

Bovine Abortion Diagnostics

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Diagnostic Strategy

- Diagnostic testing must provide information of value to justify the cost to the producer
- Information:
 - Rule in or rule out diseases that require action
 - Prevent more pregnancy loss?
 - Prepare for a prolonged wreck?
 - Guide investigation of biosecurity failure
 - Explain poor reproductive performance
 - Illuminate need for other management changes

The Reality

- Abortion diagnostics are challenging
- Fetuses are often autolyzed
 - Limits ability to isolate pathogens
 - Limits ability to identify gross & histologic lesions
- Negative diagnostics on good samples ≠ failure
 - Rule out “big bads” of infectious abortion
 - Evidence to shift focus of investigation
 - Genetic abnormalities, nutritional deficiencies or excesses, environmental factors, management/husbandry

The Reality

- Improved management and vaccines have reduced the frequency and severity of *contagious* abortion outbreaks
- Reproduction is just one stage of livestock production
- If management deficiencies compromise overall state of health, reproduction will suffer
- Entire operation should be evaluated when investigating cause of abortion(s)

History

- Animal information
 - Who is affected? (age, % of herd)
 - When are they affected? (stage of pregnancy)
 - How are they affected? (Sick? Retained placenta?)
 - What has changed (or not)?
- Nutrition
- Preventions and treatments
- Environmental influences

Fetus

- Document crown-to-rump length
 - Gestational age
- Note overall condition/degree of autolysis
- Gross lesions are rarely seen
 - Pinpoint foci on liver, lung, kidney
 - Plaques on skin +/- fetal membranes
 - Anatomic anomalies
- Brains lack tissue integrity
 - pour into specimen jar

Samples

- Maternal serum +/- herd mate serum
- Fetal fluids +/- heart blood
- Abomasal contents
- Ocular fluid
- Fresh: liver, lung, kidney, heart, brain
- Fixed: liver, lung, kidney, heart, brain, thymus, lymph node, spleen, skeletal muscle
 - Any tissues with lesions
 - Formalin to tissue ratio: 10:1

Fetal membranes

- Placenta
- Reflect the maternal environment
- Cotyledonal and noncotyledonal samples
 - Fresh and fixed

Infectious Abortions

- Hematogenous route common
 - Bacterial, viral, fungal, protozoal
- Ascending infections from cervix uncommon
- Other routes
 - Venereal
 - Contaminated semen or embryos
 - Preexisting mucosal infections

Infectious Abortions

- Placenta → amniotic fluid → fetal GI tract, respiratory tract, skin
 - Bacterial and fungal infections

Infectious Abortions

- Fetal membranes → umbilical vasculature → fetal hepatic and systemic lesions
 - *Listeria monocytogenes*, *Salmonella* spp., BHV-1, *Neospora caninum*

Microbiology

- Fresh samples: abomasal content, lung, liver
 - Placenta if in good condition
- Aerobic culture
- *Campylobacter* spp. culture
- *Brucella* spp. culture
- Fungal cultures if placental or skin plaques

Histopathology

- Fixed samples: brain, lung, heart, liver, kidney, spleen, thymus, LNN, skeletal muscle, placenta
- Often provides useful information
 - Even with autolysis
- Utility limited by mummification
- IHC for BVDv or BHV-1

Molecular Diagnostics

- Identifies and quantifies pathogen specific genetic material
- *Leptospira* spp.: kidney, liver, placenta, urine
- Bovine herpesvirus-1: lung, trachea
- Bovine viral diarrhoea virus: lung, trachea
- *Neospora caninum*: brain, placenta, liver, lung, heart
- *Listeria monocytogenes*: liver, brain, placenta

Virology

- Sample: organ pool of fetal tissues
 - Lung, liver, spleen, kidney, placenta
- BVDV
- BHV-1

Serology – Maternal

- Single sample cannot differentiate vaccination from natural exposure
 - Recent vs previous exposure?
- Maternal seroconversion often before abortion
 - Compare titers to herd mates
 - Collect titers from pregnant animals, submit as acute sample if abortion occurs
- Acute + Convalescent titers may be useful for early embryonic loss investigation
 - Lepto titers

Serology – Fetal

- Heart blood or thoracic fluid
- IgG >20mg/dL = active immune response to foreign antigen
- Elevated titers suggest exposure
 - BHV-1, BVDV, Lepto, *Neospora caninum*, *Brucella abortus*, Bluetongue virus, Parainfluenza virus 3
- Placental lesions may allow maternal antibodies to enter fetal fluids
 - Interpret with caution

Serology Titers

- Serologic titer – expression of Concentration
- Use serial dilutions to obtain semi-quantitative results from a series of positive/ negative tests
- Titer result corresponds to the Highest Dilution factor that still yields a positive reading

Positive Titers

- Vaccination
- Natural exposure to infectious agent
 - Clinical disease
 - Sub-clinical insult
- Combination(s)

Negative Titers

- Animals may fail to develop a titer in response to vaccination or exposure
 - Improper vaccine handling
 - Poor condition +/- nutrition
 - Nutrition imbalances (vitamin A, copper)
 - Lack of antigenic stimulation
 - Immune suppression
 - Stress
 - Maternal interference

Titer Results

- A 4 fold increase in titers between paired samples = good evidence of recent infection
- Changes of 2 fold or less are within the understood error margin of serologic testing
- Other factors/test results needed to weigh significance of titer changes < 4 fold

Titer General Guidelines

- BVD VN
 - Vaccination titers vary widely (1:32-1:2048)
 - Titers in precolostral neonates & unvaccinated calves > 6 months are indicative of recent infection
- BHV-1 VN
 - Titers >1:128 consistent with recent infection
- Leptospirosis
 - Vaccination titers generally <1:3200 and decrease by 6 months post vaccination
 - Titers >1:3200 indicate acute infection

Common Abortion Pathogens

- Bovine herpesvirus-1 (IBR)
- Bovine viral diarrhea virus
- Opportunistic bacteria
- Brucellosis
- Listeriosis
- Salmonellosis
- Leptospirosis
- Neospora caninum

Bovine herpesvirus – 1 (IBR)

- Abortions usually in second half of gestation
 - 5 months to term
- Histopathology
 - Liver, placenta, lung, spleen, lymph node, adrenal gland
- PCR
- Confirmation
 - IHC or virus isolation

Bovine viral diarrhoea virus

- Wide range of disease manifestations
 - EEL, PI, transient infection, congenital defects
- BVDv infection can contribute to abortion due to bacterial or mycotic infection
- Gross and microscopic pathology – fetus
- PCR – lung
- Antigen cELISA – ear notch
- IHC – kidney, lung, placenta
- VI – lung, liver, kidney, lymphoid tissue
 - Sensitivity reduced by autolysis

Opportunistic Bacteria

- Isolated sporadic abortions
- Usually second half of gestation
- Maternal bacteremia → placenta → fetus
 - Dam may retain placenta
- Culture abomasal contents
 - Common: *Truoperella pyogenes* & *Bacillus* spp.
 - *E.coli*, *H.somni*, *Pasteurella* spp., *Pseudomonas* spp., etc
- Histopathology
 - Suppurative placentitis, fetal bronchopneumonia

Brucellosis

- *Brucella abortus* abortion frequency reduced
- Zoonotic potential
- Uterine infection during second trimester
 - Abortion after fifth month of gestation
 - Retained placenta and metritis common
- Histopathology
 - Chronic placentitis, fetal pneumonia
- Culture abomasal fluid, lung, placenta

Listeriosis

- *Listeria monocytogenes*
- Sporadic abortions to abortion storms
- Fever and anorexia in cows d/t metritis
 - Retained placenta common
- Usually third trimester abortion
- Histopathology
 - Suppurative placentitis, multifocal hepatic necrosis
- Confirmation
 - PCR or IHC

Salmonellosis

- Sporadic abortions
- Abortions usually second half of gestation
- Retained placenta common
- Histopathology
 - Lesions similar to Listeriosis
- Culture
- PCR

Leptosporosis

- Abortions usually 4 months to term
- Histopathology
 - Various lesions
- PCR the most sensitive and reliable confirmatory test

Neospora caninum

- Parasite can be maintained in the cow as a chronic infection
 - Efficient transmission to fetus
- Some abortions, many asymptomatic carriers
 - 80-90% calves or seropositive cows
- Placentas not retained
- Abortions 3 months gestation to term
 - 4-6 months most common
- Histopathology: brain, heart, liver, skeletal mm
- PCR

Pathology Words of Wisdom

- Gayman Helman DVM, PhD, MA
- Will Sims, DVM, MS
- Jay Hoffman, DVM, PhD
- Barbara Lewis DVM, MS
- Gabriel Gomez, DVM, PhD
- Andres De La Concha, DVM, PhD
- Eric Snook, DVM, PhD



Pathology Words of Wisdom

- Prefer to have entire fetus at the lab
- If not possible:
 - Fresh: lung, spleen, liver, kidney, brain, 4-5 ml of any body cavity effusion
 - Fixed: lung, heart, thymus (if present), liver, kidney, abomasal wall, skeletal muscle, brain
- Make sure fetus is whole before sending
 - Need thoracic and abdominal viscera (predation)
- Mummified or mascerated carcasses
 - Usually a waste of time and money

Pathology Words of Wisdom

- Placenta, placenta, placenta
- Be sure to send abomasal contents for culture
 - Free of contamination
- Serum from the dam is helpful
 - May need a repeat sample in a few weeks
- Include a complete history
- Report vaccination history of cows

Pathology Words of Wisdom

- The purpose of sending an aborted fetus to the lab is to rule out the most common causes of infectious abortion
- There are other causes that cannot be identified
- Realize that diagnosis is only found in ~20% of cases, be prepared for difficulty
 - Negative diagnostic results are valuable

Pathology Words of Wisdom

- Remember genetics
- Pawnee Farm Arlinda Chief
 - One of the most prolific bulls in the history of the Holstein breed
 - 16,000 daughters, 500,000 granddaughters, >2Million great granddaughters
 - Introduced a lethal gene (APAF1) into the population
 - responsible for an est. half million spontaneous abortions worldwide



Pathology Words of Wisdom

- Some causes of abortion are zoonotic
 - Can make people sick
- Fetuses need to be handled properly

Questions?

