Bovine Disease Diagnostic Manual

A COMPREHENSIVE GUIDE TO BOVINE DISEASE DIAGNOSIS

Newport Laboratories

As the nation's largest manufacturer of custom-made vaccines, Newport Laboratories is a highly focused, technology-based company dedicated to providing timely, science-based solutions to food animal disease problems. Our products and services are delivered and supported by a dedicated and experienced sales staff and Veterinary Technical Service team.

Table of Contents

Bovine Diagnostic Submission Guide

Disease Suspected	Specimen	Sample Preparation	Laboratory Procedure
Actinomycosis	Abscessed Tissue	10% Formalin	Histopathology & Tissue Stains
	Abscessed Tissue & Exudate	Fresh, Refrigerate	Anaerobic Bacterial Culture
	Anaerobic Culture Swab	Refrigerate	Anaerobic Bacterial Culture
Bovine Herpes Virus 1 (IBRV)	Lung, Trachea, Nasal Swabs	Refrigerate	PCR, Virus Isolation
		10% Formalin	Histopathology
Bovine Respiratory Syncytial Virus (BRSV)	Lung	Refrigerate	PCR, Virus Isolation
		10% Formalin	Histopathology
Bovine Virus Diarrhea (BVDV)	Lung, Ileum, Cecum, Spiral Colon, Mesenteric Lymph Nodes, Spleen, Whole Blood (Purple-Top Tube) Ear Notch	Refrigerate	PCR, Virus Isolation
		10% Formalin	Histopathology
Calf Diphtheria	Lesion Material, Swab from Lesion	Refrigerate	Anaerobic Bacterial Culture
Caseous Lymphadenitis (sheep & goats)	Purulent Exudate from Abscess	Refrigerate	Culture, Sensitivity
Clostridioides* (*Clostridium*) *difficile	Colon (sections with contents)	Refrigerate	Anaerobic Culture, PCR, A/B Toxin ELISA
***Clostridium perfringens* Types A, C, D, E**	Small Intestine (tied off), Abomasum (fresh), Liver (fresh) Note: Do not submit fecal samples.	Refrigerate	Anaerobic Culture, Sensitivity, Toxin PCR Testing
		10% Formalin	Histopathology
Coccidiosis/ Cryptosporidiosis	Small Intestine (with Cecal & Spiral Colon & Contents), Feces	Refrigerate	Fecal Float
		10% Formalin	Histopathology
Colibacillosis	Small Intestine (Jejunum, Ileum & Colon), Feces from Calves less than 7 days old.	Refrigerate	Culture & K99 Pilus Identification
		10% Formalin	Histopathology
Colisepticemia	Lung, Liver, Spleen, Kidney, & Lesions	Fresh	Bacterial Culture
	Lung, Liver, Spleen, Kidney, & Lesions	10% Formalin	Histopathology
Coronavirus (respiratory)	Lung, Nasal Swabs	Refrigerate	PCR, Virus Isolation
Enteritis (Rotavirus and Coronavirus)	Intestine (with Cecal & Spiral Colon Section & Contents)	Refrigerate	PCR, Virus Isolation, Sequencing
	Feces		PCR, Virus Isolation, Sequencing
Footrot (*Fusobacterium necrophorum*)	Swab from Lesion	Refrigerate	Culture
Hardware Disease	Reticulum, Pericardium	10% Formalin	Histopathology

For bacterial culture, we recommend swabs with transport media to prevent desiccation.
For virus isolation, swabs should be placed into viral transport media; call us for information.

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Bovine Diagnostic Submission Guide

Disease Suspected	Specimen	Sample Preparation	Laboratory Procedure
***Histophilus somni* (formerly *Haemophilus somnus*)**	Affected Lung	Refrigerate	Culture, Sensitivity, Gene Sequencing
		10% Formalin	Histopathology
	Myocardium, Brain	Refrigerate	Culture, Sensitivity, Gene Sequencing, PCR
		10% Formalin	Histopathology
	Joint Swabs (if involved)	Refrigerate	Culture, Sensitivity, Gene Sequencing, PCR
Interstitial Pneumonia	Lung, Ventral & Dorsal Areas	Fresh	Bacteriology & Virology
	Lung, Ventral & Dorsal Areas	10% Formalin	Histopathology
Johne's Disease	Ileum	10% Formalin	Reference Lab
	Ileum or Feces	Fresh, Refrigerate	Reference Lab
***Mannheimia haemolytica* (formerly *Pasteurella haemolytica*)**	Affected Lung, Lymph Nodes (Mediastinal or Bronchial)	Refrigerate	Culture, Sensitivity, Gene Sequencing, PCR, Serotyping
		10% Formalin	Histopathology
Mastitis	Milk Sample from Affected Quarter or Bulk Tank	Refrigerate or Frozen	Culture, Sensitivity
Mycoplasma bovis	Affected Lung	Refrigerate	Culture, Speciation, Gene Sequencing
		10% Formalin	Histopathology
	Joint Swabs/Fluids, Tracheal Swabs, Swabs or Exudate from Middle Ear	Refrigerate	Culture, Speciation, Gene Sequencing
Parainfluenza-3 Virus (PI_3)	Lung, Nasal Swabs	Refrigerate	PCR, Virus Isolation
		10% Formalin	Histopathology
Pasteurella multocida	Affected Lung, Lymph Nodes (Mediastinal or Bronchial)	Refrigerate	Culture, Sensitivity, Serogrouping PCR
		10% Formalin	Histopathology
Pinkeye (*Moraxella bovis*, *Moraxella bovoculi*, *Mycoplasma bovoculi*)	Eye Swabs	Refrigerate	Culture, Sensitivity, Gene Sequencing
Polioencephalomalacia	Cerebral Cortex, Brainstem	10% Formalin	Histopathology
	Water, Feed/Forage	Fresh	Sulfate Analysis
Pyelonephritis	Kidney, Urinary Bladder	10% Formalin	Histopathology
	Kidney, Urinary Bladder, Urine	Fresh, Refrigerate	Bacterial Culture
Reproductive Failure/Abortion	Fetus with Placenta, if Available	Refrigerate	Reference Lab
Salmonellosis	Small Intestine, Spleen, Lung, Liver, Mesenteric Lymph Nodes (all fresh and in formalin): Gall bladder, Fresh Feces & Fecal Swabs	Refrigerate	Culture, Sensitivity
		10% Formalin	Histopathology
Trace Mineral Deficiency (i.e., copper & selenium)	Liver (fresh)	Refrigerate	Reference Lab

Whenever possible, animals selected for laboratory analysis should be free from antibiotic therapy and in an early or acute disease stage. Selected tissues should be collected as aseptically as possible. A meaningful history of the disease outbreak and a tentative diagnosis, based upon clinical evaluation and necropsy findings, should be included. Laboratory test results are directly affected by animal selection, necropsy technique, specimen selection and specimen handling, including preservation and shipment to the laboratory. Contact Newport Laboratories if you have any questions regarding sample collection or the diagnostic process.

Preparation and Collection of Tissues/Samples

TISSUES – FRESH

Aseptically collect approximately 2- by 4-inch samples and place in a plastic bag. Sample visible lesions with adjacent normal tissue. Double-bag in Whirl-Pak® bags. Do not mix swabs, intestines or brains with other tissues in one single bag. Transport tissues with two or three cold packs in an insulated container. It is important that the tissue samples arrive at the laboratory before the cold packs thaw.

Collect sections of small and large intestine. The selected, clearly identified samples should be double-bagged and sealed in Whirl-Pak bags to prevent spillage. Do not longitudinally cut the loops of intestines open. The intestine, approximately 2 inches long, should be refrigerated and cooled thoroughly prior to shipping. Avoid shipping over the weekends or holidays.

SWABS

Aerobic Culture

Commercial swabs with Stuart's or Amies transport media are recommended to prevent desiccation.

Anaerobic Culture

For anaerobic culture, charcoal media and swabs are recommended. A serum tube with a snug stopper may be used with exudates. Cary Blair culturettes are recommended for sampling footrot lesions.

Deep Nasopharyngeal Swab Technique

Two (2) 27–30-inch double-guarded equine uterine swabs are required for each animal: One swab will be placed in bacterial transport media and the other swab in viral/mycoplasma transport media. Proper restraint of the animal's head is essential since movement of the head can cause the swab to break off in the pharynx. Clean the nostrils with a clean cloth. Measure the distance from the nostril to the medial canthus of the eye. Remove the twist tie from the culture swab. Insert the double-guarded culture swab into the ventral meatus of the nose, and advance it the pre-measured distance from the nostril to the medial canthus of the eye. (Swabs placed in the dorsal meatus of the nose cannot advance far enough to obtain a deep pharyngeal sample.) Retract the culture swab approximately 1–2 inches. Push the swab sheath through the end of the outer clear PVC tube. Then push the polyester-tipped polystyrene swab through the swab sheath for about 1–2 inches. Vigorously rotate the swab against the pharyngeal mucosa for 15–30 seconds. Organisms such as mycoplasma are tightly associated with mucosal cells, making it important to adequately swab the nasopharynx. Retract the polyester-tipped swab into the swab sheath. Remove the entire double-guarded swab from the animal's nose.

Using a clean pair of scissors, cut the polyester-tipped swab a few inches from the tip. Do not cut the swab too short; short swabs are difficult to remove from the transport media. Place the swab in the bacterial transport media. Make sure the polyester-tipped swab is fully immersed in the transport media.

Repeat the procedure in the other nostril. Place the polyester-tipped swab in the viral/myco transport media. Label all the transport media legibly in marker with the animal's identification number or name.

Samples should immediately be placed in a cooler and stored at 4° C. Maintaining swabs at 4 °C instead of at room temperature increases the recovery rate of pathogens from diagnostic samples. It is very important that samples be shipped with ice packs to maximize the chance of organism recovery.

Nasal Swabs – Bacterial Suspect

Clean the external nares and internal nostrils with a moist towel to remove common contaminants. (Use swabs with transport media such as Amies or Stuart's). Insert swab into the pre-cleaned nasal cavity and rotate. Upon successful sample collection, the swab is inserted into the accompanying sterile plastic sheath. The ampule located at the end of the sheath is gently crushed, releasing transport medium.

Tissue Submission Guidelines

Nasal Swabs – Viral Suspect

Prepare nostrils and sample as in bacterial suspect. For viral swabs, use Universal Viral Transport Kit (Becton Dickinson #220528) or equivalent.

Use of the incorrect swab and media may jeopardize the ability to detect or culture the offending pathogen. For bacterial isolation, avoid using Mycoplasma spp. or viral media, which contain antimicrobials and may inhibit growth of the desired pathogen.

Mycoplasma Culture

Universal Viral/Mycoplasma transport swabs and media are recommended for mycoplasma PCR and culture. Other bacterial culturettes are acceptable.

Identify all swabs with the following:

- Farm ID, including site and pasture/lot where appropriate
- Animal identification number

HISTOPATHOLOGY

Preparation of Tissue for Fixation

Multiple sites or types of lesions, to include both normal and diseased tissue and a sample at the line of demarcation, should be taken. **The sections should be no more than 1 inch thick. The small size of the tissue results in rapid and complete penetration of the fixative.**

Selected tissues should be cut with a sharp knife or scalpel, since the squeezing action of scissors crushes and tears tissue. Autolysis or freezing will make samples unsuitable for histopathological evaluation. Place formalin and tissues in double Whirl-Paks. Identify bags if multiple animals are submitted. Do not use narrow-mouth bottles to submit fixed tissues.

Volume of Fixative

The selected tissues should be fixed in 10 percent neutral buffered formalin. Use 10 times the volume of the tissues being fixed to ensure good perfusion of the sample and to maintain the tissue architecture. After 24 hours of fixation, excess formalin can be poured off, and a smaller formalin volume can then be used for shipping.

Formula to Make 10% Neutral Buffered Formalin

37–40% formaldehyde	100 mL
Distilled water	900 mL
Sodium phosphate, monobasic monohydrate	4.0 g
Sodium phosphate, dibasic anhydrous	6.5

Tissue Selection for Histopathology

Check the recommended samples in the guideline table on pages 4 and 5. If the cause of death is unknown or the clinical syndrome is vague, then submit samples exhibiting suspected gross lesions and the following tissues: heart, liver, lung, kidney, spleen, various levels of the gastrointestinal tract, mesenteric lymph nodes, and brain.

If hollow organs (gut or uterus) retain significant amounts of content, then they should be gently flushed with 10 percent formalin without disturbing the mucosal lining before placing in the formalin bag. Be sure to take proper precautions when handling formalin.

I.D. AND HANDLING OF BLOOD SAMPLES:

Collection of Blood Samples

- Collect in sterile tubes. Serum separator tubes work well. Follow the manufacturer's directions. Based on the number of tests requested, 1 mL – 3 mL of non-hemolyzed serum is required.
- Fill vacutainer tubes 3/4 full, and allow to stand at room temperature for an hour to permit a solid clot to form and retract.
- Pipette the serum into sterile tubes with snap caps. (3-mL plastic tubes with snap caps, Falcon #2054, are recommended). Make sure caps are securely closed.
- Use permanent markers and underline the I.D. numbers (e.g., 16 vs. 91).
- Do not freeze whole blood or samples with the clot remaining.
- Contaminated or toxic samples cannot be used in virus isolation tests. Many serology tests are adversely affected by hemolysis.

I.D. SAMPLES ON SUBMISSION FORMS

- Using one form per client and site, identify the tubes on the submission request form by different barns, or age groups, as logical for the diagnostic investigation.
- Clearly specify the test(s) requested on the submission form.
- When sending paired sera, identify the acute samples from the convalescent samples on the tube and on the request form.

Diagnostic submission forms can be downloaded from our website, www.newportlabs.com, or by calling Newport Customer Service at 800-220-2522.

Tissue Submission Guidelines

PACKING SPECIMENS

To avoid leaking in transit, double-bag ALL samples. Whirl-Pak bags or equivalent are recommended. Wrap sample bags and two to four ice packs in absorbent paper (e.g., newspaper). Place the package into a Styrofoam container. Completed submission forms should be inserted into a separate bag in case of leakage and clearly attached to the matching specimens. This is especially important if your container contains specimens from multiple clients or sites. Avoid mixing intestinal samples with other tissues. If you need more information about shipping specimens to Newport's Diagnostic Laboratory, please call us at 800-220-2522.

SAMPLE SUBMISSION

Newport Laboratories provides free diagnostic kits for sample submission. Call us at 800-220-2522 to request submission form(s) or shipping containers. Submission forms are also available online at www.newportlabs.com. Samples should be submitted by the fastest means possible to avoid deterioration of specimens. Next-day or overnight delivery is preferred. The most reliable services that we have found are listed below:

- FedEx
- United Parcel Service (UPS)
- Spee-Dee
- U.S. Parcel Post (only as a final option)

LABORATORY HOURS

The Newport Diagnostic Laboratory is open for service from 8:00 A.M. to 5:00 P.M. (CT) Monday through Friday, with the exception of holidays.

Diagnostic Shipping Address

Newport Laboratories
1524 Prairie Drive
Worthington, MN 56187

Diagnostic Reporting and Management Software

NEWPORT
DX-REPORTS

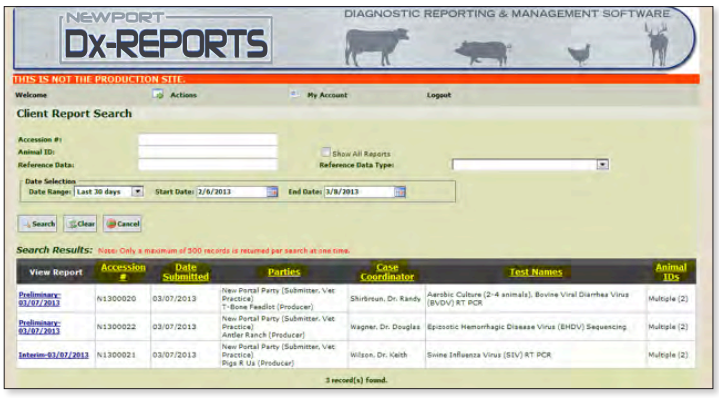
The Dx-REPORTS is a secure site which allows veterinarians to view diagnostic testing results where they want and when they want. This system allows veterinarians to easily organize and distribute diagnostic results. Livestock producers receive pertinent information from their veterinarian in a precise and understandable format.

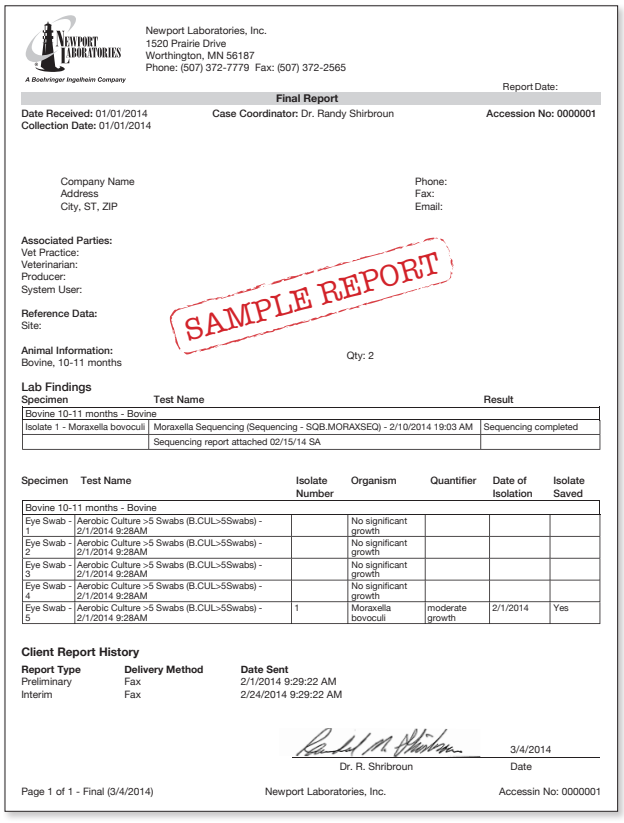
DX-REPORTS PROVIDES NUMEROUS FEATURES AND BENEFITS:

- Password-protected site maintains confidentiality of all diagnostics information.
- Complies with producer's and attending veterinarian's privacy requirements.
- Accessible from any computer location at any time.
- Easy to navigate interface.
- Applications for all food animals and cervidae.
- Ease of collecting, distributing and banking individual production-site data.
- Data analysis to identify disease trends within groups and between groups.
- Left-margin icons and header action button provide data management menu options.
- Real-time database allows you to see results and status of submissions.

CALL NEWPORT LABORATORIES AT 800-220-2522
FOR MORE INFORMATION ABOUT DX-REPORTS CAPABILITIES.

ONLINE WEB PORTAL




Newport Laboratories, Inc.
1520 Prairie Drive
Worthington, MN 56187
Phone: (507) 372-7779 Fax: (507) 372-2565

A Boehringer Ingelheim Company

Report Date:

Final Report

Date Received: 01/01/2014 **Case Coordinator:** Dr. Randy Shirbroun **Accession No:** 0000001
Collection Date: 01/01/2014

Company Name
Address
City, ST, ZIP

Phone:
Fax:
Email:

Associated Parties:
Vet Practice:
Veterinarian:
Producer:
System User:

Reference Data:
Site:

SAMPLE REPORT

Animal Information:
Bovine, 10-11 months

Qty: 2

Lab Findings

Specimen	Test Name	Result
Bovine 10-11 months - Bovine		
Isolate 1 - Moraxella bovoculi	Moraxella Sequencing (Sequencing - SQB.MORAXSEQ) - 2/10/2014 19:03 AM	Sequencing completed
	Sequencing report attached 02/15/14 SA	

Specimen	Test Name	Isolate Number	Organism	Quantifier	Date of Isolation	Isolate Saved
Bovine 10-11 months - Bovine						
Eye Swab - 1	Aerobic Culture >5 Swabs (B.CUL>5Swabs) - 2/1/2014 9:28AM		No significant growth			
Eye Swab - 2	Aerobic Culture >5 Swabs (B.CUL>5Swabs) - 2/1/2014 9:28AM		No significant growth			
Eye Swab - 3	Aerobic Culture >5 Swabs (B.CUL>5Swabs) - 2/1/2014 9:28AM		No significant growth			
Eye Swab - 4	Aerobic Culture >5 Swabs (B.CUL>5Swabs) - 2/1/2014 9:28AM		No significant growth			
Eye Swab - 5	Aerobic Culture >5 Swabs (B.CUL>5Swabs) - 2/1/2014 9:28AM	1	Moraxella bovoculi	moderate growth	2/1/2014	Yes

Client Report History

Report Type	Delivery Method	Date Sent
Preliminary	Fax	2/1/2014 9:29:22 AM
Interim	Fax	2/24/2014 9:29:22 AM

Dr. R. Shirbroun — 3/4/2014 Date

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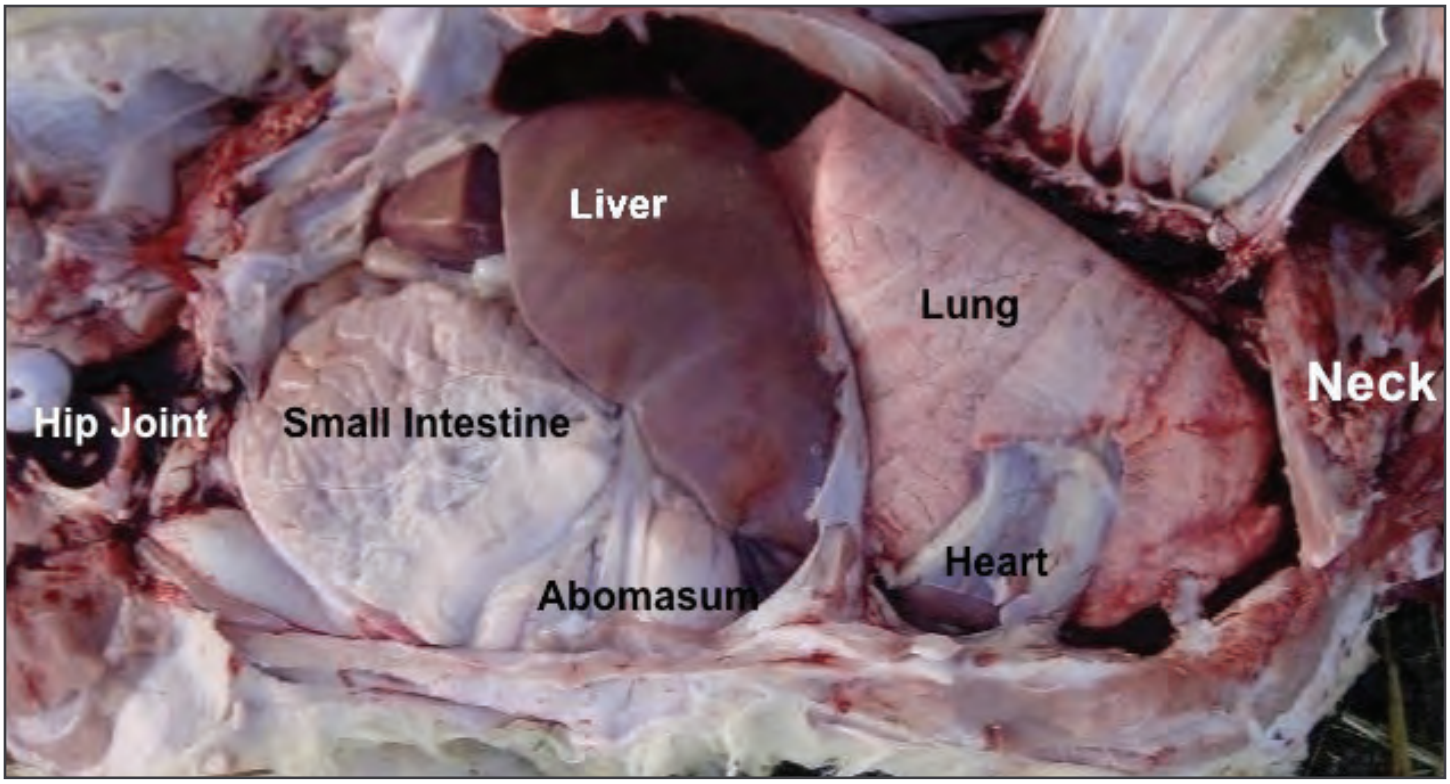
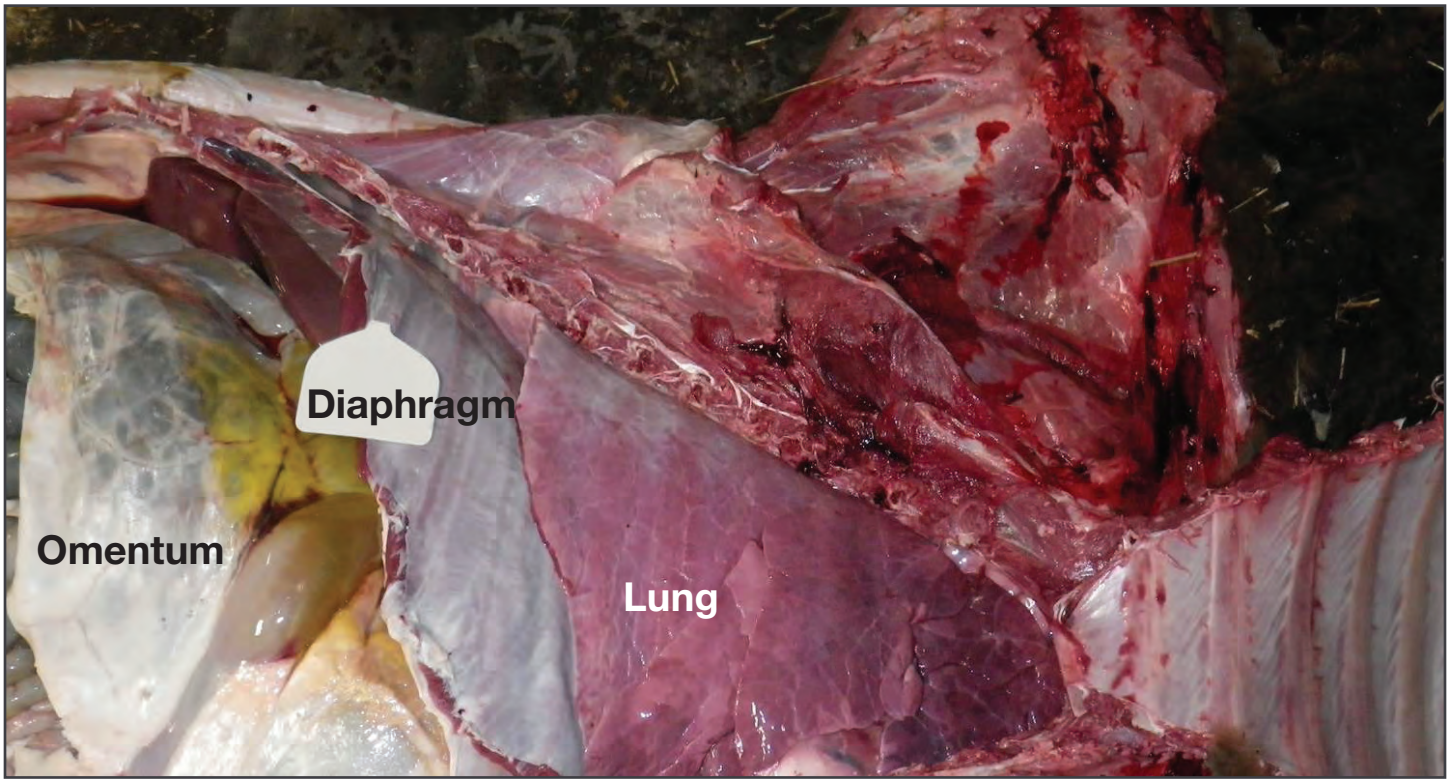
Major Bovine Organs



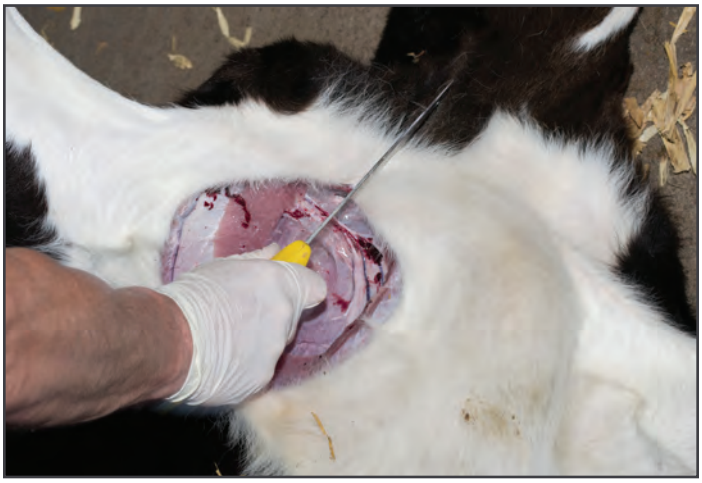
Exposed thorax and abdomen of a calf.



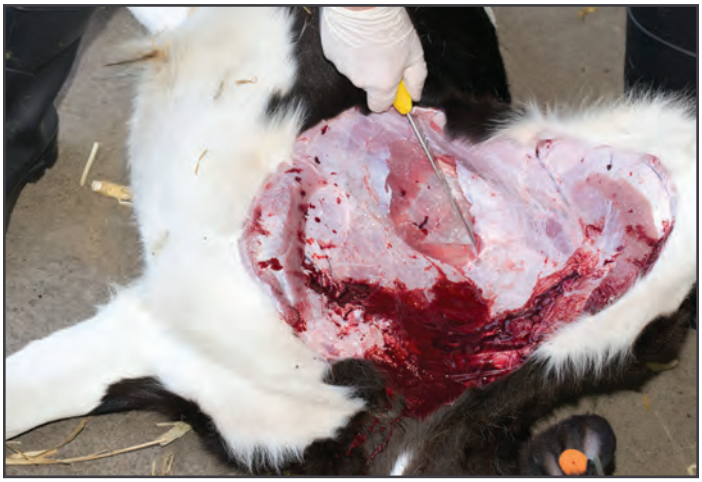
Feedlot bovine necropsies will require ribs to be cut from the thorax with a rib cutter. Cut each rib free along the back and along the sternum, and then reflect the rib cage away to expose the lungs. The necropsy can be continued by dissecting free the trachea and larynx, and then removing the entire pluck (lung, heart, trachea, larynx) as a unit.

Necropsy Instructions

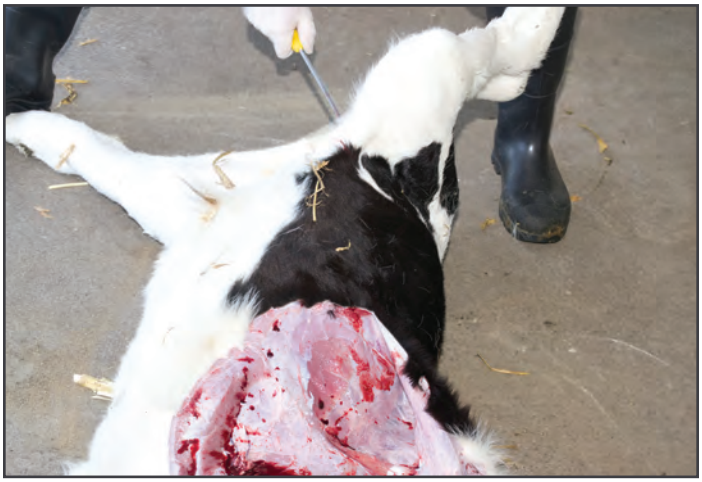
Important: Start with a sharp knife.



Cut through the axilla (armpit) to partially separate the front limb from the rib cage.



Cut deep enough so the leg will lie flat.



Cutting through the groin skin, the upper hind limb is cut and laid back likewise.

Cut between the skin and body wall, beginning at the pelvis, along the midline all the way to the neck.

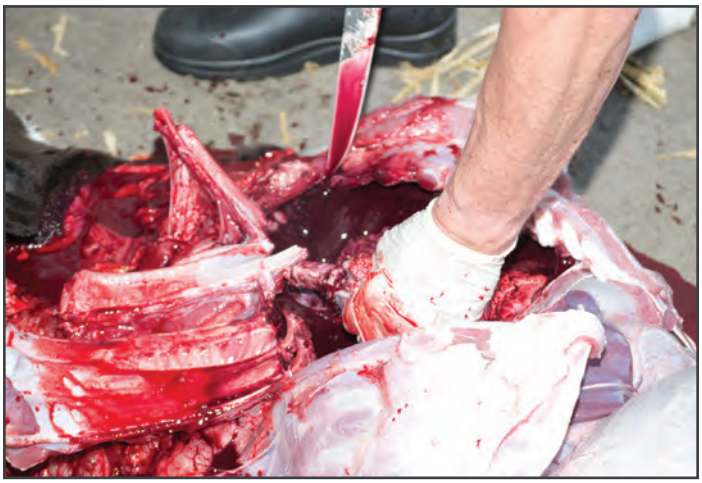
Following the cut just made, dissect the skin away from the body wall, reflecting it over the back.

Continued on next page

Necropsy Instructions

Carefully open the abdominal wall, and puncture the peritoneum. Use the butt of the knife to push the guts out of the way as you extend the knife toward the ventral midline, then toward the pelvic canal.

Dissect the flap of abdominal wall you just created away toward the back. The abdominal organs are now exposed. To expose the thoracic organs, cut through the sternum.

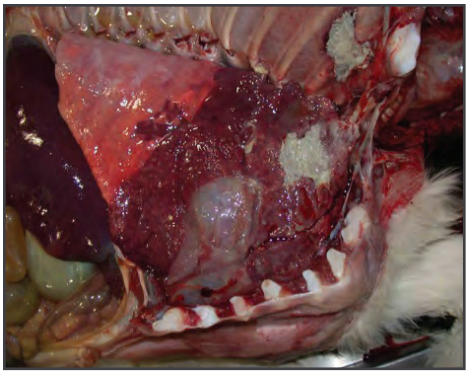


Cut the muscle between each rib, and snap them one at a time toward the back to expose the thoracic organs.

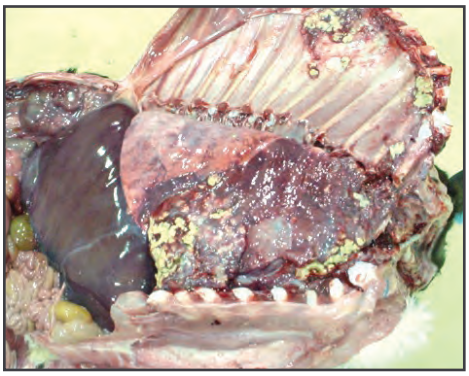
Thoracic organs are now easily examined and sampled.

H. somni Pneumonia / TME / Myocarditis

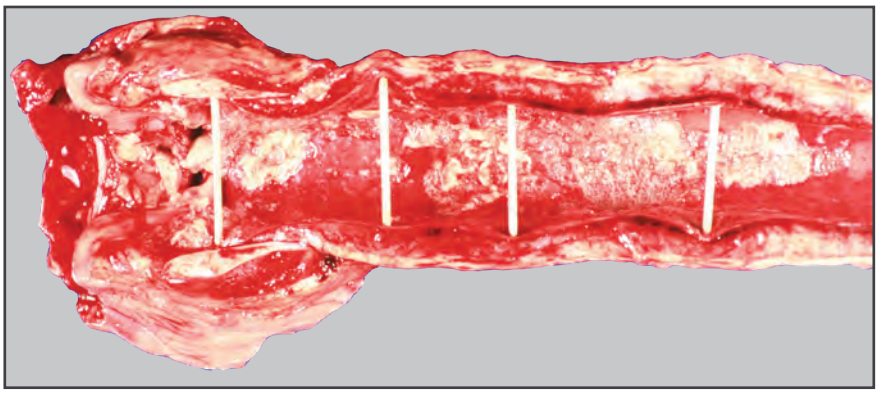
Histophilus somni (formerly *Haemophilus somnus*)



Consolidated lung – early case of *H. somni* pneumonia with pleuritis.



Consolidated lung with severe pleuritis in a chronic case. Note small abscesses in lung (yellow dots), which represent pus-illed airways, very typical of *H. somni.*



H. somni laryngitis and proximal tracheitis. Note fibrinous exudate on surface with ulceration. This lesion is seen in many cattle that become septicemic and develop Throboembolic meningoencephalitis (TEME), myocarditis or polyarthritis. Can grossly be confused with IBR.

CLINICAL SIGNS AND HISTORY

- Sudden death is often the first indication of *H. somni* infection in a feedlot animal.
- Thrombotic meningoencephalitis (TME) is the result of septic bacterial infarcts within the brain, especially the cerebral cortex and brainstem. Animals with the nervous form exhibit profound depression, often the most noticeable clinical sign of histophilosis.
- Fever is also a common finding; however, animals diagnosed with undifferentiated fever may be suffering from *Mannheimia pneumonia*, Histophilosis, or both.
- Specifically, animals affected with the fibrinous pleuritic form of the disease may exhibit extreme labored breathing.
- Animals with inflammation of the heart (myocarditis) may exhibit sudden collapse and death on exertion (e.g., being moved through a handling facility).
- Other findings are determined by the system(s) involved, and may include rapid respiration, stiffness, lameness, muscle weakness, lack of coordination, paralysis and eye twitching.
- Animals found dead and confirmed with *H. somni* infection often have a history of having been treated for undifferentiated fever or depression in the previous 14 days.

Continued on next page

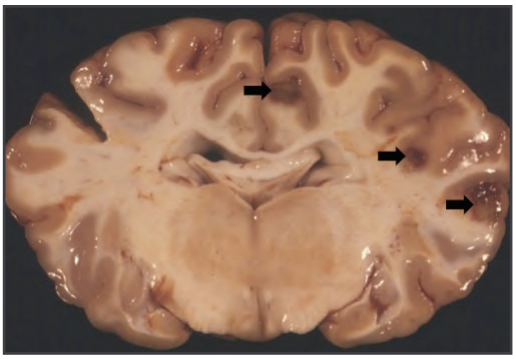
H. SOMNI

Tissues to Submit
- Affected Lung
- Myocardium
- Joint Swabs (*if involved*)
- Brain including Brainstem, Cerebellum & Caudal Cerebrum

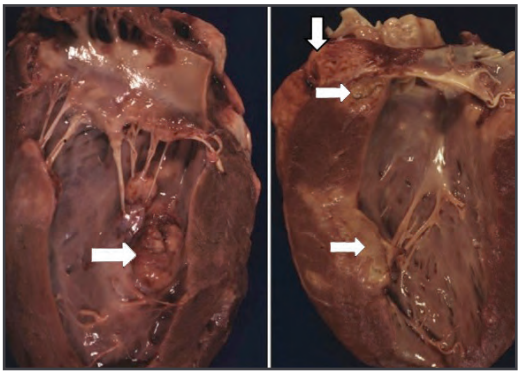
Diagnostic Tests
- Culture, Sensitivity
- Gene Sequencing
- Histopathology

H. somni Pneumonia / TME / Myocarditis

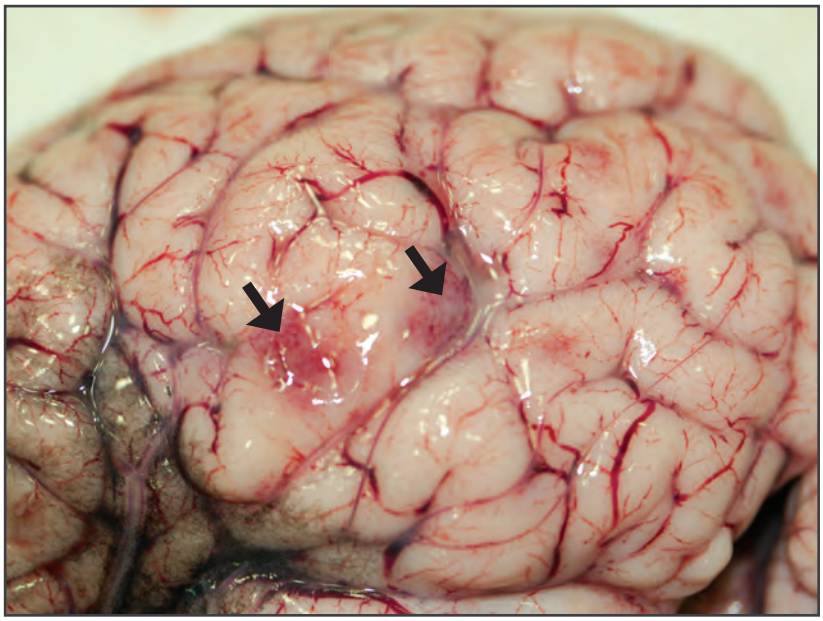
Histophilus somni (formerly *Haemophilus somnus*)



Arrows point to three septic infarcts, typical of TME.



H. somni myocarditis. Note pale necrotic tissue visible on the endocardial surface of the left ventricle and in cross section.



Necropsy view of two TME lesions (arrows) in the cerebral cortex. These necrotic septic infarcts appear on the surface as red foci, usually less than 1 cm. Confirm these are real lesions and not just agonal hemorrhage by sectioning into the lesion, which should extend into the parenchyma. Meningeal hemorrhages are superficial only.

AGE OF OCCURRENCE

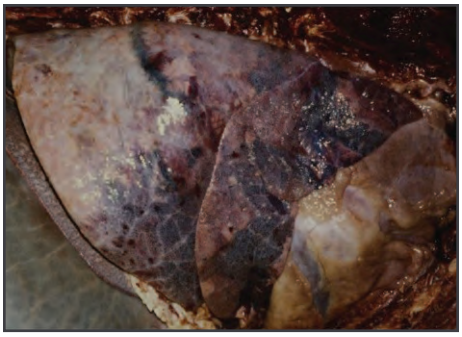
- Histophilosis is a common disease in North America, affecting a wide variety of ages and production types.
- All feedlot cattle are at risk of histophilosis for the duration of the feeding period.
- It also is seen sporadically in individual beef and dairy cattle worldwide.

DIAGNOSIS

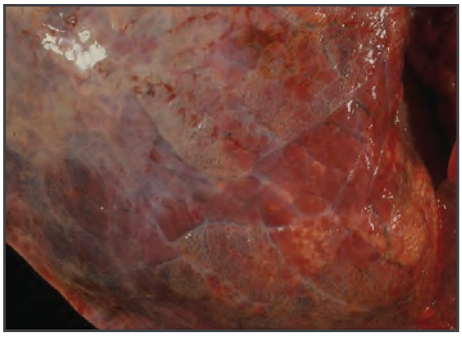
- Be suspicious if the herd has cattle showing one or more of the following: pneumonia, CNS disease, sudden death related to heart failure, and lameness.
- Necropsy and organ examination for the following: bronchopneumonia with small abscesses and pleuritis; purulent myocarditis; hemorrhagic septic infarcts in brainstem and brain (TME).
- Isolation of the organism from lung, CSF (cerebral spinal
- fluid), brain, blood, urine, joint fluid or other sterile internal organs or fluids confirms the diagnosis.

BRSV Pneumonia

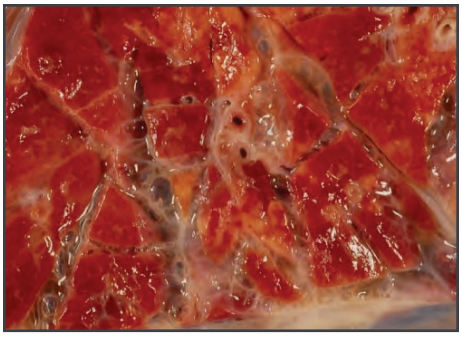
Bovine Respiratory Syncytial Virus



BRSV lung with postmortem color change. Note cranioventral consolidation and fine bubbles on surface due to sub-pleural emphysema.



Closer view of fresh BRSV lung, cranioventral region. Note red rubbery lobules admixed with more normal tan lobules. Note prominent sub-pleural emphysema bubbles.



Close view of cross section of fresh BRSV lung. Note red rubbery lobules, and inter-lobular emphysema.

CLINICAL SIGNS AND HISTORY

- BRSV infection usually begins three to five days after cattle are exposed to the virus.
- BRSV commonly occurs with secondary bacteria, as is often the case with other respiratory virus infections in cattle.
- Infected cattle have a watery-to-thick mucous discharge from the nose and eyes.
- Cattle have decreased appetites or go off feed, and appear slightly depressed.
- In pastured cattle that are not seen daily, sudden death may be the first sign of BRSV infection.
- If the disease progresses, cattle may develop a dry cough and have difficulty breathing.
- Frequently breathe with open mouths, with tongues hanging to the side of the mouth.
- Saliva may be frothy and blood-tinged.

AGE OF OCCURRENCE

- Occurs predominately in young beef and dairy cattle .
- BRSV can infect and cause disease in all ages of cattle, although suckling calves often experience the most severe disease.

DIAGNOSIS

- Increased temperatures (between 104–108.5° F) with increased breathing rates (>40 per minute).
- Affected cattle are frequently seen near water troughs, but have trouble drinking due to difficult breathing.
- The course of clinical disease may last one to two weeks.
- A diagnosis of BRSV requires laboratory confirmation.
- Chances of virus isolation are improved when cattle are sampled during incubation or acute phase.

BRSV

Tissues to Submit

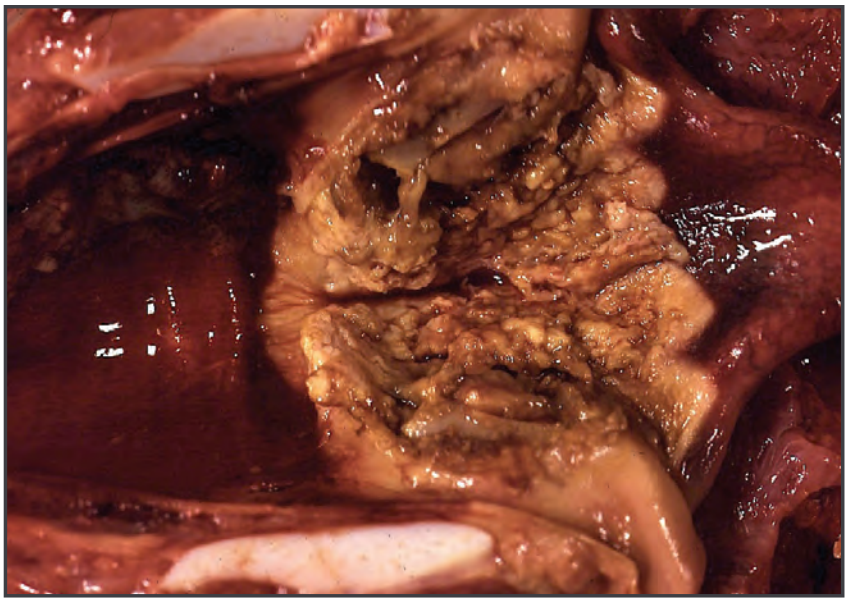
- Lung

Diagnostic Tests

- PCR
- Virus Isolation
- Histopathology

Calf Diphtheria

Fusobacterium necrophorum



Necrotic lesions on larynx.

CLINICAL SIGNS AND HISTORY

- Calf diphtheria (necrotic laryngitis) usually occurs sporadically and typically affects a small percentage of cattle.
- Found primarily in feedlot cattle.
- *Fusobacterium necrophorum* is the primary pathogen; occasionally, other organisms may be present, most often *Trueperella pyogenes*.
- Clinical presentation consists of dyspnea and a harsh, painful cough.
- The cough, as well as efforts to inhale, may produce loud "honking" sounds.
- Exertion may result in sudden death due to upper-airway obstruction.
- Laryngeal contact ulcers, which commonly occur in feedlot cattle due to a variety of causes (severe coughing, irritation from forages, etc.) may predispose them to infection.

DIAGNOSIS

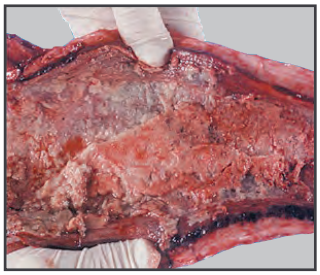
- Lesions noted at necropsy are typically associated with the larynx.
- Lesions may vary from edema and hyperemia in the acute form to areas of necrosis and caseous granulation in chronic cases.
- Differential diagnoses include pharyngeal trauma and infectious bovine rhinotracheitis (IBR).

Tissues to Submit
- Lesion Material
- Swabs from Affected Areas

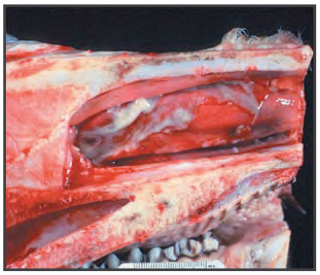
Diagnostic Tests
- Anaerobic Culture

Infectious Bovine Rhinotracheitis (IBR)

Bovine Herpesvirus 1 (IBRv)



Hyperemic (red), inflamed necrotic tracheal mucosa with thick adherent mucopurulent exudate on surface.



Hyperemic (red), inflamed nasal turbinates mucosa with adherent mucopurulent exudate on surface.

CLINICAL SIGNS AND HISTORY

- Respiratory form clinical signs range from mild to severe, depending on the presence of secondary bacterial pneumonia.
- Coughing, difficulty inhaling, rapid breathing, profuse watery nasal discharge.
- Nasal discharge becomes thicker and darker as the infection progresses.
- If encrusted nostrils are rubbed off, the underlying tissue appears very red and inflamed; hence, the term “red nose.”
- Progression of the disease is marked by increasing nasal encrustation.
- Depression, high body temperature (104–108° F).
- Decreased appetite, rapid weight loss and possible diarrhea.
- Incubation period is two to six days.
- Other forms are conjunctivitis, abortion and infectious pustular vulvovaginitis (IPV).
- IBR virus is one of the most common agents in the bovine respiratory
- disease complex of feedlot cattle.
- Keeping cattle in close contact is an ideal situation for virus to spread rapidly.

AGE OF OCCURRENCE

- Susceptible cattle of all ages, but can be severe in young calves.

DIAGNOSIS

- Lesions are restricted to upper respiratory tract and trachea, appearing as small hemorrhages.
- Lesions are found in the mucous membrane of nasal cavity and the paranasal sinuses.
- Samples taken for virus isolation should be taken early in the disease.
- Lesions: Acute – tracheal pseudomembrane and ulcerative rhinitis. Chronic – secondary bacterial bronchopneumonia.

IBRV

Tissues to Submit

- Lung
- Serum
- Section of Inflamed Trachea

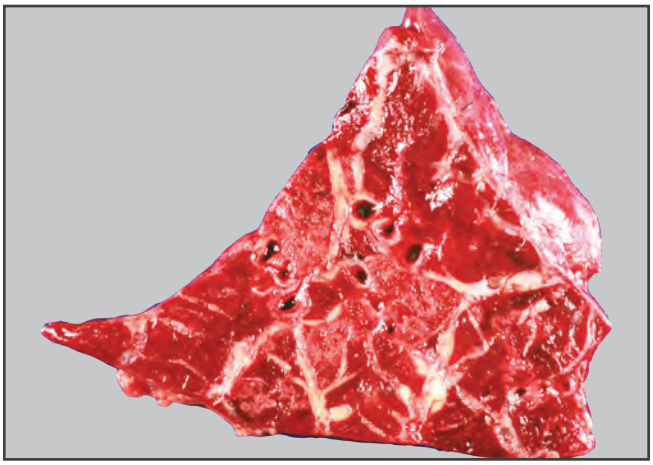
Diagnostic Tests

- Histopathology
- Serology
- PCR
- Virus Isolation

Mannheimia bronchopneumonia

Mannheimia haemolytica

Cranioventral consolidation of the lung, showing dark lobes covered with yellowish fibrinous exudate.



Cross section of typical *M. haemolytica* pneumonic lung; note marbled appearance due to thick layers of pus in the inter-lobular septa.

CLINICAL SIGNS AND HISTORY

- The first clinical signs observed in calves affected by *Mannheimia haemolytica* are vague, and often limited to a slight depression and lack of interest in eating. As the disease rapidly progresses, the calf refuses to eat, becomes depressed, exhibits lowered or drooped head and ears, and suffers increasing nasal discharge, which changes in consistency from thin and clear to thick yellow and viscous.
- Body temperature may rise to as high as 107° F, with breathing often rapid and labored.
- *Mannheimia haemolytica*, serotype 1 and serotype 6, is the bacterium most frequently isolated from the lungs of cattle with the bovine
- respiratory disease complex (BRD).
- A cough may be noted early in the disease; however, as lung damage increases, coughing and breathing become very painful for the animal.
- If the disease process is not stopped, the lungs become irreversibly damaged, the body temperature drops to below normal, and the animal usually dies.
- Commonly seen in stressed, high-risk calves infected with BRD viruses or severe stress such as recent transport.

AGE OF OCCURRENCE

- Young and growing cattle.

DIAGNOSIS

- The diagnosis is confirmed by culture from the lung with characteristic lesions; also, check lung for common viral co-pathogens such as IBR, BVD, BRSV, BCV or PI_3.
- Lung specimens can be collected for culture at post mortem. If possible, specimens for culture should be collected from animals that have not been treated with antibiotics.

Tissues to Submit

- Consolidated Lung
- Tracheobronchial Lymph Nodes

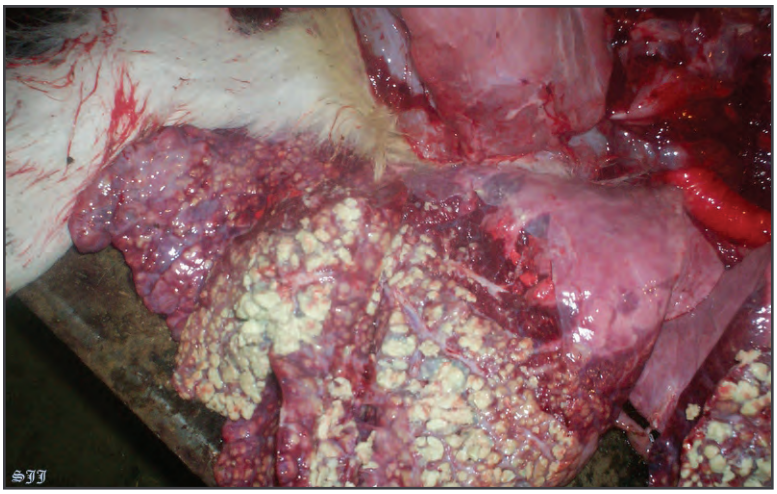
Diagnostic Tests

- Culture, Sensitivity
- Gene Sequencing
- Serotyping PCR
- Histopathology

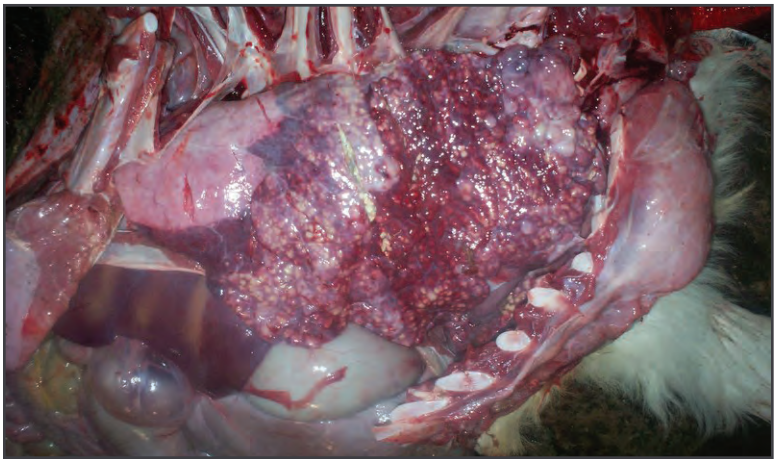
MANNHEIMIA

Mycoplasma Pneumonia

Mycoplasma bovis



Multiple coalescing lung abscesses: caseous, yellowish and tannish.



Multiple coalescing lung abscesses: caseous, yellowish and tannish, cranioventral.

Carpal joints markedly distended with pus.

MYCOPLASMA

Tissues to Submit

- Affected Lung
- Joint Swabs/Fluid
- Tracheal Swabs
- Swabs or Exudate from Middle Ear

Diagnostic Tests

- Mycoplasma Culture
- Speciation
- Gene Sequencing
- Histopathology

CLINICAL SIGNS AND HISTORY

- *M. bovis* has been associated with middle-ear infections in young calves and polyarthritis in feedlot cattle, as well as pneumonia in all ages.
- It is thought to play a synergistic role in conjunction with viruses and other bacteria in BRD.
- Mycoplasma can be recovered from the respiratory tract of non-pneumonic calves, but the frequency of isolation is greater in those with respiratory-tract disease.

AGE OF OCCURRENCE

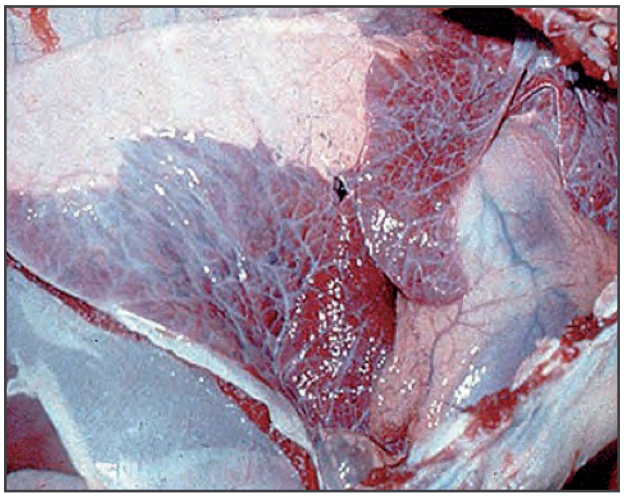
- Any age.

DIAGNOSIS

- Lung lesions show numerous coalescing abscesses: tannish, yellowish, predominantly cranioventral.
- Culture of Mycoplasma organisms requires special media and conditions; growth of the organisms may take up to a week or longer.

Pasteurella Pneumonia

Pasteurella multocida



Cranioventral consolidation of the lung, with minimal pleuritis.

CLINICAL SIGNS AND HISTORY

- *Mannheimia haemolytica*, serotype 1, is the bacterium most frequently isolated from the lungs of cattle with BRD. Although less frequently cultured, *Pasteurella multocida* is also an important cause of bacterial pneumonia, usually preceded by signs of viral infection of the respiratory tract.
- Fever (104–106° F); serous to mucopurulent nasal discharge; moist cough; and a rapid, shallow respiratory rate may be noted.

AGE OF OCCURRENCE

- Cattle of all ages are affected with BRD virus.
- Young dairy calves especially, but also pasture calves.

DIAGNOSIS

- Diagnosis relies on bacterial culture. Because the bacteria involved are normal inhabitants of the upper respiratory tract, the specificity of culture can be increased by collecting ante-mortem specimens by deep nasopharyngeal swab, trans-tracheal wash or bronchoalveolar lavage.
- *P. multocida* is associated with purulent bronchopneumonia, only small amounts of fibrin exudation, some thrombosis, limited lung necrosis, and suppurative bronchitis and bronchiolitis.
- Lung specimens can be collected for culture at post mortem. If possible, specimens for culture should be collected from animals that have not been treated with antibiotics.

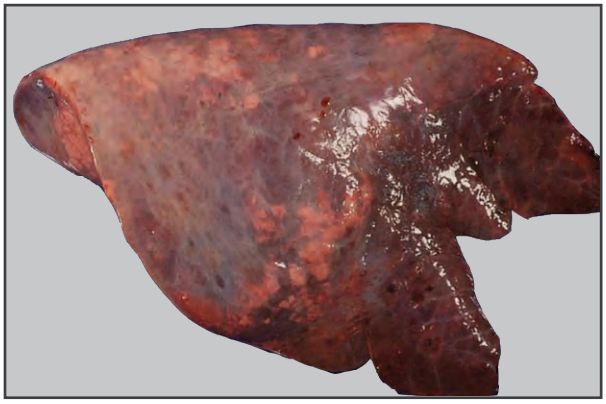
Tissues to Submit
- Affected Lung
- Lymph Nodes

Diagnostic Tests
- Culture, Sensitivity
- Histopathology
- Serogrouping PCR

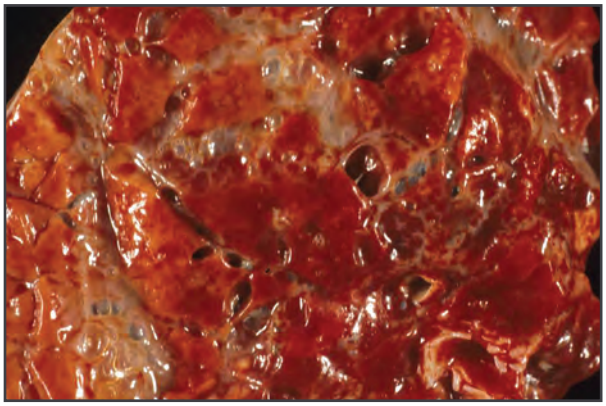
PASTEURELLA

Interstitial Pneumonia

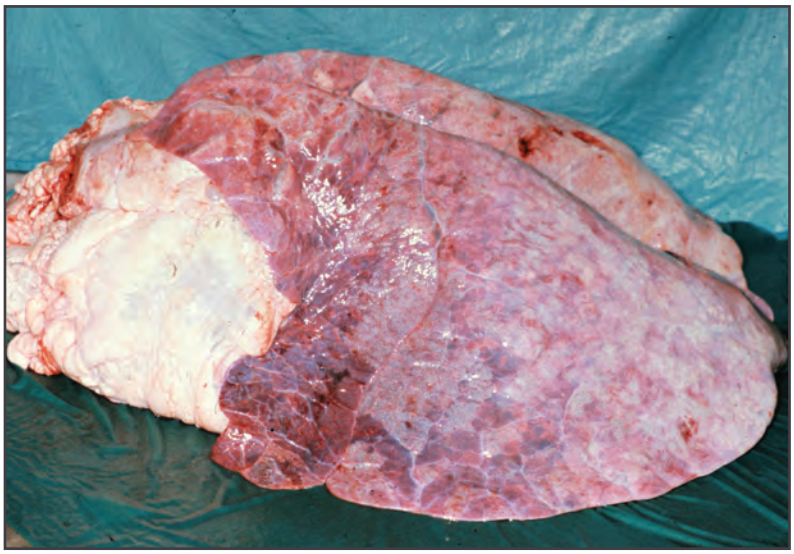
Atypical Interstitial Pneumonia (AIP) and Acute Bovine Pulmonary Emphysema and Edema Syndrome (ABPEE)



AIP in feedlot bovine. Note dorsal and caudal lung is puffed up, not collapsed, and tends to fill the thorax. Note rounded caudal margins. Cranioventral lung has collapsed and palpates rubbery; not as firm as bacterial bronchopneumonia.



Cross section of AIP lung. Note all lobules are expanded, some have collapsed and congested red lobules, while some have air-filled tan lobules. Note inter-lobular gas bubbles and diffusely edematous and heavy lung.



AIP lung. Note the entire lung sits high, fills the thorax and has not collapsed like a normal lung would during necropsy. The dorsal lung feels spongy. The ventral lung is semi-firm and rubbery; not hard consolidation.

CLINICAL SIGNS & HISTORY

- Atypical interstitial pneumonia (AIP) and acute bovine pulmonary emphysema and edema syndrome (ABPEE) are not infectious diseases, but are often clinically confused with infectious pneumonias.
- Sudden onset of respiratory distress or sudden death within a few days of new feed source.
- Can be associated with sudden dietary changes to lush green forages such as alfalfa, rape, kale or turnip tops, certain toxic plants (such as purple mint), and moldy feeds (such as moldy sweet potato).
- The tryptophan in forages is metabolized to a pulmonary toxin, 3-methylindole.

AGE OF OCCURRENCE

- Cattle with functional rumens are susceptible.

DIAGNOSIS

- The lungs are markedly distended and do not collapse; also feel rubbery, not hard consolidation.
- The pleura is normal, but inter-lobular septa are distended with gas vacuoles or edematous fluid.

AIP

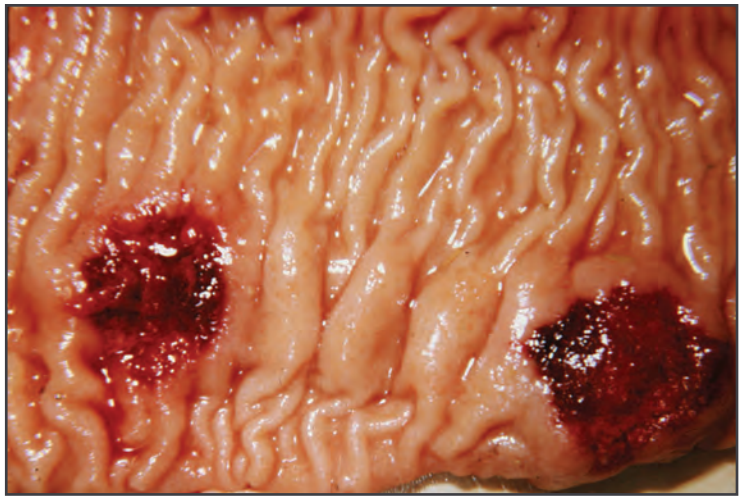
Tissues to Submit
- Fresh Lung

Diagnostic Tests
- Histopathology

Bovine Virus Diarrhea and Mucosal Disease

BVD Virus

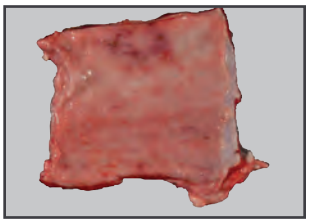
Erosions and ulcers on the ventral surface and tip of the tongue.



BVD ulcerative enteritis. Note ulcers are over Peyer's patches.

CLINICAL SIGNS AND HISTORY

- BVD virus infection can be involved with many disease syndromes including pneumonia, severe ulcerative alimentary disease (commonly called mucosal disease in persistently infected animals), abortions and birth defects.
- Acute transient (not PI) BVD can present as a mild or severe disease syndrome. In the mild form, cattle may show depression, decreased milk production, transient inappetence, rapid respiration, excessive nasal secretion, excessive lacrimation and diarrhea.
- In severe acute transient BVD, cattle may show high fever (~107°F), oral ulcers, weeping dermatitis of the coronary band and interdigital cleft, diarrhea, dehydration, leukopenia, thrombocytopenia and associated petechiation on mucosal surfaces, swollen lymph nodes, erosions and ulcerations of the GI tract. Morbidity and mortality may be high.
- Mucosal disease is a highly fatal form of BVD that may be acute or chronic, and occurs when persistently infected cattle become super-infected with cytopathic BVD virus. Acute mucosal disease is characterized by fever, leukopenia, diarrhea, anorexia, dehydration, erosive lesions of the nares and mouth, and death within a few days of onset. Erosions and ulcers may be found throughout the GI tract with extensive necrosis of lymphoid tissues, especially Peyer's patches.
- Transmission of the pathogenic virus can occur through secretions from a transiently or a persistently infected animal.



Ulcers with hemorrhage on the mucosal surface of the esophagus.

AGE OF OCCURRENCE

- Can affect cattle of all ages.
- Commonly associated with young cattle with pneumonia.
- Mucosal disease cattle are usually under 2 years old.

DIAGNOSIS

- Diagnosis is confirmed by compatible gross and microscopic lesions and virus identification via isolation, PCR or IHC tests.
- Samples taken for virus isolation should be taken early in the disease.

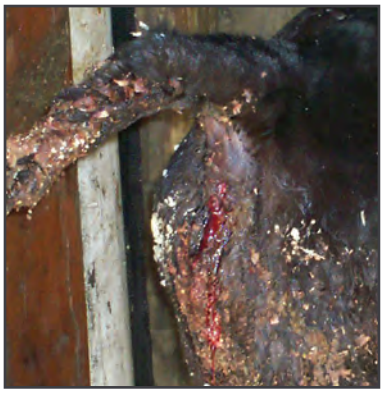
Tissues to Submit

- Lung
- Nasal Swabs
- Spleen
- Mesenteric Lymph Nodes
- Small Intestine or Colon with Ulcers
- Whole Blood
- Ear Notch

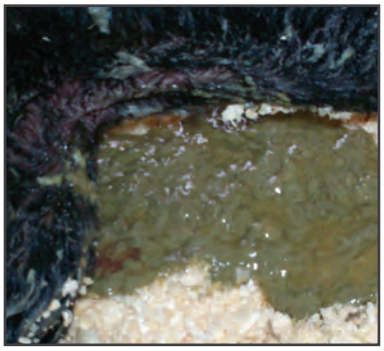
Diagnostic Tests

- PCR
- Virus Isolation
- Sequencing
- Histopathology

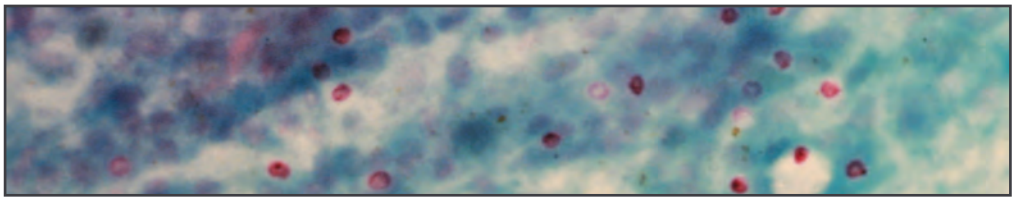
Coccidiosis / Cryptosporidiosis



Calf with diarrhea-contaminated hide; note blood clot adhered to perineum.



Cryptosporidiosis: green loose mucoid stool, with streak of blood



An acid-fast stained fecal smear showing red cryptosporidium organisms.

CLINICAL SIGNS AND HISTORY

Coccidiosis

- Calves may appear unthrifty and have fecal-stained perineal areas. In light infections, the most characteristic sign of clinical coccidiosis is watery feces, with little or no blood, and the animal shows only slight discomfort for a few days.
- Severely affected cattle develop thin, bloody diarrhea that may continue for >1 wk, or thin feces with streaks or clots of blood, shreds of epithelium and mucus. They may develop a fever; become anorectic, depressed and dehydrated; and lose weight.
- During the acute period, some cattle die; others die later from secondary complications (e.g., pneumonia).
- Outbreaks usually occur within the first month of confinement.
- Incubation period is 17–1 days.
- Range cattle outbreaks related to severe weather stress and crowding around a limited water source.
- Severe epidemics have been reported in feedlot cattle.
- Cryptosporidiosis
- Diarrhea – profuse water, mucoid and green, occasionally bloody.
- Colic and pain.
- Depression, loss of appetite, weight loss.

AGE OF OCCURRENCE

Coccidiosis

- Young cattle (1–2 months to 1 year), and usually is sporadic during the wet seasons of the year.

Cryptosporidiosis

- Calves between 5 days and 2 weeks of age.
- Inconsequential in animals older than 1 month of age, because by this age, most animals will have become immune to infection.

DIAGNOSIS

Coccidiosis

- Finding oocysts on fecal flotation or direct smear or by the McMaster's technique.
- Differential diagnoses include salmonellosis, bovine virus diarrhea, malnutrition, toxins or other intestinal parasites.

Cryptosporidiosis

- Examination of diarrhea for the presence of cryptosporidia.
- Caution must be taken when evaluating animals because it is zoonotic.

COCCI / CRYPTO

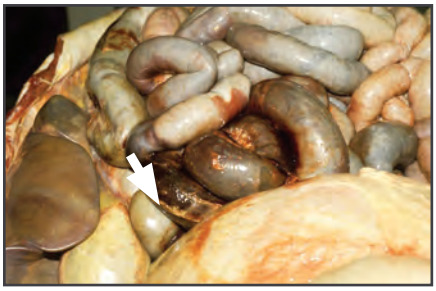
Tissues to Submit

- Fresh Small Intestines with Cecal & Spiral Colon Contents
- Feces
- Formalin-Fixed Duodenum, Jejunum, Ileum, Cecum & Colon

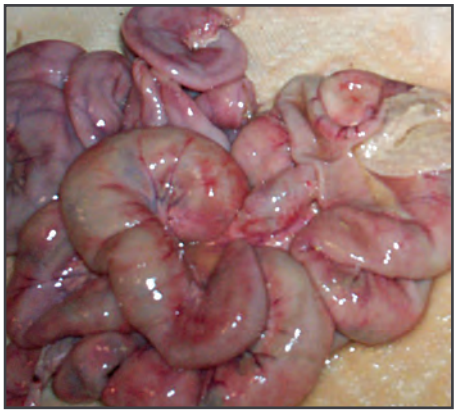
Diagnostic Tests

- Fecal Flotation
- Histopathology
- Acid-Fast Stained Fecal Smear

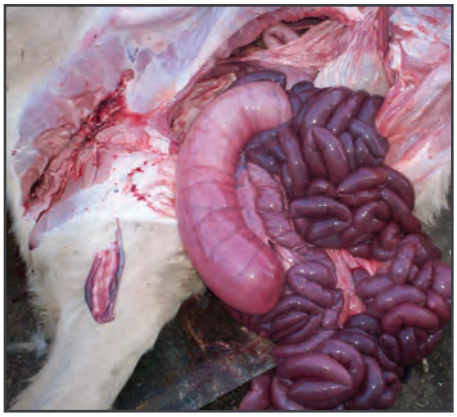
Clostridium perfringens Diseases
Types A, C, D and E



Jejunal hemorrhage syndrome, aka hemorrhagic bowel syndrome of cattle. Note the large segment of necrotizing, hemorrhagic jejunitis; note fibrin exudate on serosal surface.



Gas-distended and congested intestines associated with *C. perfringens* Type A.



Clostridium perfringens Type C

CLINICAL SIGNS AND HISTORY

Enterotoxemia

- Clinical signs are enteritis, dysentery, toxemia, high mortality.
- In cattle, usually associated with Types C, D, E and B (B not in North America).
- Gut lesions present as bright red, with necrotic mucosa, sometimes gas bubbles.

Jejunal Hemorrhage Syndrome of Adult Cows

- Clinical signs are peracute abdominal crisis or sudden death.
- Associated with *Clostridium perfringens* Type A.
- Seen in high-production dairy cows in early lactation.
- Gut lesions: segmental necrotic jejunitis.

Abomasal Clostridial Syndrome of Calves

- Clinical signs are related to abdominal pain and distension, bloated abomasum and gas-distended intestines.
- Associated with Type A, and possibly others.
- Seems to be an association with transition from milk diet to establishment of a forage-digesting rumen.
- Gut lesion: May see abomasitis with gas, abomasal ulcers, gassy small intestines.

AGE OF OCCURRENCE

- **Type A:** Lactating dairy cows and young calves 2 to 8 weeks of age, feedlot cattle.
- **Type C**: Very young calves.
- **Type D:** Sudden death in finishing cattle.
- **Type E:** Fatal enterotoxemia in newborns and finishing cattle.

Continued on next page

Tissues to Submit

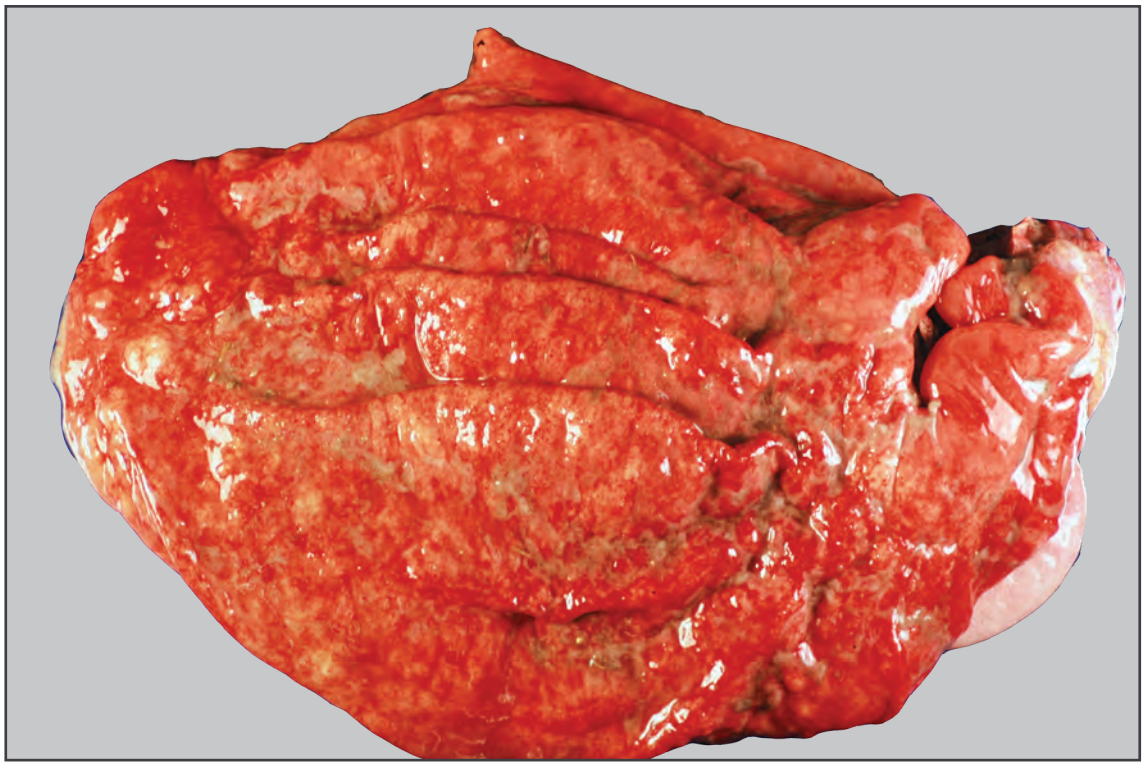
- Small Intestine
- Abomasum
- Liver

Note: Do not submit fecal samples.

Diagnostic Tests

- Anaerobic Culture, Sensitivity
- Toxin PCR Testing
- Histopathology

CLOSTRIDIUM



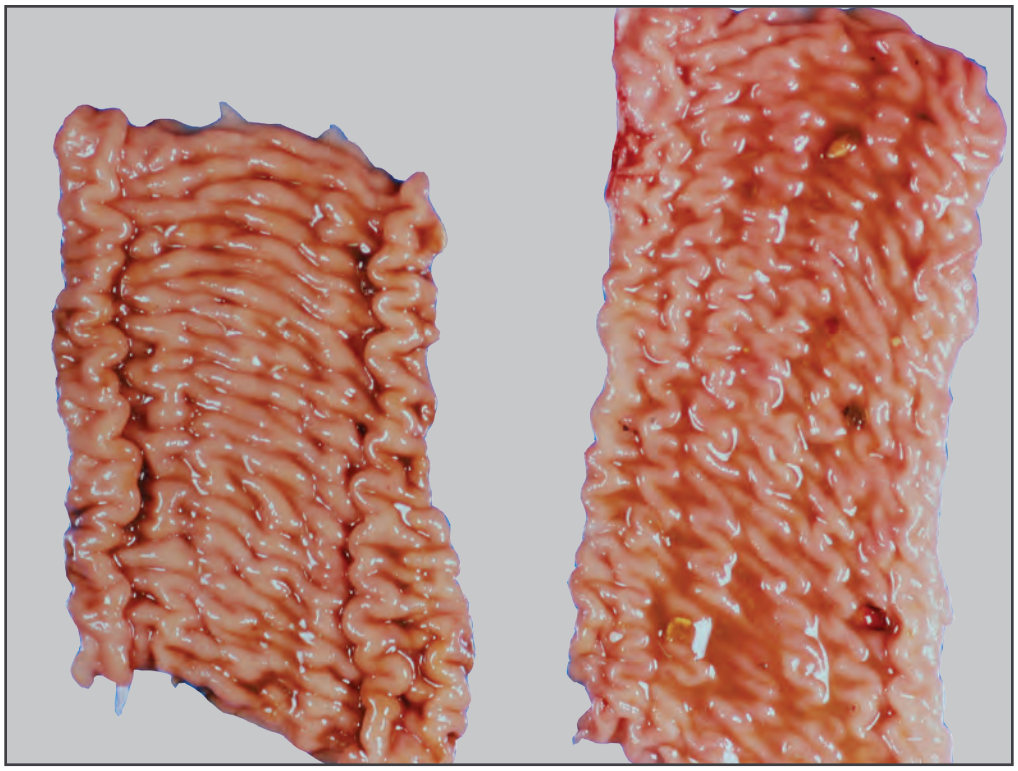
Clostridial abomasitis in a young calf, *C. perfringens* Type A. Note diffuse hyperemia, thickened folds, erosions and ulcers.

DIAGNOSIS

- The organism is often found in the large intestine of normal cattle. A simple culture of the organism from the animal is not sufficient by itself to confirm a diagnosis.
- Culture results are matched with clinical signs, lesions in the tissues and, in some cases, toxin identification, to obtain a true diagnosis.
- **Type A:** Postmortem examinations of calves affected with Type A abomasitis will often show inflammation, ulceration and hemorrhage of the lining of the rumen and abomasum. Enterotoxemia diagnosis can be difficult due to the fact that it is a very common inhabitant of the normal intestinal tract; therefore, culture results need to be matched to clinical signs and lesions in the tissues.
- **Type C:** Tissue samples from calves suspected of having clostridial enterotoxemia should be collected soon after death and kept well-preserved. (After the death of the calf, normal populations of clostridial organisms can overgrow and confuse diagnosis.)
- **Type E:** Enterotoxemia causes a severe local intestinal necrosis and systemic toxemia similar to the syndrome described with Type C.

Johne's Disease (aka Paratuberculosis)

Mycobacterium paratuberculosis (aka *M. avium* subsp. *paratuberculosis*)



Johne's Disease. Granulomatous enteritis of ileum; note the infiltrated mucosa is markedly thickened into prominent folds.

CLINICAL SIGNS AND HISTORY

- An insidious afebrile disease that finally expresses clinically as a chronic intermittent or persistent diarrhea, followed by progressive weight loss, debilitation, emaciation and death due to inanition.
- Stools are often watery, and passed without tenesmus (painful straining).
- Dairy herds have a high herd incidence, but it is also seen less commonly in beef cattle.

AGE OF OCCURRENCE

- Clinical disease is usually not expressed until cattle are > 2 years old; rarely seen in 12- to 24-month-old animals.
- Cattle are infected as young calves and remain clinically silent until the disease progresses.

DIAGNOSIS

- Necropsy shows gross thickening of the mucosa of the ileum without ulceration.
- Histopathology is diagnostic when granulomatous lesions with acid-fast positive organisms are identified.
- Culture or PCR identification of the organism also confirms the disease.

Tissues to Submit

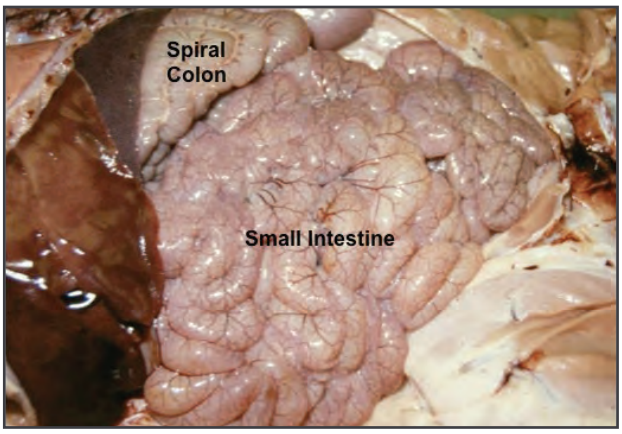
- Thickened Ileum
- Jejunum, Cecum & Colon (*to rule out other GI diseases*)
- Serum

Diagnostic Tests

- Necropsy
- Reference Lab
  - Histopathology
  - PCR or Johne's Culture
  - Serology

Enteric Colibacillosis

Enterotoxigenic *E. coli*



Enteric colibacillosis in a calf less than 1 week old. Note loops of small intestine are distended with watery yellowish fluid, as is the spiral colon.

COLIBACILLOSIS

Tissues to Submit
- Jejunum
- Ileum
- Cecum
- Colon

Diagnostic Tests
- Culture
- Fimbrial Typing PCR
- Histopathology

CLINICAL SIGNS AND HISTORY

- This disease is caused by enterotoxigenic *E. coli*, with the fimbrial antigens K99 (F5) or F41.
- Hypersecretory diarrhea in newborn calves.
- Dehydration, weakness, death.

AGE OF OCCURRENCE

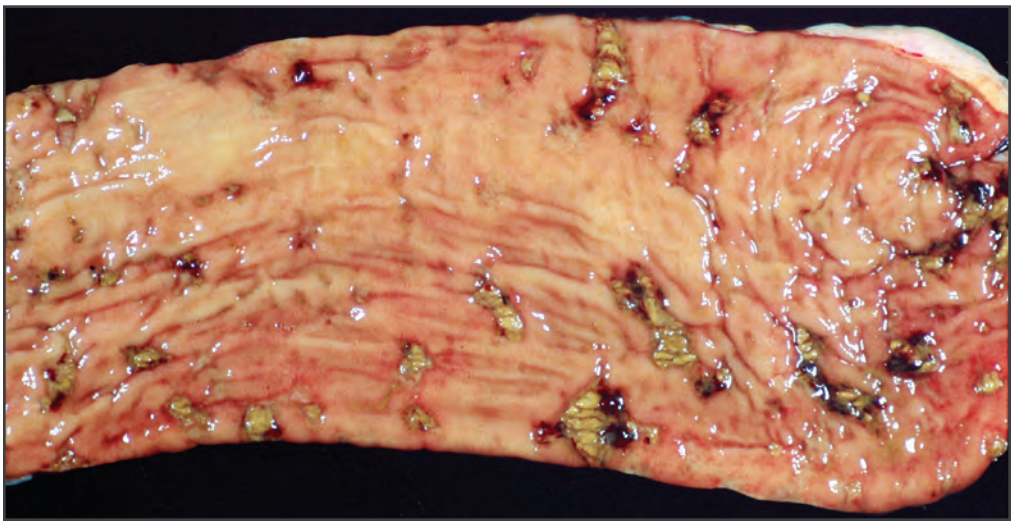
- This disease only occurs in calves less than 7 days old.

DIAGNOSIS

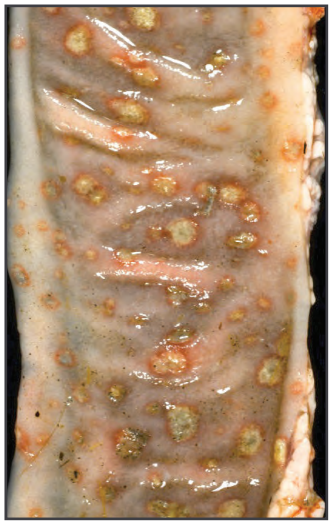
- Histopathology is diagnostic, showing prominent colonization of the jejunum or ileum brush border by noninvasive small bacilli.
- Culture and fimbrial identification of the *E. coli*.

Bovine Salmonellosis

Salmonella spp.



Multi-focal ulcers on the surface of the cecal mucosa, covered by necrotic tissue and exudate; surrounded by hemorrhage.



Multi-focal ulcers on the mucosal surface of the gut. Note tan necrotic debris covering the ulcer; note the rim of red inflammation around the ulcer.

CLINICAL SIGNS AND HISTORY

- Salmonellosis can present as septicemia or enteritis.
- Newborn Septicemia:
  - *Salmonella* Dublin, *S.* Newport or *S.* Typhimurium are most common.
  - May be preceded by enteritis, but not always detected in newborns.
  - Fever, depression, rapid progression.
  - High mortality.
- Enteritis:
  - Often associated with *S.* Typhimurium or *S.* Dublin.
  - Fever, depression, straining, diarrhea begins loose, then putrid; mucoid with necrotic flecks of sloughed tissues; sometimes bloody dysentery; emaciation.
  - Usually progresses to septicemia.
- *S.* Dublin is often endemic on a farm; *S.* Typhimurium is often recently introduced when outbreaks occur.

AGE OF OCCURRENCE

- Septicemia in newborn to 12-week-old calves.
- Enteritis in 2- to 12-week-old calves and adults.

DIAGNOSIS

- Isolation of *S.* Typhimurium, *S.* Dublin, and *S.* Newport.
- Gross lesions of necrotizing ulcerative enteritis.
- Histopathology of gut, liver and lung.

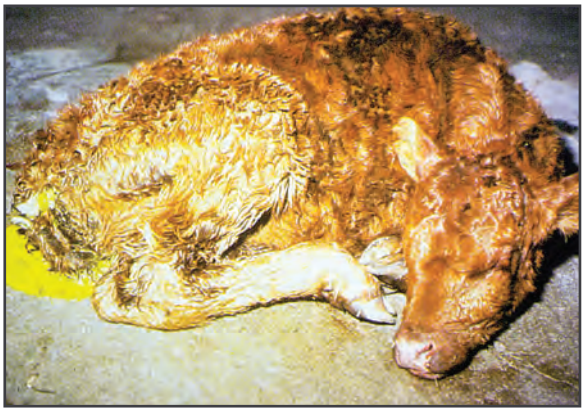
Tissues to Submit

- Gall Bladder
- Gut
- Feces
- Liver
- Lung
- Mesenteric Lymph Node (*collected near gut lesions*)

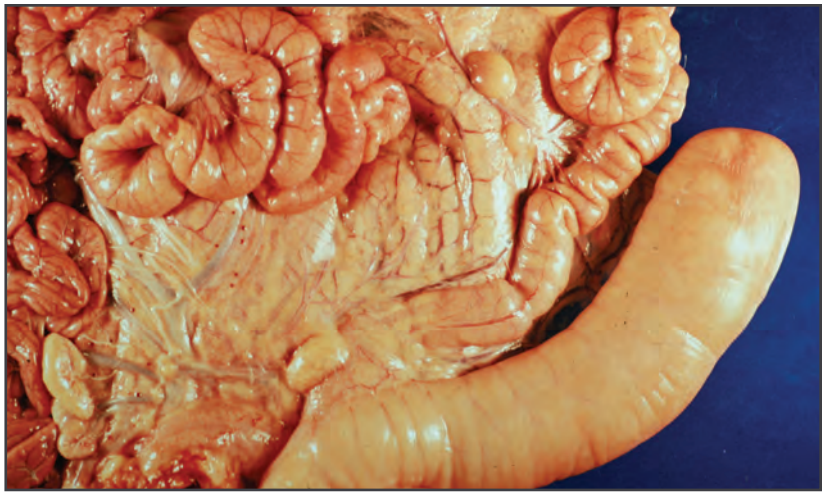
Diagnostic Tests

- Culture
- Sequencing to Determine Serovar

Viral Enteritis
Rotavirus and Coronavirus



Diarrhea, dehydration and yellow stool consistent with enteritis.



Rotavirus enteritis in a calf during the second week of life. Note ileum and cecum are distended (rounded) due to accumulation of large amounts of watery diarrhea fluids. Otherwise, the serosa appears normal, not inflamed.

VIRAL ENTERITIS

Tissues to Submit
- Jejunum
- Ileum
- Cecum
- Spiral Colon
- Cecal/Spiral Colon Contents
- Feces

Diagnostic Tests
- PCR
- Virus Isolation
- Sequencing
- Histopathology

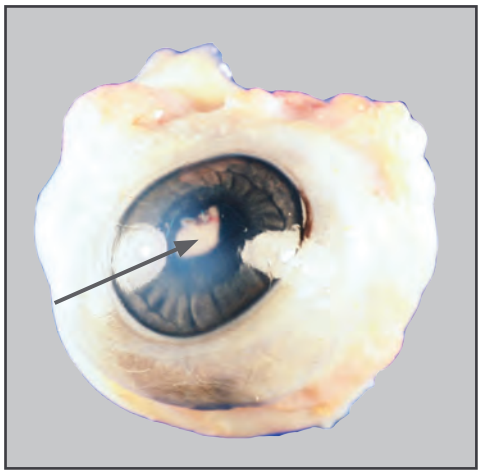
CLINICAL SIGNS AND HISTORY
- Calves from 5 to 21 days old experiencing sudden onset of diarrhea.
- Diarrhea caused by rotavirus is watery and pale yellow at first, changing to pasty as dehydration sets in, sometimes with mucus and blood flecks. Calves are dull and reluctant to drink.
- The differences between rotavirus and coronavirus diarrhea are subtle, with coronavirus usually more severe and leading rapidly to dehydration and acidosis.
- Coronavirus diarrhea is initially fluid yellow diarrhea; later, milk clots and mucus are passed and the diarrhea becomes very watery. Depression, fever and anorexia are common.
- Clinical signs of either disease usually last four to eight days.
- Calves become severely dehydrated and emaciated.
- Combined rotavirus and coronavirus infections are common, and sometimes associated with cryptosporidiosis also.

AGE OF OCCURRENCE
- Rotavirus and coronavirus infections are usually seen in calves between 1 and 3 weeks old, although sometimes a bit younger or older.

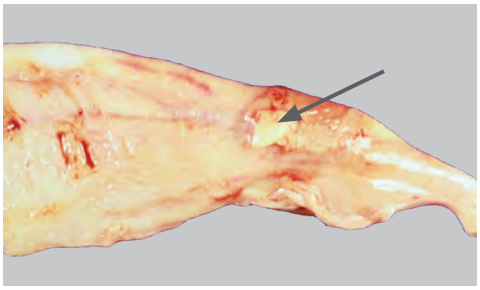
DIAGNOSIS
- Clinical signs are not enough to make a diagnosis.
- Examination of feces for presence of virus. However, it is important to remember that viruses are found in healthy calves also, so examination of feces from more than one calf is necessary.
- Definitive diagnosis requires correlation of clinical signs (diarrhea), histopathological evidence of viral enteritis, and organism identification.

Colisepticemia

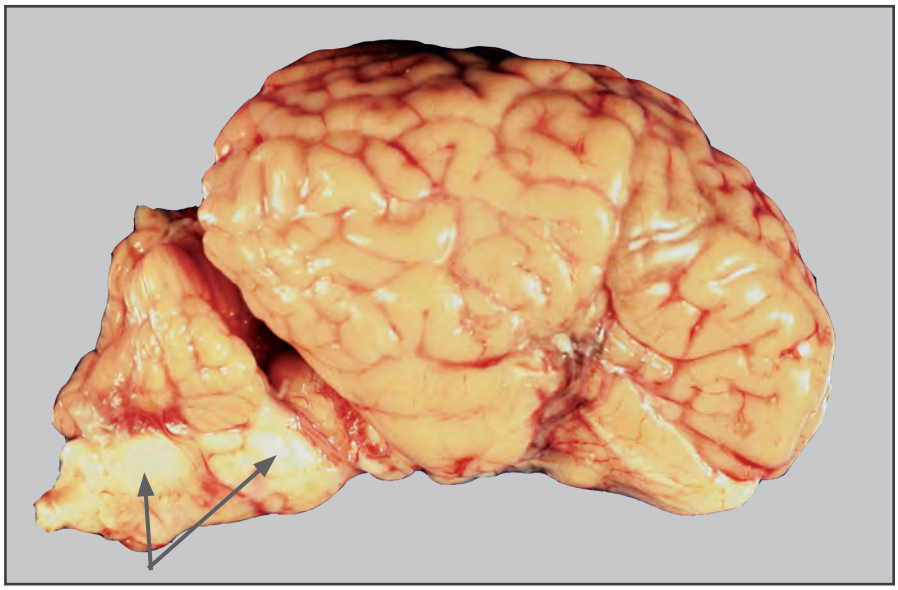
E. coli Septicemia (aka Septicemic Colibacillosis)



Hypopyon. Note large pus clot (arrow) floating in the anterior chamber of the eye.



Abdominal side of umbilical region with umbilical vessels. Note abscess (arrow).



Meningitis in a young calf with *E. coli* septicemia. Note white exudate in sulci of the cerebral cortex (arrows) and over brainstem and cerebellum.

CLINICAL SIGNS AND HISTORY

- A common disease of neonatal calves, especially dairy calves, but also beef calves.
- Calves that have failure or partial failure of passive transfer (FPT) of colostrum antibodies are highly susceptible to colisepticemia.
- Clinical signs of acute colisepticemia: depression, weakness, sudden shock, recumbency and coma without fever or diarrhea.
- Clinical signs of subacute colisepticemia: a sequel to bacteremia, leading to polyarthritis, meningitis, hypopyon, omphalophlebitis and peritonitis.

AGE OF OCCURRENCE

- Acute colisepticemia is seen in calves the first week of life; subacute or localized colisepticemia is generally seen the second week of life.

DIAGNOSIS

- Acute-form diagnosis requires a history of FPT of colostral antibody and isolation of *E. coli* from multiple fresh parenchymal organs (lung, liver, kidney, spleen) in a calf less than 1 week old.
- Subacute form diagnosis requires a history of FPT and isolation of *E. coli* from purulent lesions in multiple sites such as omphalophlebitis, polyarthritis, meningitis, peritonitis, or hypopyon in a calf generally 7 to 14 days old.

Tissues to Submit

- Lung
- Liver
- Spleen
- Kidney
- Tissues with Purulent Exudate

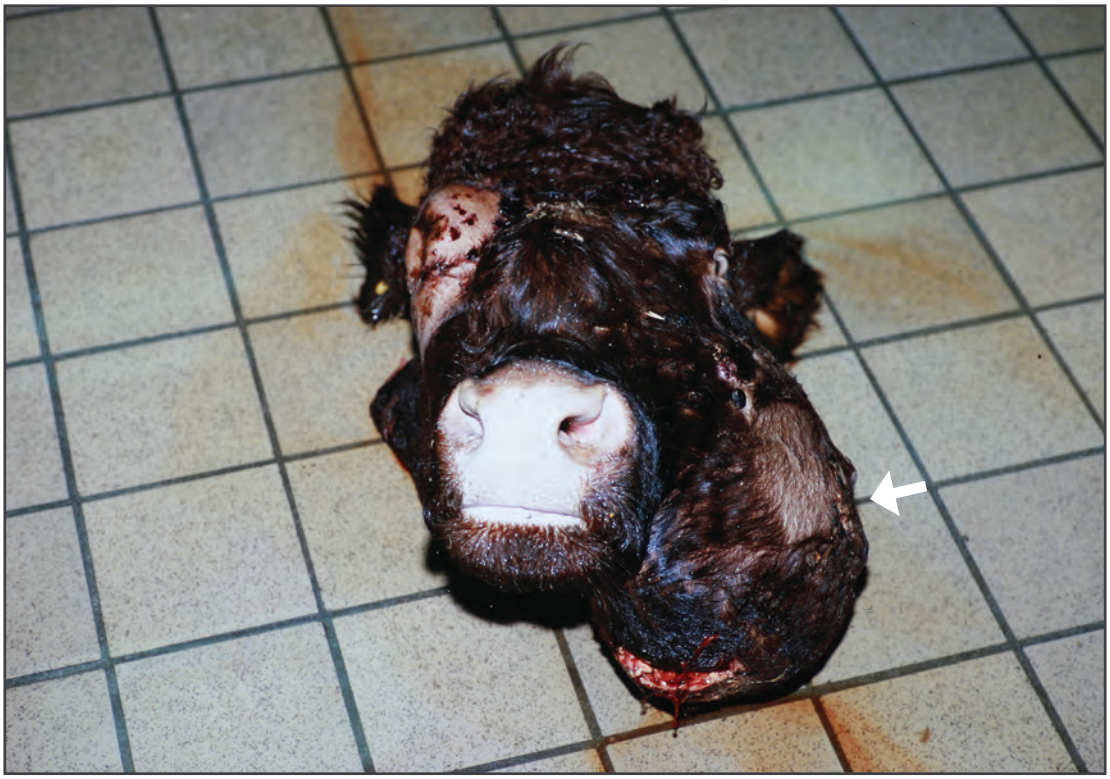
Diagnostic Tests

- Necropsy
- Histopathology
- Culture

COLISEPTICEMIA

Actinomycosis or Lumpy Jaw

Actinomyces bovis



Actinomycosis. Note large firm mass arising from the lateral and caudal aspect of the left mandible. On section, the mass is filled with multiple coalescing abscesses (arrow).

ACTINOMYCOSIS

Tissues to Submit
- Inflamed Tissue
- Fresh Exudate

Diagnostic Tests
- Gross Lesions
- Histopathology
- Anaerobic Culture, Sensitivity

CLINICAL SIGNS AND HISTORY

- Cattle develop massive granulomas and abscesses involving the bony tissues of the head, especially the mandible and maxilla.
- Large mandibular or maxillary lumps develop, often with draining tracks through ulcerated skin.
- Fetid oral odor, difficulty in mastication, loss of teeth in later stages.
- May be a concurrent history of hardware disease or cattle being fed coarse poor forage. (Puncture wounds in the mouth may initiate the infection.)

AGE OF OCCURRENCE

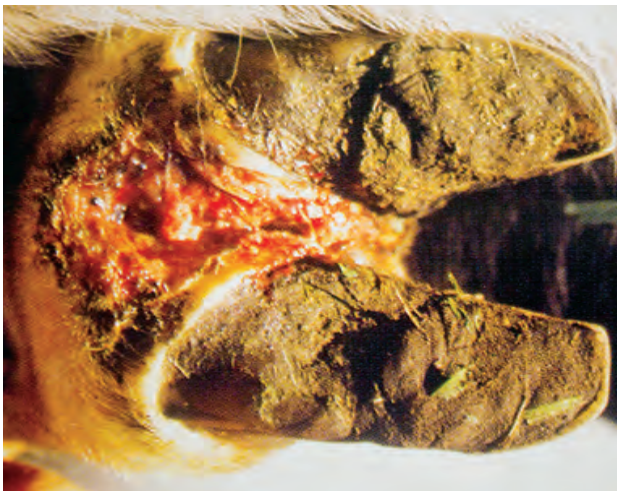
- Mature dairy or beef cattle, feedlot cattle.

DIAGNOSIS

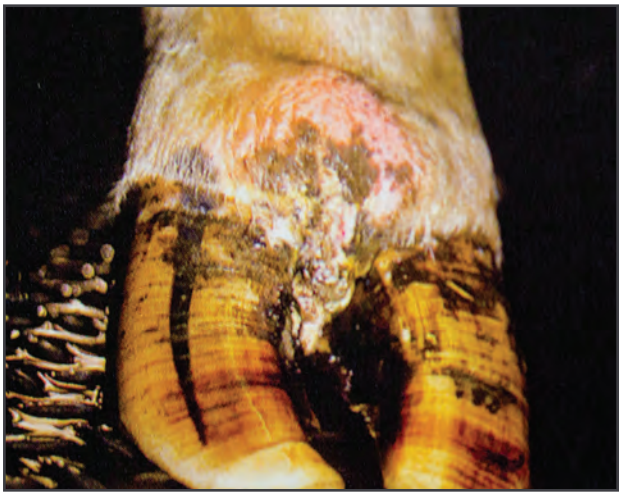
- Gross lesions are highly suggestive; sulfur granules may be visible as specks in the exudate.
- Histopathology or anaerobic culture can confirm the nature of the lesion and infection.

Footrot

Fusobacterium necrophorum



Footrot: ulcerated skin between digits and heels. Note how digits are spread apart by swelling of the entire foot.



Foul-smelling drainage between digits. Note also red swollen bulge in skin above the hoof.

CLINICAL SIGNS AND HISTORY

- Lameness in any limb, but more than one foot is rarely involved at the same time in mature cows. Footrot can occasionally develop in multiple feet in calves.
- First sign is swelling and redness of the soft tissues of the inter-digital space between toes and the adjacent coronary band.
- Inflammation may extend to the pastern and fetlock. Typically, the claws are markedly separated, and the inflammatory edema is uniformly distributed between the two digits.
- Onset of the disease is rapid, and the extreme pain leads to increasing lameness.
- The incidence varies according to weather, season of year, grazing periods and housing system. On average, footrot accounts for ~ 15 percent of claw diseases.

AGE OF OCCURRENCE

- Cows, heifers and bulls of all ages.
- Occasionally calves.

DIAGNOSIS

- It is frequently assumed that every cow with a swollen foot has footrot. However, many other conditions, such as infected sandcracks, white-line disease, retroarticular abscesses, foreign bodies in the inter-digital space, and infection of the distal inter-phalangeal joint can have a similar appearance if viewed from a distance.
- Despite the difficulties encountered in lifting a hind limb, a detailed examination should be performed in every case. An incorrect diagnosis can have disastrous results.

Tissues to Submit

- Swab from Lesion Using Cary Blair Culturettes

Diagnostic Tests

- Anaerobic Culture

FOOTROT

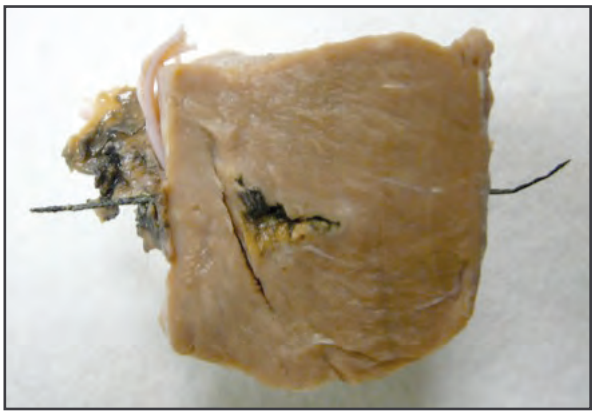
Hardware Disease

Traumatic Reticuloperitonitis or Traumatic Reticulopericarditis

Sources of hardware: magnet with barbwire.

Sources of hardware: magnet with nails from electrical insulators.

Sources of hardware: deteriorating steel-belted radial tire used as a hay feeding station.



Smooth wire passed out of reticulum, across the diaphragm and into the left ventricular chamber. Note endocarditis around the wire.

HARDWARE

Tissues to Submit
- Inflamed Tissue

Diagnostic Tests
- Necropspy
- Histopathology

CLINICAL SIGNS AND HISTORY

- A subacute to chronic condition with signs usually suggesting abdominal disease.
- Clinical signs may include: a drop in milk production, depression, careful, slow gait, grunt or moan when rising and going down, grunt when pressure applied to xiphoid cartilage.
- Cattle are indiscriminate eaters, and will consume metal objects if present in silage, chopped hay, baled hay or grain concentrates.
- Common sources include nails, wires and screws from construction trash or faulty machinery, and barbwire fences. In addition, a newer source is thin, smooth wire from steel-belted radial tires used as hay feeding stations.

AGE OF OCCURRENCE

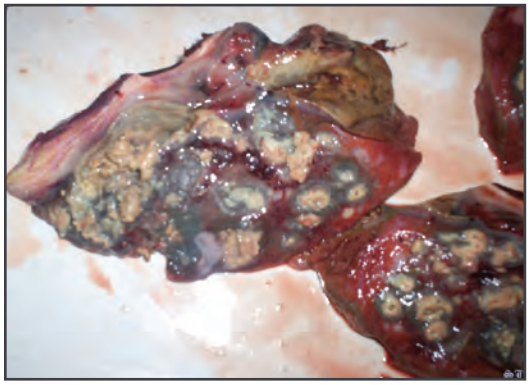
- Mature dairy or beef cattle.

DIAGNOSIS

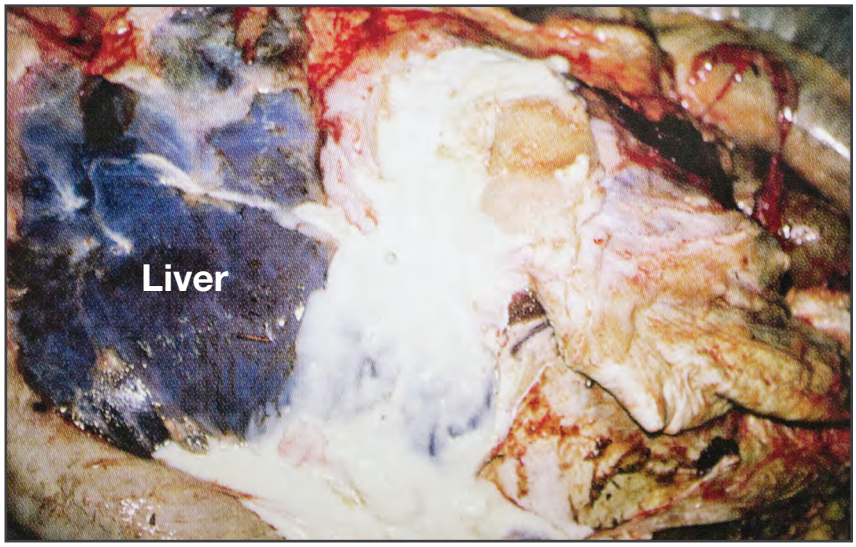
- Visually inspect or palpate the reticulum for metal foreign bodies.
- Inspect and palpate the space between the reticulum and the diaphragm; look for adhesions or metal objects crossing the space.
- If the diaphragm has been penetrated, there will be a rumen odor coming from the thorax and/or pericardium.

Liver Abscess

Fusobacterium necrophorum



Multiple liver abscesses containing tan caseous pus. Note adherence to the abdominal wall.



A large abscess has ruptured, releasing white liquid pus into the abdominal cavity.

CLINICAL SIGNS AND HISTORY

- Seen in feedlot and dairy cattle as a sequel to rumenitis.
- Clinical signs are often absent, or there is general depression and a decrease in growth rate or milk production.

AGE OF OCCURRENCE

- Feedlot and dairy cattle on high-energy rations.
- In young calves, abscesses can be an extension from omphalophlebitis (naval infection).

DIAGNOSIS

- History or gross indication of previous ulcerative rumenitis is supportive; the organisms come to the liver via blood flow, following microbial invasion of rumen ulcers.
- Root cause is anything that predisposes the cattle to ulcerative rumenitis.
- *Fusobacterium necrophorum* ssp. necrophorum is the primary etiological agent.
- *F. necrophorum funduliforme*, *Trueperella pyogenes*, streptococci, staphylococci and *Bacteroides* ssp. may be found in mixed infections.
- Gross lesions and culture of typical organisms from abscess are diagnostically definitive.

Tissues to Submit

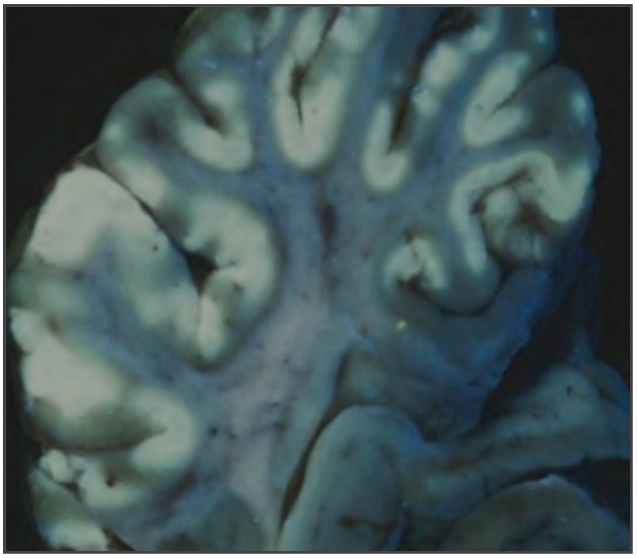
- Swabs of Abscess or Pus – taken from the inside edge adjacent to healthy liver. (*Do not culture the center of the abscess.*)

Diagnostic Tests

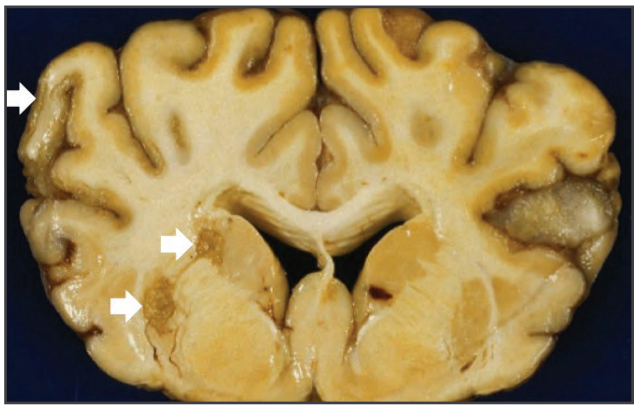
- Anaerobic Culture
- Aerobic Culture

Polioencephalomalacia

PEM or Polio or Cerebrocortical Necrosis



Wood's lamp creates fluorescence (bright areas) within necrotic cerebral cortex gray matter.



Linear areas of gray matter collapse in cerebral cortex and some nuclei.

POLIO

Tissues to Submit
- Cerebral Cortex Lesions
- Brainstem Lesions
- Feed Samples
- Water Samples

Diagnostic Tests
- Histopathology

CLINICAL SIGNS AND HISTORY

- An acute to subacute neurological condition.
- Acute clinical signs: blindness, stumbling, recumbency, seizures.
- Subacute clinical signs: dullness, ear and facial twitching, wandering, head-pressing.
- A thiamine-responsive condition if caught early, with multiple causes including upset of normal thiamine-producing gut flora, or consumption of water or plants that are high in sulfur.

AGE OF OCCURRENCE

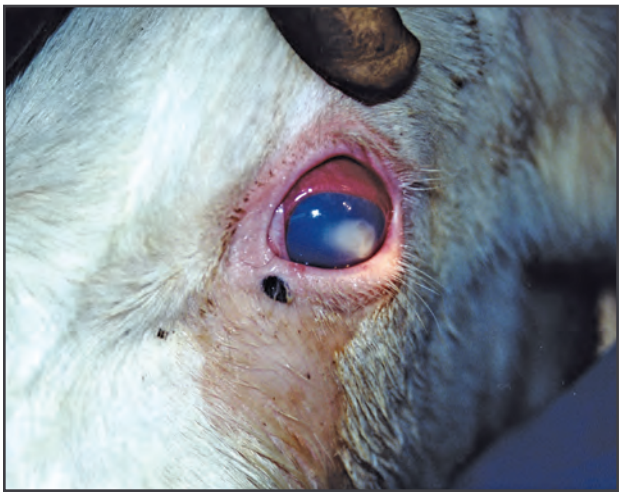
- Usually growing cattle in the feedlot or sometimes in the pasture.

DIAGNOSIS

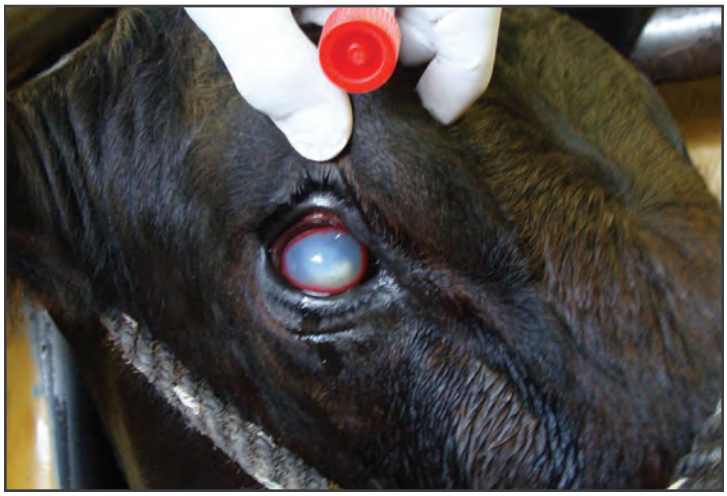
- Gross lesions when well-developed can be highly suggestive: patches of cerebrocortical necrosis and collapse; necrosis and hemorrhage of gray matter nuclei in the brainstem.
- Compatible history and clinical signs.

Infectious Bovine Keratoconjunctivitis

IBK • Pinkeye • *Moraxella bovis/Mor. bovoculi/Mycoplasma bovoculi*



Pinkeye: Note white ulcer in center of cornea, inflamed red sclera and conjunctiva, and wet skin below eye from chronic tearing.



Pinkeye: Lift the eyelids to see the red inflamed conjunctiva and sclera.

CLINICAL SIGNS AND HISTORY

- The disease usually is acute and tends to spread rapidly.
- One or both eyes may be affected.
- In cattle, dry, dusty environmental conditions; shipping stress; bright sunlight; and irritants such as pollens, grasses and flies tend to predispose to or exacerbate the disease. Flies also serve as vectors.
- The initial signs are photophobia, spasm of the orbicular muscle of the eyelids, and overflow of tears due to obstruction of tear duct.
- Conjunctivitis, with or without varying degrees of keratitis, is always present.
- Appetite may be depressed due to ocular discomfort or visual disturbance that results in inability to locate food.
- The clinical course varies from a few days to several weeks unless complicated by other diseases.

AGE OF OCCURRENCE

- Calves and yearlings are more prone to pinkeye.
- Older cattle are susceptible, with physical irritation of the eye coupled with heavy face-fly populations.

DIAGNOSIS

- Presumptive diagnosis is based on ocular signs and concurrent systemic disease. It is important to distinguish that the lesions are not due to foreign bodies or parasites.
- Microbial culture or PCR testing may identify involved organisms. *Moraxella bovis* is often isolated. The role of other organisms is less clear, but may include IBR virus, *Mycoplasma* spp. and *Moraxella bovoculi*.
- In IBR, upper-respiratory signs and conjunctivitis predominate, while keratitis accompanied by ulceration is rare.

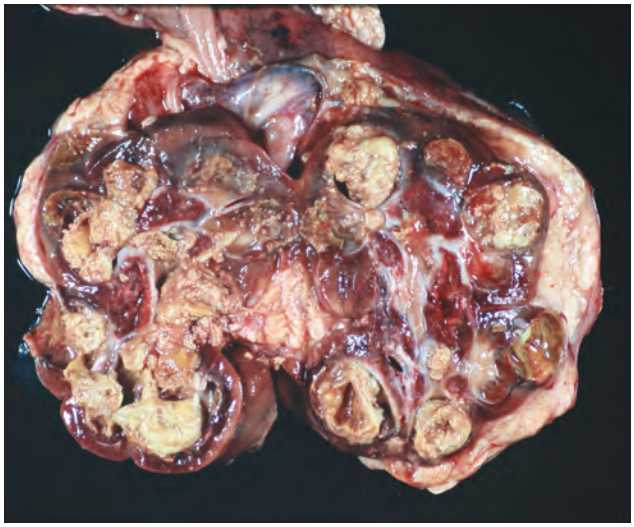
Tissues to Submit
- Eye Swabs

Diagnostic Tests
- Culture, Sensitivity
- Gene Sequencing

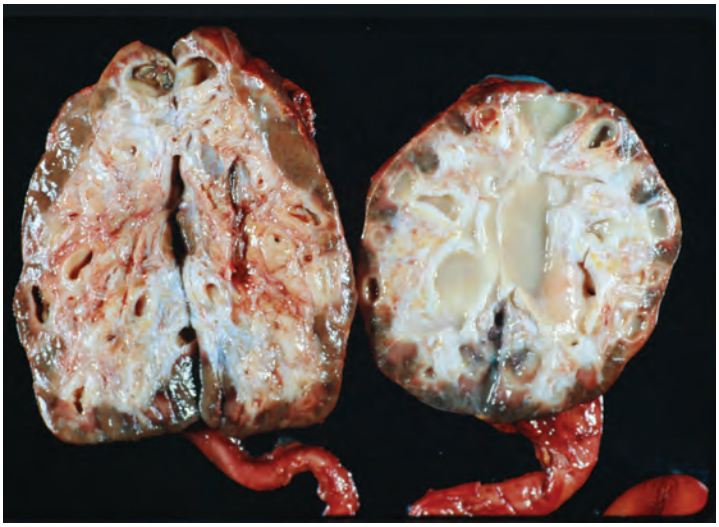
PINKEYE

Pyelonephritis

Bacterial Cystitis and Pyelonephritis



Pyelonephritis. Cross section of kidney reveals prominent multi-focal abscessation throughout. The lesions develop from infection ascending via individual nephron units.



Pyelonephritis. Note pus mixed with urine creates a thin white fluid filling many chronic abscesses. Note the extensive white tissue is fibrous scarring. Note the distended ureters.

PYELONEPHRITIS

Tissues to Submit
- Bladder
- Kidney
- Urine

Diagnostic Tests
- Necropsy
- Histopathology
- Bacterial Culture

CLINICAL SIGNS AND HISTORY

- A chronic disease that begins in the urinary bladder as bacterial cystitis, and progresses by ascending the ureters to cause pyelonephritis.
- Usually appears weeks after parturition.
- Rare in male cattle.

  A variety of bacteria may be involved, including *Corynebacterium* spp., *E. coli* or *Trueperella pyogenes*.

AGE OF OCCURRENCE

- Mature cows; risk seems to increase with parity.

DIAGNOSIS

- Clinically see increased frequency of urination, blood in urine, pus in urine, straining to urinate, twitching of tail, fever, loss of condition and production drop.
- Gross lesions include thickened urinary bladder, thickened ureters, pus pockets in the kidney.
- Histopathology shows cystitis and pus in renal tubules.
- Culture of the organisms from renal or bladder tissues.

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