

# Respiratory Pathology of Swine

Disclaimer: diseases described as occurring in US  
with notations regarding Australian situation

# Pathology of Respiratory System

- Upper Respiratory Tract
  - Non-infectious Disease
    - Laryngeal edema
    - Pharyngitis
  - Infectious Diseases
    - Viral
      - Inclusion body rhinitis
      - Swine influenza
    - Bacterial
      - Atrophic rhinitis

# NonInfectious Diseases

## ■ Pharyngitis

- Pharyngeal diverticulum predisposes to lodgement of food particles e.g. barley awns, leading to inflammation and swallowing problems
- Iatrogenic trauma e.g. drenching gun

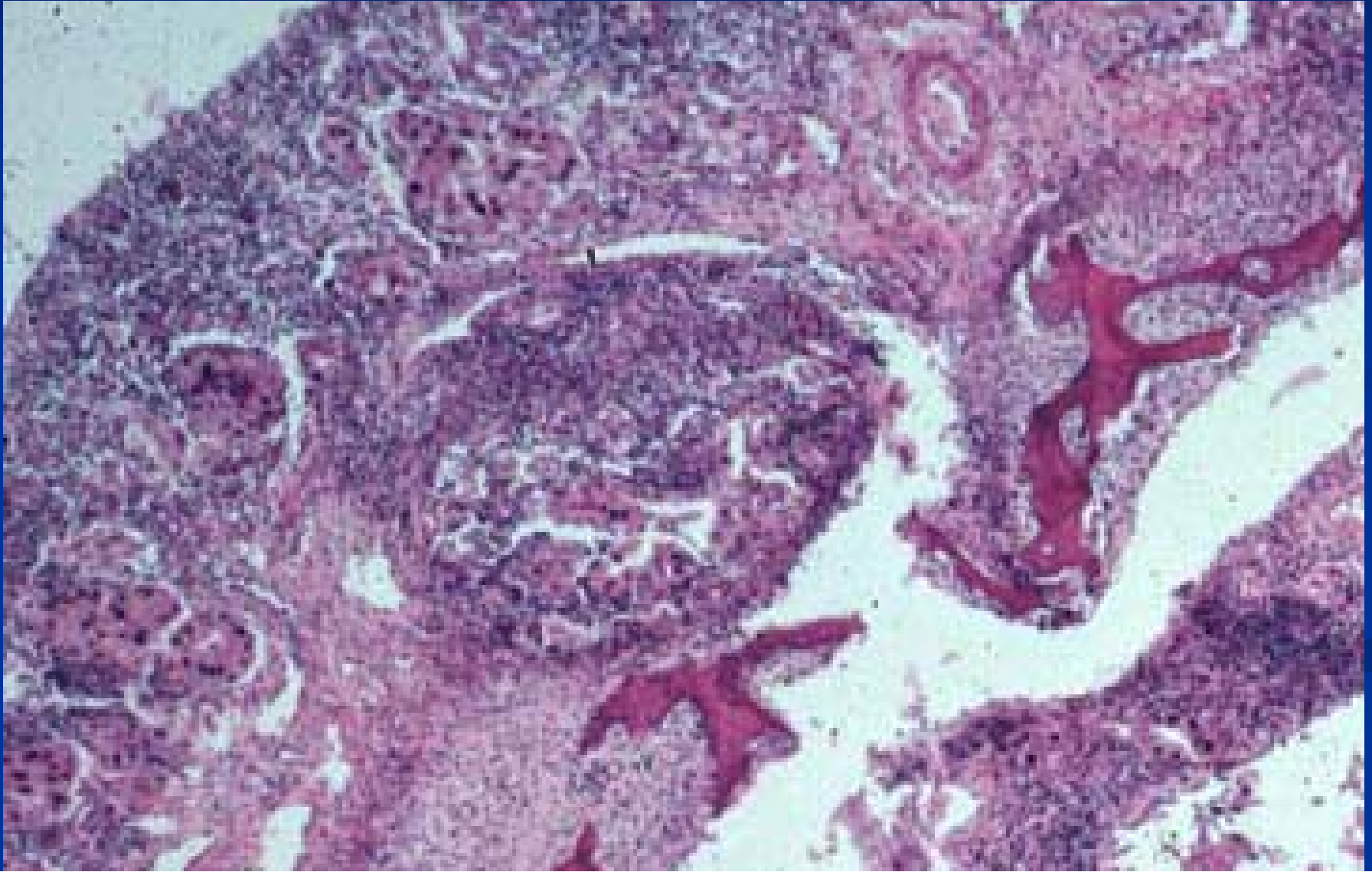
## ■ Laryngeal edema

- Allergic response to tatooing noted in Australia

# Inclusion Body Rhinitis

- Etiology: porcine cytomegalovirus (herpesvirus)
- Disease
  - Typically mild rhinitis
  - High morbidity, low mortality unless immunosuppressed
- Pathology
  - Nonsuppurative rhinitis with inclusion bodies (very large, often in submucosal gland epithelium)
  - Can be typical systemic herpes viral disease if severe

# Inclusion Body Rhinitis



# Porcine Atrophic Rhinitis

- Common worldwide disease of pigs
- Important because of production losses
- Etiology
  - *Bordetella bronchiseptica*
  - Toxigenic *Pasteurella multocida* types A & D
- Questionable predisposing factors
  - Viruses, other bacteria, genetics, environment, nutrition

# Porcine Atrophic Rhinitis

## ■ Pathogenesis

- *Bordetella bronchiseptica* promotes colonization
- *Pasteurella multocida* cytotoxin (dermatonecrosis toxin)
  - Cytotoxin is plasmid associated
  - Inhibits osteoblasts and stimulates osteoclasts
  - Cause liver injury experimentally

## ■ Pathology

- Nonsuppurative rhinitis
- Atrophy of turbinates (osteopenia)
- Facial deformity may occur

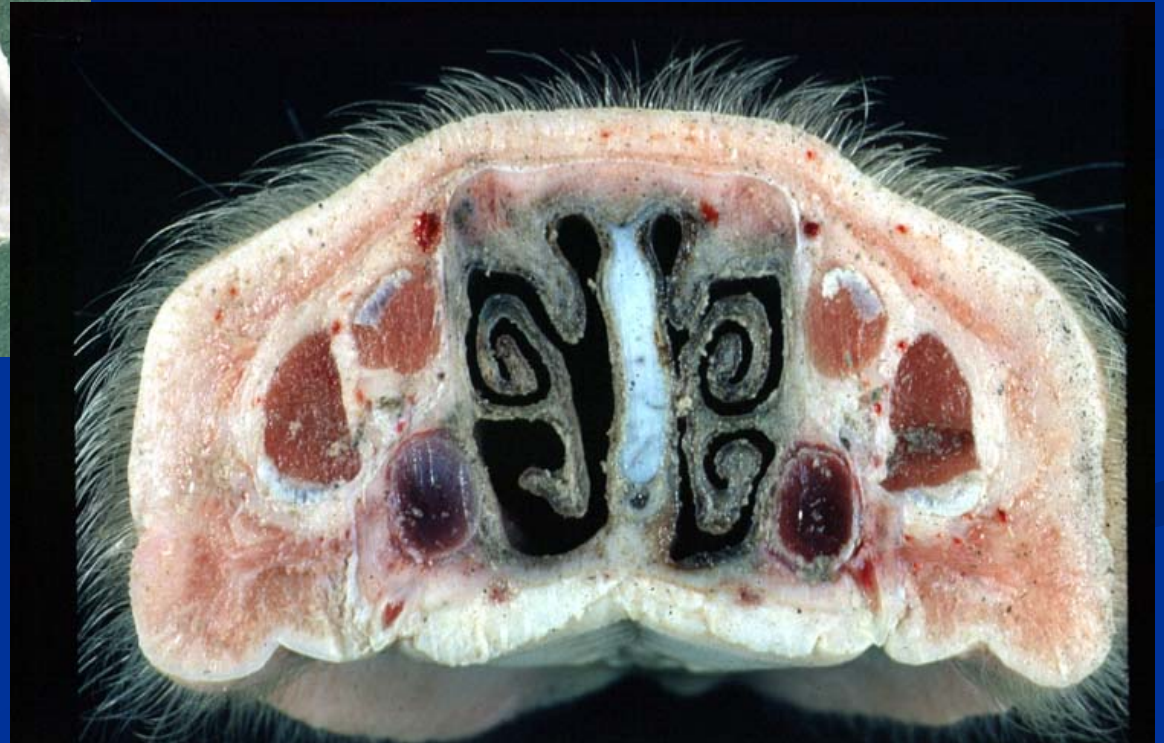


# Porcine Atrophic Rhinitis

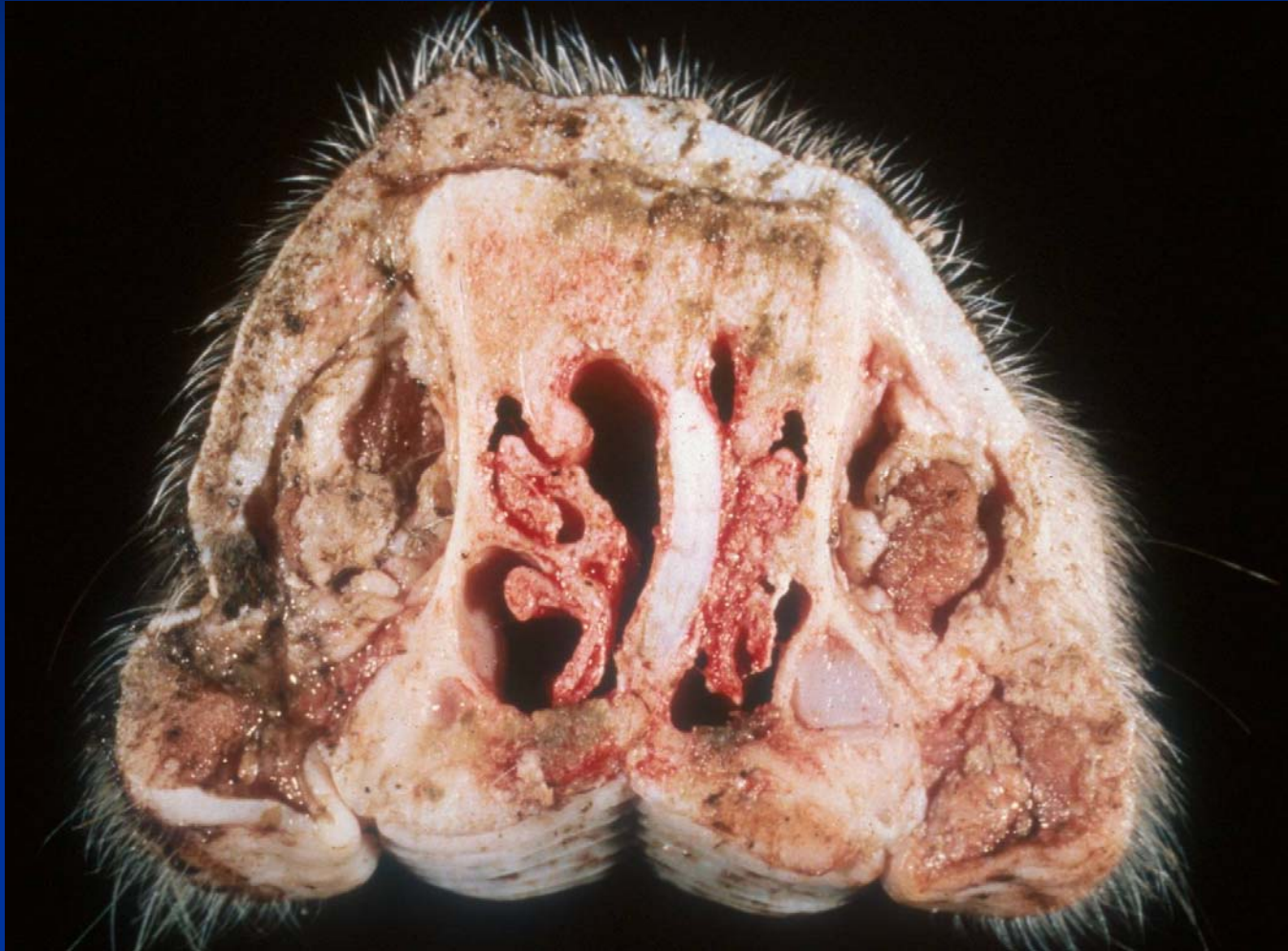




# Porcine Atrophic Rhinitis



# Atrophic Rhinitis—Porcine



# Porcine Atrophic Rhinitis

## ■ Clinical signs

- Not proportional to pathology
- Sneezing, coughing, nasal discharge
- Obstruction of nasolacrimal duct with crusting
- Poor weight gain

## ■ Diagnosis

- Clinically - culture
- At necropsy - transverse section of snout between premolars 1 and 2

# Lower Respiratory Tract

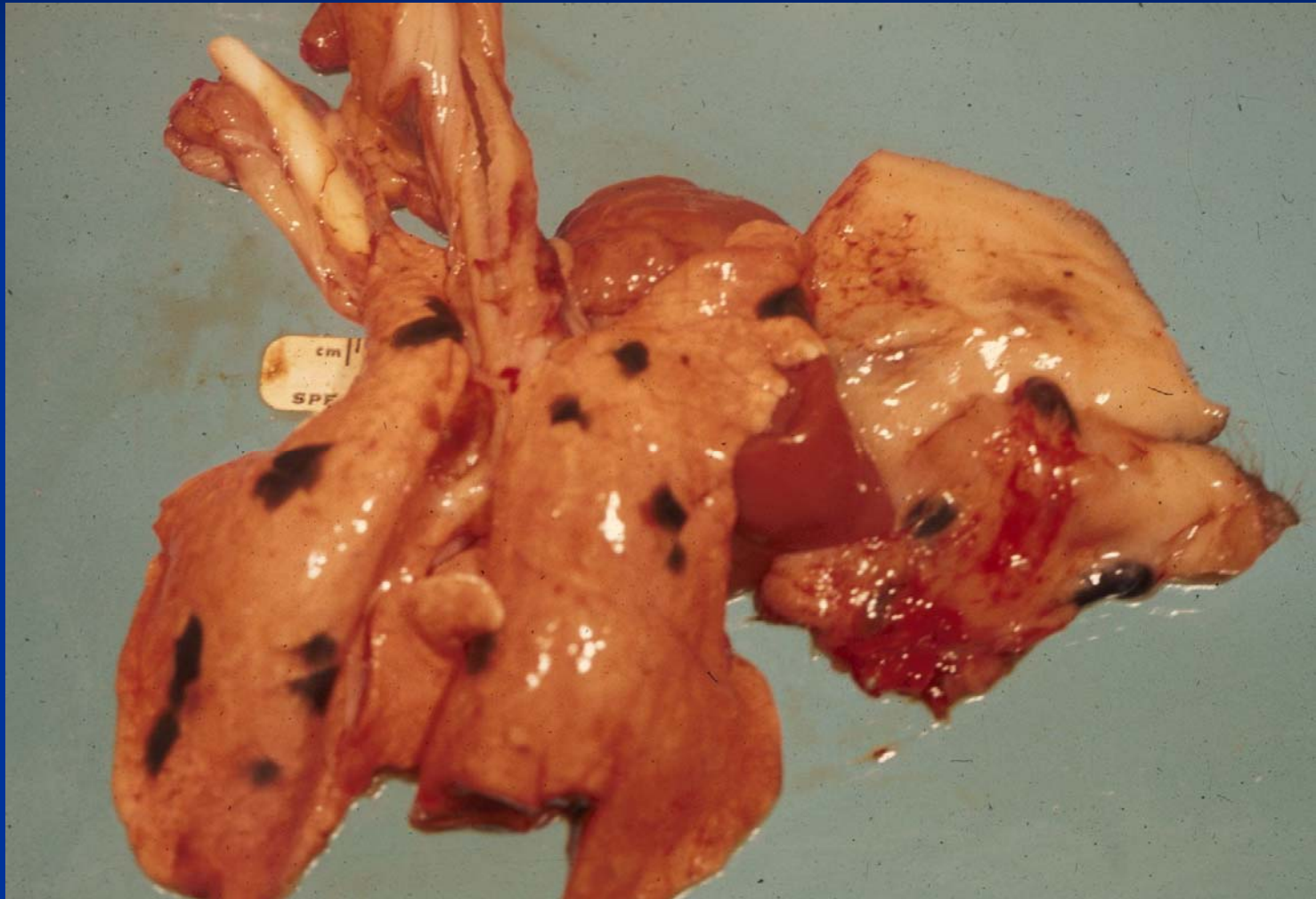
- Non Infectious Diseases
  - Developmental abnormalities
  - Circulatory disease
  - Aspiration pneumonia
- Infectious Diseases
  - Viral
  - Bacterial

# Developmental Lung Anomalies

- Accessory lungs
- Lung hypoplasia (primary or secondary)
- Surfactant deficiency
- Melanosis



# Developmental Lung Anomalies





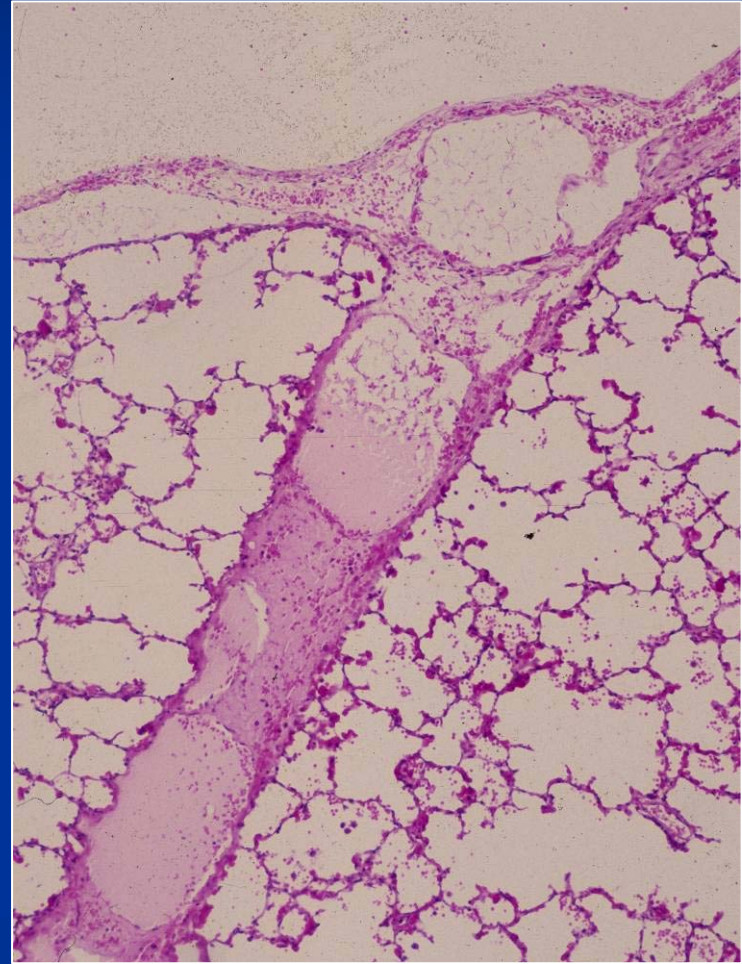
# Pulmonary Edema

- Edema with petechial hemorrhages
  - Septicemias
  - Viral diseases
    - African swine fever (exotic disease)
      - Chronic – pleuritis and lobar pneumonia
    - Classical swine fever (hog cholera) – exotic disease

# Pulmonary Edema

- Cardiogenic edema
  - Common cause of pulmonary edema in pigs
    - Vitamin E/selenium def– “mulberry heart disease”
    - Fumonisin mycotoxins
    - Other toxins
- Damage to epithelium, endothelium
  - Toxicant induced edema
    - Inhalation – smoke, oxygen, ammonia
    - Blood borne – endotoxin

# Pulmonary Edema – Pig - Fumonisin



# Aspiration Pneumonia

- Etiology/predisposing factors
  - Unpelleted feeds
    - Inhalation of vegetable material
    - Foreign body granulomatous pneumonia
  - Improper tubing (oil, medication)
  - Prenatal stress – amniotic fluid and meconium

# Infectious Disease

- Pneumonias are of great economic importance in swine
- Important factors include
  - Host e.g. age, genetics, immunity
  - Infectious agent
  - Environment e.g. humidity, temperature, ammonia concentration
  - Management practices e.g. crowding, mixing, nutrition, stress

# University of Illinois Veterinary Diagnostic Laboratory - Porcine Respiratory Disease Workup

- Total charge - \$95
- 1-4 animals
- Necropsy and histopathology
- Bacteriologic culture – lung, LN, etc
  - *Actinobacillus* and *Haemophilus* spp
  - PCR for Salmonella, PRRS as needed
- Virus isolation – lung, LN, trachea
  - PRRS, influenza (SIV), pseudorabies and others as needed



# Porcine Respiratory Disease Workup

- FA – lung – influenza, circovirus, PRCV
- PCR – lung – *M. hyopneumoniae*, PRRS
- IHC – SIV, PRRS, PCV if needed
- Serologic examination – not included in standard package

# Respiratory Viral Diseases

- **Circovirus-2** – is full manifestation of Postweaning Multisystemic Wasting Syndrome (PMWS) present in Australia??
- **In Australia (isolated outbreaks)**
  - **Menangle virus** (paramyxovirus– pulmonary hypoplasia/”butterfly” lungs)
  - **Myocarditis virus** – cardiac edema, anasarca
- **In US but NOT in Australia**
  - **Pseudorabies** (Aujeszky’s disease)
  - **Swine influenza**
  - **Porcine reproductive and respiratory syndrome (PRRS)**
- **In Asia but NOT in Australia -Nipah virus** (henipavirus, subfamily pneumovirinae)

# Pseudorabies (Aujeszky's disease)

- Herpesvirus of swine primarily
- Rhinitis, bronchiolitis, interstitial pneumonia
- Predisposes to bacterial infection
- Production losses
- Abortions, mummification, weak piglets
- Eradication program in USA
- Reservoirs – wild pigs, wildlife
- Dogs can also be affected

# Porcine Viral Abortions



# Pseudorabies

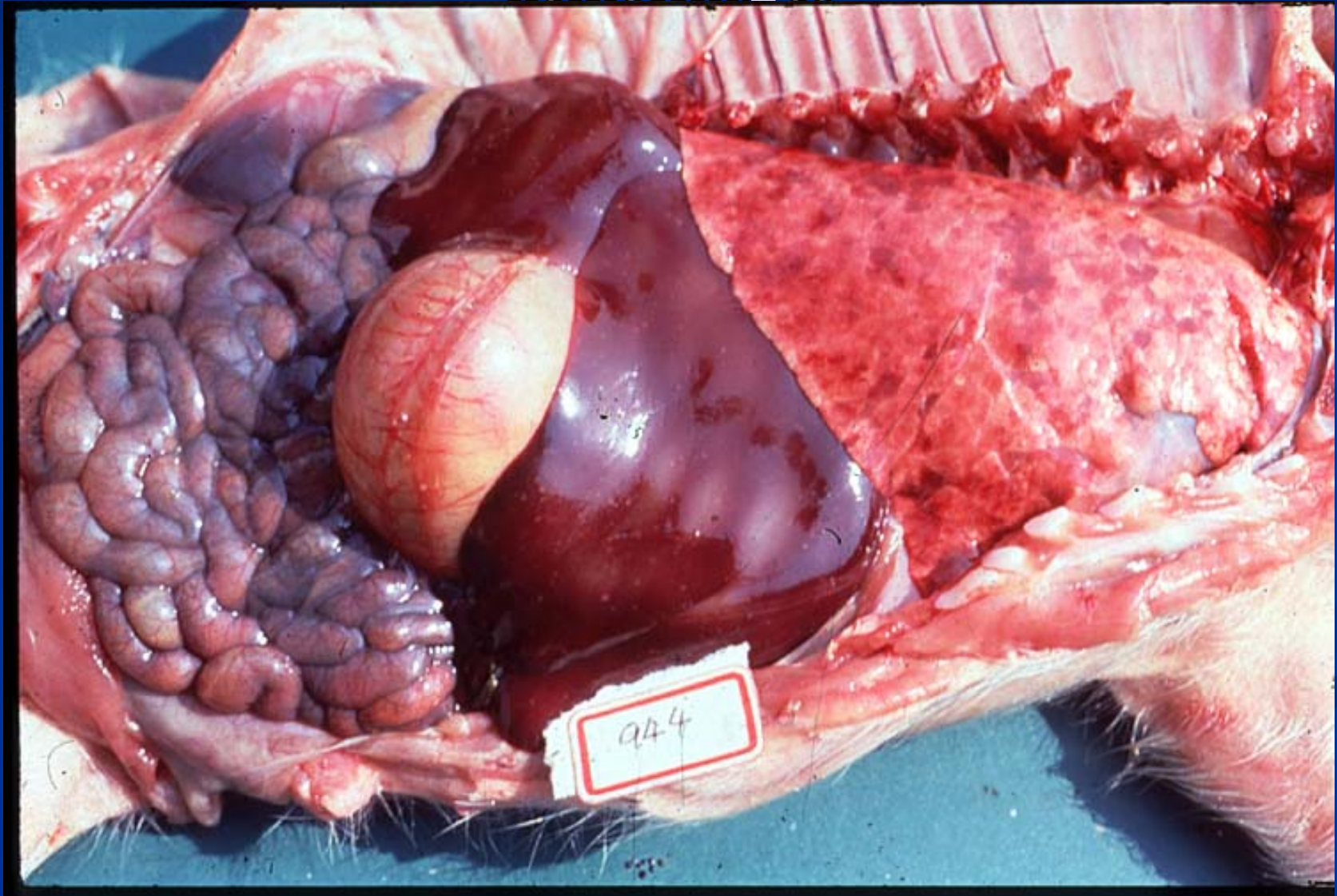
## ■ Pathology

- Typical herpesvirus infection
- Primary pulmonary– bronchointerstitial pneumonia
- Other organs – brain, liver – especially if immunosuppressed and in aborted fetuses.
- Necrosis and intranuclear inclusion bodies



# Pseudorabies

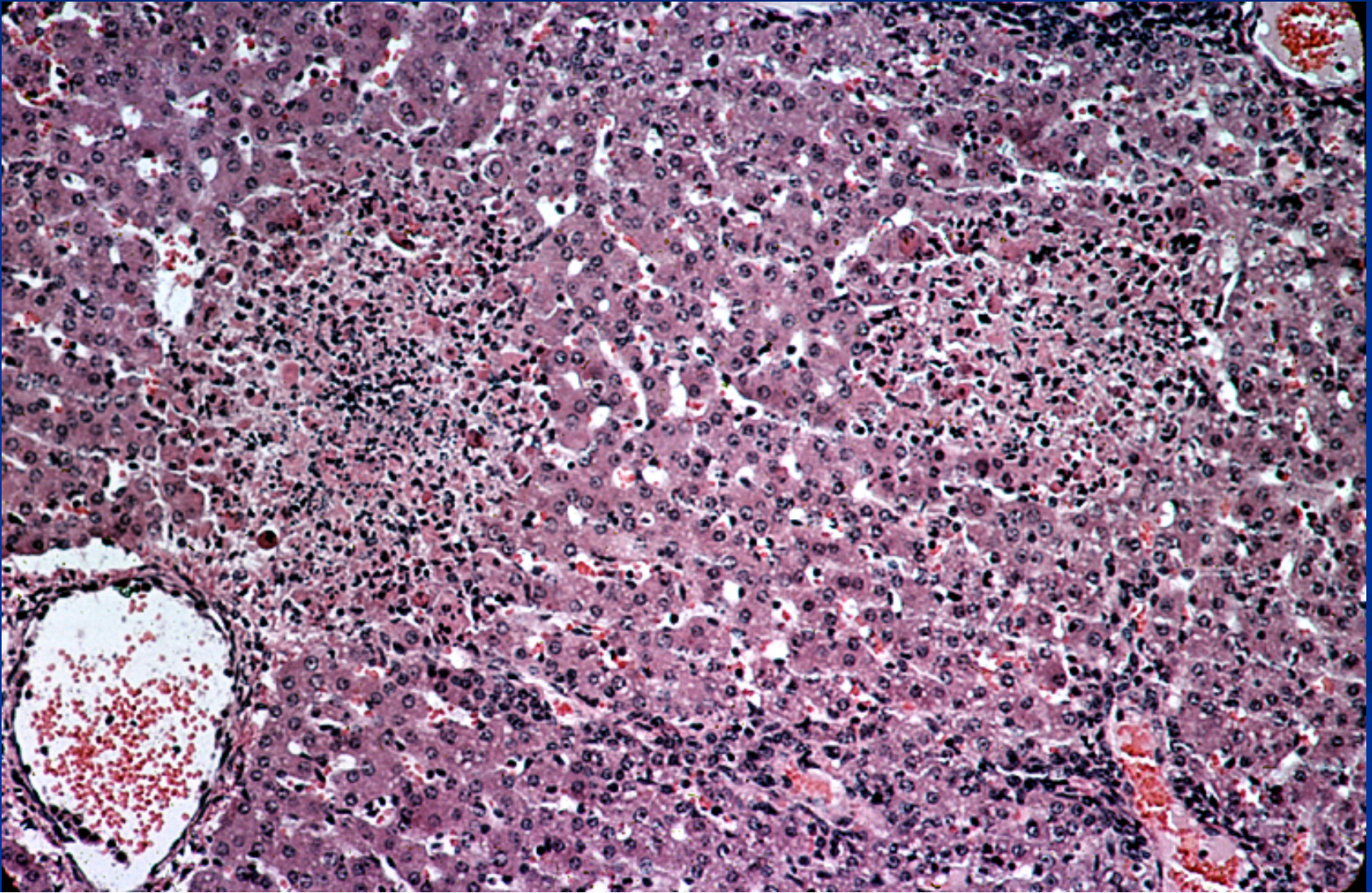
Multifocal hepatic necrosis and pulmonary hemorrhages





# Pseudorabies – Liver

## Multifocal hepatic necrosis



# Porcine Respiratory Disease Complex

- Age 2-6 month old pigs
- Clinical disease
  - Decreased growth and feed efficiency
  - Anorexia, fever
  - Cough and dyspnea
- Multiple respiratory pathogens
  - PRRSV, SIV and Mycoplasma sp
  - Porcine circovirus – 2 (PC-2) may play an important role



# Postweaning Multisystemic Wasting Syndrome (PMWS)

- New disease – progressive emaciation of weaned pigs
- North America, Europe, New Zealand
- Etiology: porcine circovirus-2 (PC-2) +
- Important role of coinfections in pathogenesis (analysis of midwest US cases)
  - PC-2 alone (2%)
  - PRRS virus, porcine parvovirus (51%)
  - *Mycoplasma hyopneumoniae* (36%)
    - PC-2 antigen high in hyperplastic BALT

# Postweaning Multisystemic Wasting Syndrome (PMWS)

## ■ Clinical disease

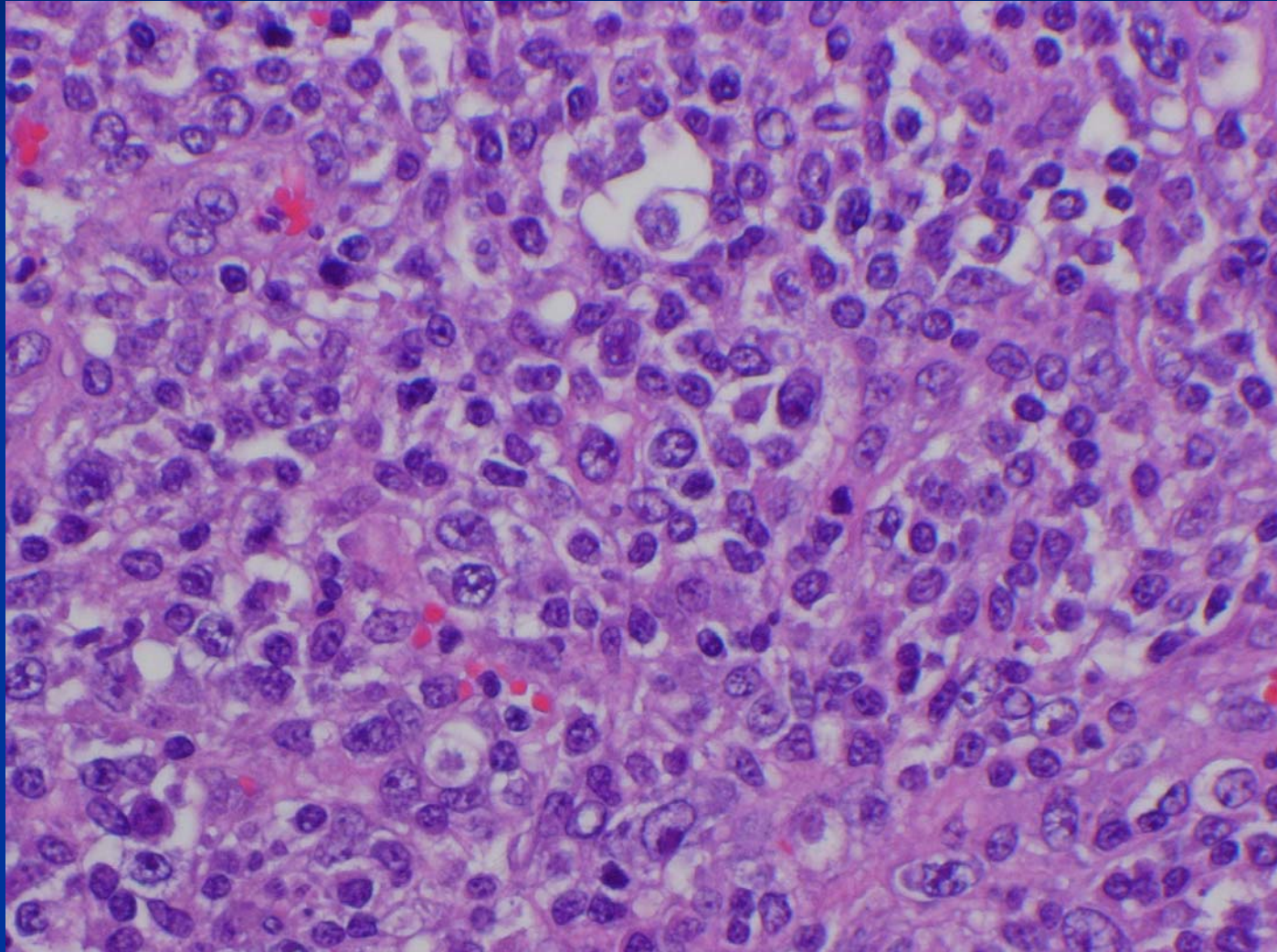
- Poor body condition
- Enlarged lymph nodes
- Dyspnea

## ■ Pathology

- Lymphoid depletion
- Granulomatous lymphadenitis with multinucleated syncytial cells
- PC-2 antigen in lymphoid tissues – PCR, IHC
- Interstitial pneumonia
- Secondary *Pneumocystis carinii* infection possible
- Basophilic botryoid ICIB in macrophages systemically

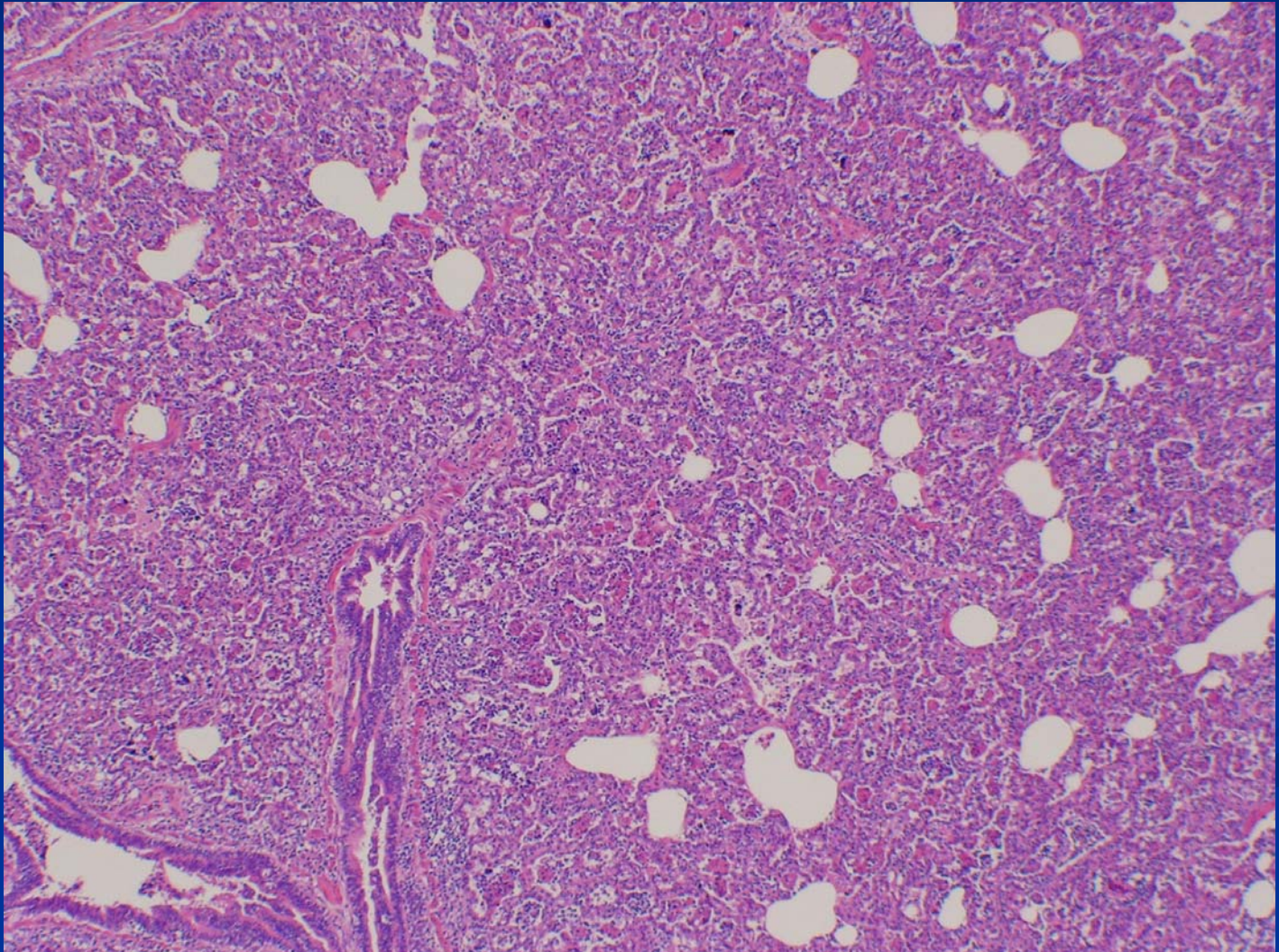
# PMWS – Lymph Node

Lymphoid tissue replaced by macrophages



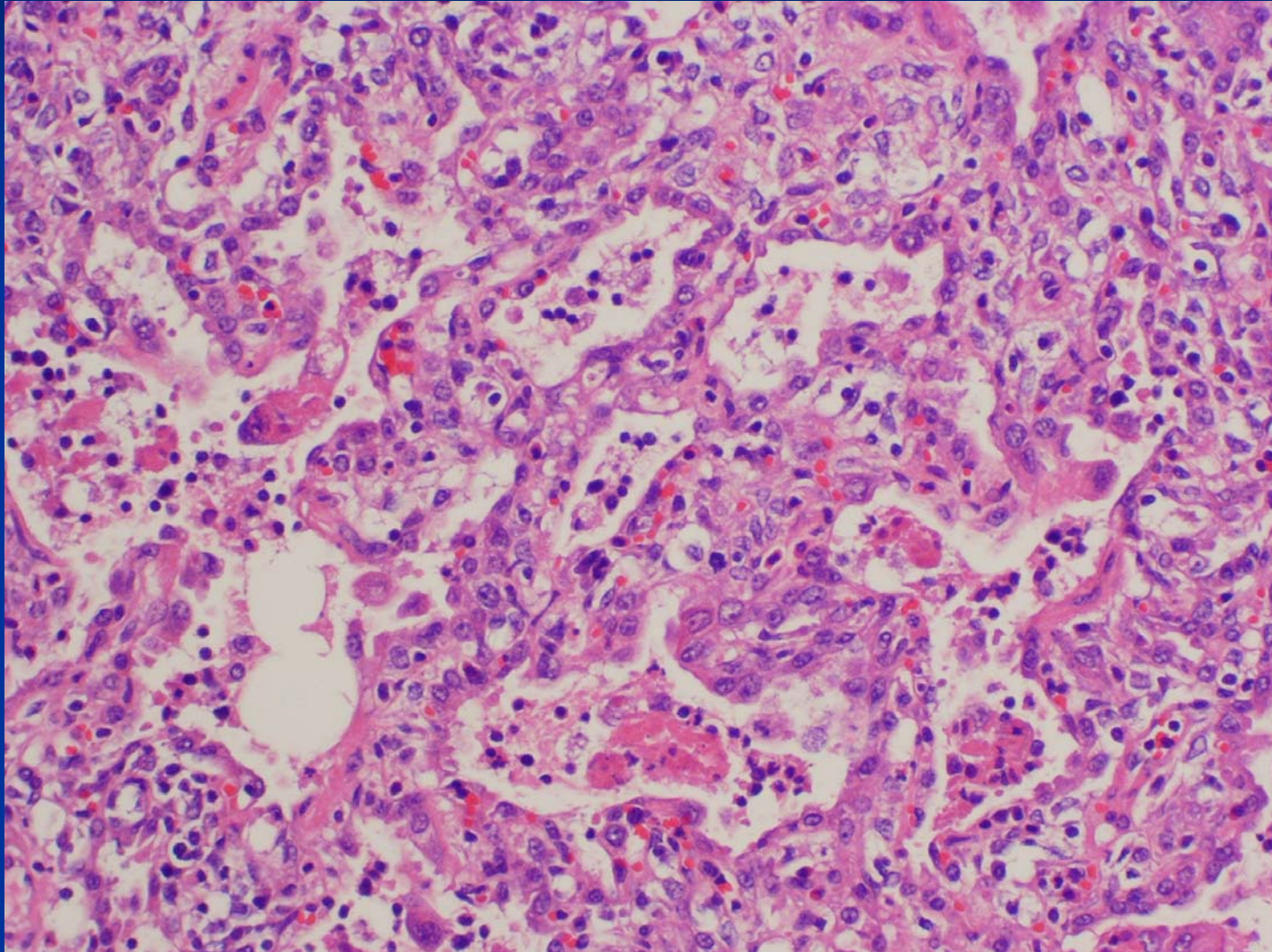


# Porcine Respiratory Disease Complex with *Bordetella bronchiseptica*



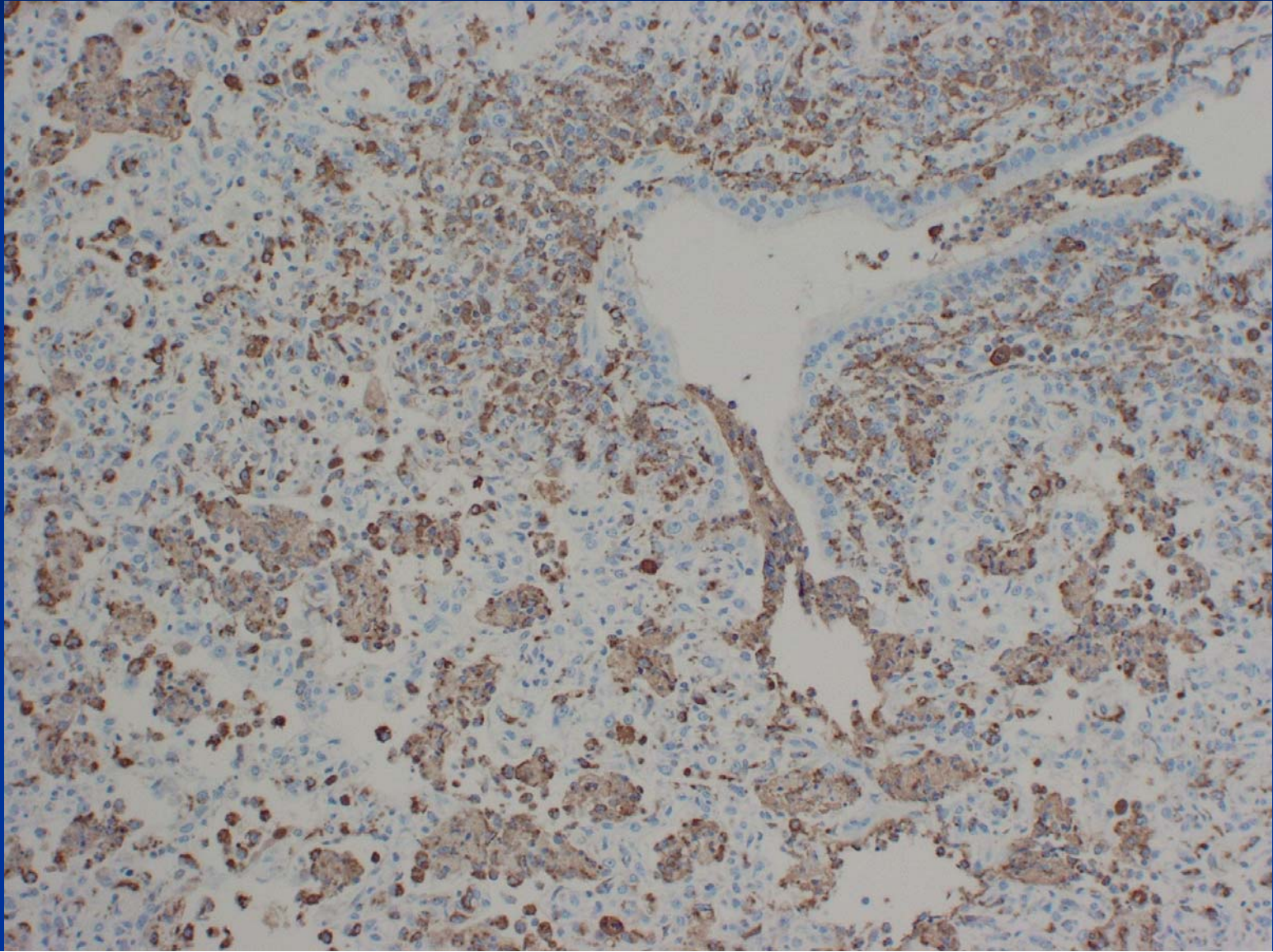


# Porcine Respiratory Disease Complex with *Bordetella bronchiseptica*

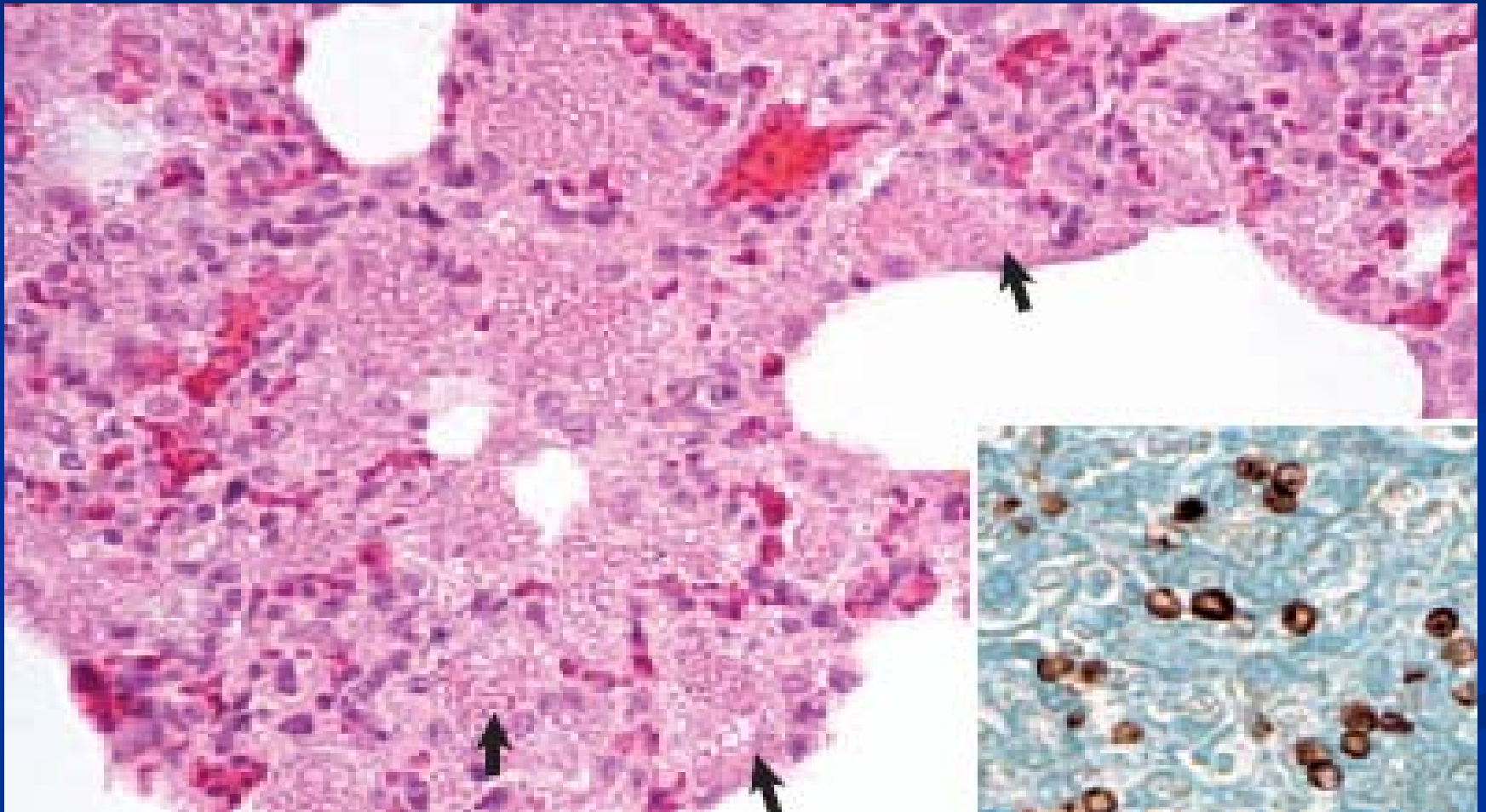




# Porcine Respiratory Disease Complex Circovirus-2 IHC



# Pneumocystosis Secondary to PWMS



# Swine Influenza

- Orthomyxovirus, Type A
- Enzootic worldwide
- Zoonotic -cause of human influenza pandemic during WW I
- Transmission
  - Aerosols and oral routes
  - Via lungworms and earth worms
- Disease – high morbidity, low mortality unless secondary bacterial infection

# Swine Influenza

## ■ Clinical signs

- Fever, cough, oculo-nasal discharge
- Weight loss, abortions, weak piglets

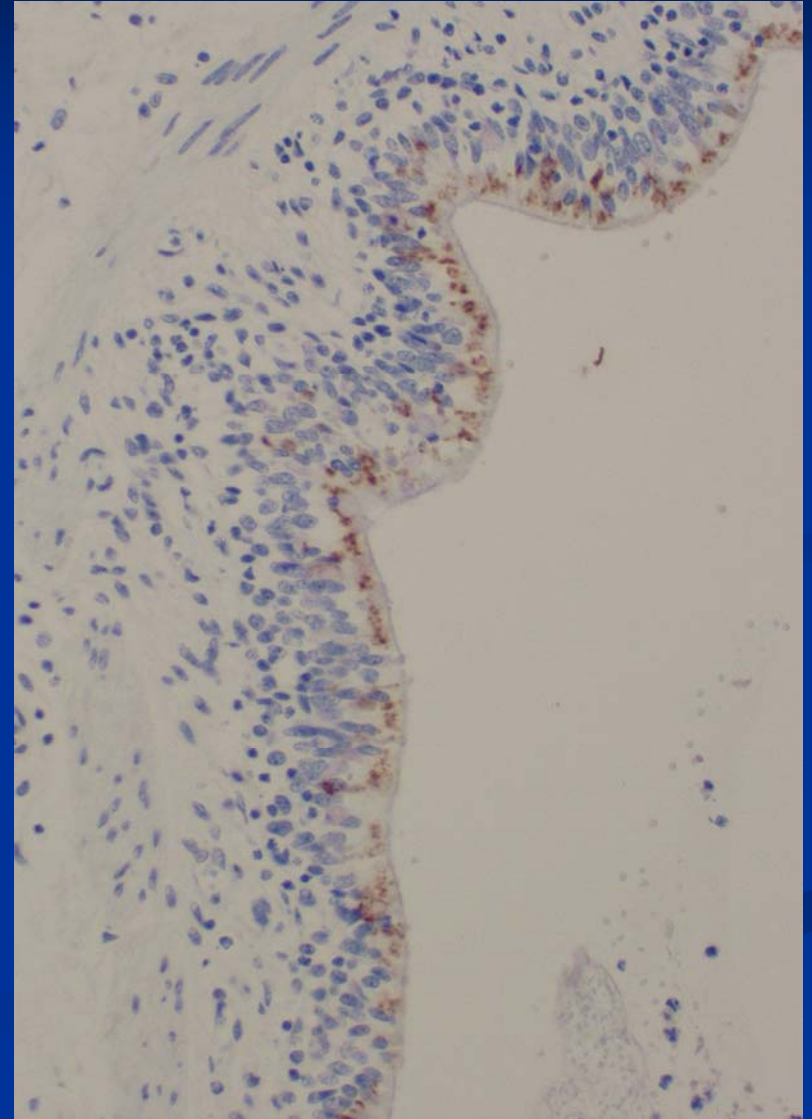
## ■ Pathology

- Mucopurulent exudate in airways
- Necrotizing broncho-interstitial pneumonia
- Multifocal atelectasis (checkerboard pattern)
- +/- Anteroventral bronchopneumonia



# Swine Influenza

- Diagnosis
  - Nasal secretions – PCR
  - Tissue – viral antigen in infected epithelial cells – IHC
- SIV IHC in porcine respiratory disease complex (right)



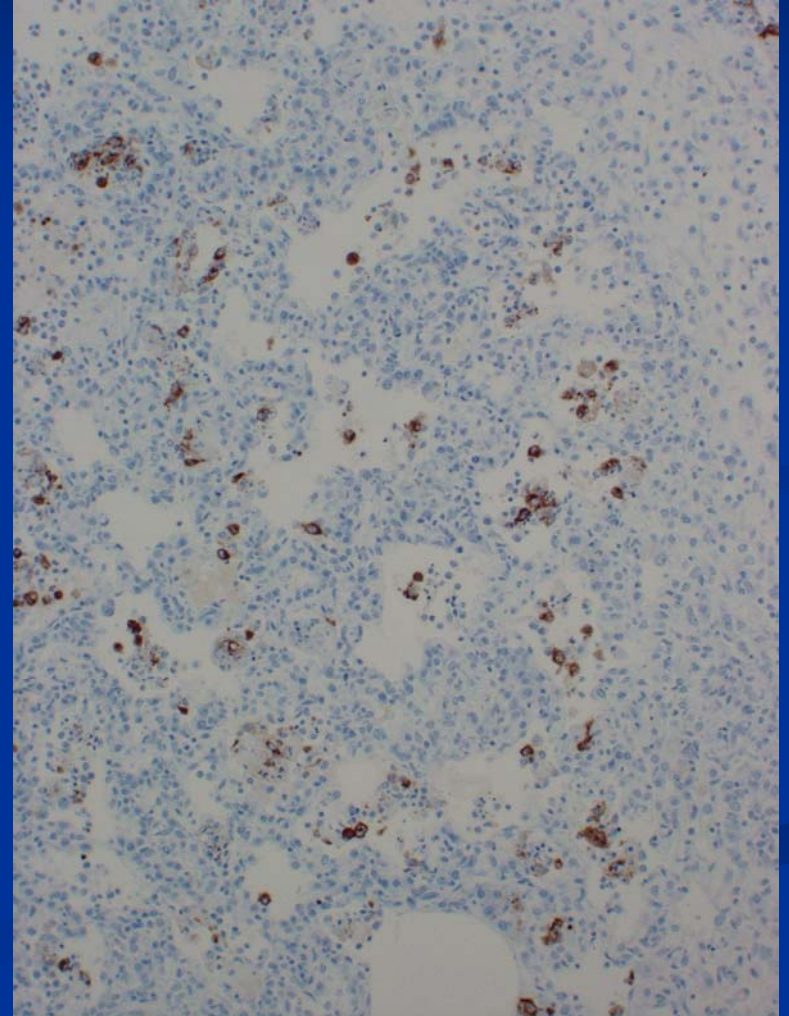
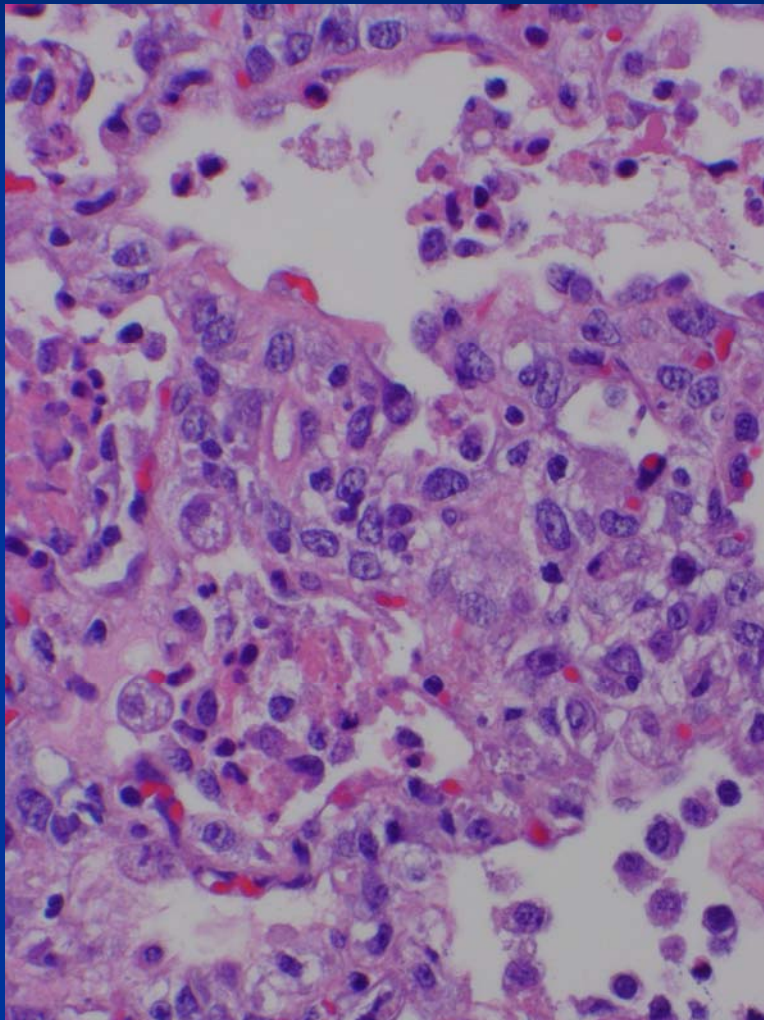
# Porcine Reproductive and Respiratory Syndrome (PRRS)

- Arterivirus
- Major problem in Americas, Europe, Asia
- Transmission – aerosol, semen
- Disease
  - Respiratory in young pigs
  - Reproductive – late term abortions and still births
- Clinical signs – anorexia, dyspnea (cyanosis if severe), cough and occasional death

# Porcine Reproductive and Respiratory Syndrome

- Pathogenesis – mucosal entry, replication in macrophages, apoptosis, followed by viremia
  - Persistent infection with shedding via semen
- Pathology: interstitial pneumonia with prominent macrophage component
  - Secondary *Pneumocystis carinii* infection possible
  - Enlarged regional lymph nodes
- Diagnosis in tissue – PCR, IHC

# PRRS IHC in Porcine Respiratory Disease Complex





# Bacterial Pneumonia in Swine

- *Mycoplasma hyopneumoniae*
- *Pasteurella multocida*
- *Actinobacillus pleuropneumoniae*
- *Bordetella bronchiseptica*
- *Salmonella* spp.
- *Streptococcus suis*
- *Hemophilus parasuis*
- *Mycobacterium* sp
- *Arcanobacterium* (*Corynebacterium*) *pyogenes*
  - secondary invader only



# Bronchopneumonia

- Common sequelae
  - Death (hypoxemia, toxemia)
  - Septicemia
  - Pleuritis, pleural adhesions
  - Chronic bronchopneumonia
  - Abscesses
  - Multifocal atelectasis

# Pleuritis following Bronchopneumonia

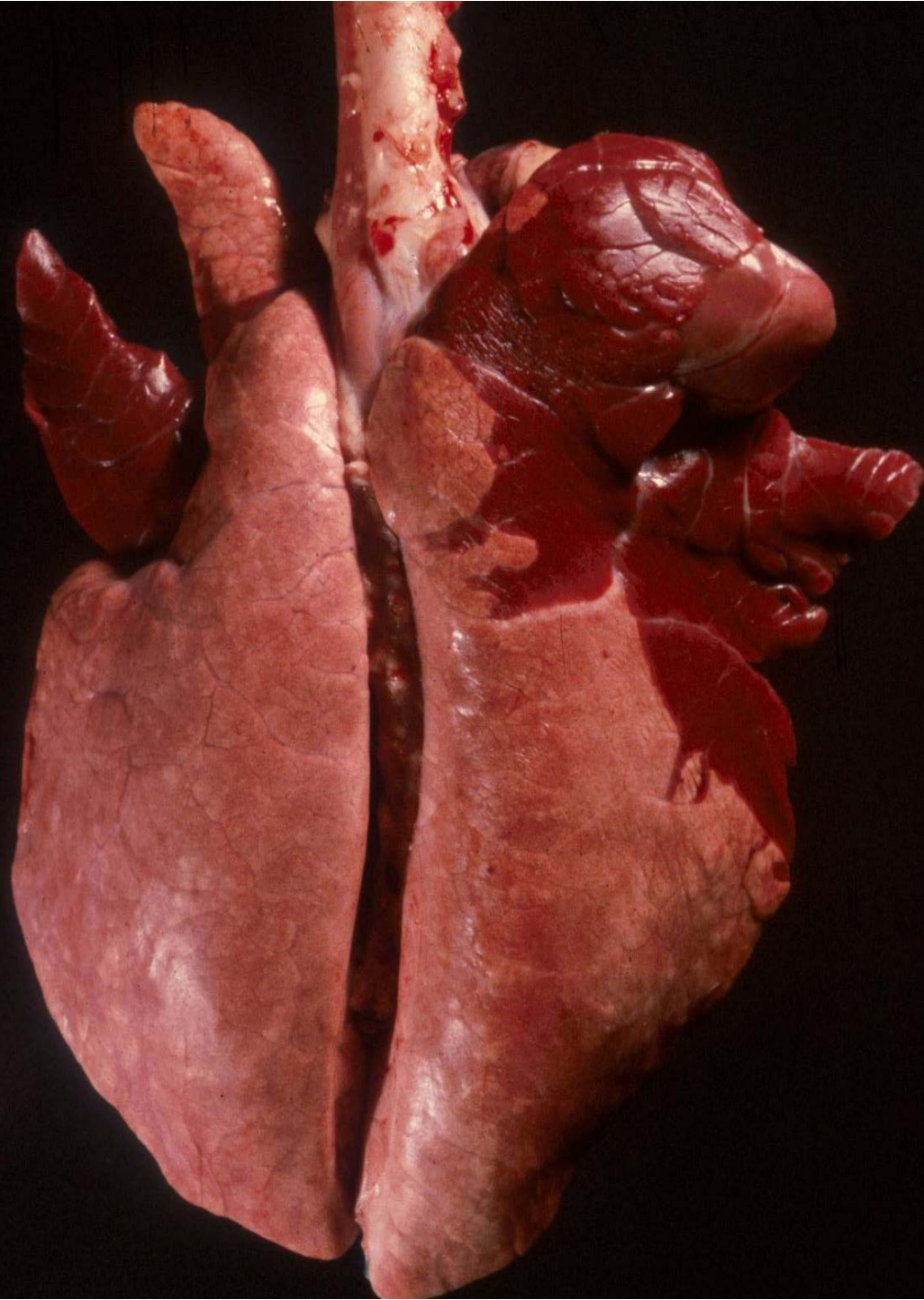


# *Mycoplasma hyopneumoniae*

- Porcine enzootic pneumonia
- Most economically significant respiratory disease in swine worldwide
- High morbidity, low mortality, poor doing
- Predisposed by environment and management
- Predisposes to secondary infection by other bacteria by effect on mucociliary clearance



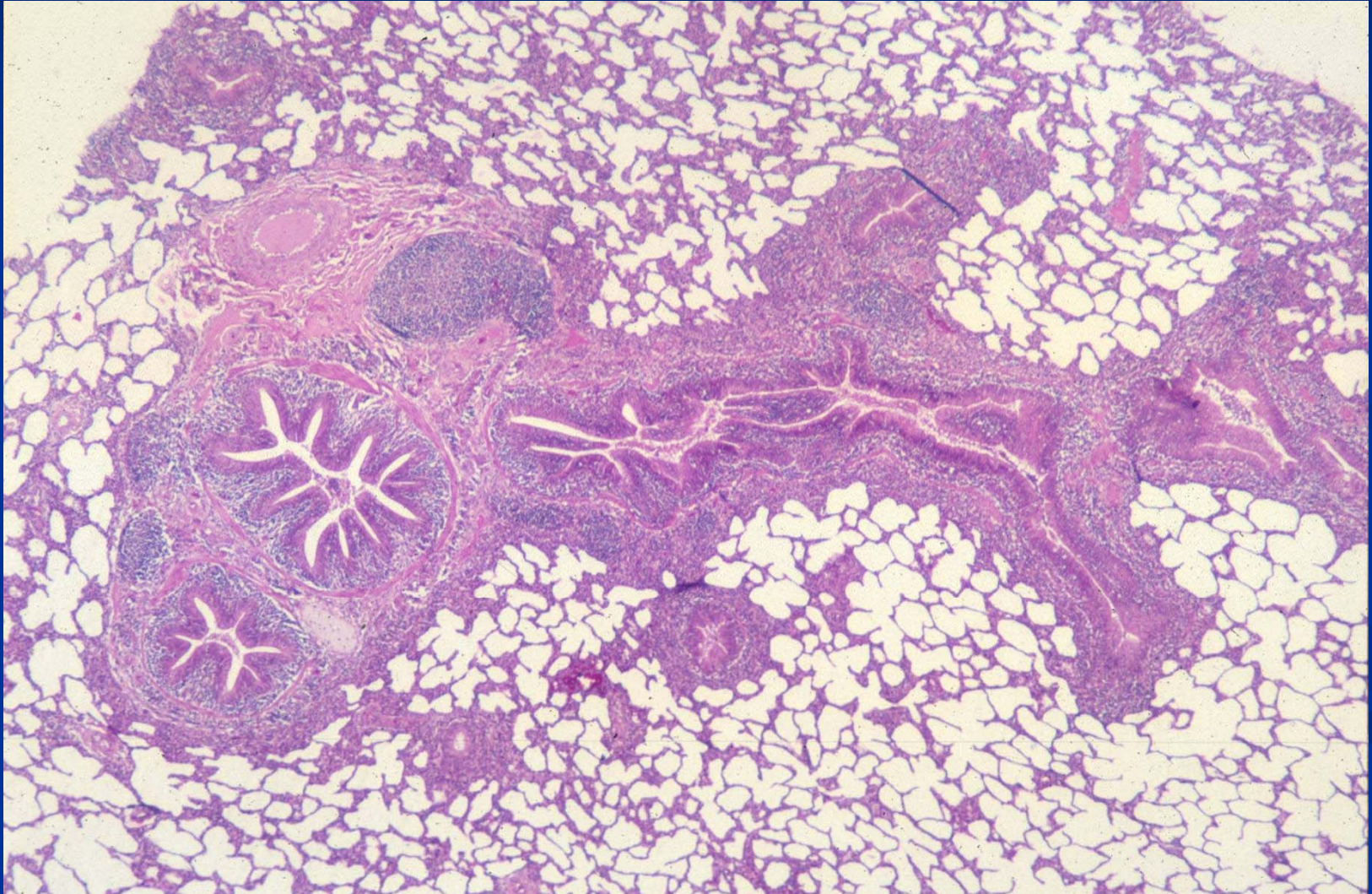
*Mycoplasma  
hyopneumoniae*





# *Mycoplasma hyopneumoniae*

Lymphoid hyperplasia and bronchitis





# *Mycoplasma hyopneumoniae*

## ■ Gross Pathology

- Anteroventral bronchopneumonia
- Often lobular pattern of consolidation and atelectasis
- Plum colored to grey (chronic)

## ■ Histopathology

- Bronchointerstitial pneumonia
- Multifocal atelectasis
- Hyperplasia of BALT

## ■ Often secondary bacterial bronchopneumonia

# *Mycoplasma hyopneumoniae*

- Diagnosis
  - Histopathology
  - PCR and IHC
  - Culture difficult

# Porcine Pneumonic Pasteurellosis

- *Pasteurella multocida* types A and D are normal porcine nasal flora
- Disease
  - Chronic bronchopneumonia secondary to other infections
  - Fulminating fibrinous bronchopneumonia

# Porcine Pleuropneumonia

- Highly contagious worldwide disease of pigs
- Etiology: *Actinobacillus (Haemophilus) pleuropneumoniae*
  - Often primary pathogen
  - 12 serotypes
- Age - 2-6 months
- Disease
  - Peracute: death
  - Acute: fever, dyspnea, blood from nose and mouth
  - Chronic: coughing
  - Occasionally septicemia, otitis media or interna



# Porcine Pleuropneumonia

- Pathogenesis similar to *M. hemolytica*
  - Transmission by respiratory route
  - Persists in tonsil
  - Virulence factors
  - Causes capillary and alveolar damage

# Porcine Pleuropneumonia

- Acute disease
  - Gross pathology
    - Fibrinous and hemorrhagic pleuropneumonia
    - Diffuse or caudodorsal distribution as opposed to anteroventral distribution to others
  - Histopathology – similar to *M. hemolytica* in cattle
    - Bronchopneumonia
    - Coagulative necrosis and hemorrhage
    - Streaming leukocytes
    - Fibrinous pleuritis

# Porcine Pleuropneumonia

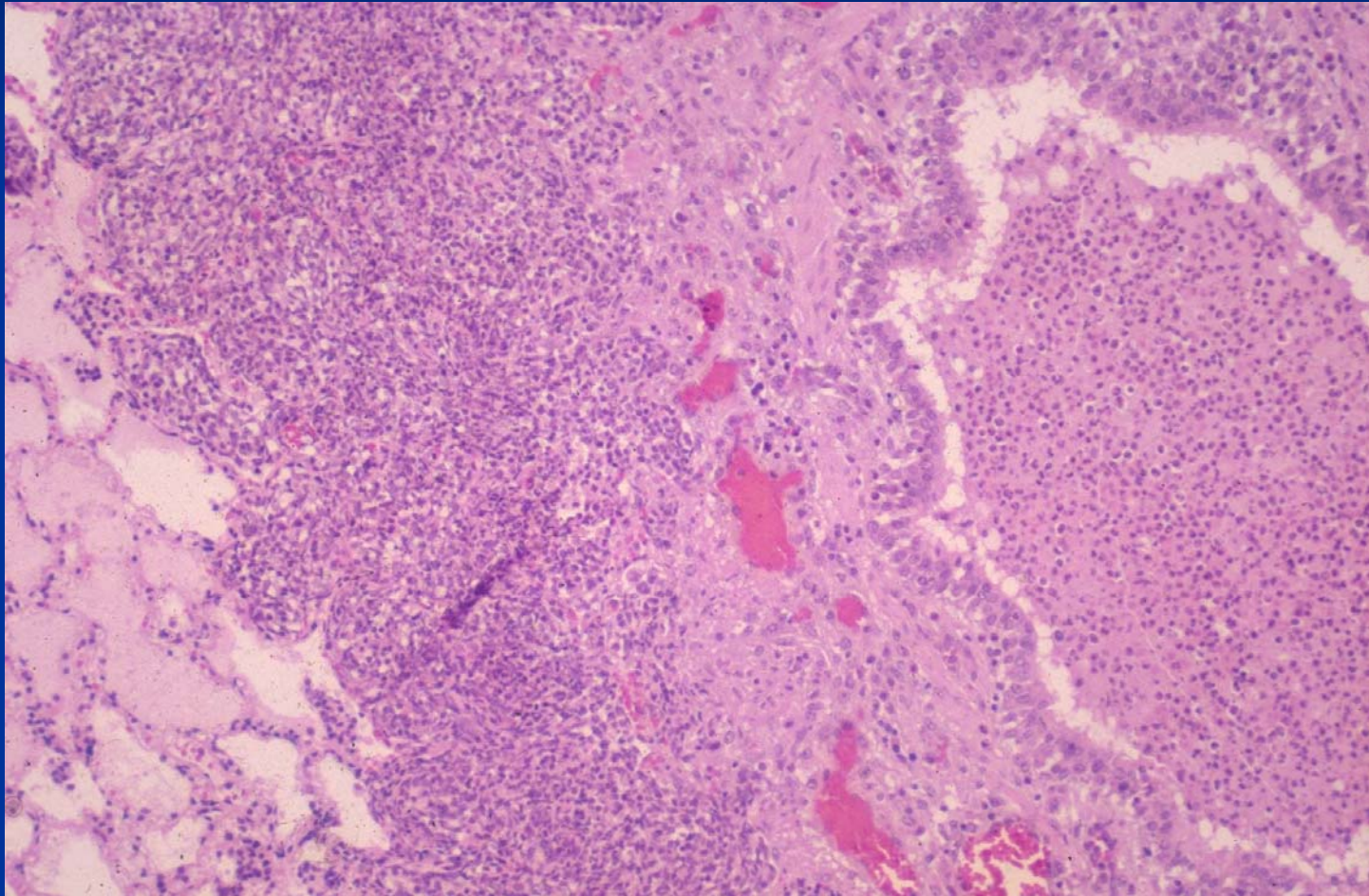
Diffuse hemorrhagic  
pneumonia with pleuritis





# Porcine Pleuropneumonia

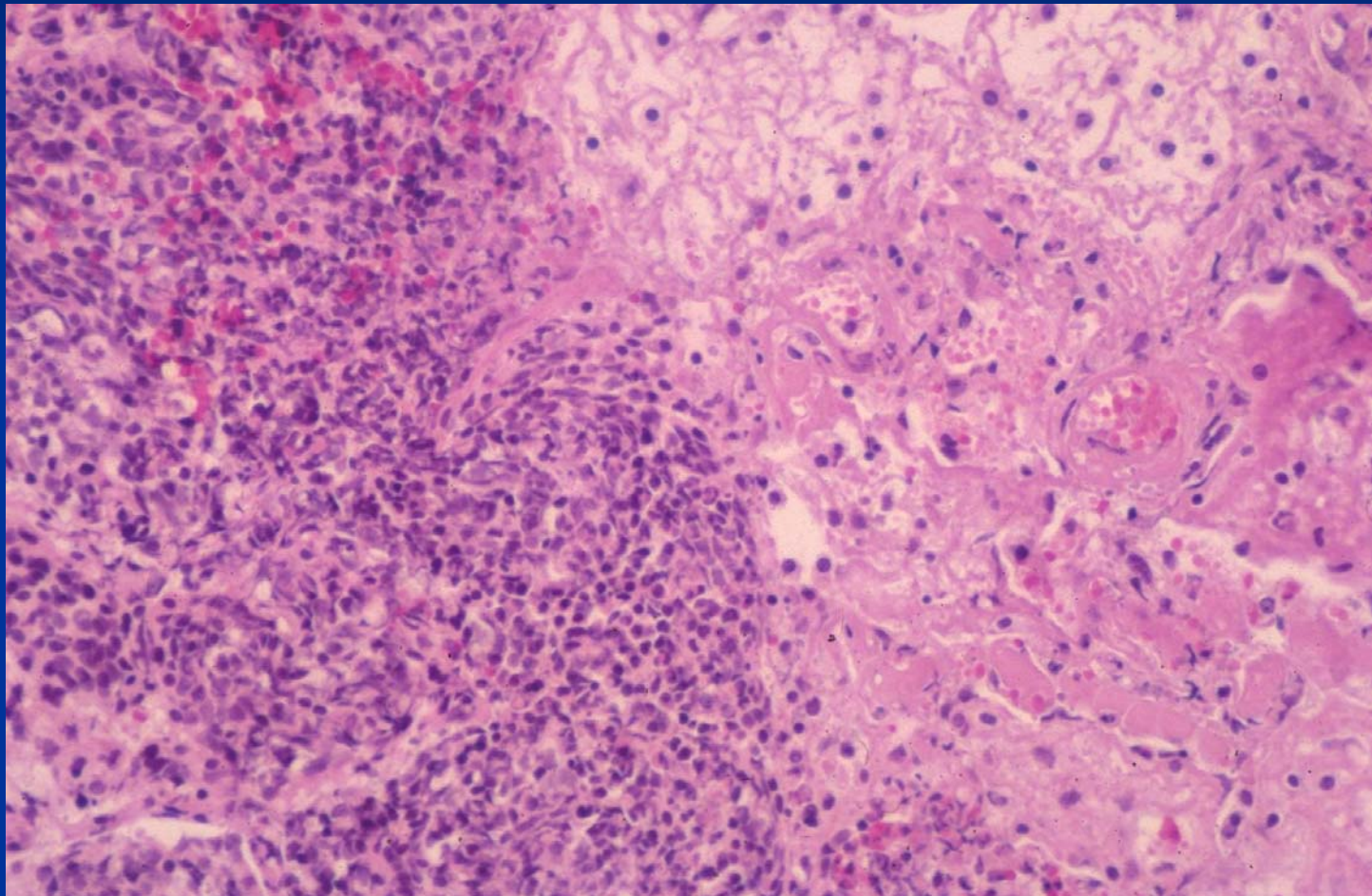
## Bronchopneumonia





# Porcine Pleuropneumonia

Necrotizing lesion with fibrin



# Porcine Pleuropneumonia

- Pathology of chronic disease
  - Multiple pulmonary abscesses
  - Sequestra

# Other Bacterial Pneumonias

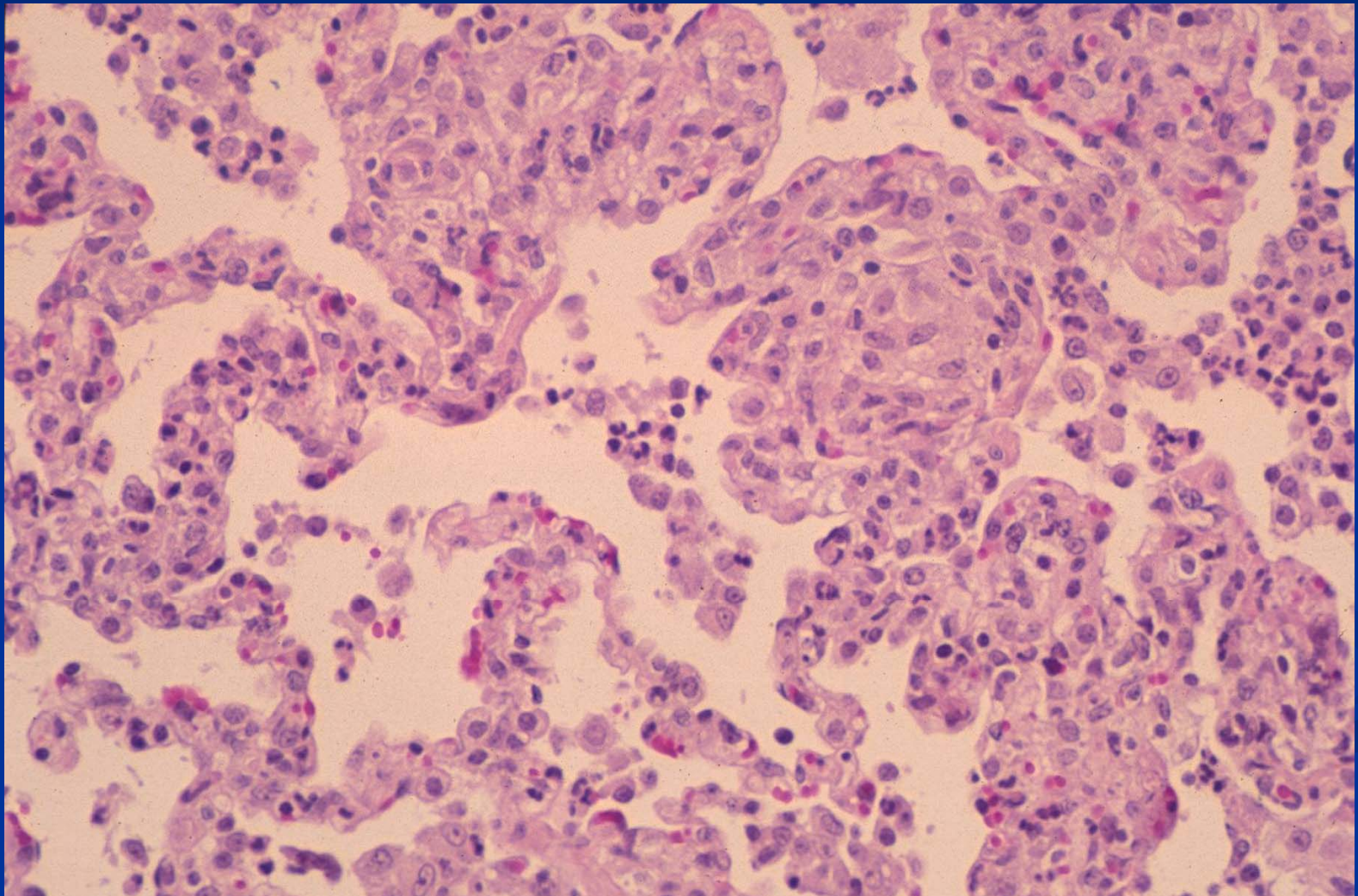
- *Haemophilus parasuis*
  - Important in Australia in medicated early weaning programs, ecoshelters
  - Carried in nasopharynx
  - Various serotypes
  - Glasser's disease
    - Polyserositis
    - Interstitial pneumonia
  - Suppurative bronchopneumonia

# Other Bacterial Pneumonias

- *Salmonella*, *E.coli*, *Listeria* spp – in very young
  - Septicemia with interstitial pneumonia
  - Occasionally bronchopneumonia with *Salmonella* spp



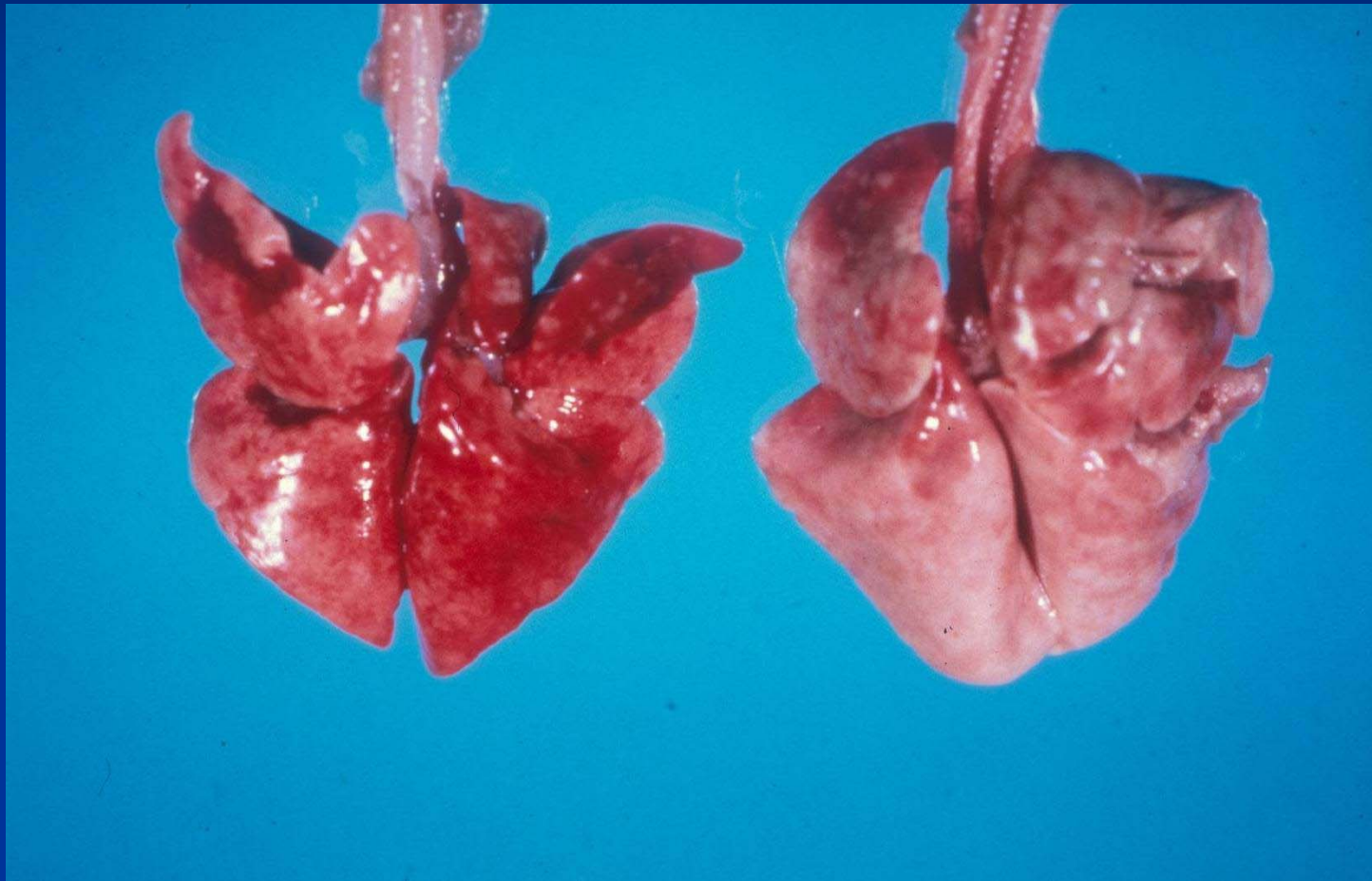
# Interstitial Pneumonia due to *Salmonella*



# Streptococcal Pneumonia

- *Streptococcus suis* type II – various serotypes
- Worldwide distribution
- Zoonotic
- Diseases
  - Suppurative bronchopneumonia especially with other pathogens
  - Neonatal septicemia with embolic pneumonia
  - Abortion

# *Pasteurella/Bordetella—Pig*

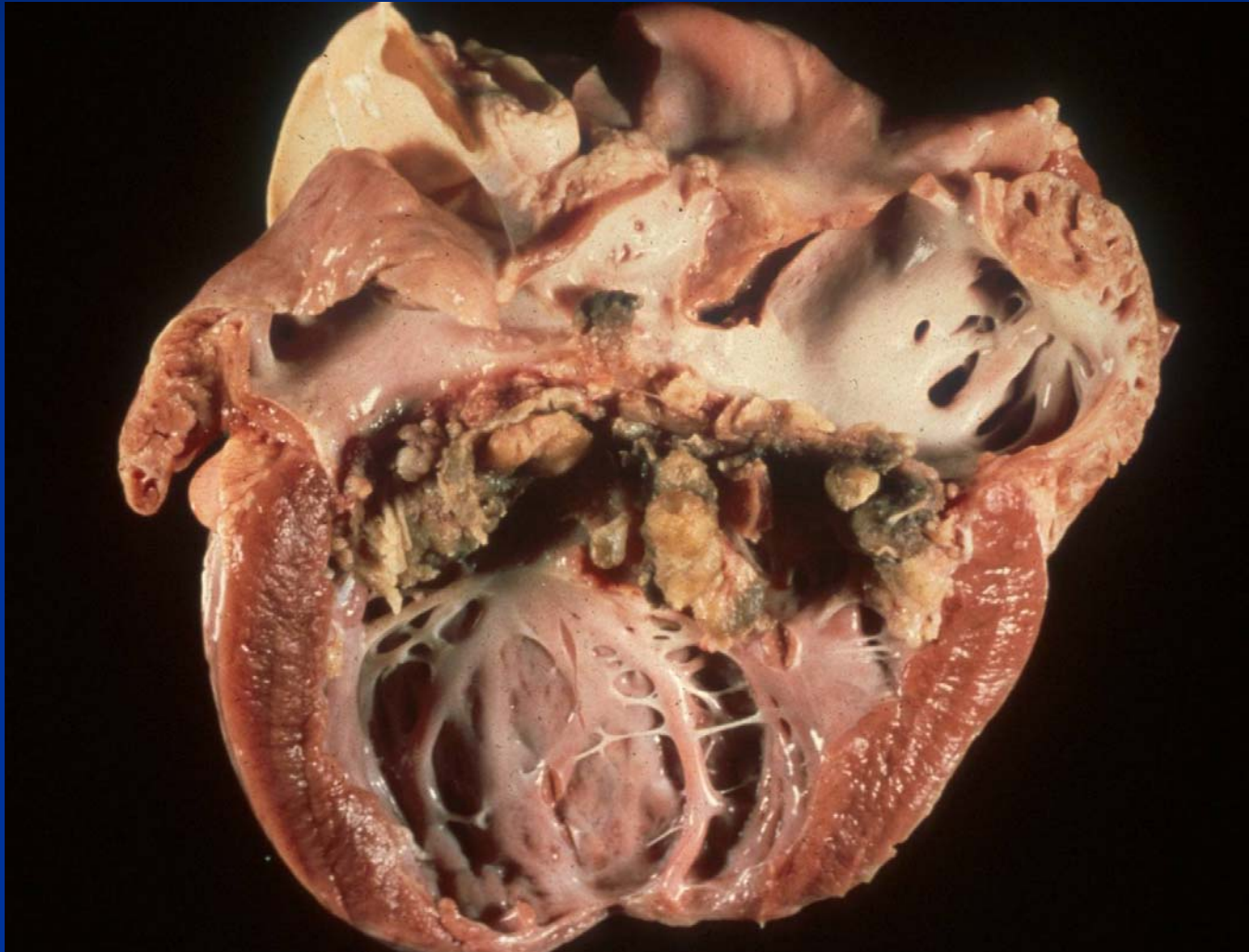


# Mycobacterial Infection

- Still occurring in USA
- *M. avium-intracellulare* complex
- Exposure by ingestion, hematogenous spread
- Lung rarely involved
  - Pulmonary granulomas



# Embololic Pneumonia - Vegetative Endocarditis—Porcine

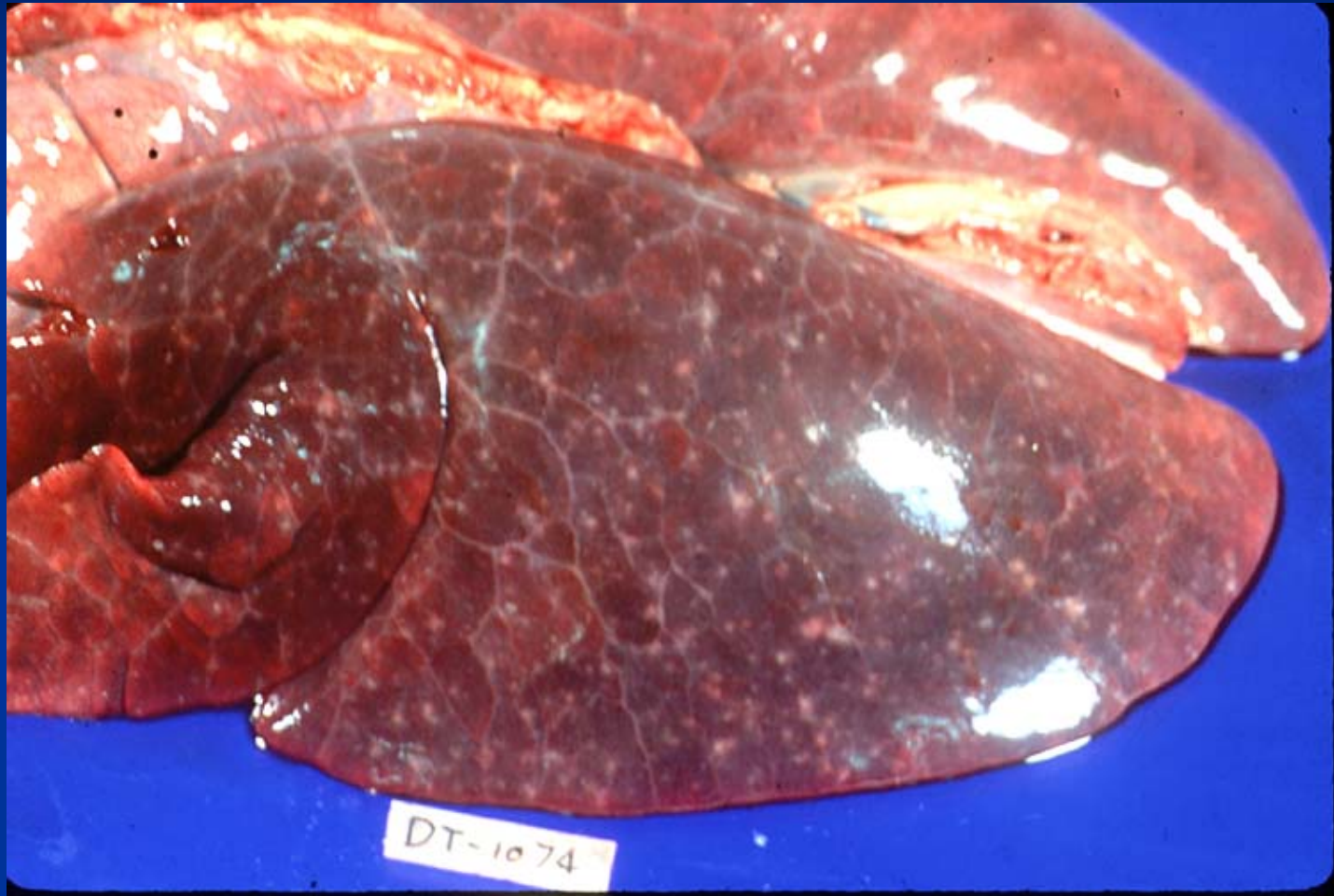


# Mycotic and Protozoal Diseases

- Generally in immunosuppressed pigs
- *Pneumocystis carinii*
  - Generally secondary to viral diseases
  - Foamy material in alveoli
  - GMS stain needed
- Toxoplasmosis – *T. gondii*
  - Cat is definitive host
  - Zoonosis

# Toxoplasmosis

Multifocal pulmonary granulomas



# Parasitic Diseases

## ■ *Ascaris suum*

- Larvae migrate thru lung
- Acutely may see petechial hemorrhages
- Cause inflammation and granulomas

## ■ Lungworms (bronchi, bronchioles)

- Worldwide distribution
- *Metastrongylus apri* (*elongatus*), *M. salmi*, *M. pudendotectus*
- Intermediate hosts are earthworms
- May transmit swine influenza virus
- Cough and growth retardation
- Pathology
  - Nodules, especially dorsocaudally



# Toxic Diseases

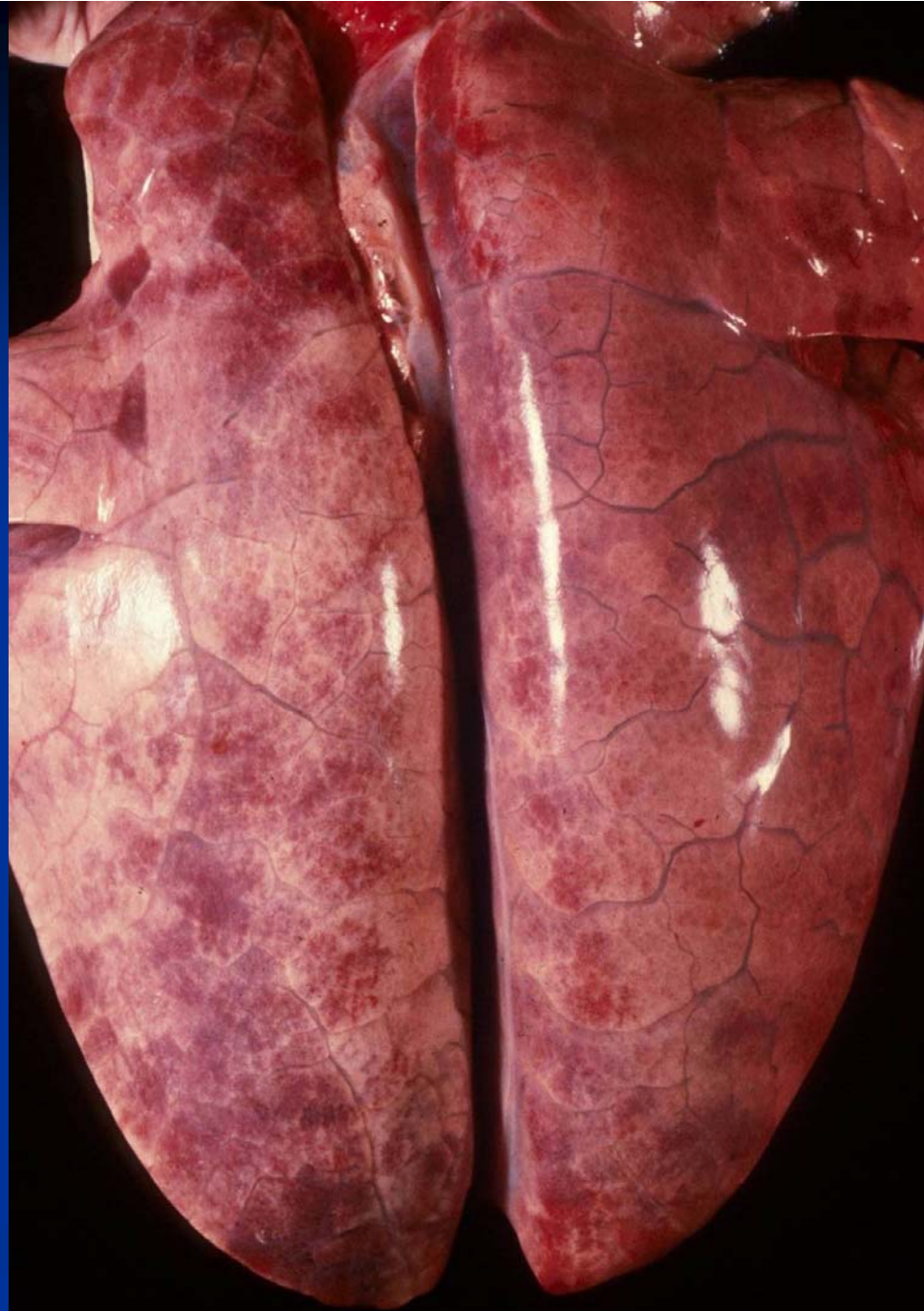
- Fumonsins
  - PPE – porcine pulmonary edema
- Pyrrolizidine alkaloids
  - Interstitial pneumonia
- Vitamin D toxicosis
  - Mineralization with multinucleated giant cells
- Warfarin toxicity (rat bait)
  - Multifocal hemorrhages

# Toxic Diseases

## ■ Fumonsins

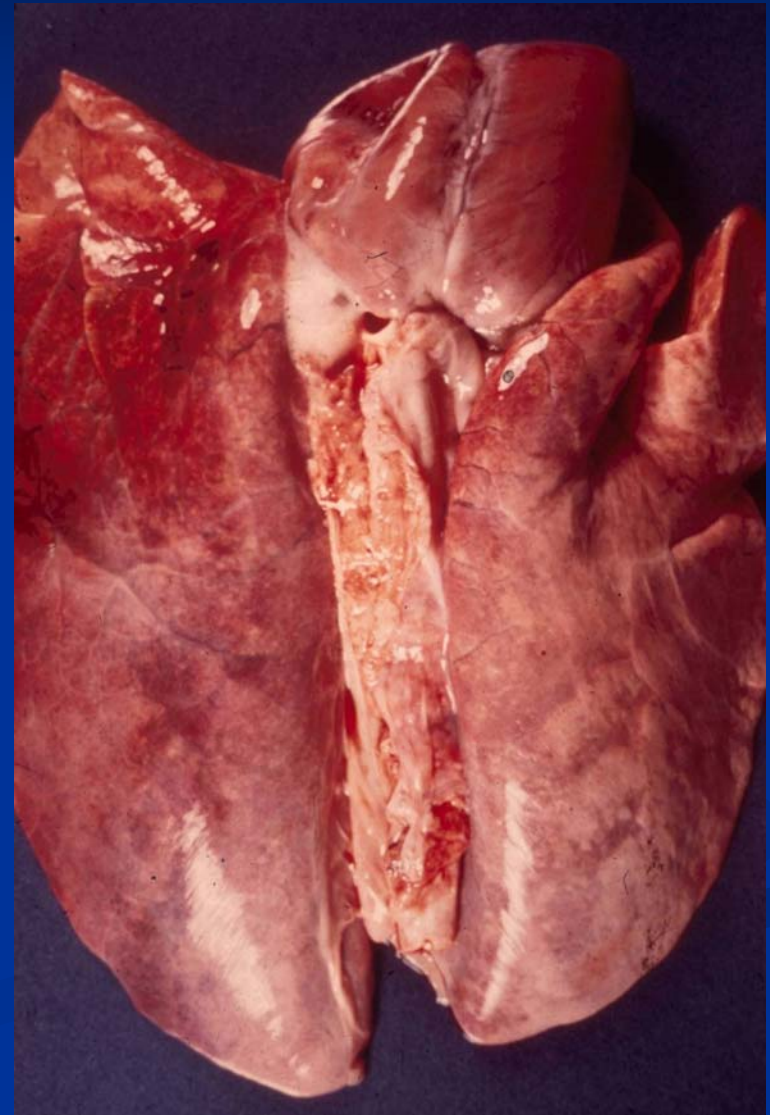
- Mycotoxins produced by *Fusarium verticillioides* (*moniliforme*) and other fungi
- Present in corn worldwide
- Hepatic injury in all species
- Leukoencephalomalacia (ELEM) in horses, most sensitive species (< 5 ppm)
- Pulmonary edema (cardiogenic) in pigs (<50 ppm)
- Epidemiologically – neural tube defects and esophageal cancer in humans

**Porcine  
Pulmonary  
Edema (PPE) –  
Fumonisin  
Toxicosis**



# Pyrrolizidine Alkaloid Toxicoses

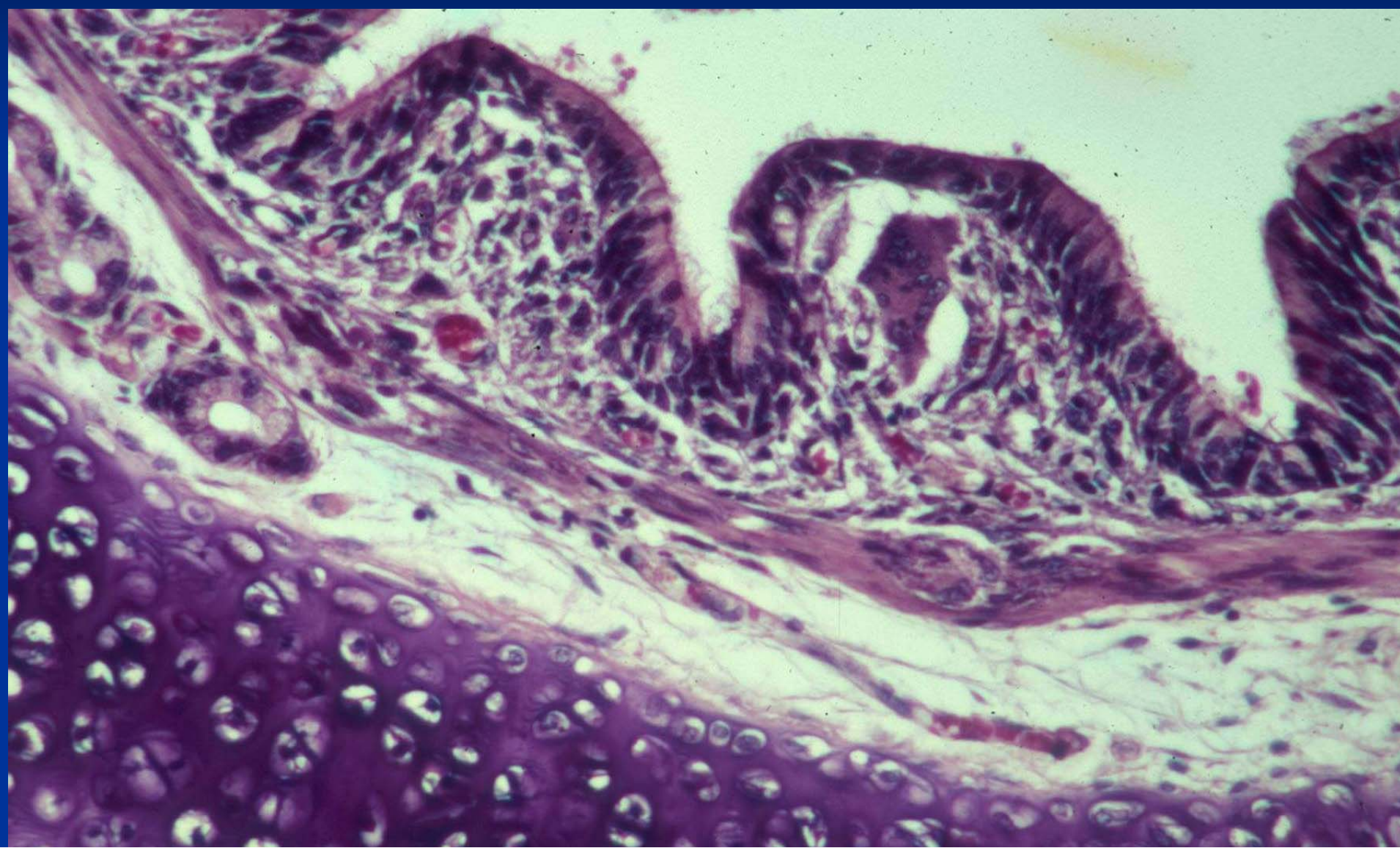
- Pyrrolizidine alkaloids (*Crotalaria spectabilis*, *C. retusa*, - both contain monocrotaline)
  - Reported in S. Africa, Northern Territory (contaminant in grain sorghum diet)
  - Interstitial pneumonia with/without megalocytosis
  - Also liver and kidney lesions with megalocytosis





# Hypervitaminosis D

## Mineralization and syncytial cell



# Warfarin Toxicity - Hematomas

