Respiratory Pathology of the Horse

Minor resource

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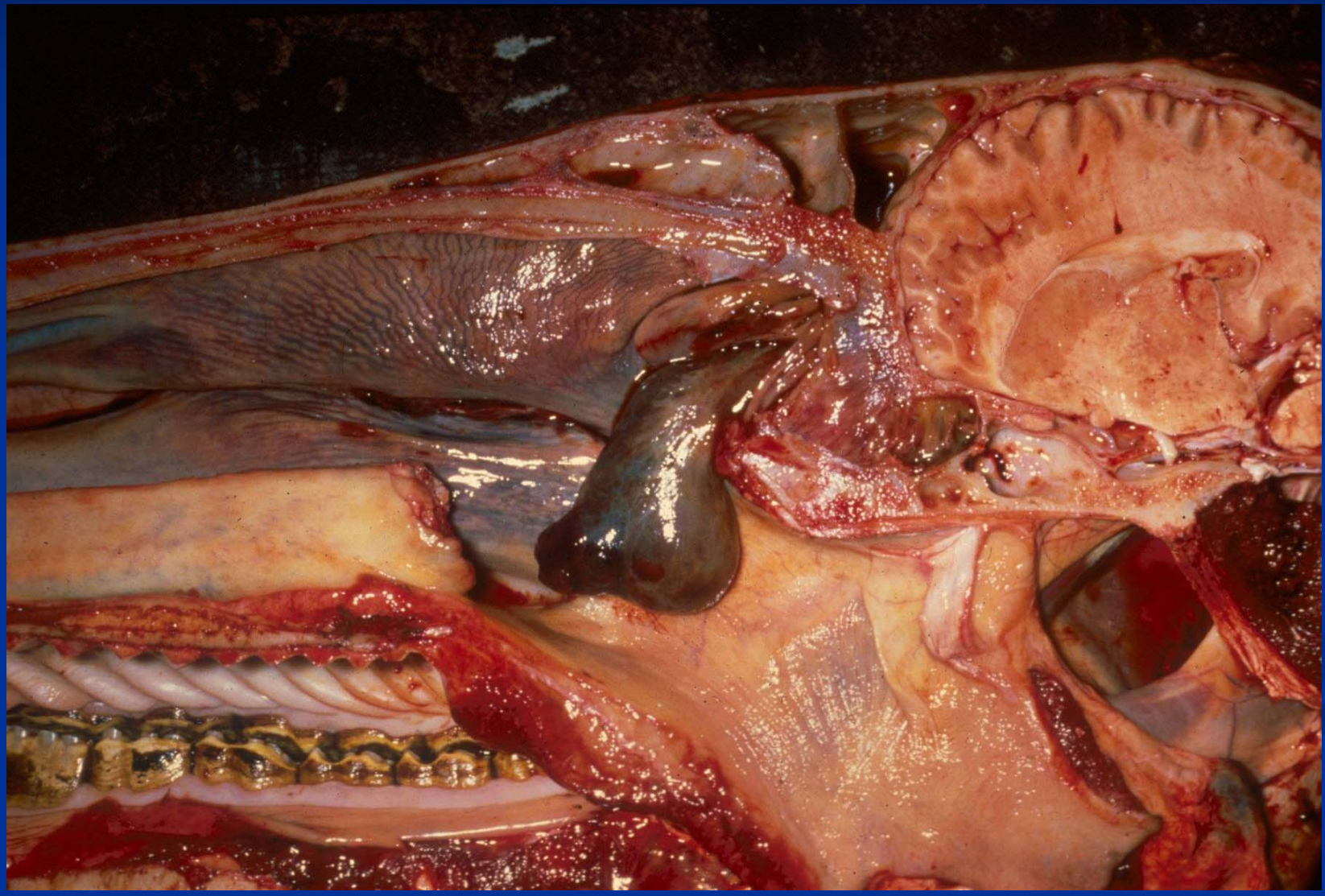
Pathology of Respiratory System

- Upper Respiratory Tract
  - Non infectious Disease
    - Developmental Abnormalities
    - Miscellaneous
    - Neoplasia
  - Infectious Disease
- Lower Respiratory Tract (Lung)
- Pleura and thoracic cavity

Noninfectious Disease of Upper Respiratory Tract – Nasal Cavity

- Ethmoid hematoma
  - Older horses
  - Cause of epistaxis
  - Polyp like mass
- Nasal amyloidosis (amyloid AL)
  - Multiple nodules
- Nasal and paranasal sinus cysts
- Neoplasia

Ethmoid Hematoma

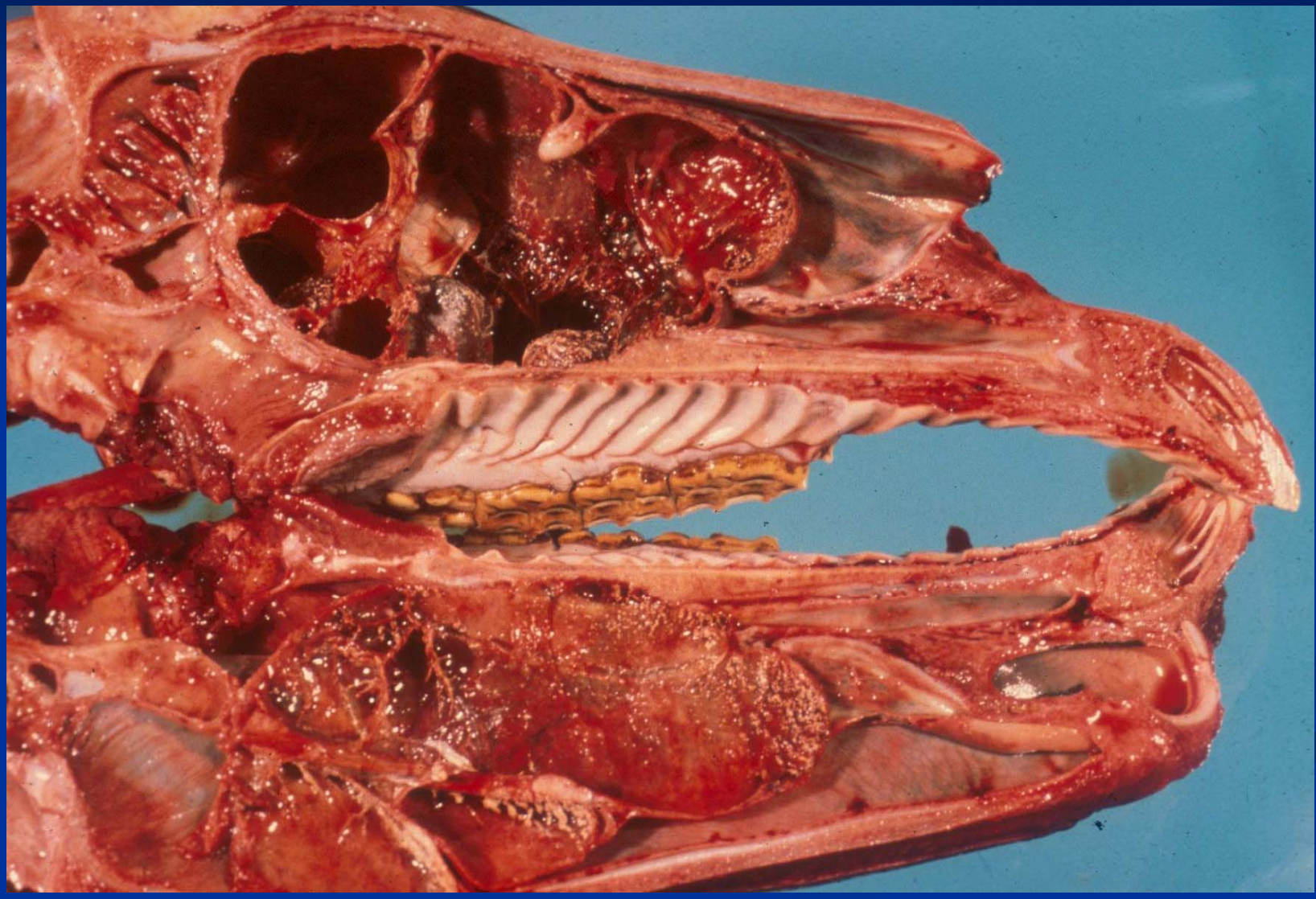


Upper Respiratory Tract - Developmental Abnormalities

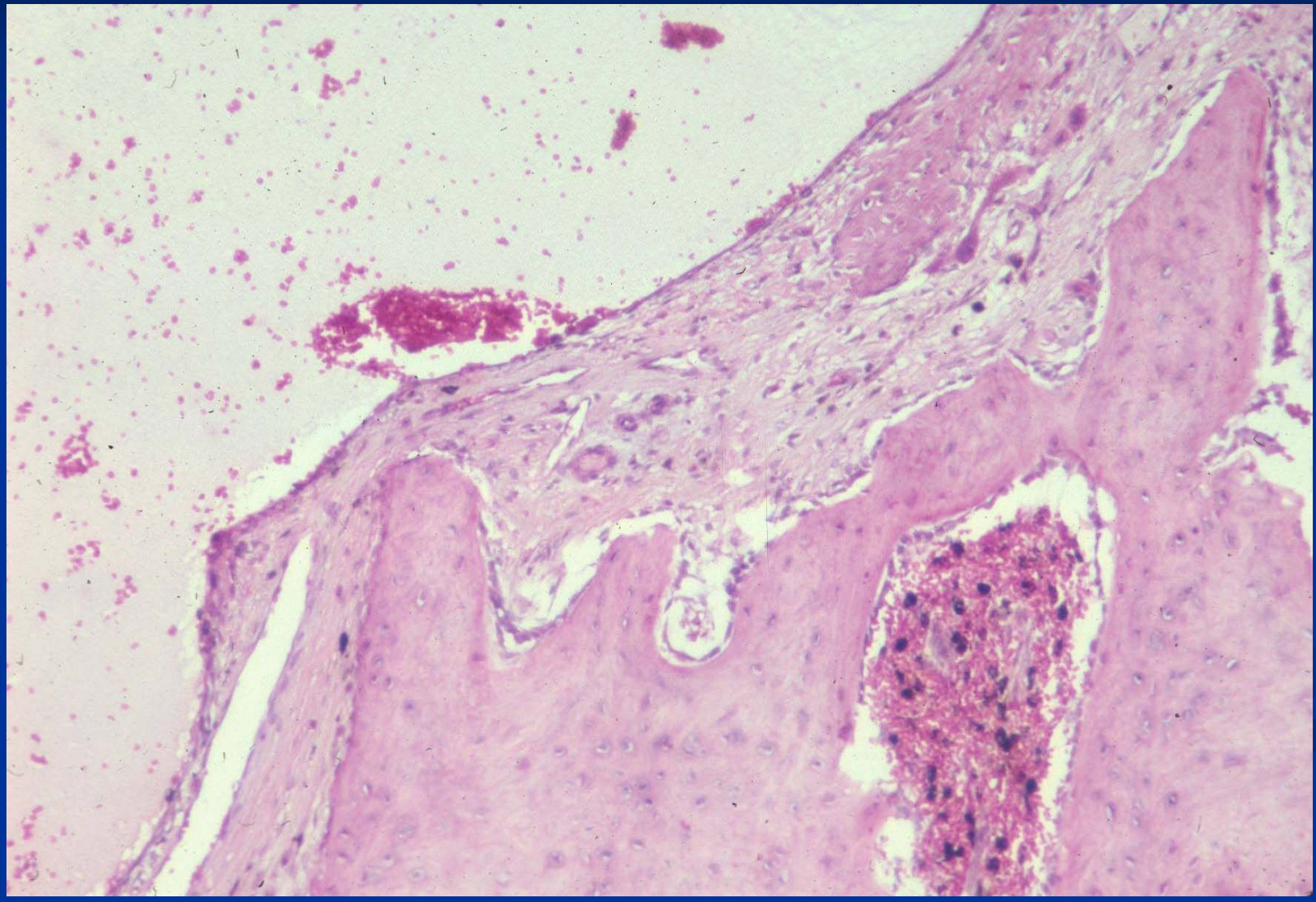
- Nasal and paranasal sinus cysts
  - Originate from dentigerous tissue
  - Slowly growing and expansive
  - Result in cranial malformation
  - Secondary infection possible
  - DD neoplasia, tooth root abscess
  - Surgical treatment possible

Nasal and Paranasal Sinus Cysts

Nasal and Paranasal Sinus Cysts



Nasal and Paranasal Sinus Cysts



Causes of Epistaxis

- Exercise induced pulmonary hemorrhage (EIPH)
- Gutteral pouch mycoses
- Trauma
- Ethmoid hematoma
- Invasive intranasal lesion
  - Neoplasia

Neoplasia of the Nasal Cavity: Clinical Signs

- Unilateral or bilateral mucoid or bloody discharge
- Intermittent sneezing
- Obstruction of nasolacrimal duct
- Facial swelling

Neoplasia of the Nasal Cavity: Clinical Signs

Neoplasia of the Nasal Cavity Pathology

- Origin
  - Nasal passages
  - Maxillary sinus
- Tumor types
  - Carcinoma
  - Sarcoma
- Sequella
  - Bony erosion
  - Extension e.g. through cribriform plate

Neoplasia of the Nasal Cavity

Other Noninfectious Disease of Upper Respiratory Tract

- Laryngeal paralysis
  - Idiopathic laryngeal hemiplegia ("roarer")
- Epiglottic entrapment
- Pharyngeal lymphoid hyperplasia
- Laryngeal edema - traumatic
- Smoke inhalation – thermal injury

Idiopathic Laryngeal Hemiplegia (Roarer)

- Left recurrent laryngeal degeneration (axonopathy) with paralysis
- Left arytenoid cartilage immobile
- Left dorsal and lateral cricoarytenoideus muscle atrophy
- Cause unknown
- Results in incomplete dilation of larynx
- DD: secondary nerve damage (Wallerian degeneration) e.g. strangles, lymphosarcoma

Idiopathic Laryngeal Hemiplegia (Roarer) – note unilateral muscle atrophy

Epiglottic entrapment

- Reduced performance and obstructive respiratory disease
- Epiglottal lesions
  - Hypoplasia (congenital)
  - Deformaties
  - Cysts, etc

Epiglottic Entrapment

Equine Pharyngeal Lymphoid Hyperplasia

- 2-3 yr old race horses
- Partial upper respiratory obstruction
- White foci or occasionally nodules in pharynx
- Cause unknown, presumably excessive antigenic stimulation

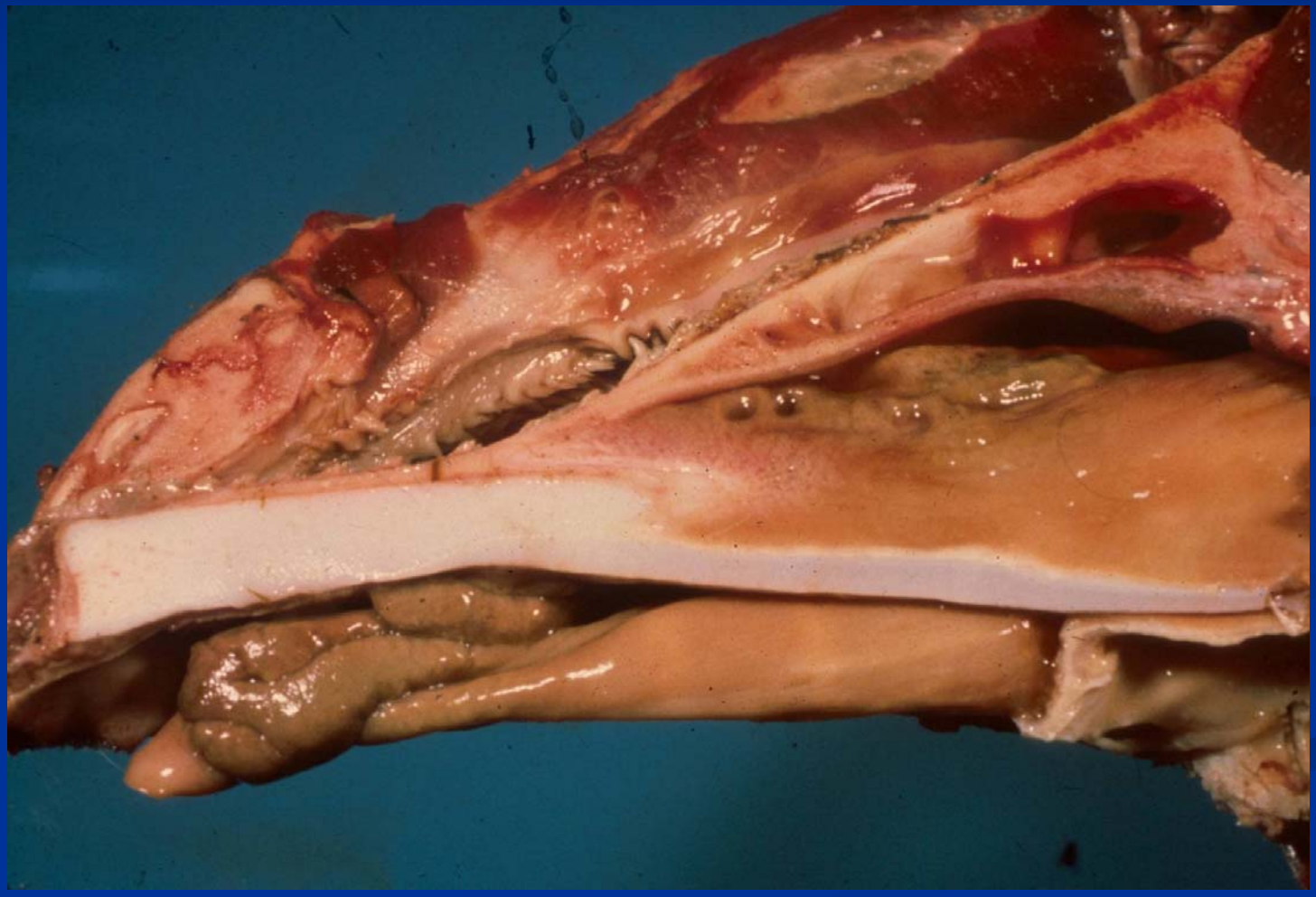
Upper Respiratory Tract - Infectious Disease

- Viral
  - Equine viral rhinopneumonitis
  - Equine Influenza
  - Parainfluenza
  - Adenovirus
  - Rhinovirus

Upper Respiratory Tract - Infectious Disease

- Bacterial
  - Systemic diseases with prominent nasal discharge
    - Strangles
    - Glanders
    - Melioidosis
  - Sinusitis secondary to sinus cysts, tooth root abscesses
- Mycotic
  - Aspergillosis (gutteral pouch mycosis)
- Aquatic protistan parasite, class Mesosmycetozoa
  - *Rhinosporidium seebori* (nasal polyps) – large sporangia containing endospores on histo

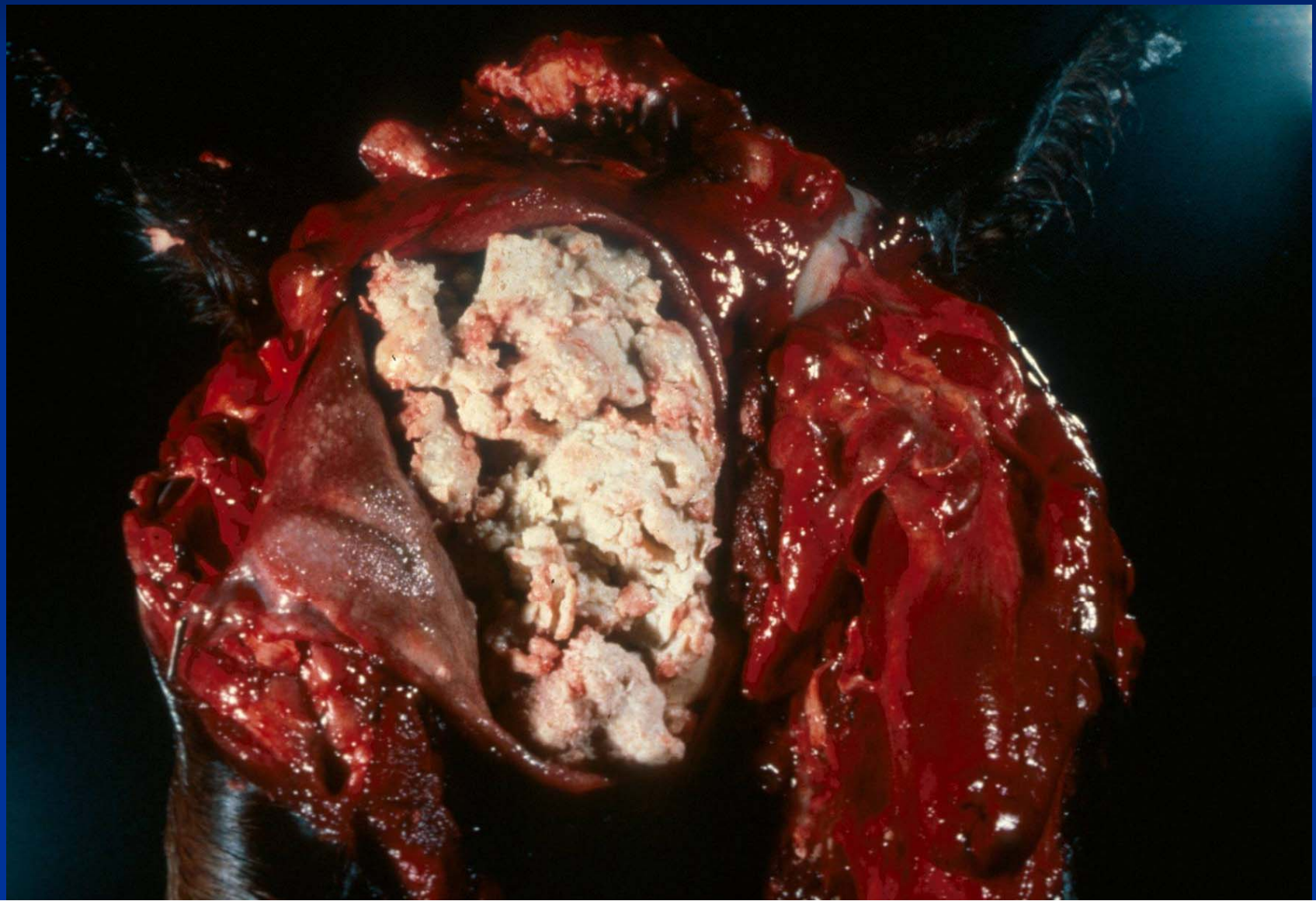
Rhinosporidium seebori (nasal polyps)



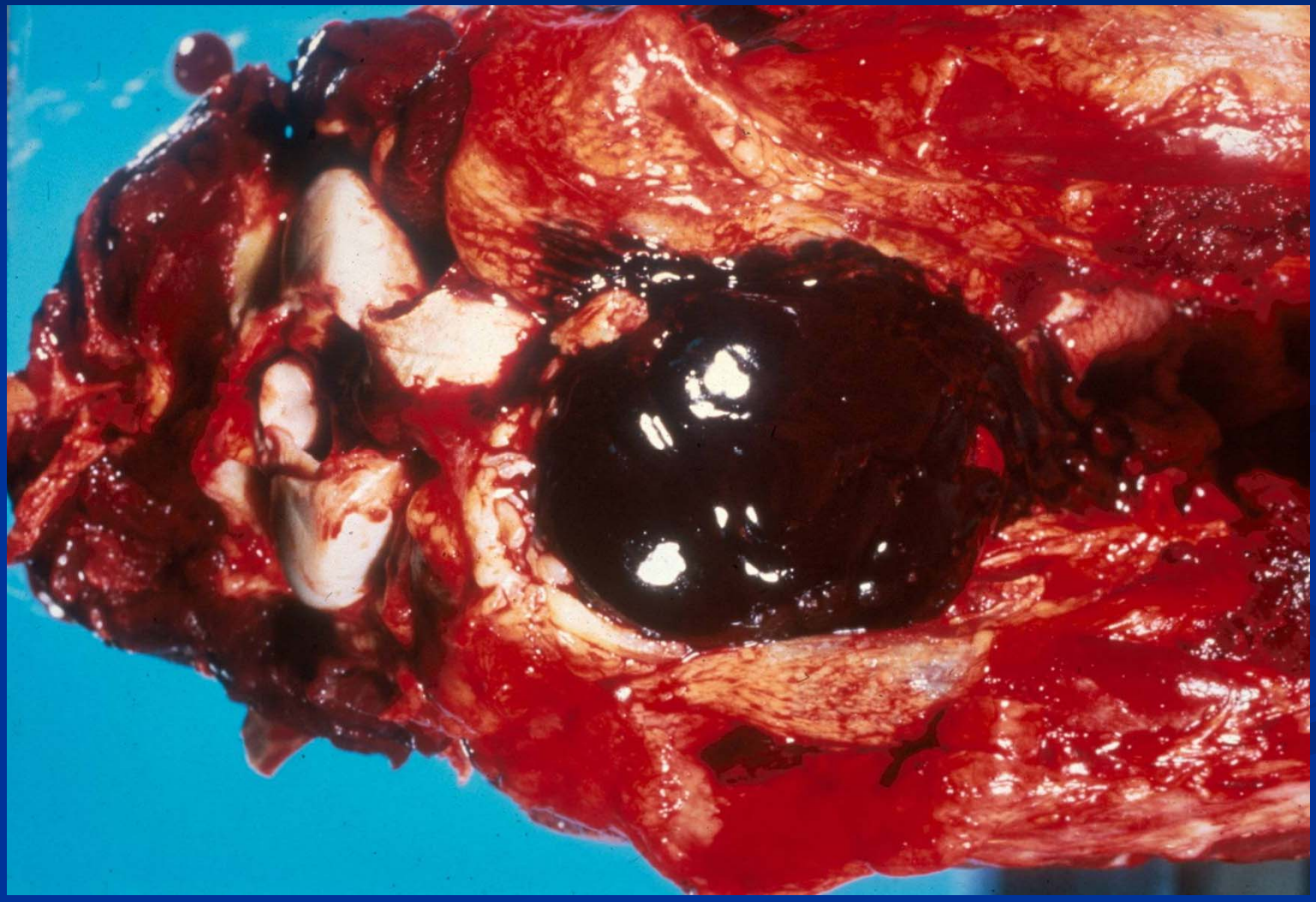
Diseases of the Guttural Pouch

- Bacterial
  - Ventral
  - Catarrhal/suppurative (empyema)
  - S*treptococcus equi* (strangles)
- Mycotic
  - Dorsal
  - Granulomatous
  - A*spergillus spp.*
- Tympany

Guttural Pouch - Empyema



Guttural Pouch – Hemorrhage Secondary to Mycotic Infection

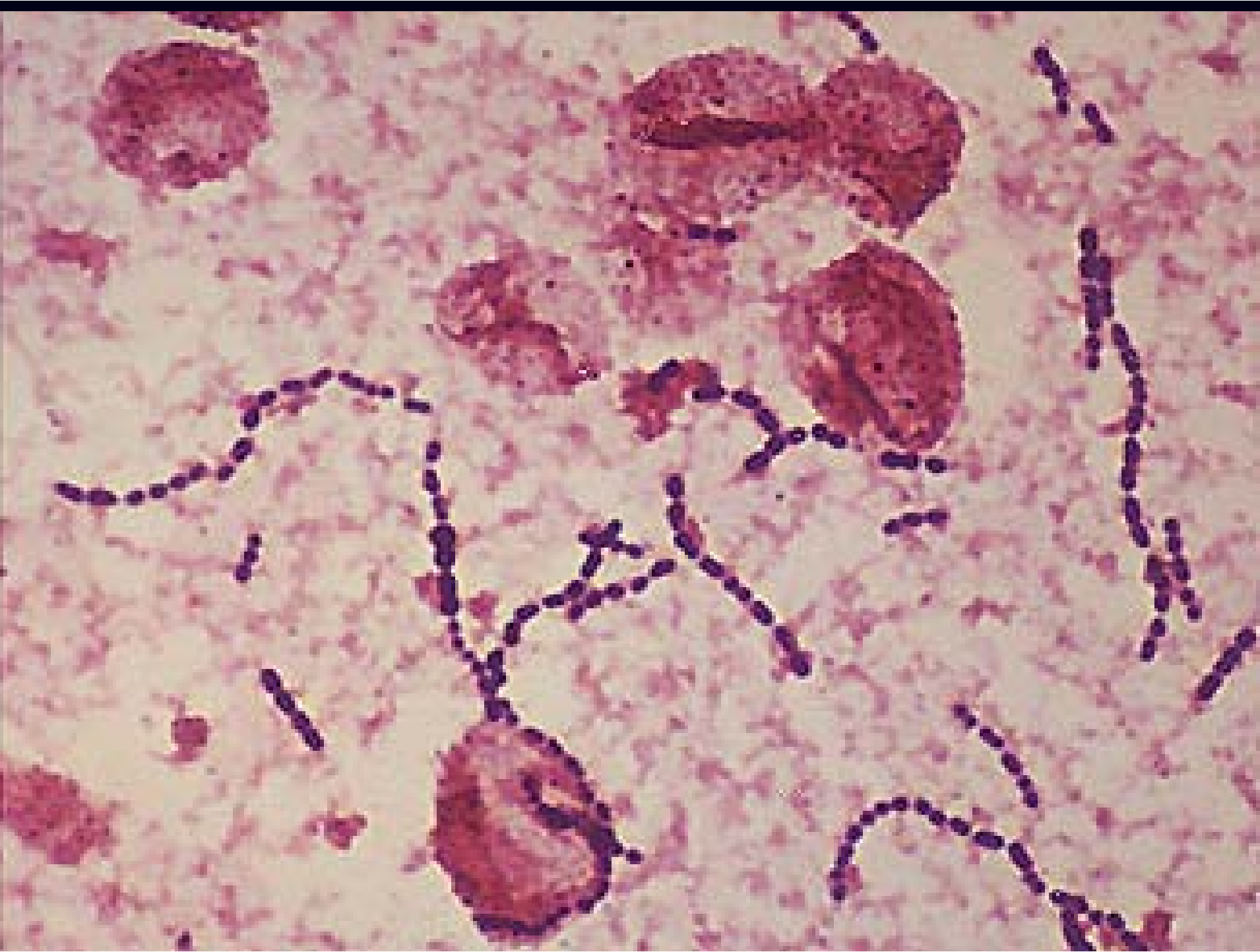


Strangles

- Etiology: *Streptococcus equi* ssp *equi*
  - Not part of normal nasal flora
- Source - infected feed, exudate or air droplets
- Worldwide occurrence
- Young horses under stress
- Acute contagious systemic disease
  - Fever
  - Purulent rhinitis
  - Cough
  - Enlarged lymph nodes

Streptococcus equi subsp *equi*

- *Strep. equi* is an obligate pathogen of Equidae
  - Gram positive cocci, β-hemolytic, catalase negative, Lancefield group C
- Virulence factors include
  - Hayluronic Acid Capsule
    - Hides antigenic determinants from immune recognition
    - Prevents phagacytosis



Strangles

- Upper respiratory disease
- Lymph nodes are infected and swollen
- Abscesses impinge on airway – obstruction
- Abscess rupture
- " Bastard" strangles complications

- Gutteral pouch empyema- uncommon
- Treatment includes drainage

Strangles

Pathology

- Purulent rhinitis
- Lymphadenitis/abscesses
  - Regional
  - Systemic

Strangles

Potential Sequella

- Guttural pouch empyema
- Internal dissemination - “bastard” strangles
- Bronchopneumonia
- Facial paralysis and Horner’s syndrome (sympathetic nerve)
- Laryngeal hemiplegia (recurrent laryngeal nerve)
- Purpura hemorrhagica (AbAg deposition)

Glanders

- Etiology: *Burkholderia mallei (Pseudomonas mallei)*
- Source - infected feed and water, rarely air droplets
- Eradicated except for North Africa, Asia, Eastern Europe, Brazil
- Zoonosis (potential bioterrorism agent)
- Contagious systemic disease
- Transmission to carnivores via ingestion of affected horses

Glanders

- Pathology
  - Nasal - pyogranulomatous rhinitis that ulcerates
  - Lung - may see miliary granulomas due to hematogenous spread
  - Skin (legs and ventral abomen)- may have suppurative lymphangitis (“equine farcy”)

Melioidosis (Pseudoglanders)

- Etiology: *Burkholderia pseudomallei (Pseudomonas pseudomallei)*
- Source - infected feed and water
- Associated with clay soils
- Southeast Asia, Europe, Northern Australia mainly
- Zoonosis (potential bioterrorism agent) – Aboriginal communities
- Also in donkeys, goats, sheep and macropods
- Contagious systemic disease with wide host range including rodents

Melioidosis (Pseudoglanders)

- Disease – similar to glanders
- Pathology
  - Systemic
    - Suppuration and abscesses
    - Creamy to caseous, yellow to green
  - Lungs
    - Embolic bacterial pneumonia with abscesses
    - Ulceration of abscesses lead to pleuritis

Lower Respiratory Tract

- Lungs
  - **Non Infectious Diseases**
  - **Infectious Diseases**
  - **Neoplasia**
- Pleura and thoracic cavity

Lung - Non Infectious Diseases

- Abnormalities of Inflation
  - Congenital atelectasis
  - Emphysema
    - Alveolar
    - Associated with COPD
- Metabolic Disease
  - Pulmonary mineralization ("calcinosis") - toxicosis
- Circulatory Disease
  - Pulmonary hemorrhage (EIPH)
  - Pulmonary edema e.g. cardiogenic, anaphylaxis
- Aspiration pneumonia

Congenital Atelectasis

- Alveoli incompletely distended
- Implies abortion or stillbirth
- Lung fails to float in formalin/water
- Lack of thrombosis in umbilical cord
- Can also occur following live birth
  - Aspiration of amniotic fluid and meconium
  - Surfactant abnormality – "barker foals" – see hyaline membrane (ARDS)

Pulmonary Mineralization

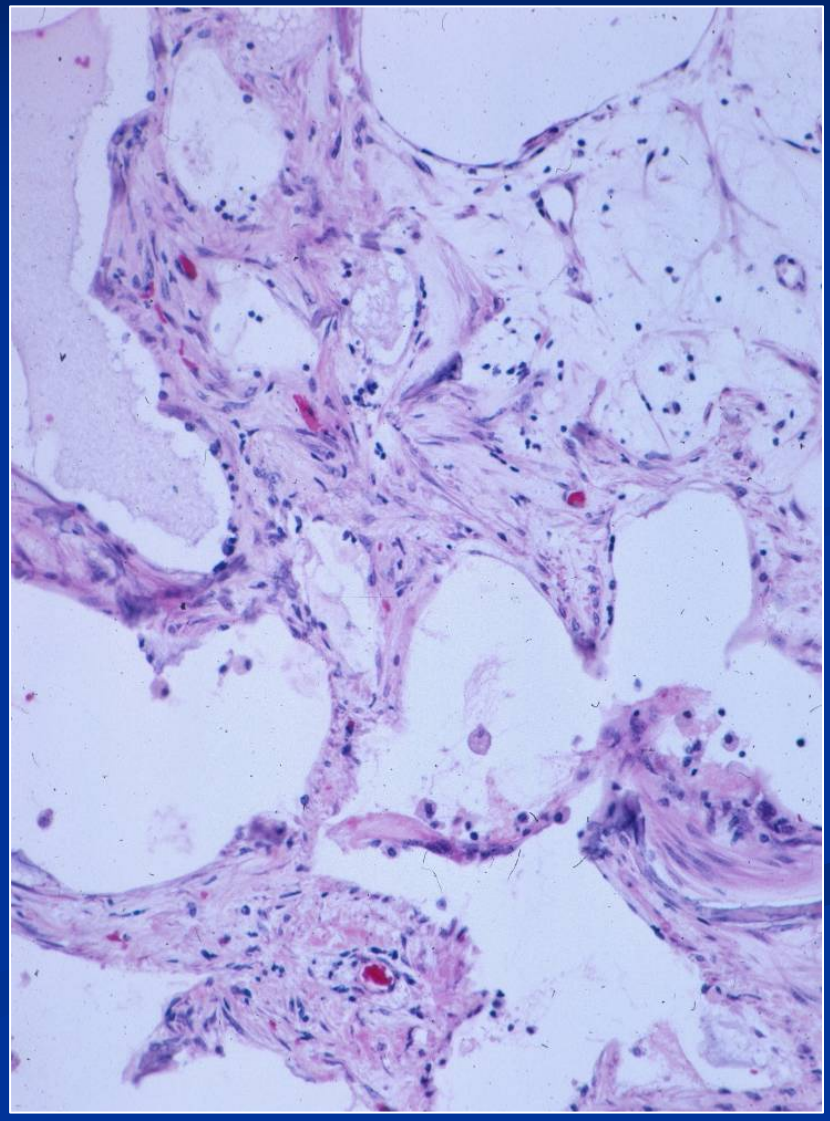
- Diffuse lesion (“pumice lung” , “calcinosis”)
- Lung does not collapse, may be gritty
- Capillary basement membranes mineralized
- Other organs affected

Pulmonary Mineralization

- Etiology
  - Hypervitaminosis D
  - Calcinogenic plants
    - *Solanum malacoxylon* ("Manchester wasting disease")
    - *Cestrum diurnum*

Vitamin D Toxicity – Horse

Mineralization and fibrosis



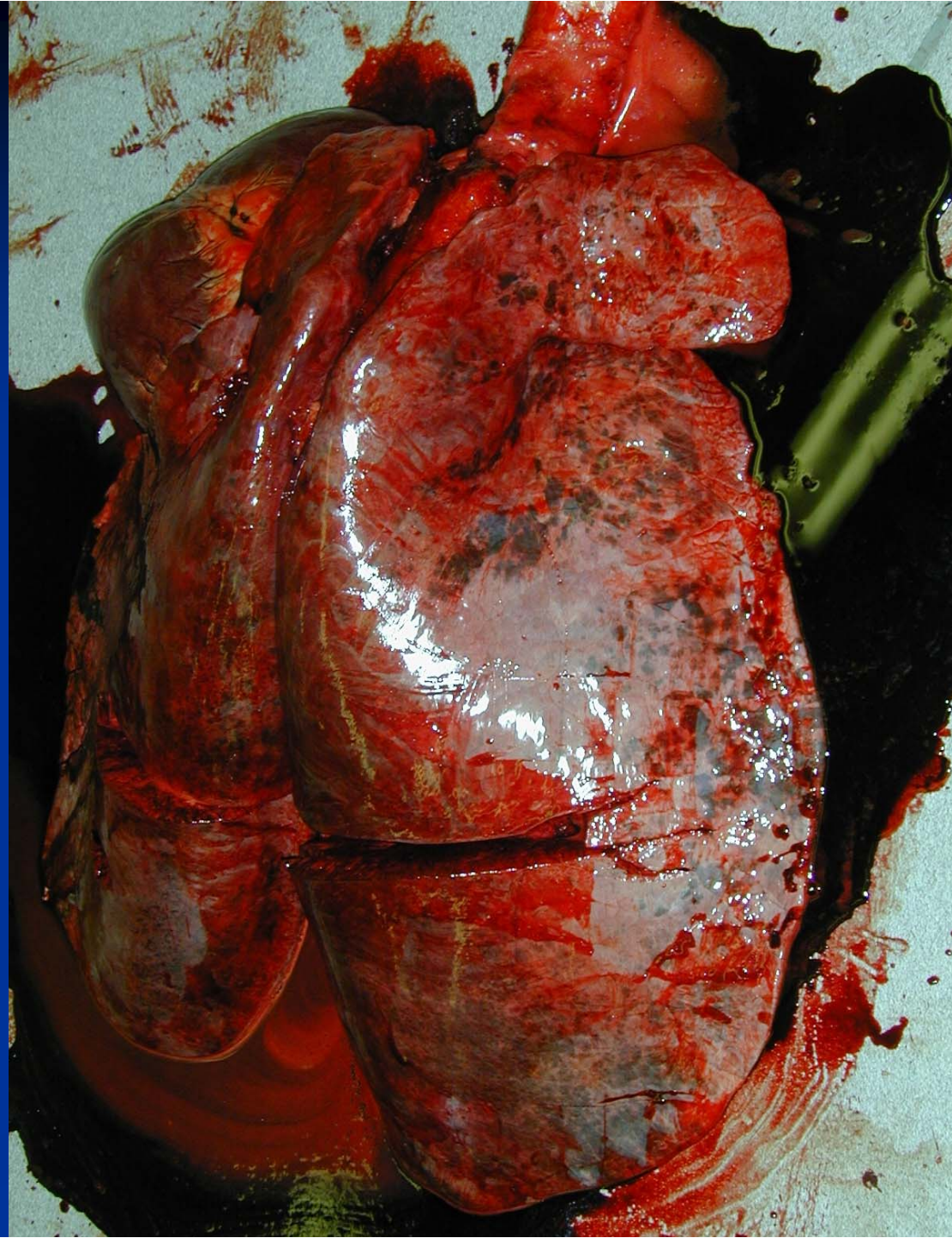
Exercise Induced Pulmonary Hemorrhage (EIPH)

- Occurs after exercise in race horses worldwide
- High incidence on bronchoscopy e.g. 80%
- Clinically observed as epistaxis
- Occasionally fatal
- Possible cause – high pulmonary vascular pressure during racing, preexisting lung injury

Exercise Induced Pulmonary Hemorrhage (EIPH)

- May be difficult to make gross diagnosis due to autolysis
- Discoloration of lung
- Histologically see alveolar hemorrhage, hemosiderosis, possibly fibrosis

EIPH



EIPH

Pulmonary Edema

- Cardiogenic
  - Toxicants
    - White snakeroot - *Eupatorium rugosum*
    - Monensin/Rumensin
    - Avocado
    - Oleander, Japanese yew – generally die without lesions
- Anaphylaxis
  - Penicillin, vaccination
- Smoke inhalation
- Differentiate from acute interstitial pneumonia e.g. Hendra virus, which may appear primarily as edema

Aspiration Pneumonia

- Etiology/predisposing factors
  - Anesthesia
  - Improper tubing (oil, medication)
  - Prenatal stress – amniotic fluid and meconium
    - Associated with syncytial cells in some cases

Infectious Disease

- Viral
  - Intersitial/bronchointerstitial pneumonia
- Bacterial
  - Bronchopneumonia
  - Granulomatous pneumonia
- Mycotic
  - Intersitial to granulomatous pneumonia
- Parasitic
  - Granulomas
  - Eosinophilic bronchitis

Viral Infectious Disease

- Generally mild and transient
- Stress, frequently related to racing
- Clinically indistinguishable
- Usually present as URT disease
- Suppress cell mediated immunity
- Predispose to infection
  - Bacterial, often from normal flora
  - *Pneumocystis carinii*

Viral Infectious Diseases

Most important

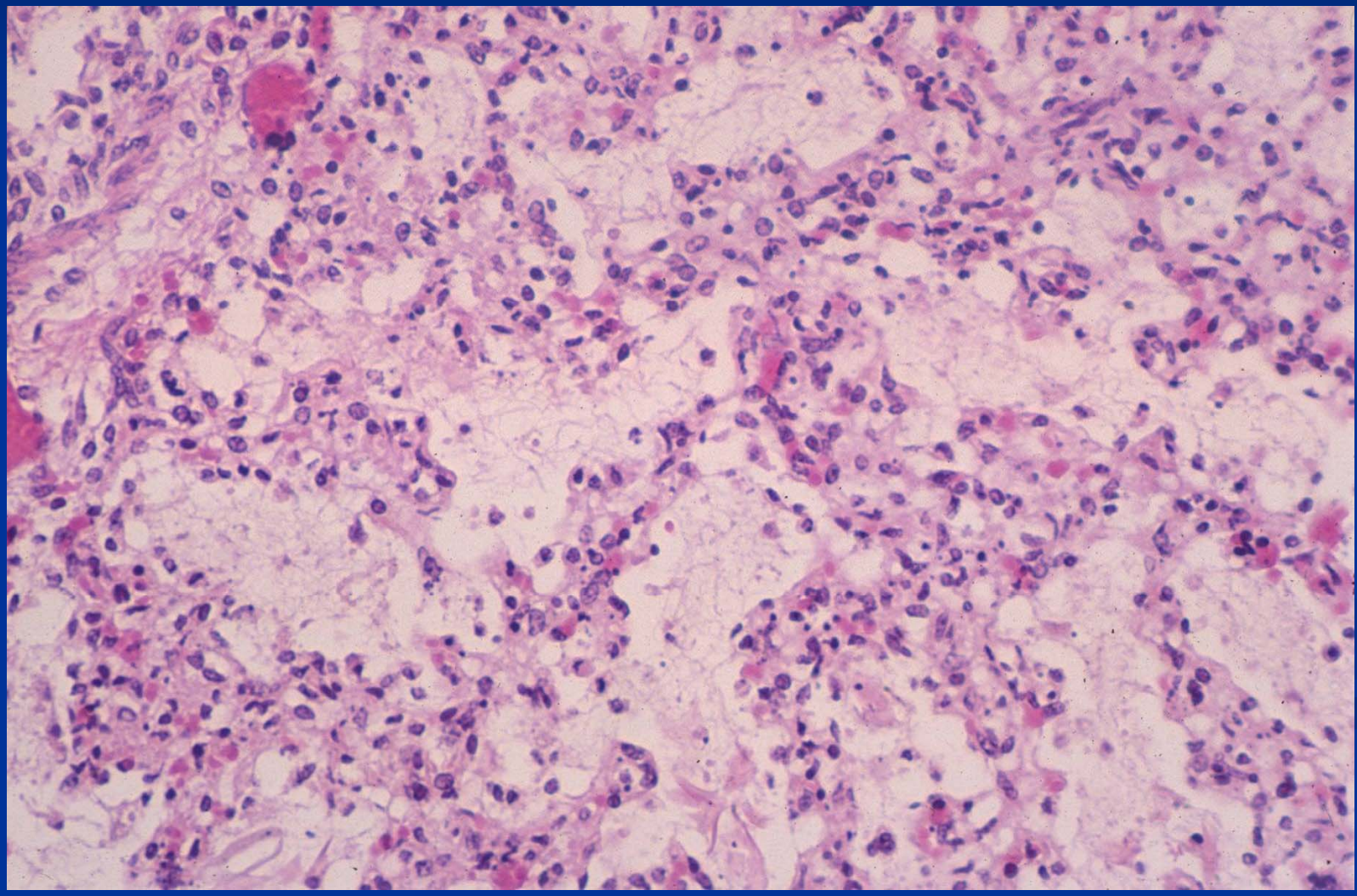
- Equine viral rhinopneumonitis
- Equine influenza
- Equine viral arteritis (EVA)
- Hendra virus

- Other
  - Adenovirus
  - Parainfluenza
  - Rhinovirus
  - African horse sickness

Equine Viral Rhinopneumonitis

- Equine herpesvirus 1 and 4 (EHV-1, EHV-4)
- Diseases
  - Respiratory (generally EHV-4)
    - Weanling foals and young race horses
  - Reproductive – abortions (generally EHV-1)
    - Fetuses/neonates infected in utero – severe disease – bronchointersitial pneumonia with necrosis and inclusion bodies
  - Neurologic – recent racetrack outbreaks in USA
- Virus persists latently in trigeminal ganglia till activated by stress or immune suppression.

Equine Viral Rhinopneumonitis – Fetal – Interstitial Pneumonia



Gamma-Herpes Virus in Donkeys

- Interstitial pneumonia
- Syncytial cells even in chronic lesion
- No inclusion bodies
- Kleiboeke et al, 2002, JVDI 14: 273-280

Equine Influenza

Type A strain (A/equi-1 and A/equi-2)

Generally in 2-3 yr olds at racetrack

High morbidity, low mortality

Clinical signs: fever, cough, oculonasal discharge

Recently mutated and "jumped" to dogs

Equine Influenza

Pathology

- Mucopurulent exudate in airways
- Multifocal atelectasis (checkerboard pattern)
- Broncho-interstitial pneumonia
- Secondary bacterial anteroventral bronchopneumonia possible

Equine Viral Arteritis (EVA)

- Arterivirus found worldwide
- Disease - pansystemic -foals and horses
- Virus infects macrophages and endothelial cells
- Clinical signs – fever, respiratory distress, abortion, diarrhea, dependent edema

Equine Viral Arteritis (EVA)

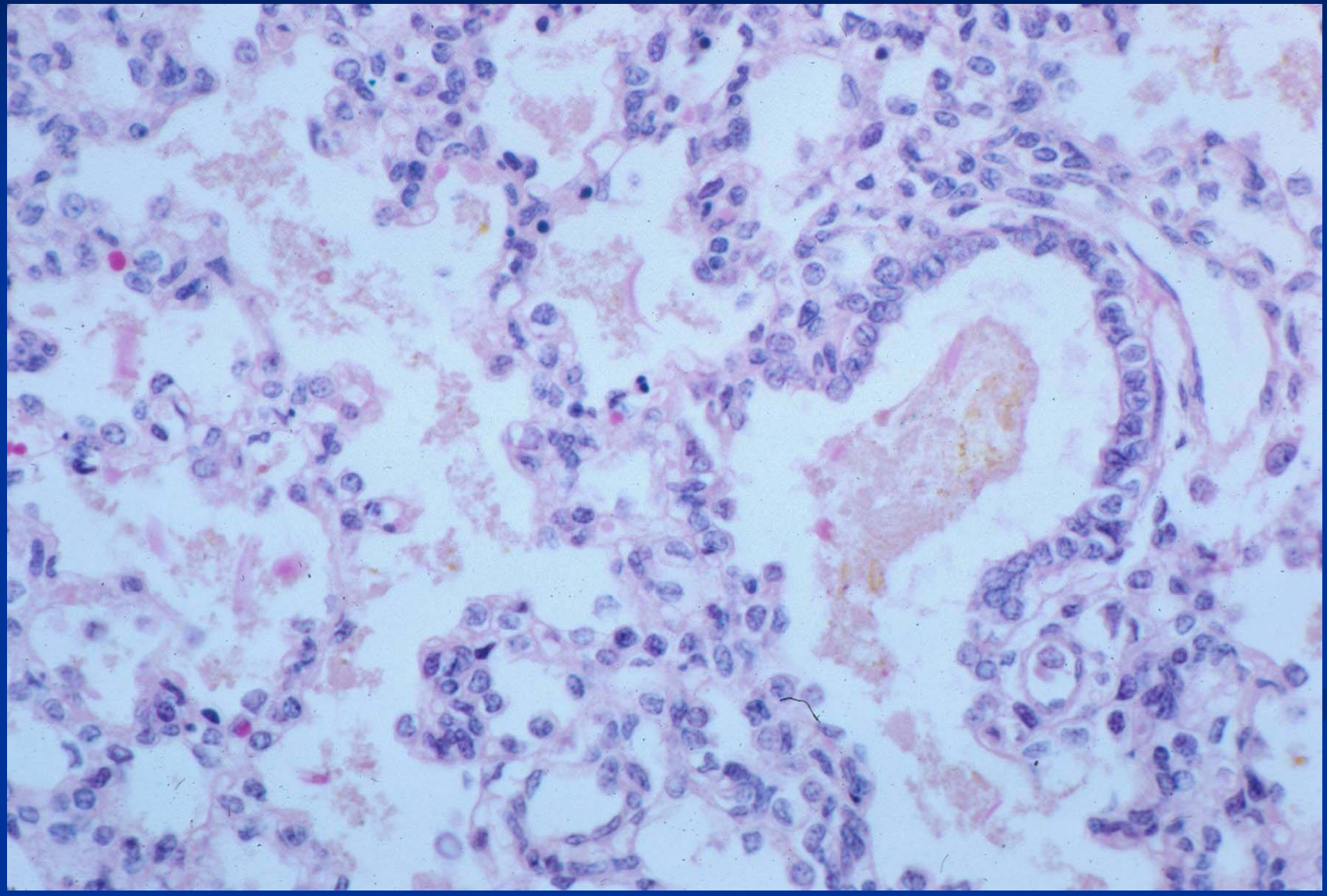
- Pulmonary pathology
  - Interstitial pneumonia
  - Fibrino-necrotic vasculitis
  - Edema and hemorrhage
  - Hydrothorax
- Other organ pathology related to vascular lesions

Equine Viral Arteritis (EVA) – Fetus

Interstitial pneumonia with rib impressions

Equine Viral Arteritis (EVA)

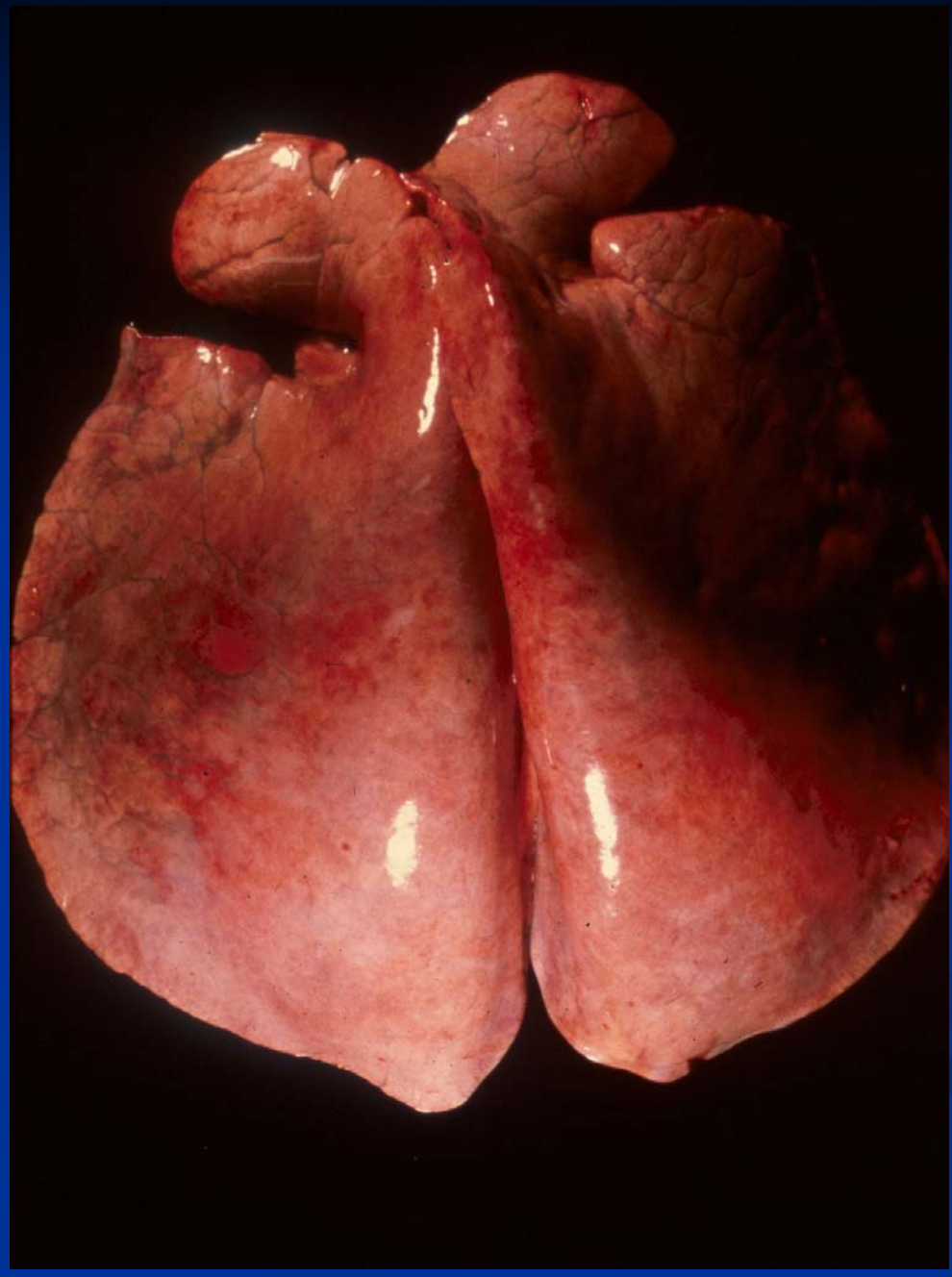
Mild interstitial pneumonia with meconium



Adenovirus

- Generally immunosuppressed/deficient foals e.g. Arabs with CID
- Low morbidity, low mortality
- Pathology
  - Bronchointerstial pneumonia
  - Intranuclear inclusion bodies
  - Often secondary infection – bacterial, *P. carinii*

Adenovirus and *P. carinii* - Arabian Foal - Interstitial pneumonia



Hendra Virus

- Family Paramyxoviridae, subfamily Pneumovirinae, a henipavirus as is Nipah virus
- Transmission by fruit bats/flying foxes
- Zoonotic
- Australia
- Pathology
  - Severe pulmonary edema
  - Fibrinoid necrotizing vasculitis – lung and kidney
  - Multinucleated syncytial cells – endothelial cells
- Diagnosis - IHC

African Horse Sickness

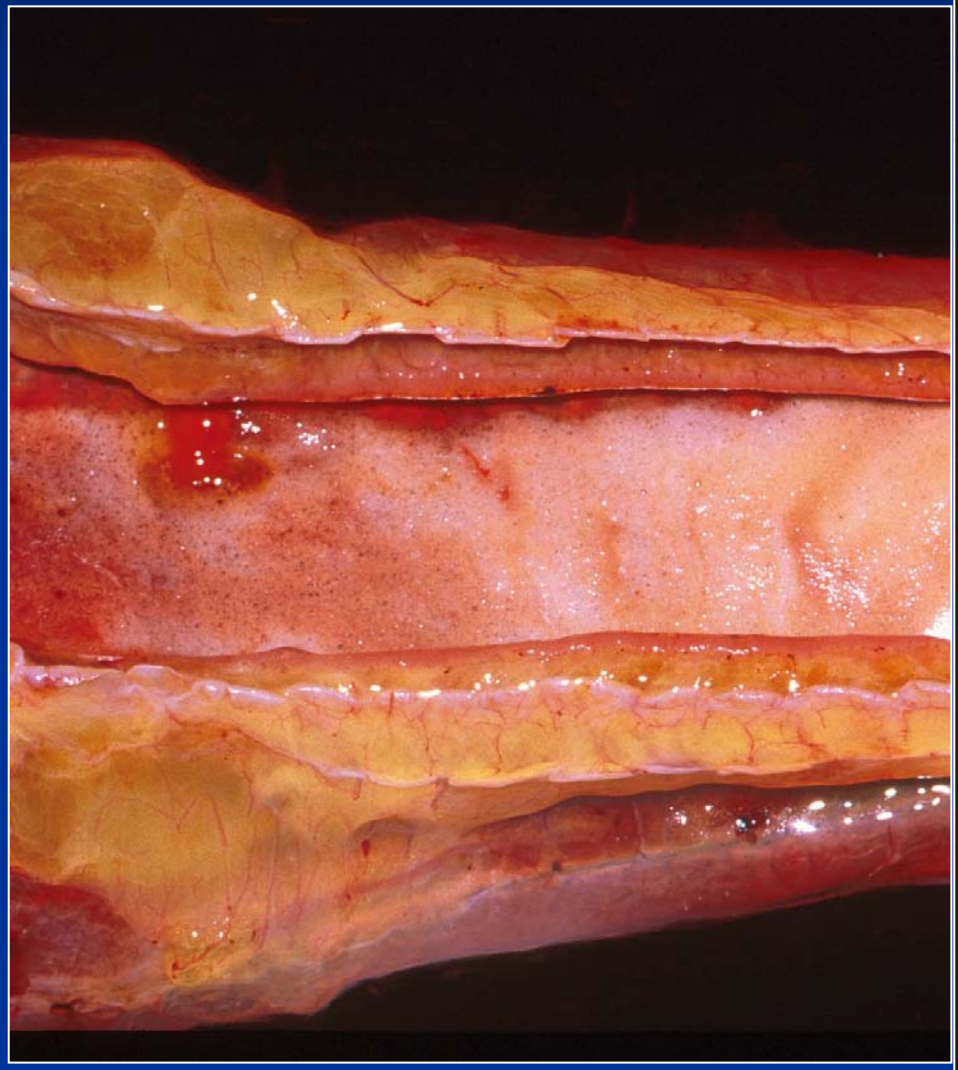
- Orbivirus, vector borne (Culicoides)
- Africa, Middle East, India, Pakistan
- High mortality (up to 95%)
- Forms
  - Pulmonary, cardiac, mixed and mild
- Virus infects endothelial cells

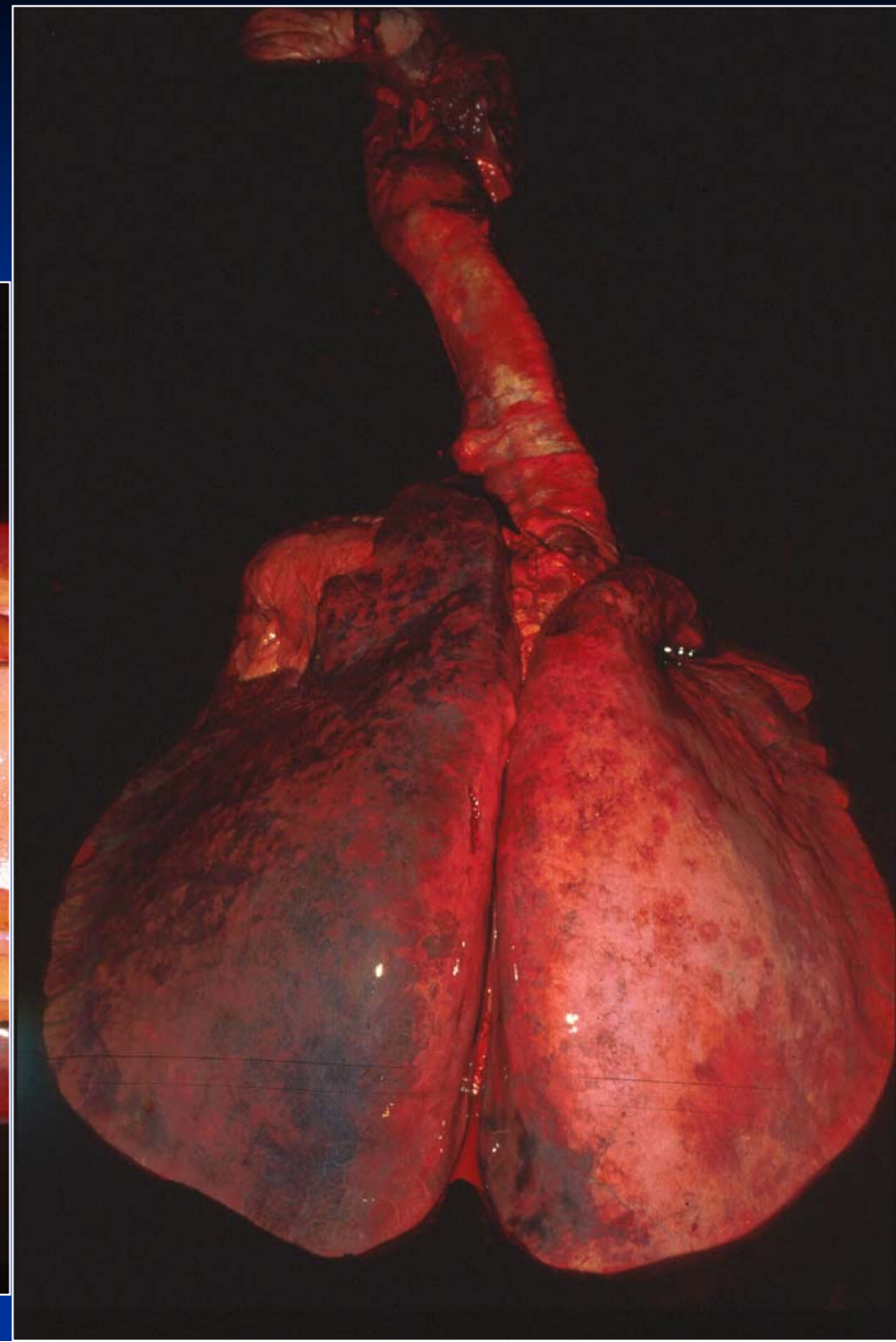
African Horse Sickness

- Pulmonary form
  - Severe respiratory distress and rapid death
  - Massive pulmonary edema
- Cardiac form
  - Cardiac failure with head edema
- Diagnosis – IHC

African Horse Sickness

African Horse Fever





Bacterial Bronchopneumonia

- Generally young, stressed animals
- Predisposition
  - Stress e.g. shipping
  - Viral infection
  - Immune deficiency/suppression

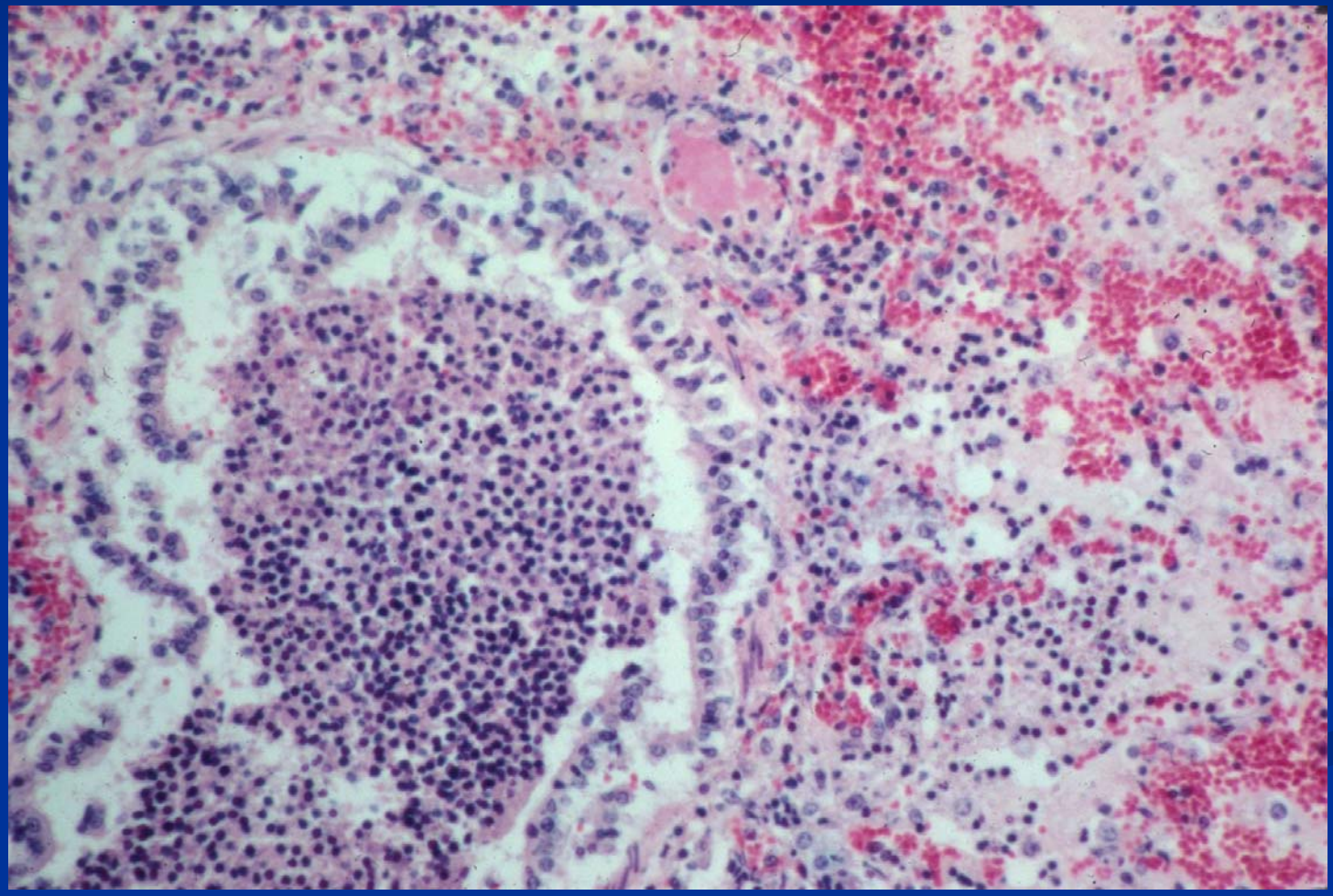
Bronchopneumonia

- Etiology
  - *Rhodococcus equi (Corynebacterium equi)*
  - Other
    - Chlamydophila
    - Mycobacterium spp
- Opportunistic infections
  - *Streptococcus spp*
  - *Strep zooepidemicus* – shipping fever
  - *E. coli*
  - *Klebsiella pneumoniae*

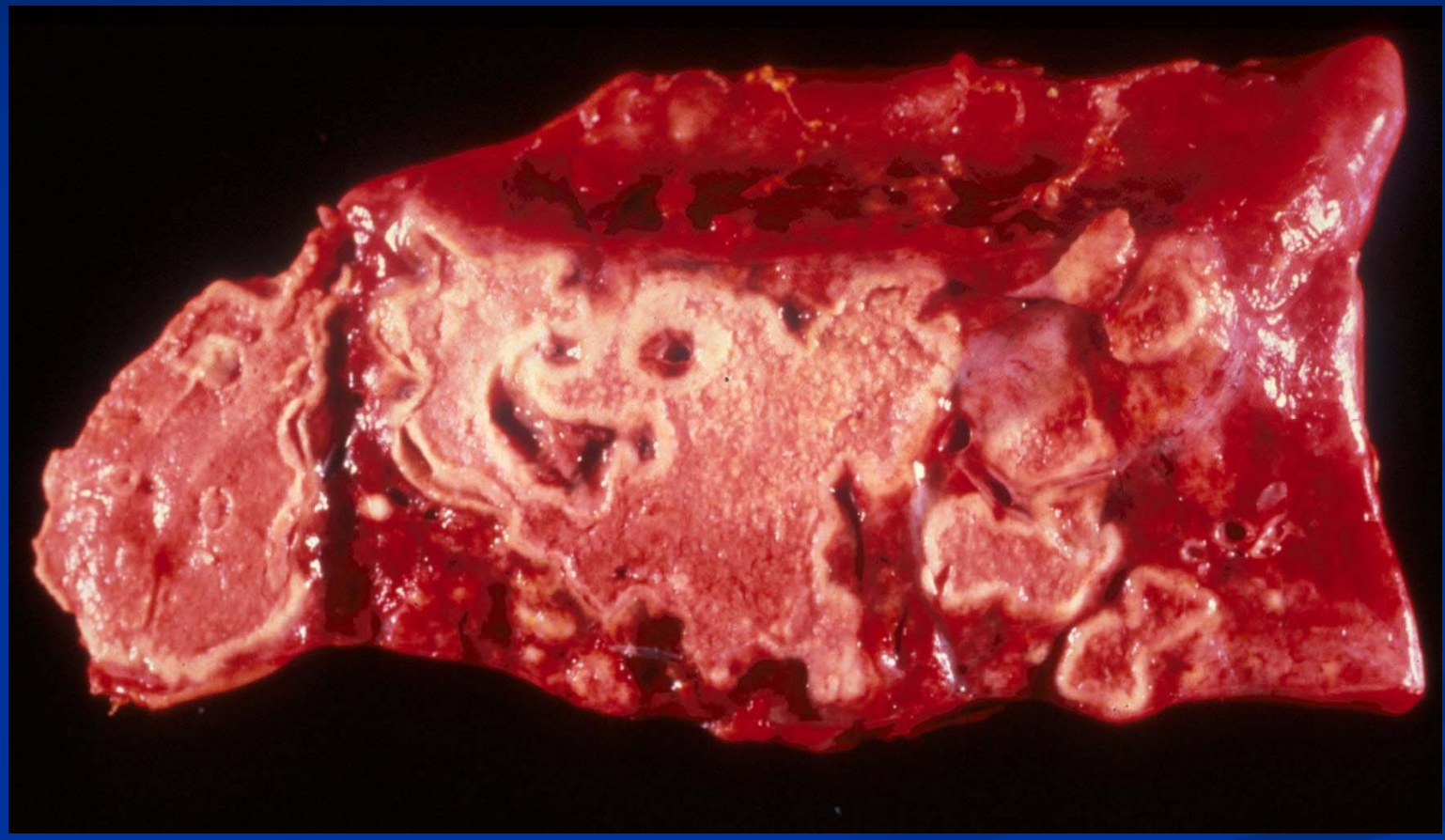
Bronchopneumonia

- Common sequelae
  - Pleuritis
  - Abscesses
  - Sequestra

Bronchopneumonia



Sequestra Post Bronchopneumonia



Pulmonary Abscesses

Rhodococcus equi

- Facultative intracellular Gram positive organism
  - Plasmid encoded virulence factors
  - Survives in macrophages
- Important worldwide cause of morbidity and mortality
- Enzootic on farms – soil and feces
- Primarily affects
  - Foals 1-6 month
  - Older immunosuppressed horses

Rhodococcus equi

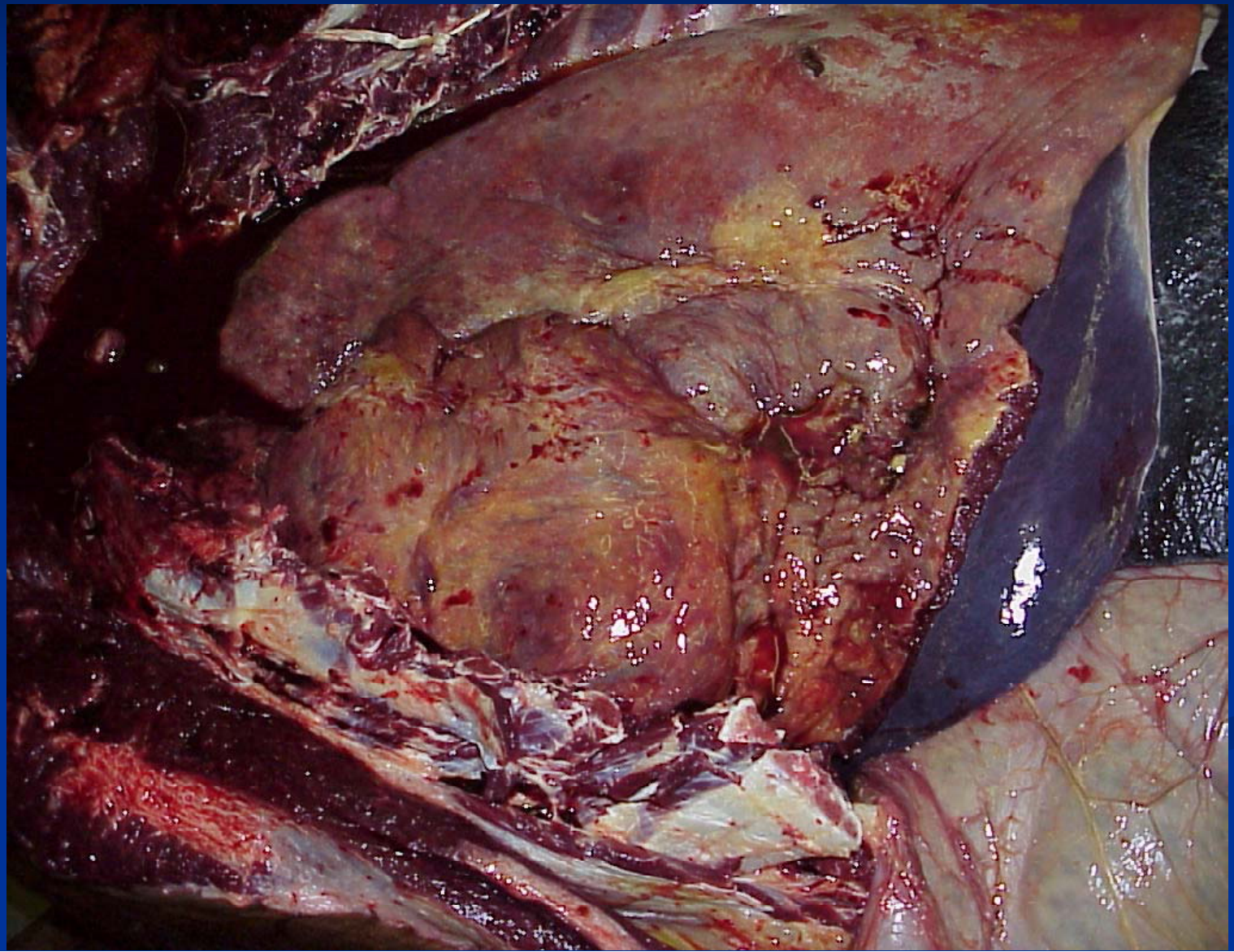
- Disease - sporadic
  - Respiratory - always
  - Enteric – ulcerative enterocolitis - sometimes
  - Disseminated occasionally
- Pathogenesis – aerogenous, infected sputum to intestines (?)

Rhodococcus equi

- Pulmonary pathology
  - Acute - anteroventral suppurative bronchopneumonia followed by
  - Abscesses progress to pyogranulomatous pneumonia with caseous necrosis
  - Chronic – large coalescing caseous masses surrounded by fibrous tissue

Rhodococcus equi –

Bronchopneumonia with abscesses



Rhodococcus equi

Bronchopneumonia with abscesses

Rhodococcus equi

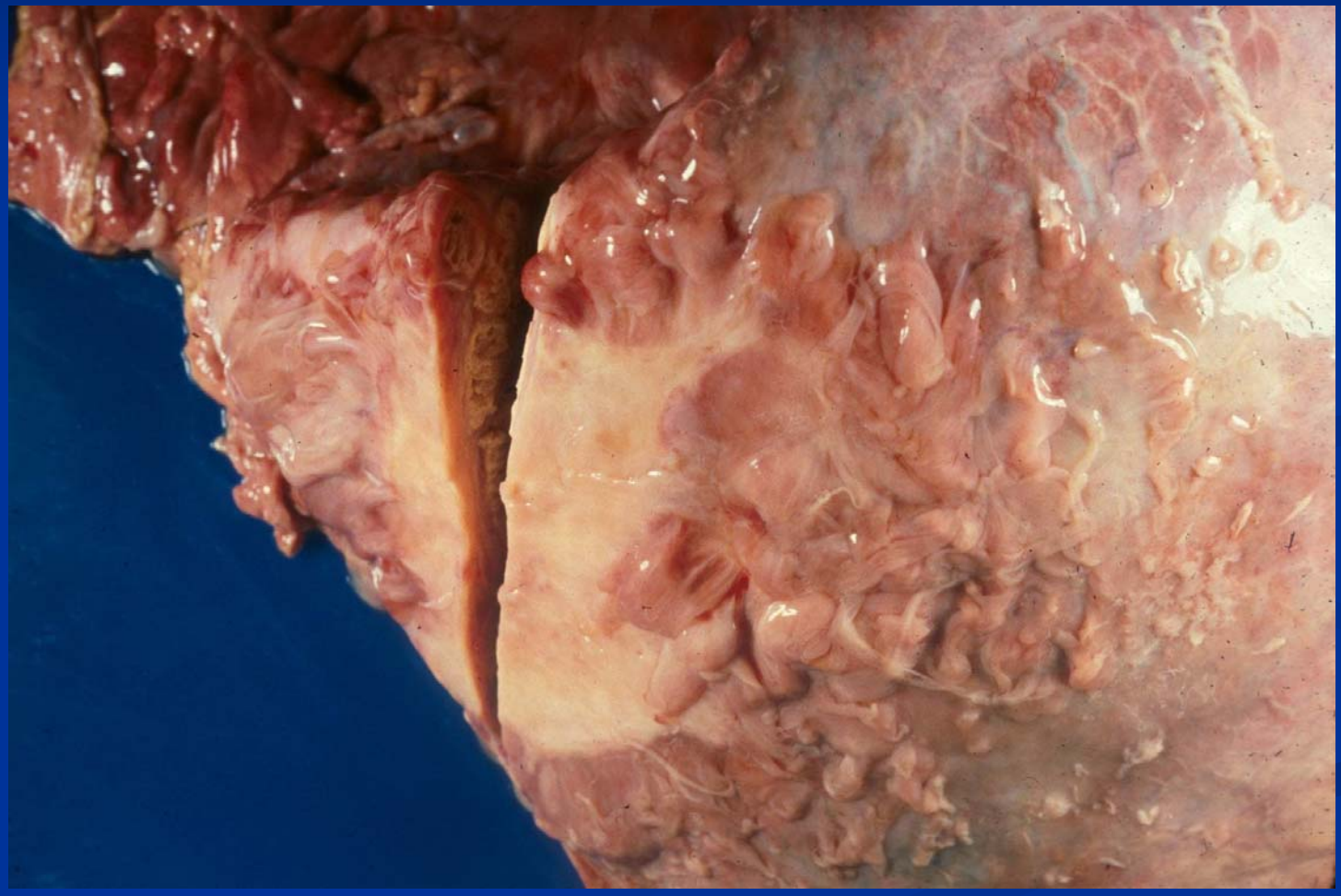
Bronchopneumonia with abscesses

Mycobacteriosis

- *Mycobacterium bovis, tuberculosis* and *avium* complex
- Ingestion followed by hematogenous dissemination
- Pulmonary granulomas without calcification or necrosis

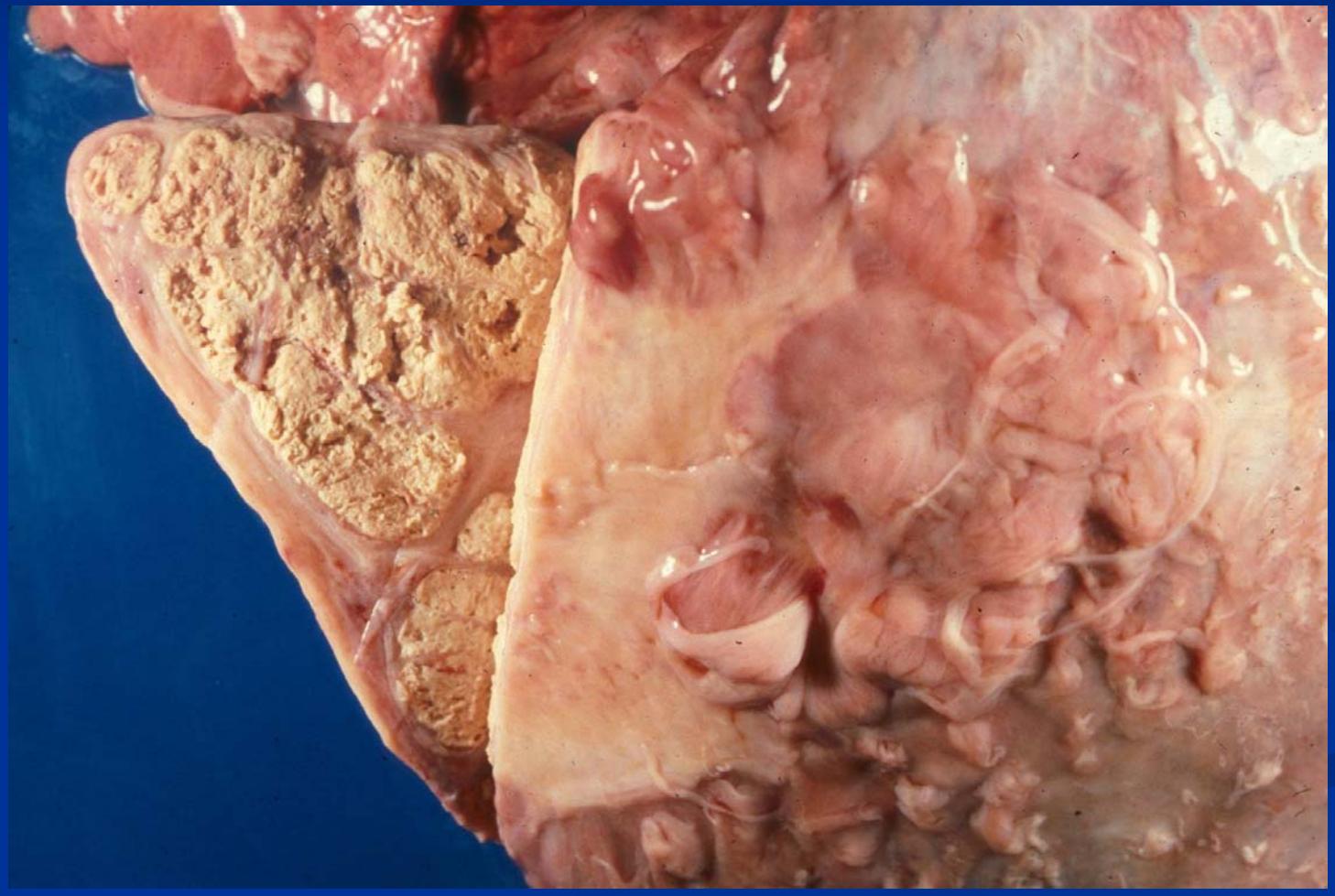
Mycobacteriosis

Pulmonary granuloma with chronic pleuritis



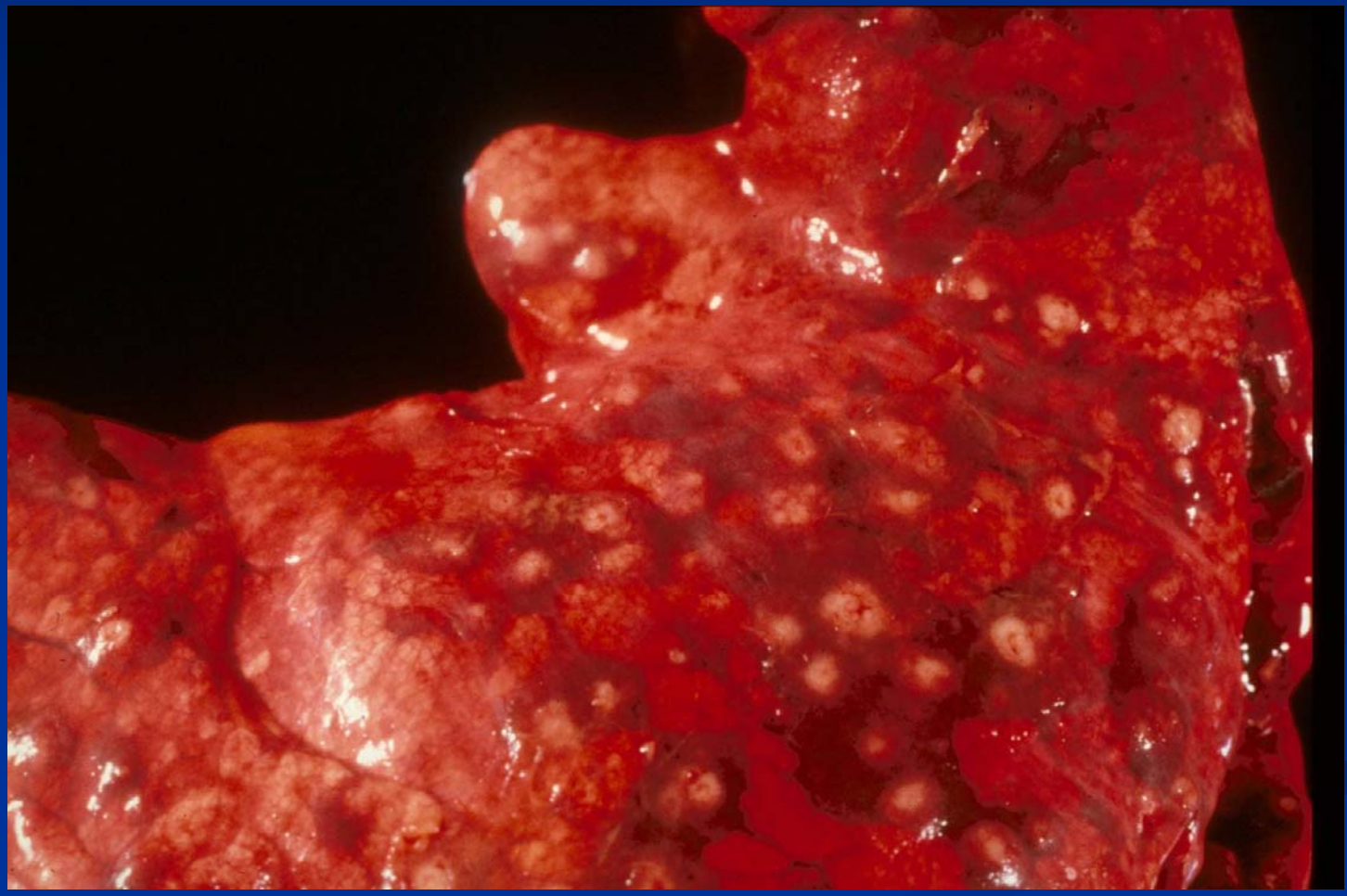
Mycobacteriosis

Pulmonary granuloma with chronic pleuritis



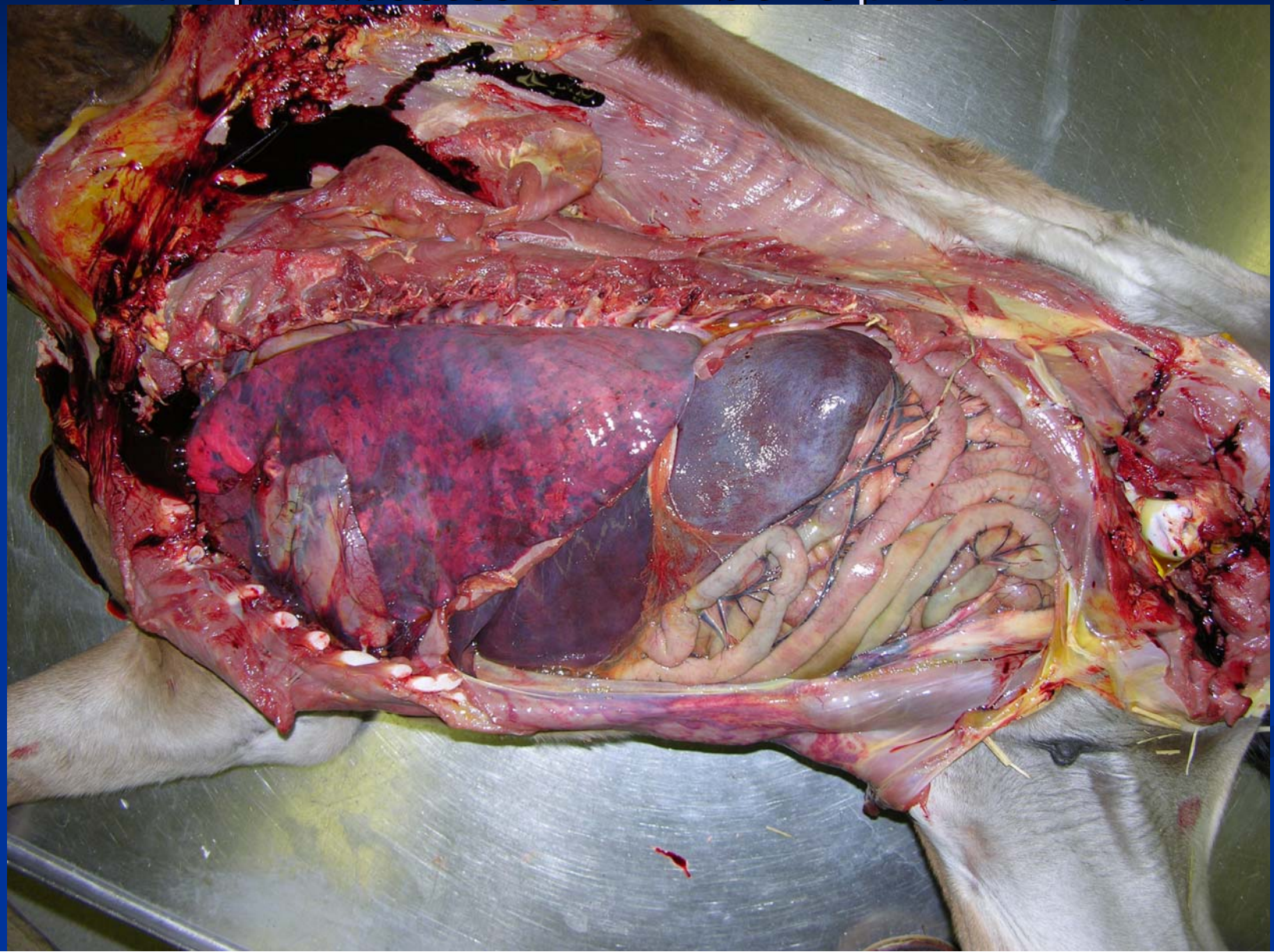
Embolic Pneumonia

Multiple abscesses

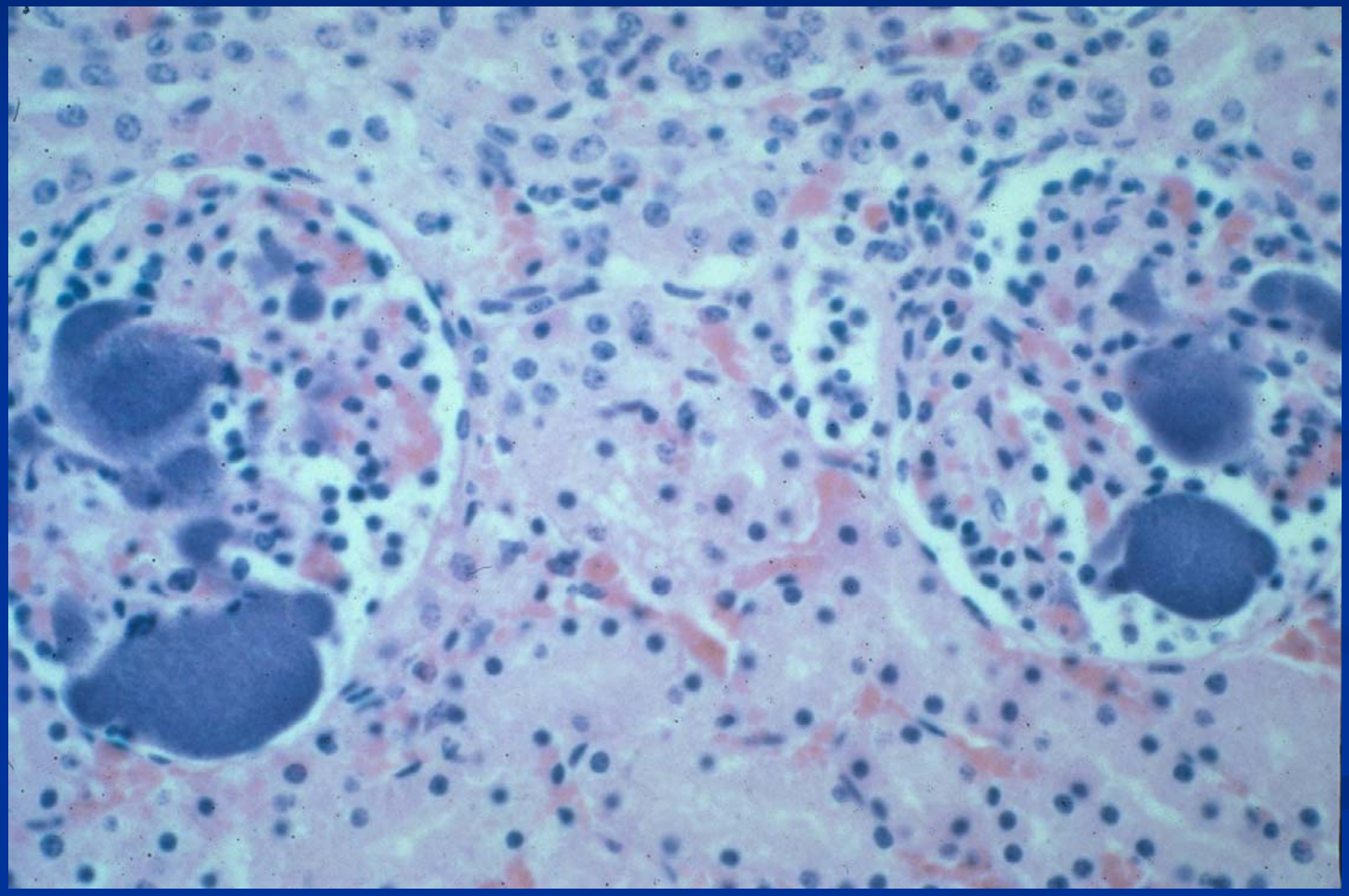


Actinobacillus sp. – Foal

Multiple abscesses – embolic pneumonia



Actinobacillus sp—Foal Kidney Embolic shower to glomeruli



Mycotic Pneumonia

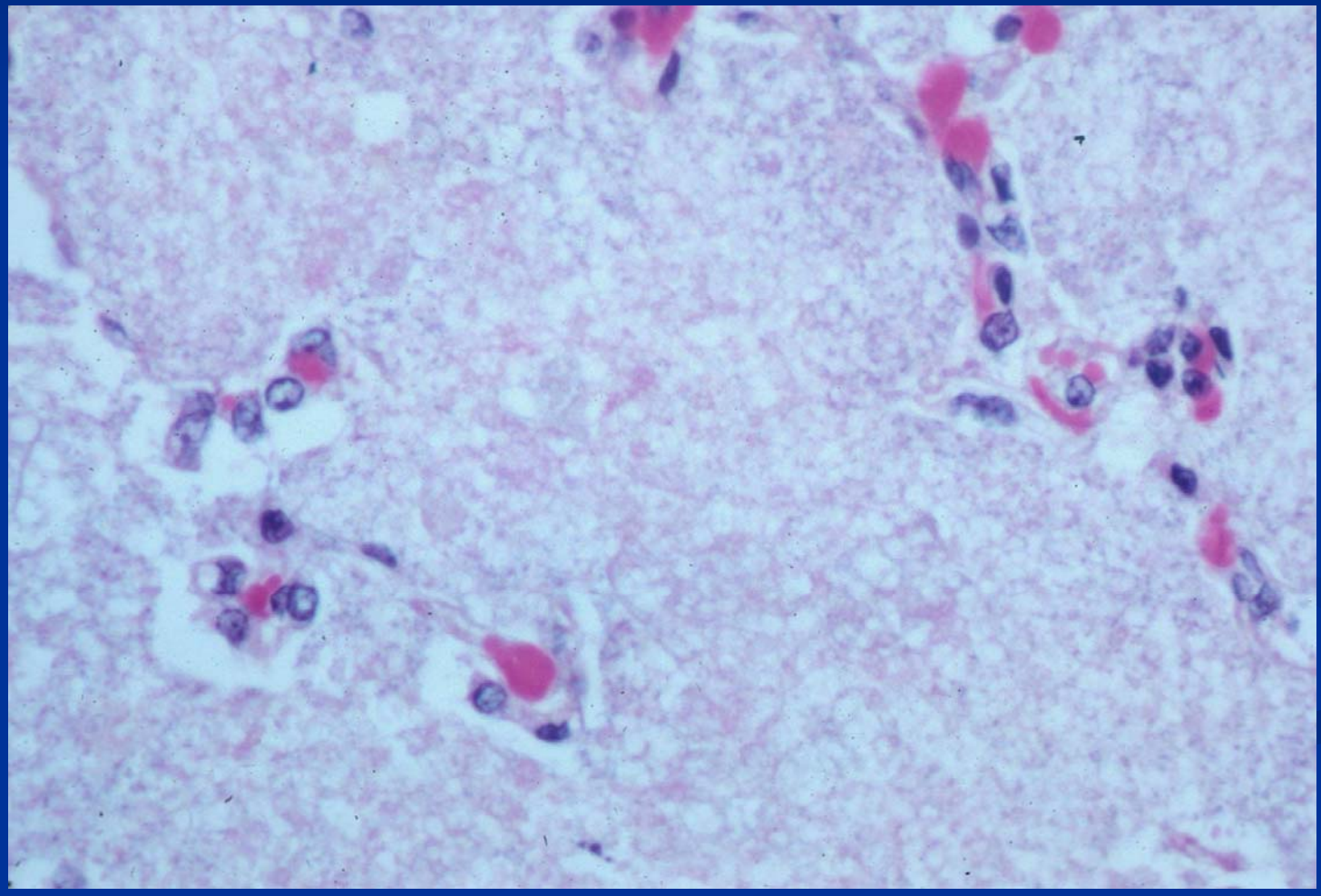
- Pneumocystosis
  - *Pneumocystis carinii* (GMS stain)
  - Immunosuppressed, such as CID foals, often with adenovirus
  - Organisms pack alveoli with foamy appearance
- *Cryptococcosis neoformans* (mucicarmine stain)

Pneumocystosis – Arabian Foal

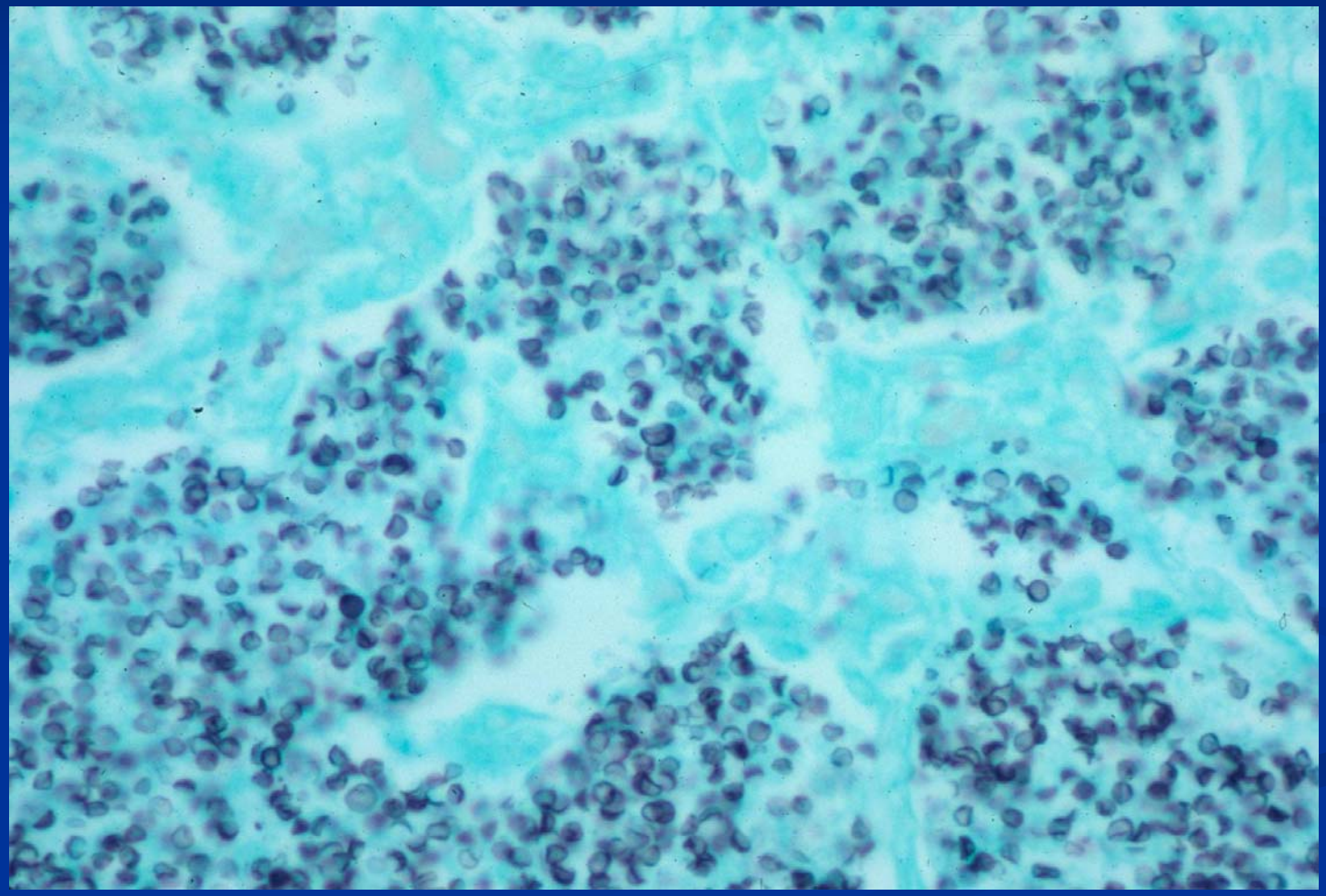
Interstitial pneumonia

Pneumocystosis

Granular material in alveoli



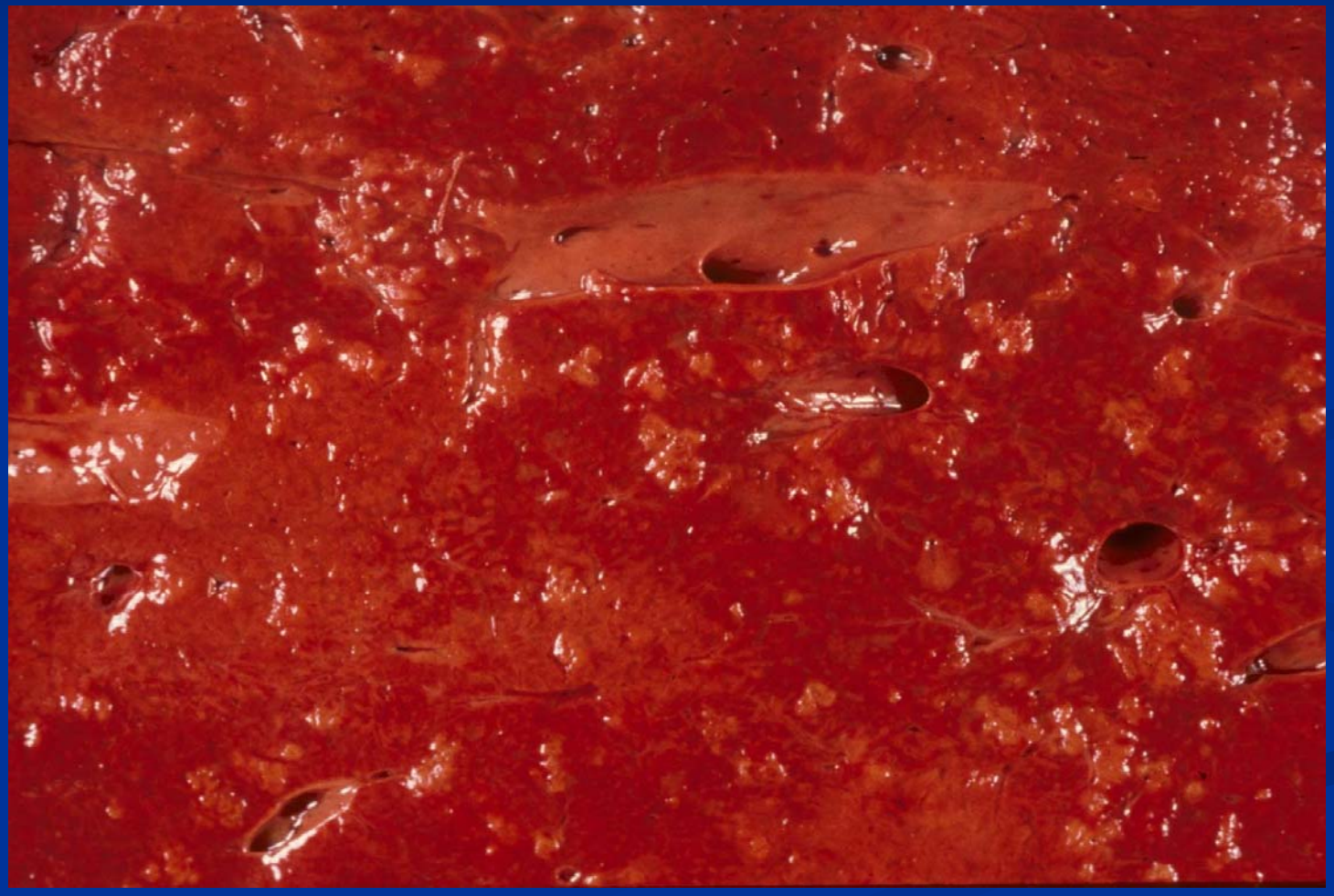
Pneumocystosis
Silver Stain (GMS)



Parasitic Pneumonia

- *Parascarus equorum*
  - Larvae migrate causing necrosis
  - Dead larvae induce granulomas
  - Associated eosinophils
- *Dictyocaulus arnfeldi*
  - Donkeys are natural hosts
  - Non-febrile coughing horse
  - Dorsocaudal lung
  - Eosinophilic bronchitis, focal atelectasis

Parascarus equorum

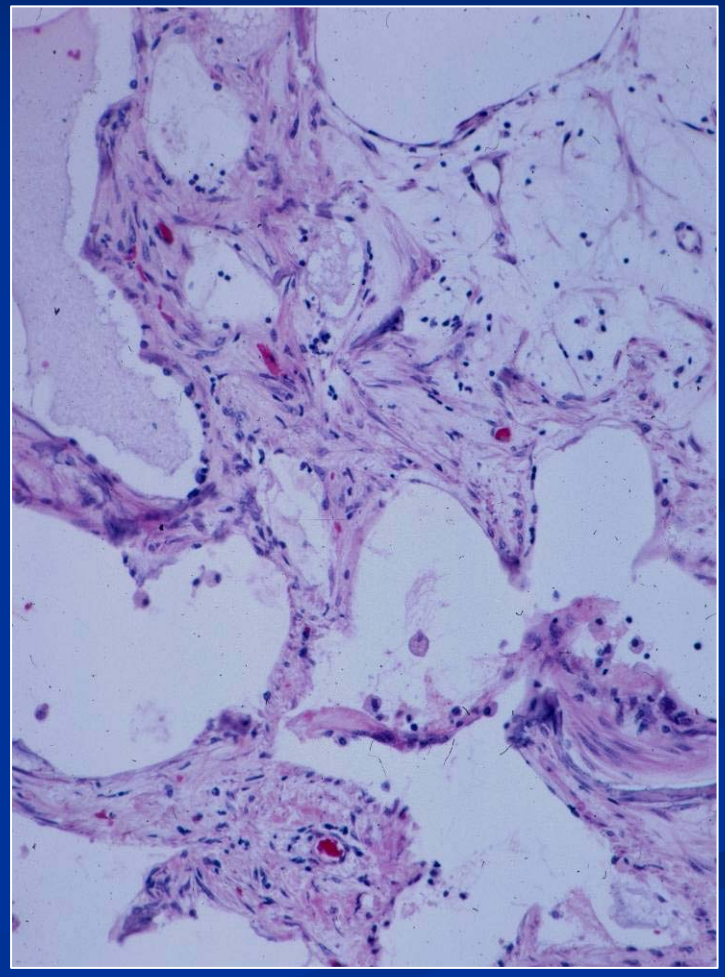


Toxic Injury

- Mineralization
  - Uremia—fibrosis
  - Hypervitaminosis D
- Edema
  - Smoke inhalation – chemical injury
- Granulomatous pneumonia
  - Silicosis
- Interstitial pneumonia
  - Plant toxins

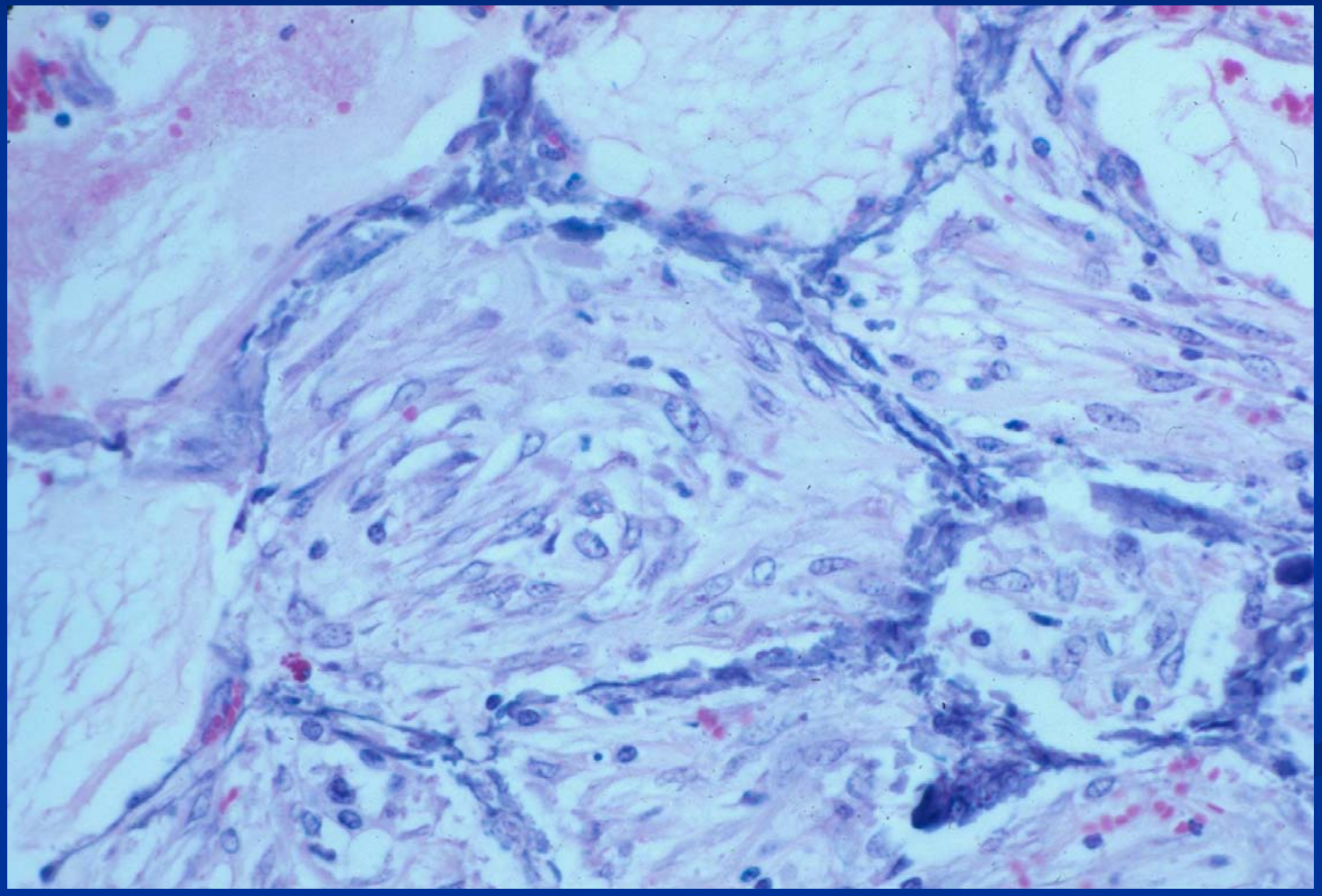
Vitamin D Toxicity – Horse

Mineralization and fibrosis



Uremia – Horse

Mineralization and fibrosis



Plant Toxins

- Crofton weed, *Eupatorium adenophorum*
  - Acute or chronic interstitial disease
- Pyrrolizidine alkaloids – while most cause hepatic injury some can cause pulmonary injury
  - Plants: *Crotalaria spp*, *Senecio spp*
    - Edema, hemorrhage, inflammation
    - Epithelial proliferation/megalocytosis
    - Interstitial fibrosis
- *Perilla frutescens* ketone
  - Interstitial pneumonia

Plant Toxins –

Interstitial pneumonia due to pyrrolizidine alkaloids

Smoke Inhalation

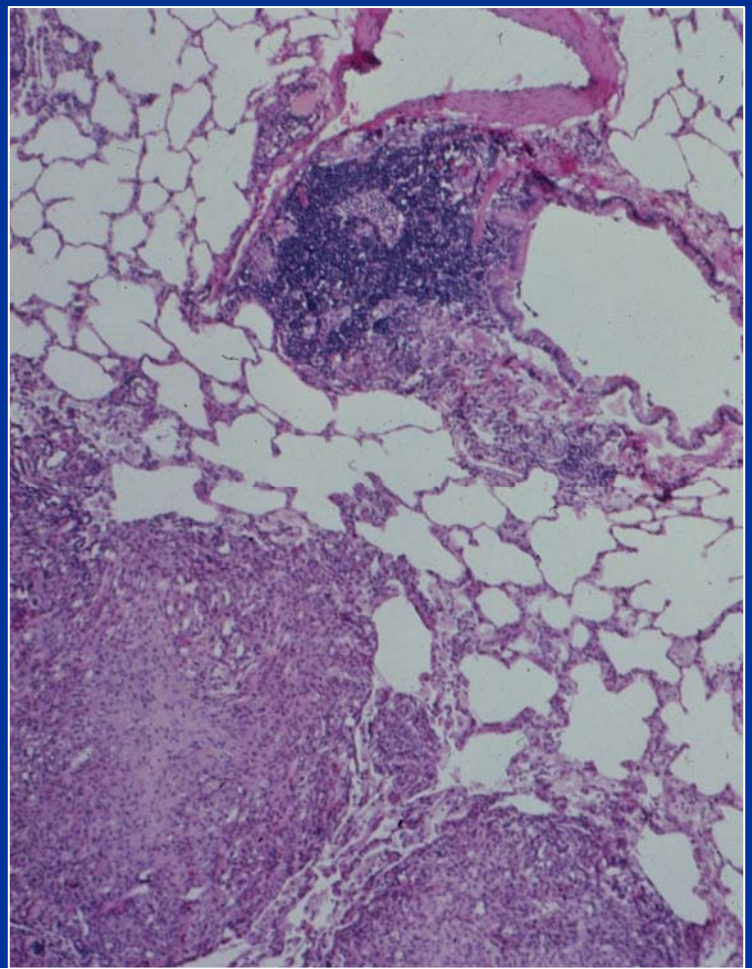
- Injury due to
  - Thermal injury (URT)
  - Chemical injury (LRT)
- Lesions
  - Langeal/tracheal necrosis with fibrin
  - Pulmonary edema
  - Often find carbon (soot) particles

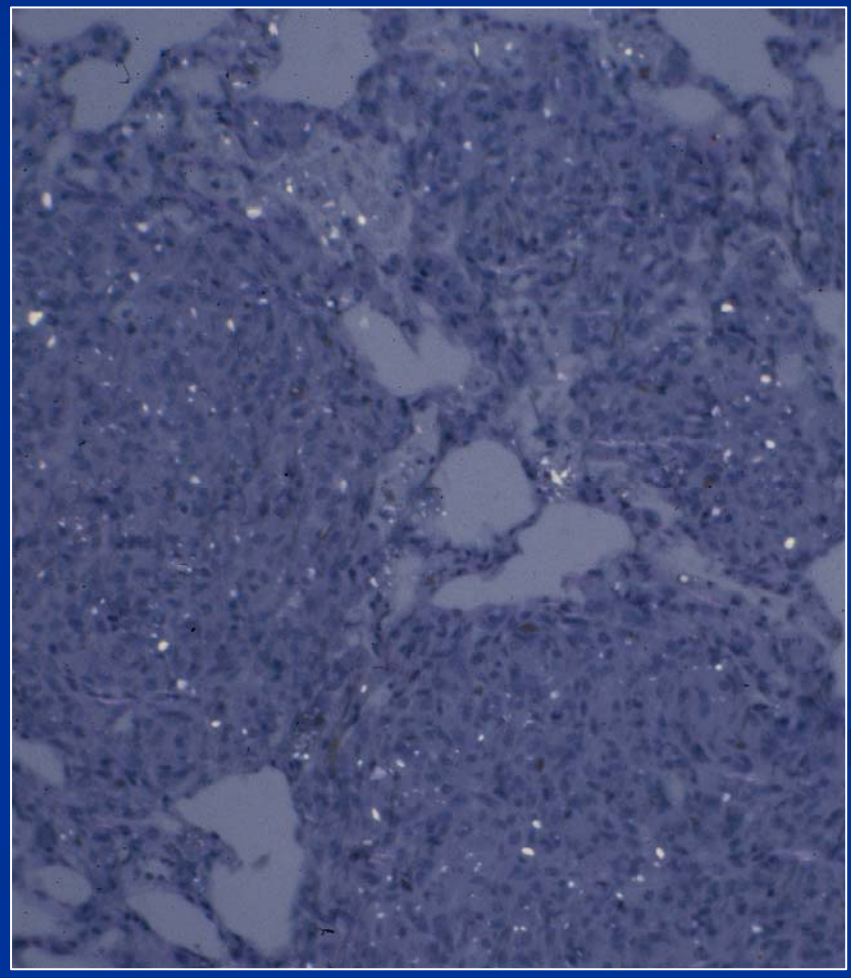
Silicosis

- Origin: mines, sandblasting, sand flouncing, soil
- Reported from California in horses fed off the ground following removal of top soil
- Pathology
  - Progressive granulomatous disease
  - Look for refractile silica particles
- Pathogenesis: cytotoxicity to macrophages

Silicosis

Experimental in rats – note granulomas and refractile silica particles (right)





Disease of Unknown Etiology

- Acute interstitial pneumonia of foals (Angela Begg)
  - 3-6 mths, generally found dead
  - Hyaline membranes, type II cell proliferation
  - Clinical treatment with steroids
- Multisystemic eosinophilic epitheliotropic disease (MEED)

Multisystemic Eosinophilic Epitheliotropic Disease (MEED)

- Chronic history of respiratory distress with weight loss
- Primarily in young horses, 3 -17 yr old
- Eosinophilic and lymphoplasmacytic infiltrates and eosinophilic granulomas
- In multiple organs including lung, skin, pancreas, salivary gland, GI and biliary and bronchial epithelium
- Similar syndrome in humans, dogs, cats and ferrets
- Etiology not known

Immune-Mediated Diseases - Anaphylaxis

- Type I hypersensitivity
- Etiology
  - Iatrogenic: antibiotic injection, vaccination
- Pathology
  - Pulmonary edema with eosinophils
  - Airway constriction

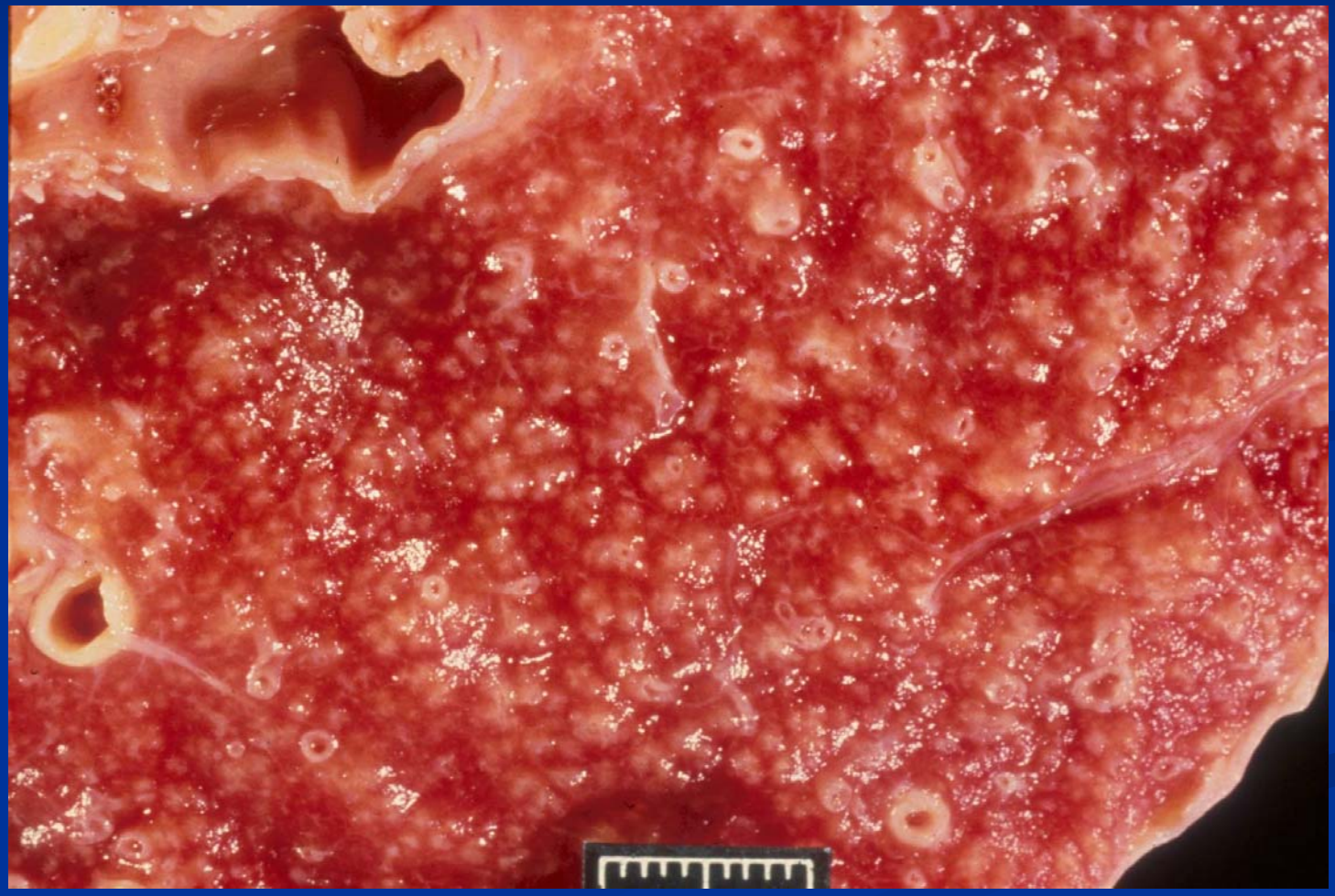
Equine Allergic Pneumonitis/Chronic Obstructive Pulmonary Disease (COPD)

- Hyperreactive airways and genetics have role
- Major disease of stabled horses (heaves)
- Type I and III hypersensitivity to allergens (fungal from hay, choock manure, etc)
- Cough, dyspnea, wheezing (expiratory)
- Pathogenesis: bronchitis/bronchiolitis leads to alveolar emphysema

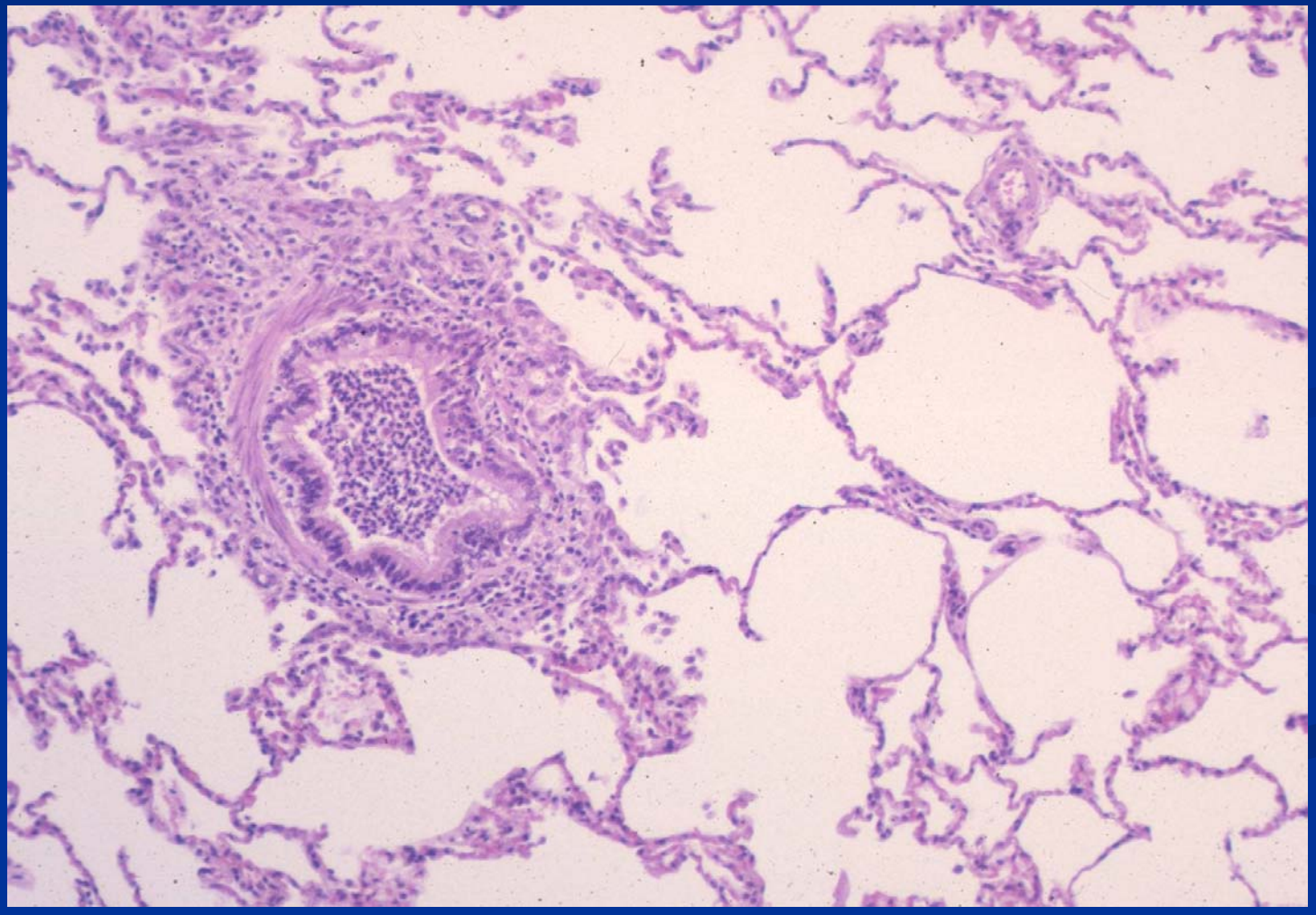
COPD – Emphysema - Horse

COPD – Emphysema - Horse

Mucoid Bronchiolitis in COPD



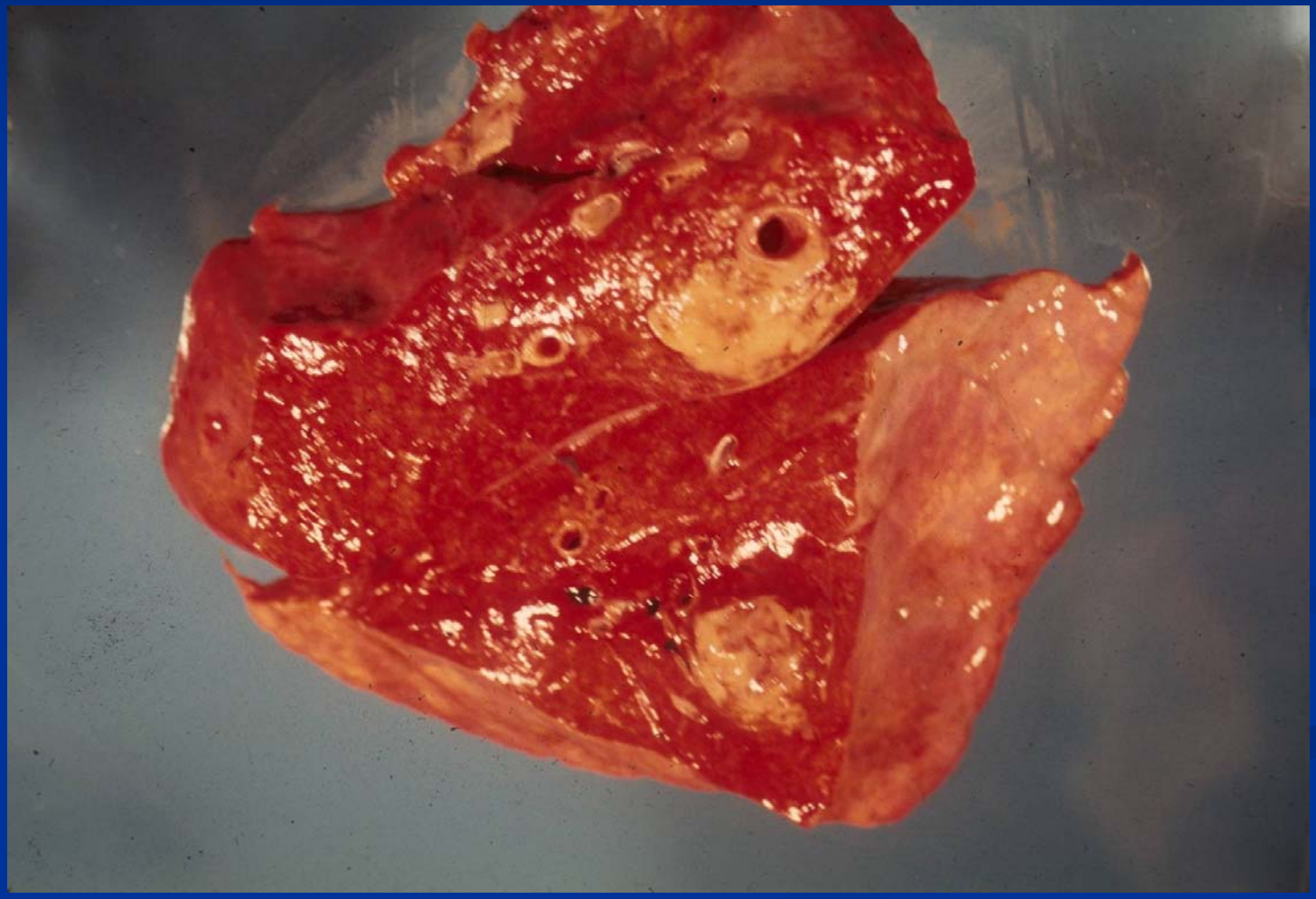
Mucoid Bronchiolitis and Emphysema in COPD



Neoplasia

- Primary – rare
- Secondary – metastatic includes
  - Melanosarcoma
  - Lymphosarcoma

Lymphosarcoma



Pleuritis/Pyothorax

- Primary
  - Bacterial e.g. *Nocardia asteroides* and *brasiliensis* – sulfur granules
- Secondary
  - Extension of pneumonia
  - Ruptured lung abscess – quite common