at amino acid level

Chernick et al.
Where are the epitopes...exact

The evolutionary rate of BVDV is $1.4 \times 10^{-3}$ AA substitutions per site per year.
Questions?

'BVDV, is there a limit to our tolerance?'

The virus, BVD pathogenesis and a pathway to eradication.