

# Bovine Viral Diarrhea and Border Disease

Dr. Elisha Frye, ACVPM  
[eah73@cornell.edu](mailto:eah73@cornell.edu) / 607-253-3112  
Animal Health Diagnostic Center  
Cornell University College of Veterinary Medicine

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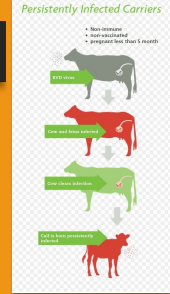
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## Goals for this presentation

- Understand the pathogenesis of pestiviruses
- Identify clinical presentations for each disease
- Confidently diagnose and manage BVD or Border disease in a herd/flock setting



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## Outline:

- Review pestiviruses: BVD, BDV
- BVD
  - Typical disease presentations
  - Diagnostics - lots on this - sorry
  - Management / Eradication / Prevention
    - Herd immunity - vaccination
    - Find and remove PIs
    - Biosecurity
- Border Disease
  - Case example
  - Available diagnostics
- Classical Swine Fever
  - *Suidae* only
  - Eradicated from US in 1976

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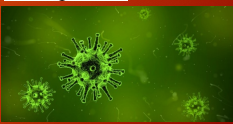
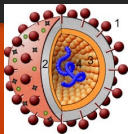
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### Nomenclature review

- Family: *Flaviridae*
- Genus: *Pestivirus*
  - 11 recognized species
    - BVD1 = *Pestivirus A*
    - BVD2 = *Pestivirus B*
    - Classical Swine Fever = *Pestivirus C*
    - Border disease = *Pestivirus D*
    - *Pestivirus E - K*
- Enveloped
- Single stranded
- RNA virus
- Infect even-toed ungulates



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### Break into groups of 2-4 to answer:

- Part 1:
  - Long-term client milking 150 cows with 30 dry cows and 75 youngstock (25 calves <60 days and 50 heifers)
  - Has a calf born 1 week ago that looks like a BVD PI.
  - What sample(s) do you collect?
  - What test(s) do you order?

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### Part 2:

- 1 week later the result comes back positive. The farmer is very motivated to eradicate BVD from his herd.
  - What samples do you collect on each age group/lactation group?
  - What test(s) do you request?
  - Approximately how much will this cost?
  - What recommendations do you make in the meantime waiting for results to come?

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### BVD history

- First described by Dr. Fox (age 23!) at Cornell in 1946



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The veterinarian is called because cows are off feed, depressed, and scouring. At this stage of the disease the temperature is normal or slightly raised. Other animals, still apparently normal, may have temperatures of 105° to 108° F. After animals have scoured a day or two, the severely affected develop ulcers in the mouth, nose, and on the muzzle. In the initial outbreak one of us (Fox) found several animals with a leukopenia. Salivation may occur early in the disease and again after ulcers appear in the mouth. Stringy mucus may hang from the muzzle to the ground. Mucous or mucopurulent nasal discharge may be present. Some animals cough throughout the course of the disease. The severely affected are depressed, ears hang down, and they may have difficulty in finding their places in the barn. There may be marked disturbance in the distribution of body heat. Ears, horns, muzzle, and extremities are cold. Parts of the body may feel ice cold while other parts are warm. The nasal and oral mucous membranes vary from a pink to a bright red color. The conjunctiva may show marked injection. Eye lesions are not present.

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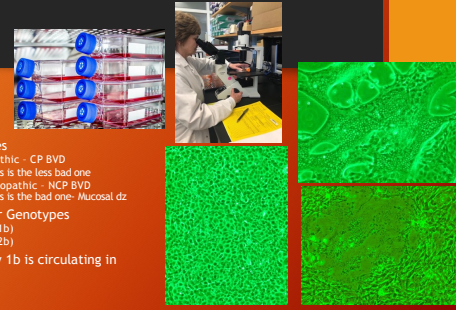
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### BVD

- 2 Biotypes
  - Cytopathic - CP BVD
    - This is the less bad one
  - Noncytopathic - NCP BVD
    - This is the bad one- Mucosal dz.
- Strains or Genotypes
  - 1 (1a, 1b)
  - 2 (2a, 2b)
- Currently 1b is circulating in US



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### Transmission

- Horizontal
  - Any secretions (nasal, ocular, urine, milk, semen)
- Vertical
  - EED/abortions
  - PI 40- 125 days gestation
  - Congenital defects
  - Normal, seropositive
  - Dam will be viremic but clear virus

*Fig. 1. Potential clinical reproductive outcomes following infection with bovine viral diarrhea virus.*

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*Fig. 1. Potential clinical reproductive outcomes following infection with bovine viral diarrhea virus.*

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PI window: 40-125 DCC

*Fig. 1. Potential clinical reproductive outcomes following infection with bovine viral diarrhea virus.*

Source: Reproductive consequences of infection with bovine viral diarrhea virus. Daniel L. Grooms, DVM, PhD. Vet Clinics Food Animal 2004.

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### Diagnostics for BVD Abortions

- Fetus, placenta, serum and EDTA whole blood
- BVD PCR on fresh fetal lung tissue
- BVD ACE on fetal skin
- BVD SN on fetal heart blood and dam
- Virus isolation from fetal tissues



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### Trouble with PIs (40-125 days gestation)

- Shed tons of virus
- Reservoir for herd
- PI cow will always give birth to a PI calf
- PI animals have no BVD antibody titer
  - Except colostral
- Can look normal or weak and die early
- Or die before 2 yrs of age (their own NCP converts to CP or they are vaccinated or exposed to wild type CP BVD)
- Don't always have congenital defects (75-150 days gestation)
- Immunosuppressed

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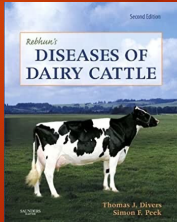
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### Trouble with PIs (40-125 days gestation)

- "PI animals may shed so much virus that the finite immunity in herd mates can be overwhelmed, resulting in infection of non-PI, immunocompetent and previously exposed and/or immunized herd mates"



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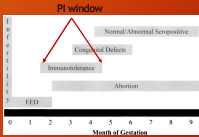
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### Congenital defects 75-150 days gestation

- Cataracts
- Retinal degeneration
- Cerebellar hypoplasia
- Hydrancephaly
- Brachygnathism
- Hairless
- May or may not be a PI



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### BVD PI example

- 2 yr old heifer came from an auction
- Draining tracts over hips and shoulders
- Shared a field with boarding heifers running with a bull



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### Diagnostics for a PI

- BVD Antigen capture ELISA (ACE)
  - EAR NOTCH any age
  - Or serum >61 days
- BVD PCR on EDTA whole blood (does not differentiate PI from acute infection)



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### BVD Clinical Disease: 3 presentations

1. PI can get both CP and NCP strains and then die
  - Immunosuppressed
    - Die from opportunistic pathogens
  - Thrombocytopenia
    - Can bleed at injection sites
  - Clinical signs can vary by strain
  - Same farm will have same signs
2. Non-PI, immunocompetent cows and calves can be subclinical and develop BVD SN
3. Non-PI Clinical disease:
  - Biphasic fever
  - Tachypnea from fever
  - Diarrhea
  - Oral erosions, GI ulcers

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### Case example

- 5 mo old Holstein show heifer
- BVD ACE negative at birth = not a PI
- Presented to CUHA for oral and nasal ulcers
- Temp 105-108 few days
- Did not respond to NSAIDs
- Positive for Parapox virus



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**CBC- Anemia of inflamm dz, neutropenia, lymphopenia = severe acute inflammatory leukogram**

Blood, Whole, EDTA				
Fibrinogen (Heat Precipitation)	1500	(H)	100-600	mg/dL
Hematocrit	19	(L)	25-35	%
Hemoglobin	7.1	(L)	8.7-12.4	g/dL
HbC	6.4		5.0-7.2	g/dL
MCV	30	(L)	38-51	fL
MCH	11	(L)	14-19	pg
MCHC	37		34-38	g/dL
RDW	25.5	(H)	15.0-19.4	%
Nucleated Red Blood Cells	0		0-0	/100 WBC
WBC	1.3	(L)	5.5-14.0	/mm <sup>3</sup>
Segmented Neutrophils	0.0	(L)	1.5-7.2	%
Band Neutrophils	0.0		0.0-0.1	%
Lymphocytes	1.3	(L)	1.7-7.5	%
Monocytes	0.0		0.0-0.9	%
Eosinophils	0.0		0.0-1.2	%
Basophils	0.0		0.0-0.3	%
Platelet Count	204	(L)	250-728	/mm <sup>3</sup>
MPV	6.8		5.7-8.0	fL
Platelet Count Estimation	Low			
TP Ref	6.7		5.9-8.1	g/dL
Heamat Appearance	Normal- slight			
WBC Exam	Band/seg lymphocytes-lev			
RBC Morphology	Erythrocytes-many			
Platelets	None seen			

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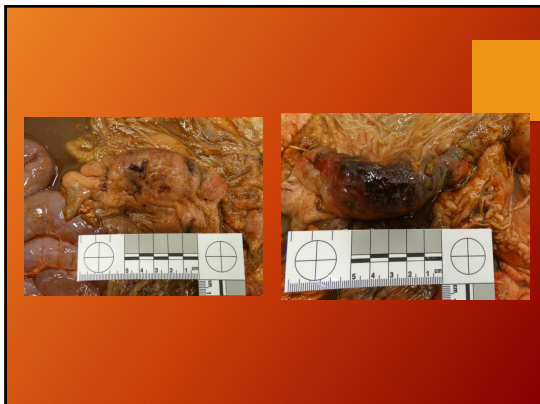
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### Clinical case diagnostics

- BVD PCR on GI and spleen
- BVD IHC on tissue with lesions
- BVD FA
- ACUTE BVD!

PCR

Fluorescence

Threshold

Positive sample

Negative sample

Negative sample

Ct

Ct = 40 (35.19)

PCR cycles

FA

IHC

POSITIVE CONTROL: A

NEGATIVE CONTROL: B

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### Diagnostics

- BVD Antigen Capture ELISA "ACE"
- Sample types:
  - Ear notch - any age
  - Serum - >61 days
- This is what you need for fair papers ☺
  - \$6.00 at AHDC
  - AHDC does not pool ear notches
  - Ear notching baby calves is easy - do it!

Ear notch pliers

Test tube

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Ear notch is good evidence of BVD testing!

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BVD PCR

- Detecting either acute infection OR PI
- EDTA whole blood at any age
- Serum if >61 days of age
- Pooling available
  - Up to 10
  - \$41 per PCR = \$4.10/animal
  - If pool is +, individually test each animal with ACE (\$6.00)
- MLV vaccine can be detected by PCR within 3 weeks of administration

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BVD Bulk Tank

- BVD Bulk Tank testing
  - BVD PCR and Virus Isolation
  - \$68
  - +/- 400 cows per sample
  - +/- 200 ml
  - NOT CURDLED
  - NOT FROZEN
  - Clean container ok!
- Record who was in the tank the day of sampling!
  - No dry cows
  - No treated cows
- Any cows culled after sampling?

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### BVD Bulk Tank

- If BT is positive
  - Need to start looking for PIs
  - Serum for pooled BVD PCR
    - >61 days of age
  - Then BVD ACE each serum sample if pool is positive
- Notch any cow that is culled while waiting for BT milk results!
- Positive BT + negative pooled serum samples = frustrating!



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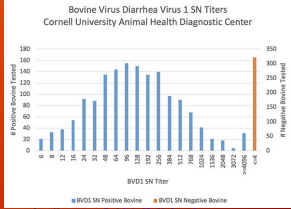
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### BVD serum neutralization (SN)

- Antibody titer on serum \$15.90
- Vaccinated animals will have a detectable titer
  - MLV >> Killed
- Consider acute and convalescent titers (3-4 wks apart)
- Not overly helpful diagnostic test
- If no titer and herd vaccinated, get nervous
  - BVD PI has no titer



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### Diagnostics: Find PI animals vs acutely infected animals

Test	Samples	Cost	Notes
BVD ACE	Ear notch any age Serum >61 days	\$6.00	PI v nonPI
BVD PCR	EDTA whole blood Serum Tissues from necropsy (GI or spleen)	\$41	Acute or PI Pool up to 10 animals = \$4.10/animal Will detect recent MLV
BVD SN	Serum	\$15.90	Serum neutralization (antibody titer) reflects vaccine or exposure
BVD Bulk Tank	400 cows	\$68	Combination of PCR and virus

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### AHDC BVD ACE data 1/20-4/22

Total tested	137,612	Percentage
Negative	128,530	93%
Positive	3,459	3%
Inconclusive/suspect	5,624	4%

BVD Type	#
1a	0
1b	6
2	1
Inconclusive	1
Total:	7

State	Number positive
NY	3,417
MD	29
CT	5
MI	4
PA	2
VT	1
ME	1

"BVD PI are 2% of population"

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### AHDC BVD BT data 1/20-4/22

Total Tested	484	Percentage
Negative	466	96%
Positive	18	4%

State	Number positive
NY	7
MI	1
OH	2
PA	1
SD	3
VA	1
VT	1
WI	2

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### Management: You must slaughter PI calves

- It is not ethical to send them to market
- It is not ethical to keep them alive
- Pestiviruses can spread to Artiodactyla (bearing wt on 2 toes)
- Experimental infection in pregnant white-tailed deer in 2008



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### Management: Vaccination

- MLV >>> killed
- "A Fetal Protection Guarantee program gives producers confidence that cattle properly vaccinated with BOVI-SHIELD GOLD® FP® ... will not be persistently infected with BVDV."
- Immunosuppressive
- Don't give near breeding
- Follow label! Give to pregnant animal within 12 mo



The image shows several boxes and vials of BOVI-SHIELD GOLD FP vaccines. One box features a cow and the text 'Fetal Protection Guarantee'. Another box shows a cow and the text 'BOVI-SHIELD GOLD FP'. There are also several vials of different sizes and colors (white, yellow, pink).

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### Vaccination = MLV

- Heifers at 5-6 months of age
- Again 60 days before breeding
- Adults: yearly 2-4 weeks prebreeding
- If long calving interval- make sure within a year!
- If using Killed - make sure heifers get a booster



The image shows a black cow being vaccinated. A person's hand is visible holding a syringe and injecting the cow's neck. The cow has a yellow tag on its ear.

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### Management: Biosecurity

- Test any new animal
- Test any calf born to a cow that was not from the home farm
  - Heifer raiser
- Cattle get exposed to BVD at the fair!



The image shows a group of black and white calves lined up in a dirt arena, likely at a fair or show. There are people in the background watching.

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Pearls of wisdom from Dr. Ed Dubovi

- HERD SCREENING STRATEGY
  - BULK TANK ON LACTATING ANIMALS
  - POOLED SERUM for PCR ON NON- LACTATING COWS
  - EAR NOTCH ON any age animal for BVD ACE

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Pearls of Wisdom from Ed Dubovi

- ON-GOING HERD SCREENING STRATEGY FOR DAIRY HERDS
  - Ear Notch **All** Calves as they are born
    - Single test defines the status of two animals
      - calf and dam
      - Negative calf can only come from negative dam

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Discussion

- Ear notch BVD ACE all calves under 60 days of age:
  - 56 x 25 = 150
  - Or EDTA whole blood for BVD PCR on calves under 60 days of age:
    - 25 calves, groups of 10 = 3 x \$41 = \$123
- Bulk Tank milk BVD PCR and VI on all lactating cattle
  - 568
- Pooled BVD PCR on serum from nonlactating cattle
  - 30 dry cows, groups of 10 pooled = 3 x \$41 = \$123
- Pooled BVD PCR on serum from youngstock > 60 days
  - 50 heifers, groups of 10 pooled = 5 x \$41 = \$205
- **TOTAL initial testing: \$546**

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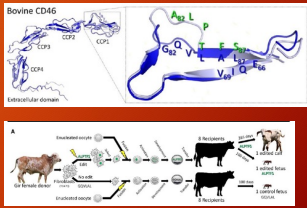
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**New in the literature: "First gene-edited calf with reduced susceptibility to a major viral pathogen"**

- Workmen et al 9 May 2023
- Used skin fibroblasts
- Substituted 6 amino acids in the BVD binding domain CD46
- Put 3 unedited wild type CD46 and 8 CD46 substitution embryos into recipis
- Used Gir cattle



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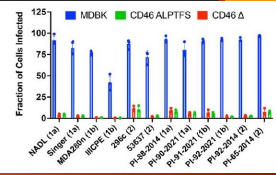
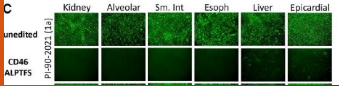
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**Outcomes**

- In vitro, primary cells, fibroblasts and immune cells from gene edited calf had up to 96% reduction in BVD susceptibility
- Ex vivo fetal kidney lung SI liver and heart cells reduction in BVD susceptibility

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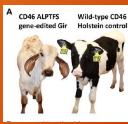
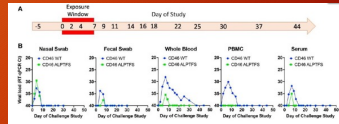
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**Outcomes**

- 1 wild type and 1 edited calf were housed w a PI at 10 mo of age
- Both had fever, low WBC
- Wild type calf was BVD PCR pos for 28 days, cough, rhinitis, mononuclear cells infected 12 days
- Edited calf BVD PCR pos 3 days, mononuclear cells neg
- Goal would be decreased viremia during gestation = no PI

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### Association of Border Disease Virus with a high mortality outbreak amongst 3-month-old feeder lambs shipped from Colorado to New York State

- Outline:
  - Case history
  - Clinical presentation
  - Diagnostics
  - Review of Border Disease
- I will publish this . . . someday!



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### Lambs arrive in NY Summer 2019

- Experienced sheep farmer in CO
- Born on open range 9,000-11,000 ft elevation
- Closed flock
- No vaccines
- Breeds: Suffolk, Dorset, Rambouillet crosses
- Lamb crop split btw NY and SD
- Weaned when loaded on trailer
- Healthy approximately 100-115 lb lambs



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### Transport

- 1,708 feeder lambs were transported from CO to NY
- NY lambs arrived in 4 loads
- Hauler brings sheep out on 4 deck trailer, pine shavings
- 17 hr trip
- Returns with cattle as a 2 deck
- Clean with citric acid wash between animals



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### NY Housing / Management

- 9/25/19 lambs arrived in NY
- Housed in new barn w center feed alley
  - 4 pens
- 5 Wagyu/Holstein crosses had been on property 60 days prior
- 9/27/19 CD&T vaccine and injectable Ivermectin dewormer



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### Fed low quality hay 1<sup>st</sup> 3 wks

- No grain
- No supplementation



Sample Description	Farm Code	Sample ID
10000000000000000000	1000	1000000000
10000000000000000000	1000	1000000000
Analysis Results		
Component	As Fed	DM
-----		
1 Moisture	73.0	
10 Dry Matter	27.0	10.1
1 Crude Protein	4.8	1.8
1 Acid Detergent Fiber	4.4	1.7
1 NDF	1.0	1.1
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10 Adjusted Crude Protein	4.4	10.1
10 Acid Detergent Fiber	4.4	10.1
10 NDF	1.0	1.1
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10 DM	27.0	42.2
10 CP	4.8	4.7
10 NDF	1.0	1.1
10 DM	13.1	14.0
10 CP	0.6	0.6
10 DM (Single Sugar)	2.9	4.2
10 Crude Fat	0.2	0.4
10 Ash	1.42	1.93
10 DM	54	47
DMC	48	31
DMC	48	31
DMC	48	31
Inclusive Feed Value	34	31
10 Crude Protein	27	28
10 Crude Protein	17	18
10 Crude Protein	6.72	6.6
10 Crude Protein	3.1	3.4
10 Crude Protein	101	102
10 Crude Protein	1.3	1.4
10 Crude Protein	1.3	1.4
10 Crude Protein	1.3	1.4

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### Case History

- 10/16/19 started feeding oats
- 10/30/19 CD&T booster
- Early Nov: Flock shorn
- Cold snap the following week

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Deaths began shortly after

- Very thin, BCS 1-2/5
- Found dead in am, producer attributed it to poor nutrition and exposure
- Field veterinarian performed 20 autopsies
  - Emaciation
  - Pneumonia
  - Ruminant acidosis



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Approx 382 animals died or were euthanized over 3 wks (22.4%)



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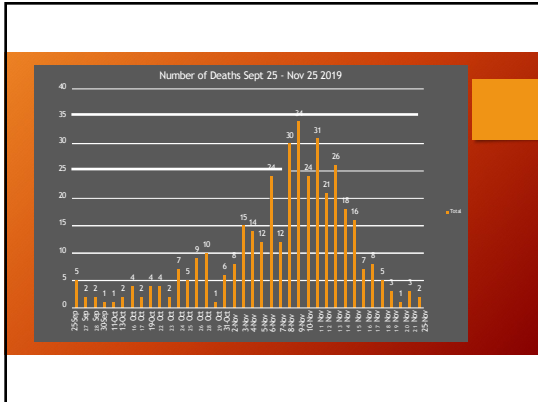
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### Histology

- Lamb 1:
  - Bronchopneumonia
  - Polyserositis
  - Sepsis, moderate lymphoid depletion in spleen
    - *Pasteurella multocida* cultured from lung, kidney, lymph node and pericardium
- Lamb 2:
  - Bronchopneumonia
    - *Pasteurella multocida* cultured from lung
  - Sepsis
- Lamb 3:
  - Bronchopneumonia
  - Necroulcerative esophagitis
  - Necroulcerative ileitis with lymphoid depletion of Peyer's patches
    - *Bibersteinia trehalosi* cultured from lymph node

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### Gross necropsies on 3 others

- Lamb 4:
  - Severe bilateral pneumonia
    - VI negative on lung tissue
- Lamb 5:
  - Pneumonia and neck abscess
    - VI negative on lung tissue
- Lamb 6:
  - Neck abscess
    - VI+ on lung tissue

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### Ancillary Diagnostics

- Liver Seleniums WNL
  - 1.60 ppm, 1.57 ppm, 1.46 ppm (RI 1- 7.5 ppm)
- Liver mineral panels mostly WNL
  - Lamb 1 molybdenum 3.25 ppm (RI 6-30 ppm)
- BRSV PCR: not detected in 3 lambs
- BVD PCR: Moderate positive for lamb 3

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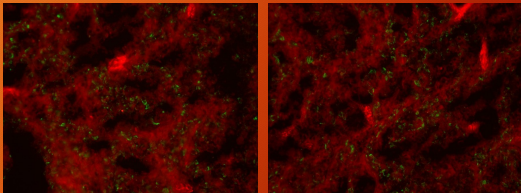
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### BVD Monoclonal antibody FA of lymph nodes



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### Virus Isolation

- Cultured a pestivirus in both ovine and bovine cell lines from lambs 1, 3 and 6, and on 11/25 on 2 more ram lambs
- Presumed it was Bovine Viral Diarrhea initially, and had BVD PCR positive
- Whole Genome Sequencing from lamb 1 isolate:
  - Border Disease Virus† Ranging 100%-92% match w all isolates

† Classical swine fever virus isolate RUCSHUM, complete genome

- Border disease virus isolate B235/15, complete genome
- Border disease virus isolate R9356/11, complete genome
- Border disease virus isolate baby 58987, complete genome
- Border disease virus isolate R478506, complete genome
- Border disease virus strain Anoyone, complete genome
- Border disease virus strain H2121 (Chantou-1), complete genome
- Border disease virus strain JLS12.01 polyprotein gene, complete cds
- Border disease virus isolate Iul 830/09 polyprotein gene, partial cds
- Border disease virus isolate 030101, complete genome
- Border disease virus strain Gilthon clone pBdvGH3, complete genome
- Border disease virus strain 297 polyprotein gene, partial cds
- Pestivirus strain 1 V04 Kertel complete genome
- Border disease virus isolate Coos Bay 5 c, complete genome
- Border disease virus isolate Coos Bay 5 c, complete genome
- Border disease virus isolate L8394 polyprotein gene, partial cds
- Border disease virus strain X218, complete genome
- Border disease virus gene for polyprotein, complete cds, strain: FNK2012.1
- **BVDV\_06\_11\_20\_classification**
- Border disease virus strain BD01 polyprotein gene, complete cds
- Pestivirus type 1 polyprotein gene, partial cds
- Border disease virus structural polyprotein gene, partial cds

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### Made a Border Disease serum neutralizing antibody test

- 11/15/19
  - Sampled 30 apparently healthy lambs
  - 12/30 had developed titers (8-512)
- 12/18/19
  - Sampled 100 lambs
  - 48/100 had titers (8-3,072)
  - Included 29 from the initial sampling
    - 9 more had seroconverted

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Animal ID	Titer 11/15/19	Titer 12/18/19	Animal ID	Titer 12/18/19	Animal ID	Titer 12/18/19	Animal ID	Titer 12/18/19
2111	-8	6	9502	16	9503	768	9504	-4
2112	-8	-4	9505	6	9506	24	9507	-4
2113	-8	128	9508	-4	9509	6	9510	12
2114	-8	48	9511	-4	9512	-4	9513	-4
2115	-16	6	9514	4	9515	64	9516	-4
2116	-4	304	9517	-4	9518	192	9519	8
2117	-4	1536	9520	12	9521	-4	9522	-4
2118	192	3072	9523	768	9524	256	9525	1024
2119	-4	-4	9526	96	9527	4		
2120	-16	-4	9528	256	9529	4		
2121	-4	128	9530	12	9531	-4		
2122	128	192	9532	6	9533	6		
2123	-8	-4	9534	-4	9535	4		
2124	-4	-4	9536	8	9537	-4		
2125	512	192	9538	192	9539	-4		
2126	-8	8	9540	128	9541	4		
2127	12	128	9542	-4	9543	4		
2128	-8	-4	9544	-4	9545	32		
2129	48	-4	9546	-4	9547	-4		
2130	48	8	9548	1024	9549	8		
2131	-8	-4	9550	-4	9551	-4		
2132	-4	96	9552	128	9553	-4		
2133	192	32	9554	-4	9555	8		
2134	-4	4	9556	8	9557	6		
2135	12	192	9558	4	9559	-4		

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### Border Disease Review

- Typically causes reproductive issues
  - Fertility
  - Abortions/ stillborn
  - Premature/ weak lambs
  - Hairy Shakers (persistently infected lambs)
    - Hair-like fleece
    - Rhythmic tremors

Nettleton, P.F. and Willoughby K. Diseases of Sheep, Fourth Edition, Chapter 18 Border Disease. Editor: I.D. Aitken (Edinburgh, UK), ARCVS, First published: 15 March 2007 Copyright © 2007 by Blackwell Publishing. Pg 119-126

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### Border disease infection and gestation

(Nettleton, P.F. and Willoughby K. Diseases of Sheep 4th Edition)

- Less than 60-85 days gestation:
  - Fetal death or mummy OR hairy shaker
  - No NA titer
- Ewes and other adult sheep have no clinical signs
- More than 60-85 days
  - Fetal death or weak lambs or normal lambs
  - Detectable NA titer
- Btw 60-85 days =??

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### Other high mortality BDV outbreaks

- 1984: French outbreak w 50% mortality, enteritis and leukopenia in 3-5 mo old lambs (Chappuis et al).
- 1,500 ewes and 24,000 lambs died (?)
- VI from 3-8 week-old lambs "AV strain"
- Experimentally infected lambs, 15/31 died with leukopenia




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### Previous BDV Report

- 1988: Netherlands report of CSFV contaminated by infected lamb kidney cells (Wensvoort et al)
  - Sows vaccinated
  - Caused congenital infections in piglets
  - Experimentally infected 4 lambs with contaminated vaccine strain
    - Autopsies revealed pleuropneumonia and catarrhal or hemorrhagic enteritis
- 2002: Tunisian sheep pox vaccine contaminated by BD (Thabti et al)
  - Repro issues in sheep
  - Experimentally inoculated lambs with the AV strain and 2 contaminated vaccine strains of BD, developed leukopenia and fever and NA to each strain
- 2004: 21 Pyrenean chamois sheep in Spain found dead, BD detected (Arnal et al)

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### “Identification of border disease virus in naturally infected pigs in Mexico” Navarro-Lopez et al 2023

- 8/2021: 15 45-day-old piglets died on a semi-intensive farm in Mexico
- Piglets had fever, anorexia, prostration and died
- 2 necropsies:
  - Hemorrhage in lungs, intestine, bladder, kidney.
  - Pleuritis
- BDV PCR pos spleen, kidney, tonsil
- Sanger sequencing clustered with BDV-1

- From 2011-2021, BDV seroprevalence in pigs in Mexico was 41.7%
- “Detection of border disease virus in Mexican cattle” Romero et al, 2016



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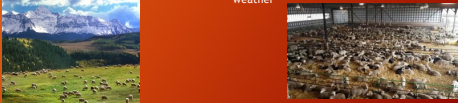
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### Unique presentation of BDV

- High mortality rate
- Unsure where virus came from
  - No hairy shaker lambs seen by CO producer or NY producer
- Did not test all sheep for BD

- Did management factors predispose?
  - Long transport
  - Going from open range to intensively housed
  - Poor nutrition / underweight
  - Shearing and then unseasonably cold weather



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### Current diagnostics available:

- BDV SN \$15.90
  - Serum
  - PI will lack titer
- Virus Isolation \$75
  - Fresh tissues (intestine, lung etc)
  - EDTA whole blood 5 ml
  - Sequencing available
- BVD ACE \$6 (maybe...)

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### Example from 2021:

- Large farm in PA doing AI and ET, bought in receipts recently
- Had lambs with "hairy wool", thought on purpose
- 5/6 died, tested a 6 wk old
- "Dams carrying PI have very high antibody titers because of continual antigenic challenge"

Hairy shaver suspect - Ovine Mixed Sheep Male	
Serum	
Border Disease Virus SN	Neg 8
Bovine Viral Diarrhea Virus SN, Type 1	Neg 8
Bovine Viral Diarrhea Virus SN, Type 2	Neg 8
Blood, Whole, EDTA	
Virus isolation	POSITIVE
Border disease virus	

Dam of Suspect - Ovine Mixed Sheep Female	
Serum	
Border Disease Virus SN	Pos =>#192
Bovine Viral Diarrhea Virus SN, Type 1	Pos 256
Bovine Viral Diarrhea Virus SN, Type 2	Pos 32

Recip Of Suspect - Ovine Mixed Sheep Female	
Serum	
Border Disease Virus SN	Pos =>#192
Bovine Viral Diarrhea Virus SN, Type 1	Pos 256
Bovine Viral Diarrhea Virus SN, Type 2	Pos 256

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