

AAVLD 2017 Slide Seminar

60th AAVLD Diagnostic Pathology Slide Seminar



American Association of Veterinary Laboratory
Diagnosticians
San Diego, California
Saturday, October 14, 2017
3:30-6:00 PM

60th AAVLD Diagnostic Pathology Slide Seminar

Case #	Species	Organ/Tissue	Diagnosis/Cause
1*	Reindeer	Intestine	Histoplasma capsulatum
2*	Cat	Spleen	Cytauxzoon felis
3*	Camel	Nasal cavity	Fibrous osteodystrophy
4*	Cow	Lung	Mycotic pneumonia
5*	Goat	Placenta	Toxoplasma gondii
6*	Pig	Ovary	B cell lymphoma
7*	Horse	Skeletal muscle	Systemic calcinosis
8*	Pig	Spinal cord	Porcine astrovirus type 3
9*	Calf	Lung	Helcococcus ovis & Mycoplasma bovis
10*	Chicken	Tendon	Avian reovirus
11*	Cow	Eye	Malignant catarrhal fever
12*	Dog	Kidney/Heart	Borrelia burgdorferi
13	Sheep	Liver	Steroidal saponin toxicosis
14	Horse	Lung	Klebsiella pneumoniae
15	Horse	Paranasal sinus	Aneurysmal bone cyst
16	Pig	Brain	PRRS virus
17	Horse	Lung	Granulomatous pneumonia of unknown cause

***Note: Case presentations #1-12 are under consideration for the 2017 Diagnostic Pathology Slide Seminar Resident/Graduate Student Award.**

Case 1

Intestinal Histoplasmosis in a Captive Reindeer (*Rangifer tarandus*), Missouri, USA*

Jessica S. Fortin¹, Michael J. Calcutt², Dusty W. Nagy³, Keiichi Kuroki¹

¹Veterinary Medical Diagnostic Laboratory, ²Veterinary Pathobiology and ³Department of Veterinary Medicine and Surgery, College of Veterinary Medicine, University of Missouri, Columbia, 65201

Signalment: 4-year-old, captive, neutered male reindeer (*Rangifer tarandus*) (caribou).

History: The animal had persistent diarrhea for at least one week prior dead. It had recently been sold with a herdmate and transported approximately 50 miles to another farm waiting shipment to a facility in California.

Gross necropsy findings: Fecal staining was seen around the perineum. The mucosa of the small intestines and proximal colon was dark red and thickened.

Histopathology findings: Microscopically the intestinal mucosa was diffusely expanded by abundant epithelioid macrophages with numerous intrahistiocytic round to oval, 2–4 µm yeast forms with basophilic centers and peripheral clear zones surrounded by an indistinct outer cell wall. Yeast forms stained positively with Gomori methenamine silver (GMS) and periodic acid-Schiff (PAS). Antibody against *Histoplasma capsulatum* was used for recognition of H and M antigens. Numerous yeast forms stained positively for *H. capsulatum* M and H antigens by immunohistochemistry.

Laboratory Findings: Aerobic and anaerobic cultures of the intestines were negative for *Salmonella*, *Clostridium perfringens* and *Campylobacter jejuni*. Serology analysis was negative for Johne's disease. ELISA assays of the intestinal contents were negative for *Clostridium perfringens* enterotoxin and *C. difficile* toxin A and B. *Salmonella spp.* and Bovine Viral Diarrhea virus were not detected via PCR.

Final diagnosis: Histiocytic enterocolitis with intrahistiocytic yeast, etiology of *H. capsulatum*.

Comments: *Histoplasma capsulatum*, the cause of histoplasmosis, is widely distributed in temperate and subtropical climates throughout the world.^{1,2} The most commonly reported affected animal species with histoplasmosis are dogs and cats, with fewer reports in horse, cattle and wildlife species. *H. capsulatum* is a dimorphic fungi which has a filamentous mycelial (mold form) with growth in the soil and a monocellular, yeast-like animal tissue or virulent form. Bats and birds are known to shed and spread the organism in their feces, but without having disease, putatively because of their high body temperature.³ With desiccation over time, dust from droppings have resulted in outbreaks of respiratory histoplasmosis. The principal routes of infection are by inhalation or ingestion of microsporidia produced by mycelial forms.⁴ The disease is not transmissible, but concurrent disease may occur across species or within a species because of shared environmental exposure.

Herein, it can be speculated that the animal succumbed to malabsorption caused by intestinal histoplasmosis. The "at risk" population for enteric histoplasmosis in reindeer is probably quite limited. In contrast, white-tailed deer (*Odocoileus virginianus*) are ubiquitous in the regions of endemic histoplasmosis in the Midwestern United States. To our knowledge, histoplasmosis in Cervidae has not been reported previously. We report an occurrence of intestinal histoplasmosis in a farmed reindeer in an endemic area for histoplasmosis.

References:

1. O'Sullivan MV, Whitby M, Chahoud C, Miller SM. Histoplasmosis in Australia: a report of a case with a review of the literature. Aust Dent J. 2004;49:94–97.
2. Wheat LJ. Histoplasmosis: a review for clinicians from non-endemic areas. Mycoses. 2006;49:274–282.
3. Jülg B, Elias J, Zahn A, Köppen S, Becker-Gaab C, Bogner JR. Bat-associated histoplasmosis can be transmitted at entrances of bat caves and not only inside the caves. J Travel Med. 2008;15:133–136.
4. Knox KS, Hage CA. Histoplasmosis. Proc Am Thorac Soc. 2010;7:169–172.

Case 2

Cytauxzoon felis* in the Domestic Cat (*Felis catus*)

Abigail Finley, Pankaj Kumar, Giselle Cino, Kelli Almes

Kansas State Veterinary Diagnostic Laboratory, College of Veterinary Medicine, Kansas State University, Manhattan, KS

Signalment and History: A 2.5 year old, female-spayed domestic shorthair cat (*Felis catus*) was received for necropsy after a previous diagnosis of *Cytauxzoon felis* made by blood smear examination followed by elective euthanasia due to poor prognosis.

Gross Pathology: External examination revealed a small amount of straw-colored fluid from both nares. The oral mucous membranes, sclera, mesenteric fat, and subcutaneous tissues of the body were diffusely pale yellow (icteric). Within the thoracic cavity, there was approximately 15 ml of clear, straw-colored fluid. The lungs were diffusely wet (edema), mottled red, and contained multifocal petechial hemorrhages on the pleural surface of all lung lobes. The spleen was diffusely enlarged (1.5-2x), dark red to black, and congested. The popliteal, mesenteric, mediastinal, and submandibular lymph nodes were diffusely congested.

Histopathology: The lumen of several vessels and intrasinusoidal spaces within the spleen were partially or completely occluded by large monocytes (up to 50 µm in diameter) that contained intracytoplasmic developing schizonts with numerous small, cytoplasmic, basophilic granular merozoites ranging from 1-2 µm in length. Large schizonts-laden macrophages similar to those described in the spleen were multifocally present within the lumen of large number of vessels in the lungs, kidneys, brain, eyes, heart, adrenal glands, pancreas, mesenteric lymph node, and liver.

Diagnosis: Intravascular histiocytosis/monocytosis with intracytoplasmic schizonts consistent with *Cytauxzoon felis*

Comments: *Cytauxzoon felis* is a protozoal parasite of exotic and domestic cats transmitted by the lone star tick (*Amblyomma americanum*) with the bobcat (*Lynx rufus*) being the natural reservoir host. The clinical signs are nonspecific and include lethargy, depression, and anorexia, which are the most common presenting complaints. The histological findings of schizont-infected white blood cells occluding vessels within numerous organs is consistent with the schizogony stage of this parasite. These white blood cells then rupture and release merozoites, which then infect the red blood cells and are identified as ring-like structures that contain a small, basophilic nucleus on a blood smear. Only about 1-4% of all *C. felis* infected cats become parasitemic and once they do, fatality occurs in 1-3 days. Historically, domestic cats infected with *C. felis* had a 100% mortality within 1 week of the onset of clinical signs suggesting that they likely serve as aberrant dead-end hosts. However, recent studies have found that some cats survive infection and become subclinical carriers. Persistently infected domestic cats could potentially serve as a reservoir host and contribute to the *C. felis* transmission risk.

References:

1. Brown HM, Lockhart JM, Latimer KS, Peterson DS. Identification and genetic characterization of *Cytauxzoon felis* in asymptomatic domestic cats and bobcats. *Vet Paras.* 2010. 172 (3-4): 311-316.
2. Rizzi TE, Reichard MV, Cohn LA, Birkenheuer AJ, Taylor JD, Meinkoth JH. Prevalence of *Cytauxzoon felis* infection in healthy cats from enzootic areas in Arkansas, Missouri, and Oklahoma. *Paras & Vect.* 2015. 8: 13.

Case 3
Fibrous Osteodystrophy in a Camel*

Martha Frances Dalton, Valerie McElliott,

University of Georgia, College of Veterinary Medicine, Department of Pathology, Athens, GA 30602

Signalment: 14-year-old, female, dromedary camel

History: The camel had presented to the UGA Teaching Hospital Large Animal Service for a five-month history of respiratory difficulty. The camel also had bloody diarrhea. A nasal mass was identified via endoscopy and radiographs. A McMaster fecal egg count detected 16,475 eggs/g of *Trichostrongyles* and few *Eimeria macusaniensis*, for which she was treated. A temporary tracheostomy tube was placed the following day. She rested comfortably after anesthesia but was found dead in her stall at 4 a.m.

Gross Necropsy Findings: Bilaterally, the right and left nasal cavities were occluded by a 16 cm x 16 cm x 4 cm, tan to white, hard, gritty, solid mass that compressed and displaced the adjacent, dark red turbinates dorsally, as well as the ethmoid bones posteriorly. With slight force, the mass could be transected with a knife. The nasal septum between the right and left nasal cavities remained intact. The mass in the left nasal cavity focally extended into the maxillary bone, but otherwise, the masses were largely separate from but firmly adhered to the bone. The peritoneal cavity contained approximately 0.5 L of clear, yellow fluid. Stomach compartment C3 had multifocal, petechiated to ecchymotic hemorrhages, and was also multifocally eroded to ulcerated.

Histopathologic Findings: Nasal cavity masses: Diffusely, the normal, compact and cancellous bone, as well as hematopoietic precursors, are replaced by abundant, expansile, mucinous, fibrous connective tissue. Numerous fragments of irregular, sometimes atrophic, bony spicules are embedded throughout the fibrous matrix. These spicules are often lined peripherally by osteoblasts and have decreased numbers of osteocytes. Clusters of multinucleated osteoclasts occasionally invade the bone spicules, are free within the fibrous connective tissue, and are rarely within Howship's lacunae (dissection osteoclasia). Occasional spicules appear moth eaten and/or completely lysed. Ethmoid bone and residual nasal turbinates are compressed peripherally by the masses, and the lining respiratory epithelium is segmentally eroded to completely sloughed.

Final Diagnosis: Nasal cavity (bilateral) and maxilla: Severe, diffuse, bone atrophy, lysis, and resorption, with marked, fibrous connective tissue proliferation (consistent with fibrous osteodystrophy)

Comments: The "nasal masses" are an unusual presentation for a metabolic disease that is less commonly seen today due to advances in animal nutrition. Fibrous osteodystrophy, or "bran disease" in horses, results from prolonged and excessive secretion of parathyroid hormone and manifests as extensive resorption of normal bone and replacement with fibrous connective tissue. The hyperparathyroidism can either be primary or secondary, due to diets with low calcium, elevated phosphorous, or vitamin D deficiency. The calcium and phosphorus levels in this camel were normal at the time of presentation, although historical calcium or phosphorus imbalances that had since been corrected may have contributed to the fibrous osteodystrophy. The camel grazed pasture and was also supplemented with Bermuda grass and peanut hay. The camel had access to mineral blocks. Severe, fibrinonecrotic, mycotic gastritis due to a zygomycete such as *Mucor* spp., was present affecting C2 and C3. There was also diffuse villar atrophy, segmental erosions, and severe, lymphoplasmacytic enteritis in the duodenum. The history of parasitism and maldigestion/ malabsorption could have contributed to development of the fibrous osteodystrophy due to impaired calcium absorption. Intermittent diarrhea associated with grazing lush pastures has been suggested as a possible cause of defective calcium absorption in camelids.

References:

1. Lynch, M. Fibrous Osteodystrophy in Dromedary Camels. *Journal of Zoo and Wildlife Medicine* 30 (4): 577-583. 1999.
2. AFIP 2506867, Wednesday Slide Conference W928/89. Case III.

Case 4
Fungal Pneumonia in a Jersey Cow*

Vanessa Wallace, Tanya LeRoith

Virginia-Maryland College of Veterinary Medicine, Virginia Tech, 205 Duck Pond Drive,
Blacksburg, VA 24060

Signalment and Clinical History: A 3-year-old, Jersey cross, dairy cow was treated for metritis three days after calving. A day later, she died. The referring veterinarian performed a field necropsy, which revealed florid pneumonia and possible hepatic lipidosis. Virginia Tech Animal Laboratory Services (ViTALS) received lung and liver samples.

Microscopic Description: Lung. Dense aggregates of degenerate neutrophils, foamy macrophages, epithelioid macrophages, and rare eosinophils, lymphocytes and plasma cells expand intra-alveolar septa and extend into the alveolar spaces, focally intensifying around bronchioles within the section. Admixed within the inflammatory aggregates are necrotic cellular debris and a homogenous, eosinophilic material (fibrin). The inflammation surrounds a dense focus of fungal hyphae, which expand alveolar septa and extend into alveoli. The hyphae are non-pigmented on H&E, have few septations, rarely branch, and measure from 2 μ M to 8 μ M in width. Multiple vessels have hyalinized vessel walls and contain poorly organized fibrin clots abutting the luminal aspect of the vessel wall; some of these vessels have marked perivascular edema. Rarely, fungal hyphae invade vessel walls, and one vessel contains hyphae within a fibrin clot. The interlobular septa are markedly expanded by large, foamy macrophages and occasional lymphocytes and plasma cells. Vessels within the septa have necrotic, hyalinized vessel walls and are lined by plump, reactive endothelial cells.

Liver. There is midzonal hepatocellular necrosis, characterized by hypereosinophilia, pyknosis, and karyorrhexis. There is diffuse hepatocellular cord atrophy and sinusoidal congestion.

Histochemistry: The fungal hyphae are poorly staining with Gomori methenamine-silver (GMS), and non-staining with periodic acid-Schiff (PAS). Gram stain and acid-fast bacteria stain are negative.

PCR: Fungal 16s PCR is pending at the time of abstract submission.

Diagnosis: Lung. Mycotic pneumonia, interstitial, pyogranulomatous and fibrinous, regionally extensive, severe, acute, with vasculitis and thrombosis.

Liver. Necrosis, midzonal, moderate, acute.

Comments: The death of this animal is attributed to a primary fungal pneumonia. However, the pattern of the lesion is consistent with hematogenous introduction of the agent to the lungs, versus inhalation exposure. The morphology, the histochemistry, and the angioinvasive behavior of the fungus is inconsistent with *Aspergillus* species, and is suggestive of a mucormycosis (previously zygomycosis). The suggested pathogenesis of the disease begins with a fungal placentitis, which enters the blood stream at the time of parturition with placental separation, and subsequent hematogenous spread to the lungs. The clinical status of the calf is unknown. The placenta and other tissues were not available for histology.

References:

1. Caswell, J.L., Williams, K.J. Respiratory System. In: Maxie, M.G. (eds) Jubb, Kennedy and Palmer's Pathology of Domestic Animals, 6th edition, Vol. 2, 2016. p. 554.
2. Cordes, D.O., Dodd, D.C., O'Hara, P.J. Acute mycotic pneumonia of cattle. New Zeal. Vet. J., 1964. 12:101-104.
3. Guarner, J., Brandt, M.E. Histopathologic Diagnosis of Fungal Infections in the 21st Century. Clinical Microbiology Reviews, 2011. 24:247-280.

Case 5

Rapid Diagnosis and Confirmation of Toxoplasma gondii Abortions in a Goat Herd*

Rahul B Dange and Mark Anderson

California Animal Health & Food Safety Laboratory, UC Davis School of Veterinary Medicine, CA

Signalment: Three near term aborted goat feti and respective placentas were submitted for necropsy examination.

Clinical History: A goat farm with a history of multiple near term abortions.

Gross examination: Two of the 3 placentas had gross changes consisting of numerous, 1-3 mm in diameter gray white, circular foci in the cotyledons.

Microscopic Description: Histologically, all three placentas had multifocal, random areas of cotyledonary necrosis with mild neutrophilic infiltration and mineralization in the cotyledons. Among these foci, there were rare intracytoplasmic protozoal zoites compatible with *T. gondii*. Brain of one fetus had mild multifocal, nonsuppurative encephalitis with focal necrosis and mineralization and this fetus also had mild diffuse interstitial pneumonia. To evaluate whether impression smears at necropsy would be an efficient, rapid method by which to confirm the presence of protozoa in suspect placentas, cotyledonary impression smears utilizing Giemsa and H and E staining were examined. The H and E stained smears were effective in demonstrating intracytoplasmic and extracellular protozoal organisms. These results suggest that at necropsy of small ruminants with compatible placental lesions, impression smears using H and E stain could be used as a rapid, efficient method to establish a presumptive diagnosis.

Additional confirmatory tests used: Immunohistochemistry for *T. gondii* was strongly positive in all three placentas and *T. gondii* antibody ELISA was positive on all three fetal fluids.

Diagnosis: Placenta: Severe, multifocal, necrotizing, cotyledonary placentitis with intralesional protozoal zoites

Comments: *Toxoplasma gondii* is an obligate intracellular coccidian protozoa which can virtually infect all warm-blooded animals (including but not limited to livestock, birds, humans, and marine mammals). Vertical transmission of *T. gondii* may occur by transplacental infection of fetus, whereas horizontal infection may occur via ingestion of tissue cysts or sporulated oocysts. Cats are considered a definitive host for this protozoa. Goats are one of the most susceptible species in which *T. gondii* infections commonly occurs through contaminated food and water by sporulated oocytes. In this case, these pregnant goats were exposed to cat litter. Through this study, for the first time we demonstrated that H & E stained impression smears could be used for rapid presumptive diagnosis of toxoplasma abortions.

References:

1. Dubey, J. P. & Beattie, C. P. 1988 *Toxoplasmosis of Animals and Man*. 2nd ed. CRC press, Boca Raton, Florida.
2. Tenter, A.M., Heckeroth, A.R. & Weiss, L.M. 2001. *Toxoplasma gondii*: from animals to humans. *Int. J. Parasitol.*, 31(2), 217-220.
3. Anderson ML, Barr BC, Conrad PA. 1994. Protozoal causes of reproductive failure in domestic ruminants. *Vet Clin North Am Food Anim Pract.* 10:439-461.
4. Dubey, J.P., 1988. Lesions in transplacentally induced toxoplasmosis in goats. *American J. Veterinary Res.* 49: 905-909.

Case 6

Multicentric B-cell lymphoma in a sow including neoplastic infiltration of the ovaries*

Drew Magstadt, Paulo Arruda, Darin Madson

Veterinary Diagnostic Laboratory, Department of Veterinary Diagnostic and Production Animal Medicine, Iowa State University, Ames, IA

Clinical History: Five first parity gilts were submitted for necropsy from a commercial breeding farm experiencing elevated sow mortality, decreased conception rate, and increased abortions and vaginal discharge. Non-ambulatory sows and conjunctivitis were also reported. This report presents the gross and microscopic findings in one of the submitted sows.

Gross Pathology: At necropsy, the left and right ovaries were diffusely pale tan, nodular, and approximately 8 times normal size; palor extended through the cut surface. Approximately 95% of normal kidney parenchyma was effaced by numerous 1-5cm diameter pale tan coalescing nodules extending through the cut surface; both kidneys were approximately 10 times normal size. Multifocal nodules of similar size and color were present in the liver. Mesenteric lymph nodes were up to 20 times larger than expected and diffusely pale on cut surface. Lymph nodes throughout the body were variably enlarged with a similar appearance on cut surface. The anti-mesenteric border of the ileum was approximately 4 times thicker than the mesenteric border.

Microscopic Description: Ovary: Expanding the ovary and effacing normal architecture is densely cellular and infiltrative neoplasm. Neoplastic cells are arranged in sheets expanding the parenchyma, surrounding follicles in various stages of development, and infiltrating tissue of the corpus luteum. Cells are round to polygonal with distinct cell borders, and contain scant to low amounts of eosinophilic cytoplasm and a single large, round and occasionally indented nucleus with 1-3 nucleoli. Nuclei are approximately 1.5-2.5 times the diameter of erythrocytes. Mild anisocytosis and moderate anisokaryosis are present, and an average of 9 mitotic figures are observed per HPF (400x). Moderate numbers of tingible body macrophages are scattered throughout the neoplasm. Multifocal areas of hemorrhage are also noted.

Ancillary Testing:

-CD3 IHC: Negative

-CD20 IHC: Positive

-Serum chemistry: BUN=88mg/dl (range: 6-30mg/dl), Creatinine=7.5mg/dl (range: 0.5-2.7mg/dl)

-CBC: Lymphocytes=4.00x10³/μl (range: 4.00-17.9 x10³/μl)

Diagnosis: Multicentric B-cell lymphoma

Comments: Lymphoma is the most common neoplasm reported in swine and is often multicentric affecting the liver, spleen, kidney, and lymph nodes.¹ Studies utilizing the WHO lymphoma classification criteria in swine are not available. Features in this case are suggestive of either diffuse large B-cell lymphoma or Burkitt-like lymphoma of dogs; the distinction between these tumors is fairly subjective.^{2,3} Since 2003, 61 cases of lymphoma have been diagnosed in swine at ISU-VDL. Of those with a reported age, 70% were between 2 and 6 months and 11% were over 6 months old. Most cases had a clinical history of sudden death or failure to thrive.

References:

1. Valli VE, Kiupel M, Bienzle D. Hematopoietic system. In: Maxie MG, ed. *Jubb, Kennedy, and Palmer's Pathology of Domestic Animals*. Vol 3. 6th ed. Elsevier; 2016:241-242.
2. Valli VE, Bienzle D, Meuten DJ. Tumors of the hemolymphatic system. In: Meuten DJ, ed. *Tumors in Domestic Animals*. 5th ed. Wiley Blackwell; 2017:238-245.
3. Valli VE, et. al. Classification of canine malignant lymphoma according to the World Health Organization criteria. *Veterinary Pathology*. 2011;48(1):198-211.

Case 7
Systemic Calcinosis in a Quarterhorse*

Argiñe Cerezo, Kelli Almes
Kansas State Veterinary Diagnostic Laboratory, Manhattan, KS

Signalment and History: A 5 year-old, Quarter Horse gelding presented to the Kansas State Veterinary Health Center with colic signs of 12 hours duration, inability to stand, and ventricular tachycardia. Bloodwork at the time of presentation revealed the following abnormalities: Creatinine Kinase (CK) 80,000 U/L [97-355], Phosphorous (P) 16.3 mg/dl [1.9-3.6] and total Calcium 11.7 mg/dl [11.7-14.0]. He was taken to surgery and a mild pelvic flexure displacement and hypermotile small intestines were discovered. During recovery, the animal was unable to stand and quickly went into cardiac arrest and died. He had a previous diagnosis of Polysaccharide Storage Myopathy (PSSM).

Gross Findings: Bilaterally, the hind limb musculature, more prominently within the quadriceps, semitendinous, semimembranous, and gluteal muscles, as well as the deep lumbar muscles, contained multifocal areas of gritty, linear streaking to locally extensive, coalescing, irregular areas of pallor. The liver, kidney and heart also contained multifocal, gritty, pale areas.

Microscopic findings: Examined sections of multiple grossly affected skeletal muscles widely contained myocyte degeneration and/or necrosis characterized by swollen, pale, vacuolated sarcoplasm with an absent or pyknotic nucleus and abundant intracytoplasmic mineralization. These areas of muscle also contained a robust infiltrate of macrophages, lymphocytes and fewer plasma cells and multinucleated giant cells. Fibrosis was also present which markedly distended the endo- and perimisial spaces. There was also occasional small, myofibers with scant lightly basophilic sarcoplasm and internal rowing of large vesiculate nuclei (regeneration). Mineralization was also present in the myocardium, lung, kidney, stomach, and brain.

Diagnosis: Striated muscle: Myocyte degeneration and necrosis with mineralization, macrophages and multinucleate giant cells, severe, multifocal to coalescing with regeneration

Comment: Systemic calcinosis is a fatal, suspected immune-mediated, myositis. The animals are typically healthy prior to the onset of clinical signs, with no evident preexisting condition. A product of serum calcium (Ca) and Phosphorous (P) above 65 is considered pathognomic for this disease. The elevated Ca and P levels are believed to be secondary to inflammation, but the exact pathogenesis is not clear. This is hypothesized as a synergistic effect of TNF- α and receptor activator of nuclear factor kappa B ligand (RANKL), producing multinucleated osteoclasts, leading to an inflammatory osteolysis, which may be sufficient to cause the hyperphosphatemia seen in patients with systemic calcinosis. Very limited literature is available on this disease in the horse, but equine cases have commonly been associated with history of other disease such as Salmonellosis or respiratory disease. This horse was confirmed to have PSSM but had no history of any recent clinical signs associated with that condition, or any other illness.

References:

1. S. A. Durward-Akhurst, S. J. Valberg “**Immune-Mediated Muscle Diseases of the Horse**”
Veterinary Pathology First published date: January-27-2017 [10.1177/0300985816688755](https://doi.org/10.1177/0300985816688755)

Case 8

Lymphoplasmacytic myelitis in a sow due to Porcine Astrovirus type 3 (PAstV 3)*

Franco Matias Ferreyra¹, Bailey Arruda¹, Paulo Arruda¹, Melissa Hench², Igor Renan³, Franco Matias Ferreyra¹, Ben Hause⁴, Li Ganwu¹, Karen Harmon¹, Laure Bradner¹, Phil Gauger¹, Kent Schwartz¹, Bailey Arruda¹

¹Veterinary Diagnostic and Production Animal Medicine, College of Veterinary Medicine, Iowa State University, Ames, IA, USA; Department of Preventive Veterinary Medicine and Animal.

²Department of Preventive Veterinary Medicine and Animal Reproduction, College of Agricultural and Veterinary Sciences, São Paulo State University (UNESP), Jaboticabal, SP, Brazil. ³The Maschhoffs. Carlyle, IL, USA. ⁴Cambridge Technologies, Worthington, MN, USA.

Clinical History: Tissue from a sow with neurologic signs that included quadriplegia and convulsions. Case fatality rate of 100%.

Gross Pathology: No gross lesions were observed at necropsy.

Microscopic Description: Spinal cord: Virchow-Robin spaces are often expanded by high numbers of lymphocytes, plasma cells with lesser macrophages and scattered eosinophils. The grey matter is disrupted by multiple, variably sized areas of gliosis and occasional small areas of hemorrhage. Rarely neurons are shrunken, angular, and hypereosinophilic (neuronal necrosis) and surrounded by glial cells (satellitosis).

Histologic examination of brainstem and cerebellum revealed similar features to the previously described for spinal cord.

Ancillary Testing:

Next generation sequencing (CNS tissue): **PAstV type 3** (2023 read count)

PAstV type 3 PCR (Cerebrum, cerebellum, cervical, thoracic and lumbar spinal cord): Positive

PAstV type 3 PCR (Serum, feces, heart, kidney, liver, lung, spleen): Negative

Diagnosis: Lymphoplasmacytic myelitis with gliosis, neuronal necrosis and satellitosis (PAstV type 3)

Comments: Cases of encephalomyelitis across different species including humans, mink and bovine have been associated with different Astroviruses. The clinical signs and microscopic lesions observed in this case are somewhat similar to those previously described for other neurotropic Astroviruses. The PAstV-3 identified in this report has a 92.2% nucleotide sequence similarity to a PAstV-3 identified in porcine feces; however, the significance between the genetic difference and virulence and potential neurotropism is unclear. To our knowledge, this is the first report of a case of neurologic disease in swine associated with a divergent PAstV- 3.

References:

1. Li L, Diab S, McGraw S, Barr B, Traslavina R, Higgins R, et al. Divergent Astrovirus Associated with Neurologic Disease in Cattle. *Emerg Infect Dis*. 2013;19(9):1385-1392. <https://dx.doi.org/10.3201/eid1909.130682>
2. Blomström AL, Widén F, Hammer AS, Belák S, Berg M. Detection of a novel astrovirus in brain tissue of mink suffering from shaking mink syndrome by use of viral metagenomics. *J Clin Microbiol*. 2010;48:4392–6.
3. Quan PL, Wagner TA, Briese T, Torgerson TR, Hornig M, Tashmukhamedova A, Astrovirus encephalitis in boy with X-linked agammaglobulinemia. *Emerg Infect Dis*. 2010;16:918–25
4. Xiao CT, Giménez-Lirola LG, Gerber PF, Jiang YH, Halbur PG, Opriessnig T. Identification and characterization of novel porcine astroviruses (PAstVs) with high prevalence and frequent co-infection of individual pigs with multiple PAstV types. *J Gen Virol*. 2013 Mar;94(Pt 3):570-82.

Case 9
Helcococcus ovis* infection in animals

Linda Huang, Rinosh Mani, Thomas Mullaney
Veterinary Diagnostic Laboratory, Michigan State University, Lansing, MI

Signalment and History: A group of 250, 13-week-old Holstein calves that were vaccinated with a 5-way viral antigen at 5 weeks-of-age were treated for bovine respiratory disease. Antibiotics were given for 5 days without any noticeable improvement. One calf was euthanized and a field necropsy performed. The larynx and sections of lung, kidney, liver, lymph node, and small intestine were submitted. The lung sections were heavy and dark red and had multifocal caseous plugs in bronchi and bronchioles.

Microscopic Findings: The lungs had severe, suppurative, bronchopneumonia with large, multifocal to coalescing regions of necrosis. Airways were plugged with caseous material or with suppurative exudate mixed with cellular debris and large colonies of cocci bacteria. Alveoli contained neutrophils, fibrinous exudate, and macrophages. There were multifocal, irregular areas of sequestration rimmed by degenerate neutrophils. Sequestra often contained colonies of cocci.

Diagnosis: Lungs: severe, subacute to chronic, fibrinosuppurative and necrotizing bronchopneumonia with intralesional bacterial colonies

Additional Findings: Bacterial culture of the lung yielded numerous *Helcococcus ovis*, numerous *Mycoplasma bovis*, and few *Mannheimia* species (not *M. haemolytica*).

Comment: The caseous lung lesions are consistent with *Mycoplasma bovis* infection, while the fibrinosuppurative and necrotic areas of lung with intralesional cocci indicate a coinfection with *Helcococcus ovis*. The large colonies of cocci bacteria are a common feature of *H. ovis* associated pneumonia. *Helcococcus ovis* is an emerging pathogen which has been reported in cases of bronchopneumonia with pulmonary abscesses in a goat, pleuritis and bronchopneumonia in sheep, and valvular endocarditis in cattle. At the Michigan State University Veterinary Diagnostic Laboratory there have been recent cases where *H. ovis* has been isolated from a sheep with necrotizing bronchopneumonia and pleuritis and from the stifle of a 1-week-old calf with fibrinosuppurative polyarthritis. As cases of *H. ovis* associated infections of various body systems are increasingly detected, *H. ovis* should be considered a differential in cases of necrotizing pleuropneumonia, valvular endocarditis in cattle, and fibrinosuppurative polyarthritis in calves.

References:

1. Garcia A, et al. *Helcococcus ovis* isolated from a goat with purulent bronchopneumonia and pulmonary abscesses. J Vet Diagn Invest. 2012 Jan;24(1):235-7.
2. Kutzer P, et al. *Helcococcus ovis*, an emerging pathogen in bovine valvular endocarditis. J Clin Microbiol. 2008 Oct;46(10):3291-5.
3. Post KW, et al. Valvular endocarditis associated with *Helcococcus ovis* infection in a bovine. J Vet Diagn Invest. 2003 Sep;15(5):473-5.
4. Zhang Y., et al. Isolation of *Helcococcus ovis* from sheep with pleuritis and bronchopneumonia. J Vet Diagn Invest. 2009 Jan;21(1):164-6.

Case 10
Avian Reovirus-associated Tenosynovitis with Degenerative Joint Disease in Broiler Breeders*

Jessica K. Hockaday¹, Martha Pulido-Landinez¹, Brittany S. Baughman², Heidi H. Rose²
¹Poultry Research and Diagnostic Laboratory, Mississippi State University College of Veterinary Medicine, Pearl MS ²Mississippi Veterinary Research and Diagnostic Laboratory, Mississippi State University College of Veterinary Medicine, Pearl MS

Signalment & history: Six, live, 27 week old, Cobb broiler breeders. “Birds limping in several houses.”

Gross Examination: Three (of 6) examined hock joints contain serous to fibrinopurulent exudate. In all hock joints, the gastrocnemius tendon is firm and fibrotic, with fusion of the tendon sheath. Ecchymotic hemorrhages are multifocal; and green discoloration is present in adjacent skin, soft tissues, and gastrocnemius muscle. Four cases demonstrate mild to severe erosion of the articular cartilage of the distal tibiotarsus.

Microscopic Description: In examined sections of tendon (7), the tendon sheath is largely effaced by granulation tissue, which multifocally dissects into adjacent skeletal muscle; hemorrhage is multifocal. Most sections include foci of dystrophic cartilage. Intact synovial membranes are composed of hypertrophied and hyperplastic synoviocytes intermixed with collagen and scattered lymphocytes and plasma cells. The epiphyseal cartilage is moderately to markedly eroded to focally fully ulcerated in sections of tibia (3/4). In ulcerated foci, underlying subchondral bone is covered by well-vascularized granulation tissue with mild lymphocytic inflammation (pannus). Adjacent synovial membrane (present in 1 section) is expanded by hypertrophic synoviocytes, fibrous stroma, and a lymphoplasmacytic infiltrate. The synovial space (1 section) contains eosinophilic fluid, as well as foci of necrotic cartilage and mineralized bone (joint mice).

Viral Isolation in Cell Cultures: Avian Reovirus positive

Morphologic Diagnosis: 1. Tendon: chronic severe fibrosing and lymphoplasmacytic tenosynovitis with intralesional dystrophic cartilage 2. Tibia: Multifocal moderate to severe epiphyseal cartilage erosion to ulceration, with rare intra-articular cartilage and bone

Comments: Avian Reovirus most commonly affects broiler breeders between 4 to 7 weeks of age. The manifestation in older breeders can be associated with the systemic stresses of sexual maturity, and the virus can persist in affected birds for up to 22 weeks post-infection (Swayne, 2013). The gross lesion typically associated with Avian Reovirus (viral arthritis) is a localized swelling of the gastrocnemius, digital flexor, and metatarsal extensor tendons. Avian Reovirus has three proposed phases: acute (7-15 days), early chronic phase (15-30 days), and late chronic phase (over 30 days post-infection). This case most resembles the late chronic phase, in which there is typically fibrous connective tissue with infiltration of lymphocytes, macrophages and plasma cells within the tendon and synovial sheath. This case of viral arthritis is notable because of the severity of associated erosive to ulcerative articular cartilage lesions, with the presence of osteochondrosis desiccans in one case.

References:

1. Anderson-Mackenzie, J. (1997). Degenerative joint disease in poultry-differences in composition and morphology of articular cartilage are associated with strain susceptibility. *Research in Veterinary Science*, 63: 29-33.
2. Maxie, M. G. (2016). *Maxie, M. Grant, K. V. F. Jubb, P. C. Kennedy, and Nigel Palmer. Jubb, Kennedy, and Palmer's Pathology of Domestic Animals. : Elsevier Saunders, 2007. St. Louis: Elsevier Saunders.* Swayne, E. D. (2013). *Disease of Poultry*. Ames, Iowa: Wiley-Blackwell.

Case 11
Ocular Lesions of Malignant Catarrhal Fever in a Heifer*

Tanit Kasantikul, Thomas Mullaney, Roger Maes, Dodd Sledge
Michigan State University Veterinary Diagnostic Laboratory, Lansing, MI

Signalment and History: This 1-year-old Red Angus-cross heifer, in a group of 25, presented with anorexia, lethargy and fever (105.1F). There were multifocal ulcers and sloughing of the epithelium of the oral mucosa, dental pad, nostrils and vulva. Clinical signs worsened over 6 days and the heifer died. A foreign animal disease investigation was initiated because of concern for Foot and Mouth Disease (FMD). The carcass was submitted to the MSU VDL.

Gross Findings: In addition to the ulcers in the oral cavity, nasal pad and vulva, there was extensive necrosis of the mucosa of the trachea, larynx, esophagus, and abomasum. Corneas, bilaterally, were diffusely white, cloudy and edematous. Palpebral and scleral conjunctiva was bright red. There were scant mats of yellow brown fibrin in anterior chambers.

Histopathologic Findings: A section of the anterior segment of one globe is provided. There are variably intense, perivascular and interstitial infiltrates of small to intermediated sized lymphocytes, fewer histiocytes, and rare plasma cells within the limbal sclera, anterior uveal stroma, subepithelial scleral conjunctiva, and episcleral fascia. In some vessels in these regions, intermediate sized lymphocytes infiltrate and obscure the wall of vessels including some muscular arterioles. The anterior and posterior chambers contain mats of fibrillar fibrin, flocculent proteinaceous fluid, and aggregates of lymphocytes and histiocytes, which concentrate along Descemet's membrane and replace extensive portions of the corneal endothelium. Corneal stromal fibers, especially in the peripheral cornea, are individualized and separated by edema, and there is dense neovascularization of the superficial and mid corneal stroma extending approximately 2 mm from the limbus that is accompanied by dense infiltrates of lymphocytes and histiocytes. Conjunctival and corneal epithelium is segmentally eroded and rarely ulcerated.

Diagnosis: Severe perivascular and interstitial lymphocytic uveitis and conjunctivitis with lymphocytic vasculitis; Marked lymphocytic endotheliitis, corneal edema and corneal neovascularization

Additional Findings: There were similar dense perivascular lymphocytic infiltrates and occasional lymphocytic vasculitis in multiple organs including kidney, brain and skin. PCR, performed at the Plum Island Animal Disease Center, was negative for FMDV. PCR performed at the MSU VDL was positive for Ovine herpesvirus-2 and negative for Bovine herpesvirus-1.

Comments: In cattle in the US, malignant catarrhal fever is most commonly sheep-associated and caused by infection with Ovine herpesvirus-2. Clinically, ocular signs of malignant catarrhal fever may include conjunctivitis, photophobia, periocular discharge, blepharospasm, uveitis, and progressive corneal edema that spreads centripetally from the limbus.^{1,2} Corneal edema is due to necrosis and loss of endothelium, often associated with lymphocytic infiltrates in addition to vasculitis and epithelial changes.¹ Severity of clinical signs and disease outcome varies, and mortality is high. In animals that recover, anterior uveitis often improves, but corneal edema may persist.² The severity of ocular signs at initial diagnosis has not been shown to be prognostically significant.²

References:

1. Whiteley HE, Young S, Liggitt HD, DeMartini JC. Ocular Lesions of Bovine Malignant Catarrhal Fever. *Vet Pathol.* 1985. 22: 219-225
2. Zemljič T, Pot SA, Haessig M, Spiess BM. Clinical ocular findings in cows with malignant catarrhal fever: ocular disease progression and outcome in 25 cases (2007-2010). *Vet Ophthalmol.* 2012 Jan;15(1):46-52.

Case 12
Immune Complex Glomerulonephritis and Myocarditis in a Dog*

Cory R. Hanks, Tanya LeRoith

Department of Biological Sciences and Pathobiology, Virginia-Maryland College of Veterinary Medicine, Blacksburg, VA

Clinical History: This 4 year-old golden retriever presented to the referring veterinarian for lethargy and rapid weight loss. Upon examination, the dog was severely azotemic with proteinuria and hypertension. The dog tested positive for Lyme disease and treatment yielded minimal response.

Gross Findings: The sclera, mucous membranes, and subcutaneous and omental adipose tissue are diffusely light-yellow. The liver is mildly enlarged and slightly yellow. The kidneys are bilaterally swollen with numerous dark-red spots scattered throughout the cut surface of the renal cortices (petechiae). The myocardium contains multifocal areas of pallor and hemorrhage, which are most prominent in left ventricular free wall. The right ventricular free wall is similarly affected to a less severe extent.

Histopathology: Kidneys: Sections from both the left and right kidney contain glomeruli that are moderately to severely, segmentally thickened by abundant, brightly eosinophilic, homogenous to finely granular material admixed with small numbers of neutrophils, macrophages, and lymphocytes. Bowman's capsule is irregularly thickened in a similar manner and multifocal synechiae with the glomerular tufts are visualized. Numerous proximal tubules are ectatic and lined by multifocal necrotic epithelial cells. The lumina contain abundant amounts of cellular debris admixed with homogenous, brightly eosinophilic material. There is occasional tubular epithelial regeneration, characterized by large nuclei and increased cytoplasmic basophilia. Throughout the interstitium, there are multifocal aggregates of small numbers of lymphocytes and plasma cells.

Heart: The myocardium is multifocally altered by large foci of hemorrhage and necrosis. Affected myocardial fibers have hypereosinophilic, fragmented cytoplasm and pyknotic or absent nuclei. The adjacent interstitium is infiltrated by small numbers of neutrophils and macrophages. Few neutrophils and macrophages infiltrate and dissect the interstitium unassociated with the areas of hemorrhage and necrosis.

Morphologic Diagnoses:

Membranoproliferative glomerulonephritis, severe, diffuse, segmental with tubular necrosis and lymphoplasmacytic interstitial nephritis

Myocarditis, pyogranulomatous, severe, multifocal

Discussion: This dog's renal failure can be attributed to membranoproliferative glomerulonephritis and tubular necrosis. The histologic lesions are consistent with immune complex deposition within the glomeruli. These findings, in combination with the pyogranulomatous myocarditis and positive Lyme titer, suggest borrelial/Lyme glomerulonephritis as the most likely etiology. Approximately ~1-2% of all dogs with positive Lyme titers develop nephritis; golden retrievers are 4.9 times as likely to develop this lesion.

References:

1. Dambach DM, Smith CA, Lewis RM, et al. Morphologic, immunohistochemical, and ultrastructural characterization of a distinct renal lesion in dogs putatively associated with *Borrelia burgdorferi* infection: 49 cases (1987–1992). *Vet Pathol* 1997; 34:85–96.

Case 13
Steroidal saponin poisoning in sheep

John Mackie

QML Vetnostics, Murarrie, QLD, Australia

Signalment: 4-month-old, recently weaned Dorper sheep

Clinical history: More than 40% of the flock developed photosensitisation and jaundice approximately 2 weeks after transfer to pasture containing a dominant growth of Bambatsi grass (*Panicum coloratum* var. *makarikariense*). The mortality rate was 10%.

Clinical pathology: Serum chemistry abnormalities included elevated total bilirubin, AST, GGT and globulins.

Gross pathology: The carcase was jaundiced and the liver was swollen (necropsy was done by referring veterinarian).

Microscopic findings: *Liver:* In portal areas there is mild to moderate biliary hyperplasia with mild fibroplasia and lymphohistiocytic inflammation. Kupffer cells exhibit hypertrophy and hyperplasia, occasionally forming small aggregates. Kupffer cell cytoplasm is often vacuolated and variably contains globular debris and pale brown pigment. There is mild disruption of hepatocyte cords, accompanied by single cell necrosis, anisokaryosis, increased mitotic figures and canalicular cholestasis. Acicular clefts are present in occasional Kupffer cells/macrophages and hepatocytes, and some clefts are surrounded by small aggregates of macrophages.

Diagnosis: Crystal-associated cholangiohepatopathy

Comments: The histologic findings are consistent with intoxication by a steroidal saponin. Crystal-associated cholangiohepatopathy is caused by consumption of grasses such as various *Panicum* spp and *Brachiaria decumbens*, and other plants such as *Tribulis terrestris*, *Nartheicum ossifragum*, *Agave lecheguilla* and *Nolena texana*. It is mainly a disease of sheep and goats and occasionally affects cattle and horses. Younger animals tend to be more susceptible. The various plants responsible are toxic only sporadically. Saponin concentration varies greatly within a species of plant from site to site and with the age of the plant. Intoxication is more likely to occur with young plants or wilted plants.

Crystals derived from the plant saponins may be found in the biliary tract, Kupffer cells and hepatocytes. Acicular clefts are left by crystals removed during tissue processing. The severity of clinical disease is not related to the prevalence of acicular clefts and in acute cases clefts may be very difficult to detect.

Reference:

1. Cullen JM, Stalker MJ. Liver and biliary system. In: Maxie MG, ed. Jubb, Kennedy and Palmer's Pathology of Domestic Animals. 6th ed. Vol 2. St Louis, MO: Elsevier, 2016: 258-352.

Case 14
***Klebsiella pneumoniae* in horses**

Akinyi Nyaoke¹, Janet Moore, and Andreas Klohnen

¹ California Animal Health and Food Safety Laboratory, UC Davis, San Bernardino, CA 92408, and ² Chino Hills, CA 91709

Signalment: 12 year-old Quarter horse gelding

History: Presented for colic which was successfully treated and horse sent home. Horse returned three days later to the hospital with fever, severe pneumonia and died shortly thereafter.

Gross Necropsy Findings: Mucous membranes were pale and there was yellow discoloration of pericardial and retroperitoneal fat and mesentery. Thoracic cavity contained approximately 1 liter of serosanguineous fluid and there were hemorrhages on ventral surface of the thoracic vertebrae, costal muscles and pleural margin of the diaphragm.

The right lung was markedly enlarged approximately 1.5 times larger than the left. The caudal and accessory lobes of the right lung were firm, consolidated, deep red to red-black with prominent interlobular septae, and pleura was coated with fibrin and multifocally adhered to the ribcage. Cut surface was firm, deep red with congested vessels and extensive parenchymal hemorrhages. Cranial lobe of the right lung was pink, moist, and inflated, had focal hemorrhages scattered throughout. The ventral half of the caudal lobe of the left lung was collapsed, deep pink and sharply demarcated from the rest of the lung, and there were hemorrhages scattered throughout the left lung.

Hemorrhages were present in pericardial adipose, epicardium along the interventricular septum and coronary groove, and in papillary muscle of the heart, more severely in the left heart, in mesentery and along serosa of the gastrointestinal tract.

Histopathologic Findings: Parenchyma is extensively to diffusely consolidated from expanses of severe intra-alveolar hemorrhage and fibrinopurulent exudation populated by numerous plump bacilli, some of which have visible capsules. Bronchi and bronchioles contain clumps of fibrinocellular to hemorrhagic exudate and exfoliated epithelium. Interlobular septae and pleural stroma are markedly expanded by fibrinopurulent to multifocally hemorrhagic exudate with large bacterial aggregates in pleural stroma. Throughout the lung there is severe, necrotizing neutrophilic vasculitis with or without accompanying fibrinocellular thrombosis of medium to large caliber intralobular and interlobular vessels and multifocal fibrinous thrombosis of microvasculature.

Laboratory Findings: Pure culture of *Klebsiella pneumoniae* was isolated from the lung. Gram stain identified intralesional bacteria as monomorphic population of gram-negative bacilli.

Final Diagnosis: *Klebsiella pneumoniae*.

Comments: *Klebsiella* spp. are part of the normal urogenital and intestinal microflora in horse, and have been implicated as causes of bacterial pneumonia in horses often as a complication of mechanical ventilation.

References:

1. Estell KE., et al. Pneumonia caused by *Klebsiella* spp. in 46 horses. J Vet Intern Med 2016. 30:314-321
2. Brown JE, Corstvet RE, Stratton LG. A study of *Klebsiella pneumoniae* infection in the uterus of the mare. Am J Vet Res 1979.40:1523-1530.

Case 15
Paranasal aneurysmal bone cyst in a yearling Thoroughbred

Jennifer Janes¹, Katherine Garrett², Rolf Embertson²

¹University of Kentucky Veterinary Diagnostic Laboratory, Lexington, Kentucky

²Rood and Riddle Equine Hospital, Lexington, Kentucky

Signalment: Yearling Thoroughbred filly

History: A progressive swelling over the right maxillary sinus area was observed over the course of months. Nasal endoscopy identified obstruction of the right nasal passage and distortion of the conchae. A large mass distorting the surrounding tissue was identified on radiographs. Magnetic resonance imaging identified a large mass with heterogeneous signal intensity in the right paranasal sinus cavities. The mass compressed the right ethmoid turbinates and deviated the nasal septum to the left.

Gross Necropsy Findings: On external examination, there is moderate swelling on the right side of the head in the region of the paranasal sinuses. On parasagittal section, the right paranasal sinuses are markedly distorted due to a space occupying 10 cm x 9 cm x 6 cm mass. The right frontal, sphenopalatine and maxillary sinuses are affected; the ethmoid turbinates are compressed. The mass compresses and deviates the nasal septum to the left. The mass is composed of variably sized multiloculated cysts (honeycomb appearance) that contain red-tan opaque fluid supported by a tan, firm stroma.

Histopathology: Paranasal Sinus Mass: The mass is composed of variably sized blood filled cavernous spaces lined by flattened spindle cells with scattered multinucleated cells. Some spaces also contain acidophilic, homogenous material and mixed inflammation admixed with luminal blood. Streams of fibroblasts and spicules of woven bone lined by osteoblasts and few osteoclasts separate the cysts. Few cystic structures lined by ciliated columnar (respiratory) epithelium are interspersed. Moderate numbers of neutrophils, macrophages and few multinucleated giant cells are scattered throughout the supporting tissue. Lakes of basophilic, slightly granular material are scattered in the supporting fibrous-osseous stroma and cyst contents.

Morphologic Diagnosis: Paranasal aneurysmal bone cyst

Comment: Aneurysmal bone cysts (ABCs) are relatively rare in animals with scattered reports across several species. Specific to the horse, reported locations include the mandible and long bones.¹⁻² However although reports are still sparse, paranasal sinus ABCs have been described in the human literature.³ The cause of ABCs is unknown but thought to possibly be related to vascular disturbances leading to bone erosion.⁴

References:

1. Lamb CR, Schelling SH. Congenital aneurysmal bone cyst in the mandible of a foal. *Equine Vet J.* 1989. 21:130-132.
2. Steiner JV, Rendano VT. Aneurysmal bone cyst in the horse. *Cornell Vet.* 1982. 72:57-63.
3. Segall L, Cohen-Kerem R, Ngan BY, Forte V. Aneurysmal bone cysts of the head and neck in pediatric patients: a case series. *Intl J Pediatr Otorhinolaryngol.* 2008. 72:977-83.
4. Craig LE and Thompson KG. In: Meuten, DJ, editor. *Tumors in Domestic Animals.* 5th ed. Ames, IA: Iowa State Press; 2017. 421-422.

Case 16

PRRSv associated meningoencephalitis in 5-week-old pigs

Darin Madson and **Drew Magstadt**

Veterinary Diagnostic Laboratory, Department of Veterinary Diagnostic and Production Animal Medicine, Iowa State University, Ames, IA

Clinical History: In late 2016, an antigenically different wild-type porcine reproductive and respiratory syndrome virus (PRRSv) spread through a commercial breed-to-wean facility. Clinical signs were observed in the population for several months post-introduction and were steadily improving. However, weaned pigs were struggling following placement into nursery/grower facilities. Tissues from two, 5-week-old pigs were submitted to the Iowa State University Veterinary Diagnostic Laboratory with reported neurologic signs. One pig was reported to have signs suggestive of bacterial meningitis while the other pig had exaggerated and uncoordinated movements.

Gross Pathology: Gross necropsy lesions were not reported on the submission form. Noted tissue changes observed during case processing included patchy regions of cranioventral lung consolidation and chronic fibrosing epicarditis along with capsular fibrosis of the spleen in one pig.

Microscopic Description: Brain: There is severe and regional cerebral cortex encephalitis with neuronal necrosis. Salient features include extensive neuronal coagulative necrosis with neuropil mineralization and vacuolation, nodular or linear gliosis with associated gitter cells, perivascular accumulations of lymphocytes and macrophages and endothelial hypertrophy. Lymphocytes and macrophages variably expand the leptomeninges in these regions of intense inflammation.

Ancillary diagnostic testing:

- PRRSv PCR → **Positive**; pooled lung: 16.9 CT
- PRRSv IHC → **Positive**; brain: marked immunolabeling in macrophage-like cells
- Next Generation Sequencing, devo → **Positive** for PRRSv only; brain
- Porcine pseudorabies PCR and bacterial culture → Negative; brain

Diagnosis: Necrotizing meningoencephalitis, severe and locally extensive with PRRSv antigen detection

Comments: PRRSv is one of the most costly global swine diseases and is associated with reproductive failure in breeding animals and respiratory disease in all ages of swine. Vasculitis, interstitial pneumonia lymphoid hyperplasia with individual lymphocyte necrosis, myocarditis, interstitial nephritis and encephalitis are possible lesions. In North America, PRRSv associated neurologic disease has typically been reported in neonates and is associated with nonsuppurative inflammation or vasculitis in brain.¹ More recently, Asian highly pathogenic PRRSv strains have been associated with encephalitis in adult animals.² Demonstration of PRRSv antigen in the brain has previously been reported; however, antigen detection was found in only one of 105 cases examined.³ Adding complexity to this case is the PRRSv sequence analysis. Whole genome sequence results showed 97% similarity to novel PRRSv isolates found in recent years that have deletions in untranslated regions, and have mutations in the N gene and deletions in the NSP2 gene.⁴ This particular virus showed 95% whole genome sequence similarity to another ISU-VDL case of PRRSv associated neurologic disease in weaned pigs. PRRSv should be a differential for nonsuppurative encephalitis in all ages of swine.

References:

1. Rossow KD, Shivers JL, Yeske PE, et al. Porcine reproductive and respiratory syndrome virus infection in neonatal pigs characterised by marked neurovirulence. *Vet Rec.* 1999;144(16):444-448.
2. Cao J, Li B, Fang L, Chen H, Xiao S. Pathogenesis of nonsuppurative encephalitis caused by highly pathogenic Porcine reproductive and respiratory syndrome virus. *J Vet Diagn Invest.* 2012;24(4):767-771.
3. Thanawongnuwech R, Halbur PG, Andrews JJ. Immunohistochemical detection of porcine reproductive and respiratory syndrome virus antigen in neurovascular lesions. *J Vet Diagn Invest.* 1997;9(3):334-337.
4. Wang L, Zhang Y. Novel porcine reproductive and respiratory syndrome virus strains in the United States with deletions in untranslated regions. *Arch Virol.* 2015;160(12):3093-3096.

Case 17
Granulomatous pneumonia of undetermined etiology in a horse

Francisco A. Uzal

California Animal Health and Food Safety laboratory, UC Davis, San Bernardino Branch, California

Clinical history: 14-year-old Warmblood gelding with a history of several months of fever spikes and ~ 2-month pneumonia that did not respond to antibiotics or antifungals. This horse had lived for a few months in an area of Northern California where cases of pneumonic silicosis had been diagnosed before.

Gross findings: Both lungs presented many, multifocal and more or less equidistantly distributed, roughly spherical white to grey, firm nodules, 2-4 cm diameter. Each nodule was surrounded by a thin fibrous capsule and had a radiated appearance. Both lungs were congested and edematous and there was a large amount of stable froth in the trachea and lower airways. The tracheobronchial and mediastinal lymph nodes were mildly to moderately, and diffusely enlarged and edematous. The parietal pleura on both sides of the thorax showed multifocal nodules similar to those described in the pulmonary parenchyma.

Histopathology: There are many multifocal pyogranulomas composed of central areas of necrosis with amorphous eosinophilic material admixed with viable and degenerate neutrophils, and surrounded by macrophages, lymphocytes, plasma cells and many multinucleated giant cells. Each of these pyogranulomas is surrounded by abundant fibrosis which in many cases also infiltrates the pyogranulomas.

Morphologic diagnosis: pneumonia, pyogranulomatous, multifocal to coalescing, with severe fibrosis.

Comments: Ancillary testing, including special stains (Gram, PAS, Ziehl Nielsen), aerobic, anaerobic and fungal cultures were unrewarding, as was PCR for EHV-1, EHV-2 and EHV-5. Because of the clinical history, the submitting veterinarian suspected silicosis, but no intracytoplasmic particles, tracheobronchial lesions or bone lesions typical of that condition were detected. The etiology of this pneumonia remains undetermined.