Cost of workup - $95

1 terminal

Necropsy and histopathology

Bacteriologic culture – lung, LN, etc
  - *Haemophilus somnus* with special media

Mycoplasma – lungs – PCR and RFLP

Virus isolation – lung, LN, trachea, spleen
  - IBR, BRSV, BVD, PI-3 and others as needed
Bovine Respiratory Disease Workup

( cont )

- **FA**
  - Trachea for IBR
  - Lungs – EFS and PR 3
- **PCR – BVD**
- **IHC – lungs for BRSV**
- **Sero logic examination – not included in standard package**
Ruminant Respiratory Pathology

- Upper Respiratory Diseases
  - Noninfectious Disease
  - Infectious Disease
- Lower Respiratory Tract (Lung)
  - Infectious Disease
  - Noninfectious Diseases
Bovine Respiratory Pathology

- Upper Respiratory Diseases
  - Noninfectious Disease
    - Atopic rhinitis
    - Laryngeal/tracheal edema
  - Laryngeal contact ulcers
- Infectious Diseases
  - Viral
  - Bacterial
  - Mycotic
Nasal Granuloma (atopic rhinitis)

- Bovids in Australia (southeast), UK and S. Africa
- Polypoid nodules with eosinophils and mast cells
- Type I, III and IV hypersensitivity involved
- Infectious differentials
  - Mycetomas
  - Rhinosporidiosis
  - Schistosomiasis
Laryngeal/Tracheal Edema

- Laryngeal edema
  - Acute interstitial pneumonia
  - Obstructs lumen leading to asphyxiation
- Tracheal edema
  - “honker syndrome”/tracheal edema of feedlot cattle
  - Unknown cause, usually summer
  - Edema and hemorrhages mid-cervical region and caudally to bifurcation
- Pharynx – drenching gun injury – capsule deposition
Laryngeal Contact Ulcers

- Common in fed lot cattle.
- Cause – combination of stress (vocalization), environmental factors and viruses?
- Pathology
  - Circular uni- or bilateral ulcers
- Complications
  - Necrobacillosis
  - Papillomas
  - Chondritis
Bovine Respiratory Pathology

- Upper Respiratory Diseases
  - Infectious Diseases
    - Bacterial
    - Viral
  - Mycotic
Calf Diphtheria (Necrobacillosis)

- Feedlot cattle, sheep
- Secondary to viral infection or trauma
- Etiologic agent
  - *Fusobacterium necrophorum*
- Pathology
  - Tongue, larynx, pharynx, trachea
  - Elevated necrotic plaques, ulceration
Calf Diphtheria (Necrobacillois)

- Disease
  - Systemic disease
  - Respiratory — cough and inspiratory dyspnea

- Complications
  - Pneumonia secondary to aspiration
  - Toxemia or bacteremia
  - Asphyxiation
Bovine Respiratory Pathology

- Lower Respiratory Tract Diseases
  - Noninfectious Disease
    - Congenital Emphysema
      - Immune Mediated Interstitial pneumonia
      - Toxic interstitial pneumonia
  - Infectious Disease
    - Viral Diseases
    - Bacterial Diseases
    - Parasitic Diseases
Normal Calf Lung
(note fibrous pleura)
Congenital Disease

- Pulmonary hypoplasia
- Accessory lungs (dystocia possible)
- Congenital melanosis
Congenital Lung Defects

- Pulmonary hypoplasia and anasarca (PHA)
  - An emerging genetic disease in Shorthorn fetuses in US
  - Anjou-Maine: – one case seen in Illinois
  - In Australia, seen in Dexters (Peter Windsor)
Anasarca

NOT TO BE REPRODUCED
Severe Pulmonary Hypoplasia –
Anjou-Maine Fetus

NOT TO BE REPRODUCED
Pulmonary Hypoplasia—
Normal Histology -Maine-Anjou Fetus

NOT TO BE REPRODUCED
Bovine Respiratory Pathology

- Viral Diseases
  - Upper respiratory
    - Infectious bovine rhinotracheitis (IBR)
    - Bovine malignant catarrhal fever (BMC)
  - Pneumonia
    - Bovine respiratory syncytial virus (BRSV)
    - Retrovirus infections of goats and sheep
Infectious Bovine Rhinotracheitis (IBR, “rednose”)

- **Etiology**: bovine herpesvirus I (BHV-I)
- **Species**: young cattle (feedlots)
- **Diseases**: respiratory, generalized, reproductive (IPV, IBP)
- **Clinical signs**: rhinitis, tracheobronchitis
- **Differential**: calf diphtheria
Infectious Bovine 
Rhinotracheitis (IBR)

**Pathology**
- Mucopurulent rhinotracheitis
- Multifocal epithelial necrosis
- Intranuclear inclusion bodies

**Importance**
- Predisposes to secondary bacterial infection especially *Mannheimia* (*Pasteurella*) *haemolytica*

**Diagnosis:** virus isolation, IHC, PCR
Infectious Bovine Rhinotracheitis (IBR)
Bovine Malignant Catarrhal Fever

- Etiology: herpes virus (alphaherpes)
- Two types:
  - Wildebeest derived
  - Sheep associated - worldwide
- Species: all bovines, deer
- Carriers are sheep, possibly infected deer
- Generally sporadic, with high mortality, but herd outbreaks may occur.
- Clinical signs:
  - Fever, keratoconjunctivitis, rhinitis
  - Encephalitis
  - Death
Bovine Malignant Catarrhal Fever (BMC)

- Pathology:
  - Digestive and upper respiratory tract erosions
  - Encephalitis
  - Lymphoid hyperplasia (lymphadenopathy)
  - Vasculitis with fibrinoid necrosis
- Differential diagnoses: Rinderpest, BVD, IBR
Bovine Respiratory Syncytial Virus (BRSV)

- Pneumovirus (paramyxoviridae)
- <1 year, beef calves
- Clinical signs
  - Fever
  - Anorexia
  - Nasal and lacrimal discharge
  - Increased respiratory rate
  - +/- Death
Bovine Respiratory Syncytial Virus

- Pathology
  - Bronchointerstitial pneumonia
  - Syncytial giant cells of bronchiolar epithelium
  - Acidophilic cytoplasmic inclusion bodies
- Secondary bacterial infection
- Diagnosis – IHC, virus isolation
- In Australia mainly non pathogenic
- Differentials: other interstitial pneumonias
Bovine Respiratory Syncytial Virus (BRSV)

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Bovine Respiratory Syncytial Virus (BRSV)
Bovine Respiratory Syncytial Virus (BRSV)

NOT TO BE REPRODUCED
Bovine Respiratory Syncytial Virus (BRSV)

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Retrovirus Infections of Goats and Sheep

- Ovine Progressive Pneumonia (Maedi)
- Caprine Arthritis-Euencephalitis (CAE)
- Ovine Pulmonary Adenomatosis/Ovine Pulmonary Carcinoma (Jaagsiekte)
Ovine Lentivirus-Induced Lymphoid Interstitial Pneumonia (LIP)

- Etiology: Lentivirus, "slow" virus (2-3 yr incubation)
- Widespread infection but few clinical cases
- Most countries except Australia and New Zealand
- Pulmonary form also known as Maedi, ovine progressive pneumonia (OPP)
- Can affect CNS (Visna), mammary tissue, joints, etc
- Pathology
  - Severe chronic interstitial pneumonia
  - Marked BALT and smooth muscle proliferation
  - Tracheobronchial lymph nodes enlarged
Ovine Lentivirus-Induced Lymphoid Interstitial Pneumonia (LIP)
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NOT TO BE REPRODUCED
Ovine Lentivirus-Induced Lymphoid Interstitial Pneumonia (LIP)

NOT TO BE REPRODUCED
Barbary Sheep in Australia

- Interstitial pneumonia
- BALT hyperplasia
- Cause? LIP? Mycoplasma?
Caprine Arthritis- Encephalitis (CAE)

- Etiology: Lentivirus of goats
- Disease: similar to LIP in sheep
- Transmission horizontal and vertical: in utero, milk
- Australia, USA, Canada, Europe
- Disease
  - Chronic interstitial pneumonia, lymphocytic (adult)
  - Tracheobronchial lymph nodes enlarged
  - Arthritis, mastitis (adult)
  - Encephalitis (2 - 4 mth old)
Caprine Arthritis-Encephalitis (CAE)
Caprine Arthritis- Encephalitis (CAE)

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Bacterial Pneumonias

- Bacterial Agents
  - Mannheimia (Pasteurella) haemolytica
  - Pasteurella multocida
  - Histophilum somni (Haemophilus somnus)
  - Mycobacterium sp.
  - Mycoplasma mycoides ssp. Mycoides
- Sheep and goats – pseudoglanders – Burkholderia pseudomallei – pulmonary abscesses
Bovine Respiratory Disease (BRD)

- “Shipping Fever Complex”
  - Acute disease
    - High mortality

- Enzootic pneumonia
  - Young calves that are intensively housed
  - High morbidity, low mortality

- Embolic pneumonia
  - Sporadic
“Shipping Fever Complex”

Predisposing factors

- Shipping and other stressors (feedlot)
- Viral infections (IBR, BRSV, BVD, PI-3)

Etiology

- *Mannheimia (Pasteurella) haemolytica* biotype A, serotype 1
- *Pasteurella multocida* (type A)
- *Histophilum somni* (Hemophilus somnus)
  - Respiratory hemophilosis
  - TEME – thrombo-embolic meningoencephalitis
“Shipping Fever Complex”

- **Disease**
  - Few days to weeks after shipping
  - Systemic and respiratory clinical signs

- **Gross Pathology**
  - Severe fibrinous anteroventral bronchopneumonia
  - Fibrinous pleuritis and pleural effusion
“Shipping Fever Complex”

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Bronchopneumonia—Fibrinous
Pneumonic Mannheimiosis

- *Mannheimia haemolytica*

- Virulence factors
  - Exotoxin – leukotoxin, kills ruminal neutrophils and macrophages, releasing proinflammatory cytokines, free radicals, etc.
  - Endotoxin, LPS, membrane proteins

- Histopathology
  - Necrotic areas rimmed by degenerating and elongated neutrophils (“oat cells”)

NOT TO BE REPRODUCED
Pneumonic Mannheimiosis

NOT TO BE REPRODUCED
Pneumonic Mannheimiosis

NOT TO BE REPRODUCED
Pneumonic Mannheimiosis

NOT TO BE REPRODUCED
Pneumonic Mannheimiosis

- Sequella
  - Death due to toxemia
  - Abscesses
  - Sequestra
- Chronic pleuritis with adhesions
- Bronchiectasis
Bronchiectasis

NOT TO BE REPRODUCED
Pleuritis - Sheep

NOT TO BE REPRODUCED
Chronic Pleuritis - Cow

NOT TO BE REPRODUCED
Pneumonic Pasteurellosis

- *Pasteurella multocida* (type A)

- Histopathology
  - Suppurative bronchopneumonia

- Sequellae
  - Similar to previous but not sequestra

- Differentiate from septicemic pasteurellosis/hemorrhagic septicemia - serotype B and E.
Sheep and Goat Pneumonias

**Sheep**
- *Pasteurella* (biotype T)
- *Mannheimia haemolytica* (biotype A) which can also cause mastitis

**Goats**
- *Mycoplasma mycoides* ssp. *mycoides* large colony type
- Isolated from goats recently in Australia

**Note** – this is an incomplete listing
“Enzootic Pneumonia”

Predisposing factors
- Stress (temperature extremes, crowding)
- Viral infection (IBR, BRSV, BVD, PI-3 virus)
- Mycoplasmas (*M. bovis*, *Chlamydophila* sp.)
- Bovine leucocyte adhesion deficiency (BLAD)

Etiology (mixed)
- *Mannheimia* (*Pasteurella*) *haemolytica*
- *Pasteurella multocida* (*type A*)
- *Histophilus somni* (*Hemophilus somnus*)
- *Arcanobacterium* (*Actinomyces, Corynebacterium*) *pyogenes*
- *E. coli*

- Acute or chronic forms
- Similar in lambs
“Enzootic Pneumonia”

NOT TO BE REPRODUCED
Bronchopneumonia—*A. pyogenes*
Atelectasis - Sheep

NOT TO BE REPRODUCED
Contagious Bovine Pleuropneumonia (CBPP)

- Eradicated from Australia in 1970s, US in 1800s
- Enzootic in Africa, Asia and Eastern Europe

- Etiology
  - In cattle, *Mycoplasma mycoides* ssp. *mycoides* small colony type (note: large colony type isolated from goat pneumonias recently in Australia)
  - In goats, *Mycoplasma capricolum* ssp capripneumoniae
Contagious Bovine Pleuropneumonia

Pathology:
- Extremely severe fibrinous bronchopneumonia/pleuritis (similar in nature to *M. hemolytica*).
- Interlobular septa severely widened ("marbling") – edema and fibrin.
- Caudal lobes affected, not anteroventral distribution.
- Thrombosis and infarction.
- Sequestration prominent.

**NOTE:** SEVERE EDEMA AND FIBRIN IN LUNG AND THORACIC CAVITY.
Contagious Bovine Pleuropneumonia (CBPP)
Mycobacterium sp Pneumonia

- Cattle - *M. bovis*
  - *M. bovis* eradicated from Australia
  - In US, *M. bovis* occurs sporadically - mainly transmitted from deer and occasionally from cattle south of the border
  - Pulmonary granulomas

- *M. avium*
  - Occasionally in cattle, may see pulmonary granulomas

- Deer – both *M. bovis* and *M. avium*
  - Outbreaks in deer, especially in Michigan and adjacent states, related to feeding practices by hunters
Mycobacterium sp. - Cow

NOT TO BE REPRODUCED
Mycobacteriosis - Deer

NOT TO BE REPRODUCED
Mycobacteriosis (*M. avium*) - Deer
(acid fast stain)

NOT TO BE REPRODUCED
Brucellosis

- Brucellosis eradicated from Australia.
- In US, reservoir in bison – occasionally "escapes" to cattle around national parks.
- Affected cattle can abort and fetuses have a bronchopneumonia.
Fetal Pneumonia - Brucellosis

NOT TO BE REPRODUCED
Fetal Pneumonia - Brucellosis

NOT TO BE REPRODUCED
**Embolic Pneumonia**

- **Etiology**
  - Bacterial (abscesses)
    - Ruptured liver abscess
  - Ruptured hardware disease
  - Vegetative endocarditis
    - *C. pseudotuberculosis* in sheep
    - *B. holderia* (pseudoglanders) in sheep and goats
- **Mycotic (granulomas)**
  - Rumenal ulcers
  - Foreign body (iv injection)
- **Sequella**
Embolic Pneumonia – Ruptured
Liver Abscess - Cow

NOT TO BE REPRODUCED
Embolic Pneumonia – Ruptured
Liver Abscess - Deer

NOT TO BE REPRODUCED
Mycotic Granulomas

- Pulmonary granulomas (emboletic)
  - *Aspergillus spp.* most commonly
  - Usually rumenal ulcers allow invasion of blood vessels, may go to lung or to gravid uterus.
Rumen Ulcers - Cow

NOT TO BE REPRODUCED
Embolic Pneumonia - Mycotic

NOT TO BE REPRODUCED
Mycotic Granulomas

NOT TO BE REPRODUCED
Mycotic Granulomas

NOT TO BE REPRODUCED
Sheep - *Corynebacterium pseudotuberculosis* (Caseous Lymphadenitis - CLA) - Pulmonary Abscesses

NOT TO BE REPRODUCED
Bovine Parasitic (Verminous) Pneumonia

- *Dictyocaulus viviparous* in cattle
  - Interstitial pneumonia (larval migration)
  - Bronchitis and airway obstruction (adults)
  - Multifocal atelectasis and emphysema
- Granulomatous pneumonia (dead larvae, eggs)
- Secondary bronchopneumonia
- Hypersensitivity interstitial pneumonia on re-exposure (“reinfection syndrome”)
Dictyacaulus viviparous (Verminous)

Pneumonia

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Bovine Parasitic (Verminous) Diseases

- *Echinococcus granulosus*
  - Hydatid cysts (lung, liver, etc)
  - Especially sheep
  - 5-15 cm diameter
  - Intermediate stage of canine tapeworm
  - Zoonosis
Parasitic (Verminous) Diseases in Sheep and Goats

- *Dictyocaulus filaria*
  - Mainly in lambs and kids, but also adults
  - Disease similar to that in bovids plus anemia

- *Muellerius capillaris* (nodular lung worm)
  - Snails and slugs are intermediate hosts
  - Sheep: multifocal subpleural granulomas in caudal lobes
  - Goats: diffuse interstitial pneumonia

- *Protostrongylus rufescens*
  - Especially young
  - Adults live in airways
  - Nodules in lung
Muellerius spp - Sheep

NOT TO BE REPRODUCED
Fasciola hepatica -- Fluke Migration in Sheep

NOT TO BE REPRODUCED
Bovine Respiratory Pathology

- Noninfectious Pulmonary Disease
  - Aspiration Pneumonia
  - Emphysema
  - Immune Mediated Interstitial Pneumonia
  - Toxic Interstitial Pneumonias
Aspiration Pneumonia

- Secondary to cleft palate, white muscle disease, force feeding in calves, lambs
- Medication
- Hypocalcemia
- Anesthesia – rumenal fluid
- Neurologic disease
- Amniotic fluid/meconium
Aspiration Pneumonia

- Lesion distribution: multifocal or locally extensive (e.g. anteroventral)
- Histopathology: suppurative/granulomatous to gangrenous bronchopneumonia/abscesses/granulomas
- Look for plant material, lipid
- Look for meconium/squames in fetuses, neonates – can be diffuse lesion, may have syncytial cells
Aspiration Pneumonia – Multifocal, unilateral abscesses
Aspiration Pneumonia

Rumen contents

NOT TO BE REPRODUCED
Fetal Aspiration
Meconium with syncytial cells
(courtesy of Cor Lenghaus)
Interstitial Emphysema

- Air in interlobular septae and subpleurally, occasionally subcutaneous
  - May extend into subcutaneous tissue
- Secondary to marked respiratory effort
- Generally terminal event
- Not a significant lesion
Interstitial Emphysema

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Toxicant Induced Edema

- Damage to epithelium, endothelium
- Inhalation – smoke, oxygen, ammonia
  - Blood borne – endotoxin, snake venom, paraquat, ANTU
- Anaphylaxis
- May be secondary to toxicant induced cardiac injury
- Differentiate from “dead ruminant lung” - autolysis
Anaphylaxis

- Type I hypersensitivity
- Etiology
  - Iatrogenic: antibiotic injection, vaccination
  - Ruptured liver abscess
  - Milk allergy – sensitization to own casein
- Pathology
  - Pulmonary edema with eosinophils
  - Airway constriction
Pulmonary Edema: Anaphylaxis

NOT TO BE REPRODUCED
Etiology of NonInfectious Interstitial Pneumonias

- Inhaled Toxicants
  - Smoke: thermal and chemical injury
  - Organic dust (hypersensitivity reactions)
  - Manure “pit” gases – H₂S, NH₃
  - NO₂ from silos
- Ingested Toxicants
  - Plant toxins
- Feed lot interstitial pneumonia – cause unknown
Hypersensitivity Pneumonia
(extrinsic allergic alveolitis)

- Sporadic disease
- “Farmer’s lung” in humans
- Affects housed adult dairy cows
- Type III hypersensitivity to inhaled organic antigens
- Fungal spores of *Saccharopolyspora rectivirgula* (*Micropolyspora faeni*) in moldy hay
Hypersensitivity Pneumonia
(extrinsic allergic alveolitis)

- Disease - acute or chronic
- Clinical signs - dry cough, dyspnea, fever
- Gross pathology:
  - Mild – multifocal subpleural granulomas
  - Severe - AV to diffuse consolidation, emphysema
- Histopathology – proliferation alveolar epithelial cells, lymphocytic infiltrate, fibrosis
Parasitic Hypersensitivity

- Parasitic infection
  - Dictyocaulus vivaparous – “reinfection syndrome”
  - Ascaris suis?
  - D. filariae – sheep - levamisole treatment
Etiology of Interstitial Pneumonias: Ingested Toxicants

- L tryptophan, 3-methylindole
- Potato blond potato sweet potatoes
- *Fusarium solani* – outbreaks reported in New Zealand
- Purple mint - *Perilla frutescens* ketone
- Stinkwood – *Zieria arborescens*
- Rapeseed, kale, canola reshoots (glucoscintilates) – *Brassica* spp.
Acute Bovine Pulmonary Edema/Emphysema (ABPE) – Fog Fever

**Occurrence**

- UK, Europe, USA, Australia
- Adult cattle >2 years old
- Abrupt change to lush pasture (within 2 wks)
- In Australia, where autumn growth largely grass rather than clover
- Goats/sheep are susceptible experimentally
Acute Bovine Pulmonary Edema/Emphysema (ABPE) – Fog Fever

- Gross lesion:
  - Lungs do not collapse, heavy, wet, emphysema

- Histopathology: interstitial pneumonia
  - Hyaline membranes
  - Prominent type II cell hyperplasia

- Sequella
  - Interstitial fibrosis
  - May see bronchiolitis obliterans
Acute to Subacute Interstitial Pneumonia
Subacute to Chronic Interstitial Pneumonia ("proliferative" pneumonia)
Acute to Subacute Interstitial Pneumonia
(type II cell proliferation)

NOT TO BE REPRODUCED