The Armed Forces Institute of Pathology
Department of Veterinary Pathology

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Conference 5

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Moderator:

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CASE I – 08 06-29523 (AFIP 3066303).

Signalment: 14-year-old, intact female, Thoroughbred, equine (*Equus caballus*)

History: The horse had a two day history of colic. Exploratory surgery revealed a 12 cm in diameter mass cranial to the left kidney which was not surgically resectable. Euthanasia was elected after a rapid decline in health post surgically, that was unresponsive to medical management.

Gross Pathology: 10 cm of the cranial mesenteric artery, immediately distal to the ostium, was dilated 3 cm and thickened (6 mm). The vessel was partially occluded by a 3.5 cm long red to purple, friable coagulum (thrombus) that was tenaciously adhered to the intimal surface. The intima was diffusely rough and granular.

Laboratory Results:
Clinical pathology abnormalities at surgery:
Neutrophils=16.1X10^3/ul (5.5-12.0)
Lymphocytes=0.79X10^3/ul (1.5-5.0)
Total protein = 8.1 g/dL (5.5-7.5)
Serum globulin = 4.9 g/dL (2.6-4.0)
Sodium = 133 mEq/L (137-148)
Chloride = 90 mEq/L (98-110)
Potassium = 1.9 mEq/L (2.9-5.3)
Sodium/Potassium ratio = 70 (28-36)
Glucose = 133 mg/dL (71-100)
Alk phos = 262 U/L (45-239)
Total bilirubin=2.7 mg/dL (0.6-2.6)
CPK = 1507 U/L (120-350)
SDH = 15.9 U/L (0.2-7.0)
All other values were within normal limits.

Histopathologic Description: The arterial lumen is occluded by an eosinophilic, amorphous coagulum (thrombus) containing alternating layers of free erythrocytes, intact and degenerate neutrophils, and necrotic debris (lines of Zahn) and multiple 1-2 mm cross sections of nematodes. The **nematodes (fig. 1-1)** have a bright eosinophilic, thick, smooth, cuticle with lateral cords and platymyarian musculature surrounding a central digestive tract. The thrombus adheres to and blends in with the vessel wall. The endothelium is mostly absent and the internal elastic lamina is disrupted, fragmented, and coiled. The tunica intima is diffusely thickened by proliferative immature fibrous connective tissue which also penetrates the tunica media and extends to and expands the adventitia, with separation and individualization of smooth muscle fibers. The intima is diffusely infiltrated by many neutrophils and relatively fewer eosinophils extending in from the lumen in declining numbers to the subjacent tunica media. The deep tunica media and adventitia is punctuated by variably sized aggregates of

1-1 Artery, Thoroughbred horse. Cross section of adult nematode characterized by a thin cuticle, coelomyarian-platymyarian musculature (arrows), prominent lateral cords (arrowheads), a pseudocoelom, and central digestive tract (star). (H&E 100X)

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lymphocytes and plasma cells admixed with foamy and hemosiderin-laden macrophages and rare clusters of neutrophils.

Contributor's Morphologic Diagnosis: Cranial mesenteric artery: Arteritis, chronic, severe, suppurative and lymphoplasmacytic.
Cranial mesenteric artery: Thrombus, acute with intralesional nematodes.

Contributor's Comment: *Strongylus vulgaris* is one of three species of the genus Strongylus which occur the horse and is considered to be the most damaging to the host.[6] The life cycle involves the ingestion of third-stage larvae which penetrate the mucosa and submucosa of the small and large intestines. Seven days after ingestion most of the larvae have molted to become fourth-stage larvae which then penetrate the submucosal intestinal arterioles and migrate along the intima, eventually reaching the mesenteric artery. Migrations during the fourth stage of development lead to the gross lesions which range from tortuous intimal tracts to thrombotic lesions, often referred to as "verminous aneurisms", and arteritis.[6] The small bulging tracks containing larvae, and the associated endothelial damage serves as a nidus for the development of thrombi. The arteritis and fibrosis of the arterial wall is attributed to both the disruption of the internal elastic lamina and the inflammatory response induced by the larvae. Larvae are generally found in intimal thrombi of the artery and rarely in the tunica media and adventitia.[7] Research has shown that the curvature of the vessels, not the direction of blood flow, influences migration patterns and larva prefer to migrate longitudinally along vessels[1], which accounts for the localization of the larvae in the mesenteric artery. Migration into the aorta is very infrequent, presumably because the cranial mesenteric artery branches at a right angle from the aorta. The larvae molt to the fifth stage after 3-4 months and return to the cecum and colon, where they develop into adults in two months and begin reproduction.

S. vulgaris is thought to cause colic via thromboembolic obstruction of the cranial mesenteric artery (with secondary infarction of the bowel), reduced blood flow to the branches off the cranial mesenteric artery, interference with innervation due to pressure on abdominal autonomic plexuses, or disruption of ileal motility by toxic products generated from degenerating larvae.[3]

The prevalence of cranial mesenteric arteritis due to *S. vulgaris* in horses has ranged from 80% in 1937 to 98% in 1991[7] with a dramatic decline to 6% in the late 1990's[5]. The drastic decrease in incidence has been attributed to the instigation of effective anthelmentic programs.

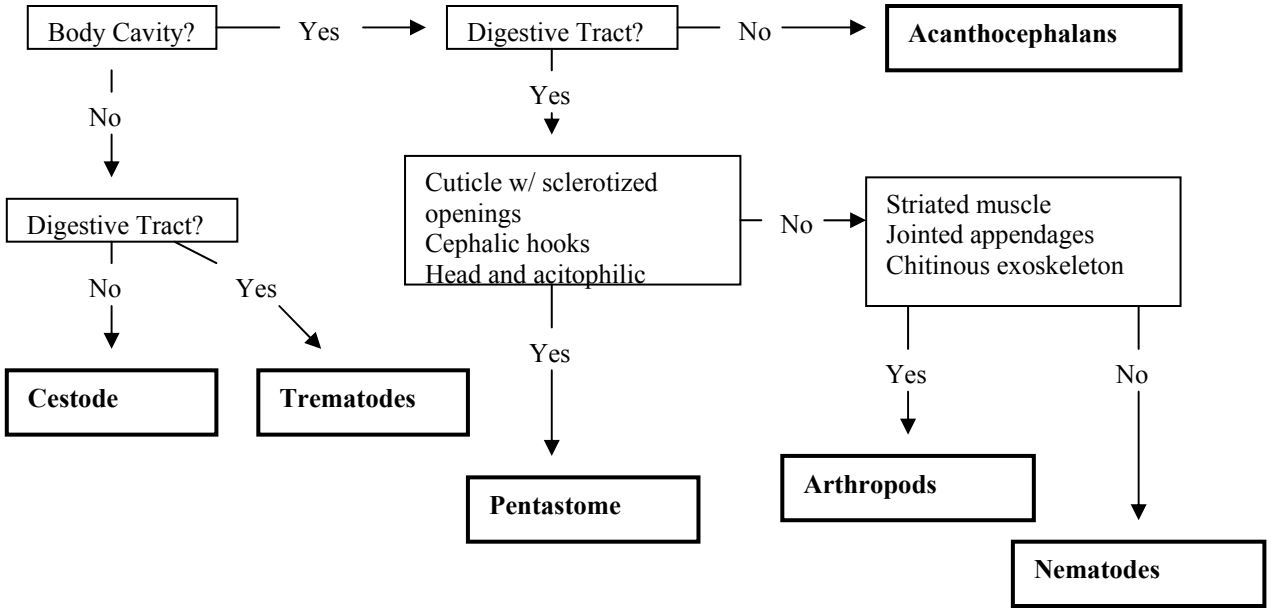
AFIP Diagnosis: Artery: Arteritis, chronic-active, multifocal to coalescing, moderate with marked diffuse transmural fibrosis, mural fibrin thrombus and intraluminal larval strongyles, Thoroughbred (*Equus caballus*), equine.

Conference Comment: *Strongylus vulgaris* is the only large strongyle that is known to undergo portions of its development within the equine arterial system.[6] The other two large strongyles that are known to commonly affect horses are *S. edentates* and *S. equines*. *S. edentates* normally migrates via the portal system to the liver, molts to L_4 within the liver parenchyma, and then returns to the cecum via hepatic ligaments. *S. equines* migrates through the peritoneal cavity to the liver then the pancreas and re-enters the cecum and right ventral colon via direct penetration.[2]

Identification of organisms as nematodes is determined by evaluating specific structures. The accompanying flow chart aids in categorization of metazoan parasites **(fig. 1-2).**

Other vascular parasites include:

- Blood flukes of mammals and birds – *Schistosoma* sp., *Heterobilharzia* sp., *Orientobilharzia* sp.
- *Onchocerca* sp. – within the walls of the aorta of cattle, buffalo and goats



1-2 Key to categorization of parasites in tissue section.

- *Dirofilaria immitis* – heart worm of dogs, cats, sea lions, muskrats

Brugia sp. – tropical parasite of dogs and cats

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CASE II – 07L21FF (AFIP 3065937).

Signalment: 19 month old, male, American Foxhound, *Canis familiaris*, dog.

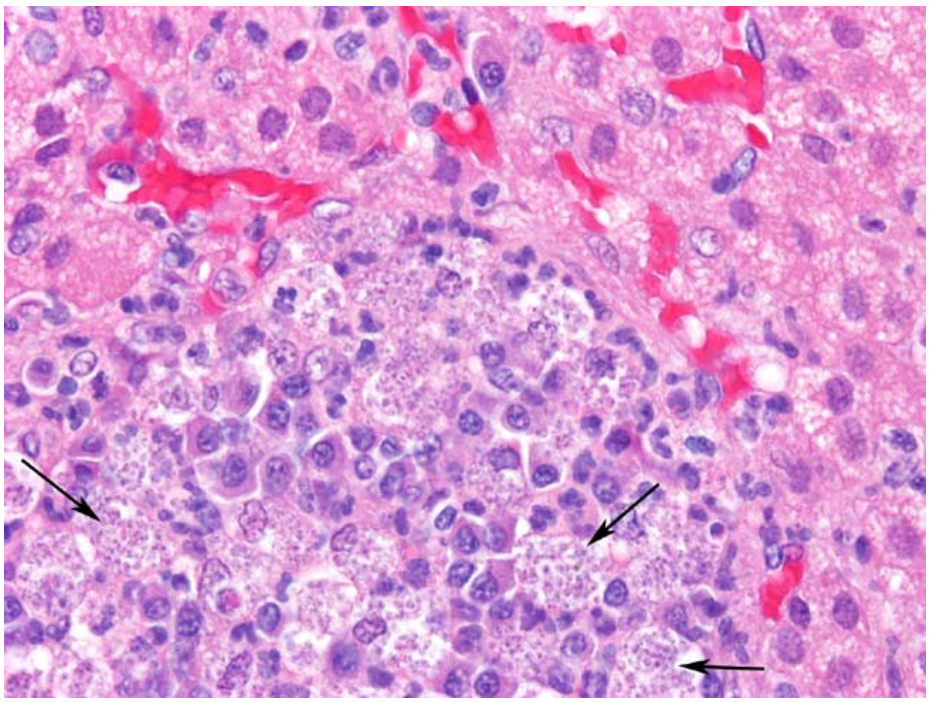
History: This male American Foxhound dog along with a sibling was donated to Iowa State University because both were seropositive for *Leishmania* spp. This animal was born in August of 2005 to a *Leishmania* positive bitch, and both siblings became serologically positive for *Leishmania* in January of 2007. Following seroconversion the dog became anemic, thrombocytopenic and leukopenic. Upon presentation, the dog exhibited epistaxis and was progressively losing weight.

Gross Pathology: The animal was thin to emaciated with minimal adipose tissue in body cavities and subcutaneous tissues. The liver was diffusely and markedly enlarged (1.65kg), pale, and firm with a diffuse finely granular texture. The spleen was diffusely and markedly enlarged (38g) and pale with finely granular capsular surface texture. All lymph nodes, including peripheral, mesenteric and mediastinal nodes were markedly enlarged. Bilaterally the kidneys were moderately enlarged and diffusely pale, and there was little peri-renal adipose tissue.

Laboratory Results: A complete blood count revealed a non-regenerative anemia and thrombocytopenia, while a chemistry panel showed elevation in alkaline phosphatase and alanine transferase as well as hypoproteinemia. On urinalysis there was 4+ protein in the urine. Spleen and bone marrow samples were culture positive for *Leishmania* by the Centers for Disease Control and Prevention (CDC). Real-time PCR on whole blood performed at ISU and the CDC were positive for *Leishmania infantum*.

Histopathologic Description: Kidney: Multifocal glomeruli have thickened Bowman's capsules and approximately 60-70% of glomeruli have markedly thickened and prominent capillary loops with numerous synechiae. Multiple glomeruli are shrunken and hypocellular (sclerosis). Within the interstitium, there are multifocal to coalescing accumulations of inflammatory cells, primarily lymphocytes, plasma cells and macrophages, with moderate numbers of macrophages containing one or more 1-2 µm round to oval basophilic organisms. Cytologically these organisms are ovoid, 1-3 µm in diameter, with a round, basophilic nucleus and a rod-shaped kinetoplast.

2-1 Adrenal gland, American foxhound. Expanding the adrenal cortex, there are aggregates of lymphocytes, plasma cells and macrophages. Macrophages frequently contain high numbers of protozoa which are ovoid, 1-3 µm in diameter, with a round, basophilic nucleus and a rod-shaped kinetoplast (arrows). (H&E 600X)



Adrenal glands: Multifocally throughout the adrenal cortex, there are multiple foci of lymphocytes, plasma cell, and macrophages. Many of the macrophages contain numerous small intracellular **organisms (fig. 2-1)** as described above.

Contributor's Morphologic Diagnosis:

1. Kidney:

a. Glomerulonephritis, membranous, severe, chronic, diffuse, with multifocal glomerulosclerosis.

b. Interstitial nephritis, lymphoplasmacytic and granulomatous, severe, chronic, multifocal to coalescing, with intra-histiocytic organisms consistent with *Leishmania* species.

Adrenal gland: Adrenalitis, granulomatous and lymphoplasmacytic, moderate, chronic, multifocal with intra-histiocytic or-

ganisms consistent with *Leishmania* species.

Contributor's Comment: The changes in the kidney and adrenal gland are consistent with disseminated visceral leishmaniasis. Parasites were also present within macrophages in the liver, spleen, lymph nodes, pancreas and bone marrow (not submitted for evaluation). *Leishmania infantum* is a protozoal parasite that causes visceral leishmaniasis. Natural hosts include rodents, small mammals, dogs, and humans, although infection is usually accidental.[4] Leishmaniasis is transmitted to the host by the sandfly bite after which the promastigote form of the parasite is phagocytosed by macrophages.[4] Once within the host cell the parasite transforms into amastigotes and multiples, eventually leading to systemic spread of the parasite. Parasite control requires the induction of a T_H1 immune response characterized by production of interferon gamma and interleukin 12 that function to activate infected macrophages to kill the intracellular pathogen.[4] Visceral leishmaniasis is characterized by fever, weight loss, hepatomegaly, splenomegaly, skin lesions and epistaxis.[4] Histologically there are focal granulomas with intra-histiocytic organisms in affected organs as well as lymphofollicular hyperplasia within the spleen and lymph nodes.[6] Membranous glomerulonephritis is a common finding in both canine and human patients with visceral leishmaniasis and is secondary to antigen-antibody complex formation and subsequent deposition within the mesangium of the glomerulus.[1]

Although endemic in southern Central and South America, the Middle East, Central Asia and Africa, this disease is also present in the United States and sporadic cases have been reported, usually travelers returning from an endemic area.[5] In the year 2000, a fox hound kennel in New York reported four foxhounds to be infected with *L. infantum*.[3] The sand fly vector is present with in the United States, although at this time it has not be determined if sandfly transmission of *Leishmania* occurs in this country. Other mechanisms have been postulated in transmission of canine visceral leishmaniasis and include vector-independent modes such as breeding and direct contact. There may also be a genetic or breed susceptibility to infection, as numerous foxhounds have tested positive and infection appears to be widespread within this breed in the United States, indicating a possible public health threat.[2]

AFIP Diagnosis: 1. Kidney: Glomerulonephritis, membranoproliferative, global, diffuse, subacute, marked with multifocal to coalescing lymphoplasmacytic interstitial nephritis, protein casts, and intrahistiocytic amastigotes, etiology consistent with *Leishmania* sp., American Foxhound (*Canis familiaris*), canine.

2. Adrenal gland: Adrenalitis, histiocytic, neutrophilic, and plasmacytic, multifocal, moderate, with intrahistiocytic amastigotes, etiology consistent with *Leishmania* sp.

Conference Comment: *Leishmania* are protozoan parasites of the family Trypanosomidae, order Kinetoplastida.[5] They survive within the cytoplasm of mammalian macrophages as amastigotes (leishmanial form) that are 2.0µm in diameter with a vesicular nucleus, no flagella and a small basophilic kinetoplast.[6]

There are three forms of Leishmaniasis:[6]
1. Cutaneous (oriental sore) *L. tropica* – Mediteranean sea
2. Mucocutaneous (espundia) *L. braziliensis* – Central America
3. Visceral (kala-azar) *L. donovani* – Europe, Africa and Asia

The primary insect vectors for *Leishmania* sp. include the phlebotomine sand flies (*Lutzomyia* sp. and *Phlebotomus* sp.). Of the fourteen *Lutzomyia* sp. in North America, three are known to be capable of transmitting *Leishmania mexicana* (cutaneous leishmaniasis in Mexico and Texas).[3] Other forms of transmission that have been implicated include mechanical transfer through ticks, shared needles, sexual contact, and bite wounds, as well as transmammary and transplacental transmission.[5]

Upon phagocytosis by macrophages, the organism survives within the phagolysosome despite the activated proteinases and the low environmental pH (4.5-5.0).[4] Studies of the cutaneous form of leishmaniasis in mice caused by *L. major* indicate immunity depends on an IL-12 driven CD4+, T_H1-type response with production of IFN gamma. A CD4+, T_H2-type response with production of IL-4 and IL-10 results in susceptibility.[3]

The initial case of visceral Leishmaniasis in a fox hound in North America occurred in 1980.[5] Since that time, visceral leishmaniasis caused by the *Leishmania donovani* complex (*L. donovani*, *L. infantum*, *L. chagasi*) has been identified in 21 states in the U.S. and 2 Canadian provinces.[5]

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CASE III – 06/8597611 Boyd V10112 (AFIP 3069488).

Signalment: 2-year-old, female, Jersey, *Bos taurus*, bovine

History: Three of 100 mature Jersey cattle died with no observable clinical signs. They were female dry cattle at pasture. The clinical differential diagnosis was Clostridial disease, botulism or anthrax. The clinician opened the carcass and quickly discovered an enlarged spleen. A 2 by 3 inch sample of spleen was removed and the clinician made his own smears and submitted the spleen sample and smears to the laboratory as a possible case of anthrax.

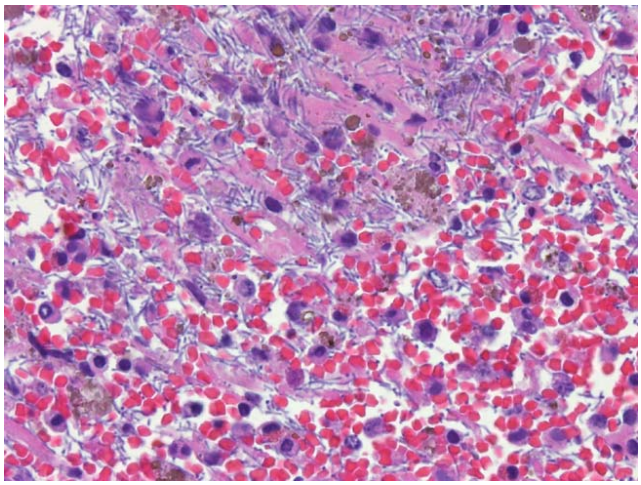
Gross Pathology: The cow had an enlarged and swollen spleen that oozed thick dark blood from the cut surface.

Laboratory Results: A smear from the spleen was prepared and stained with polychrome methylene blue. There were numerous large square ended bacilli with a pink capsule. Blood from the spleen was cultured on sheep blood agar plates and incubated aerobically. Within 12 hours of incubation, there were large numbers of small dry irregularly shaped ground glass colonies. The bacterial colonies were sensitive to penicillin. These findings are consistent with *Bacillus anthracis.*

Histopathologic Description:
The spleen was enlarged and congested with large numbers of extracellular erythrocytes filling the red pulp with a marked reduction in amount of the white pulp and small lymphoid follicles. Widely dispersed throughout the spleen were myriads of extracellular bacteria. The **bacteria (fig. 3-1)** were large and uniform in size bacilli, approximately 3um long and 1um wide. There were large numbers of widely dispersed macrophages that were filled with pigment, confirmed as hemosiderin. There was disruption of the parenchyma, due to autolysis of the tissue.

Contributor's Morphologic Diagnosis: Acute diffuse splenic haemorrhage with numerous extracellular bacilli.

Contributor's Comment: Anthrax is a peracute, acute or subacute highly contagious disease of domestic animals and humans caused by the bacterium *Bacillus anthracis*.[1] Necropsy of animals infected with *Bacillus anthracis* is not recommended because exposure to air allows the bacteria to sporulate, resulting in extremely resistant anthrax spores that contaminate the environment for years.[2] The recommended means of diagnosis is collection of a peripheral blood smear without opening the carcass. Peripheral blood smears in anthrax cases have large numbers of Gram positive rod shaped bacteria, with square ends and a pink capsule stained by methylene blue, Giemsa or Schaeffer and Fulton's malachite green technique. The bacteria need to be differentiated from Clostridial bacteria, that have rounded corners and no



3-1 Spleen, Jersey, cow. Diffusely the splenic parenchyma is disrupted by high numbers of large bacilli measuring approximately 3-7 um long and 1um wide. (H&E 600X)

capsule. The presence of *Bacillus anthracis* in a blood smear can be confirmed by microbiological culture or PCR. The USA Naval Medical Research Center developed diagnostic tests for anthrax are being trialed for their suitability, in Australian conditions, for the 'pen-side' diagnosis of anthrax in livestock.[4]

Anthrax is a disease syndrome recognized for centuries and a pathogen that is widely distributed around the world. In 1823 anthrax was the first disease of humans and animals shown to be caused by a micro-organism.[1] Anthrax occurs sporadically in Australia affecting sheep, cattle, infrequently pigs and rarely goats and horses.[5] It is largely confined to the "anthrax belt" which extends through the middle of the Australian states of New South Wales and into northern and central Victoria.[4,5] This laboratory in Victoria would typically diagnose 2 or 3 cases of anthrax per year. In January and February 2007, there was an unusual outbreak of anthrax in central Victoria with this laboratory diagnosing 37 positive anthrax cases, on eight farms from approximately 300 submissions from the surveillance area. The last significant outbreak of anthrax in Victoria was between January and March 1997, when anthrax was diagnosed on 83 properties with 202 cattle and 4 sheep confirmed to have died of anthrax.[6] In Australia, effective control of anthrax infection is achieved by vaccination of in contact farms and livestock.

Ruminants are typically infected with anthrax by ingestion of spores that germinate in the intestinal tract to form encapsulating vegetative cells that replicate and spread to the regional lymph nodes and then disseminate systemically.[2] Infection may also occur by cutaneous abrasion and insect bites.[1] Extremely rarely it is possible, in cattle, to initiate an infection by inhaling spores while grazing dry dusty contaminated sites.[1] *Bacillus anthracis* produces exotoxins termed lethal toxin and edema toxin. The toxins and the capsule of the bacteria inhibit phagocytosis, increase capillary endothelial permeability and delay clotting.[1] Animal species vary in their susceptibility to anthrax infection. Species easily infected with anthrax include cattle, goats, sheep, monkey, mouse, guinea pigs, horses and chimpanzees. Species resistant to anthrax but once infection is established, are highly susceptible to effects of the exotoxins include dog, pig and NIH black and Fisher rats.[1] Humans can be infected with anthrax by inhalation, ingestion or cutaneous abrasions. Human cases of anthrax are rare in Australia and there have been only four cases in the last ten years; all have been the cutaneous form and most of the cases have been in farmers or rendering plant workers.[3]

AFIP Diagnosis: Spleen: Congestion, acute, diffuse, severe, with lymphocytolysis, and myriad bacilli, Jersey (*Bos taurus*), bovine.

Conference Comment: The Centers for Disease Control and Prevention classifies anthrax as a Category A agent of bioterrorism. Category A agents have the potential to pose a threat against public health, spread across a large area or need public awareness, and need a great deal of planning to protect the public's health. Despite this potential, humans are relatively resistant to natural infection.

Infection of both humans and animals can occur through ingestion, percutaneously, or more rarely through inhalation of anthrax spores. Under certain conditions, spores have been known to remain viable in the soil up to 200 ±50 years. Germination of spores occurs between 20°-40° C and in conditions of greater than 80% relative humidity. Upon ingestion of spores, the organisms quickly germinate to the encapsulated toxin-producing vegetative form. The capsule is a poly-D-glutamate capsule that inhibits phagocytosis.[1]

Lethal toxin inhibits mitogen-activated protein kinase-kinase and results in terminal shock through the release of tumor necrosis factor (TNF) and interleukin-1 (IL-1). Edema factor results in altered intracellular water and ion concentrations through the abnormal production of c-AMP. Edema factor has also been implicated in preventing mobilization and activation of leukocytes. The presence of the capsule and two toxins effectively results in prevention of phagocytosis, increased capillary endothelial permeability and decreased blood clotting ability.[1]

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CASE IV - 05-801 (AFIP 2987052).

Signalment: 1-year-old intact female Rocky Mountain goat (*Oreamnos americanus*)

History: This goat exhibited 3 months of progressive respiratory difficulty that was unresponsive to an tibiotic therapy, leading to euthanasia. She was one of a small group (approximately 25) of captive bred Rocky Mountain goats at a private facility. This animal and several others were raised on raw goat's milk obtained from a local dairy goat farm. At the time the animals were raised, the dairy goat farm was believed to be free of caprine arthritis encephalitis virus (CAEV), but CAEV was subsequently confirmed on the premises. A 2-year-old mountain goat that had received the raw goat's milk from the same dairy was euthanized approximately 1 month later due to progressive weight loss, dyspnea, and recent onset of left sided spastic hemiparesis. Pulmonary lesions were similar in this second animal, and in addition there was a locally extensive unilateral nonsuppurative inflammatory and demyelinating lesion within the cranial cervical spinal cord.

Gross Pathology: Postmortem was performed approximately 24 hours following euthanasia. The animal was in thin body condition. The lungs failed to collapse and were diffusely dark red, firm, and meaty. Pulmonary lymph nodes were moderately enlarged. There were no other significant gross findings.

Laboratory Results (clinical pathology, microbiology, PCR, ELISA, etc.)**:**
Escherichia coli isolated from lung and pulmonary lymph node. No mycoplasma isolated from lung or pulmonary lymph node. Fluorescent antibody testing of lung and pulmonary lymph node was negative for IBR and BVD viruses.

Histopathologic Description: Slides from two different blocks are submitted. Both exhibit similar changes. There is severe diffuse interstitial fibrosis with priminent perivascular and peribronchiolar lymphoid aggregates. There is diffuse type II pneumocyte hyperplasia, although many cells have sloughed due to postmortem artifact. Alveoli contain protein, often in aggregates, and many prominent macrophages. Smooth muscle associated with terminal bronchioles is hyperplastic. One section contains a locally extensive zone of intrabronchial necrotic debris.

Contributor's Morphologic Diagnosis: Lung: Severe diffuse chronic interstitial pneumonia with lymphoid hyperplasia consistent with Caprine Arthritis Encephalitis Virus (CAEV) infection

Contributor's Comment: The history of progressive dyspnea associated with weight loss and the histopathologic lesions within the lung are characteristic of pulmonary disease due to CAEV infection. It should be noted, however, that the severe interstitial fibrosis in this case is somewhat unusual.[1] Secondary infection by *E. coli* is suspected.

CAEV is one of a family of small ruminant lentiviruses (SRLV) that cause chronic inflammatory disease in goats (genus *Capra*, subfamily Caprinae, family Bovidae) and sheep (genus *Ovis*, subfamily Caprinae, family Bovidae). Viral integration into host DNA causes persistent infection, primarily of monocytes, macrophages, and dendritic cells.[2,4] Mammary gland involvement is common, and infection is most often due to ingestion of milk from infected dams. Infection from direct contact is also possible, but is less common. Experimental infection of Mouflon-domestic sheep hybrids by CAEV has been reported.[3] Recent phylogenetic studies have identified multiple subgroups of SRLV. One group, SRLV subtype A4, has been found to be directly transmissible and interchangeable between goats and sheep.[5]

This is the first known instance of disease compatible with CAEV occurring in a Rocky Mountain goat (genus *Oreamnos*, subfamily Caprinae, family Bovidae). No involvement of joints or mammary gland were identified in these two cases. Neurologic disease due to CAEV is most common in goats 2-4 months of age, but sporadic cases occur in adults.[6] Although immunohistochemical confirmation of CAEV was still in progress at the time of submission, various factors strongly suggest CAEV as the cause of infection in this and the second affected Rocky Mountain goat. The histopathologic lesion of diffuse interstitial pneumonia with type II hyperplasia and lymphoid hyperplasia are characteristic of pulmonary lentivirus infection.[1] Although infection by another member of the SRLV family cannot be ruled out in this case based on findings to date, the history of ingestion of

raw goat's milk from a CAEV positive herd, and the characteristic locally extensive demyelinating myelitis in the second goat (as opposed to the more diffuse and strongly periventricular spinal cord lesions of maidi-visna virus)[6] strongly suggest CAEV infection in this captive bred Mountain goat.

AFIP Diagnosis: Lung: Pneumonia, interstitial, chronic, diffuse, moderate, with marked interstitial fibrosis, lymphoid hyperplasia, and type II pneumocyte hyperplasia.

Conference Comment: Slide variability included multifocal areas of acute neutrophilic alveolitis likely due to secondary bacterial infection. However, no organisms were seen.

Small ruminant lentiviruses (SRL), in the family Retroviridae, include the closely related maedi-visna virus (ovine progressive pneumina) and caprine arthritis encephalitis Virus. The viral gene of lentiviruses is a single-stranded RNA and encodes for various genes, including:[1]

- gag – Group specific neucleocapsid and matrix glycoproteins (detected by antibody based tests)
- pol – Reverse transcriptase
- env – Surface glycoprotein, mediates receptor binding and entry into the cell (target for neutralizing antibodies)

Infection with CAEV results in two main manifestations of the disease: slowly progressive arthritis in adult goats and more acute neurologic disease in kids 2-4 months old.[1] The arthritic lesions tend to localize within the carpus, but the tarsus, fetlock, stifle, and atlanto-occipital joint can be affected as well. Neurologic signs are variable and include encephalitis, progressive ataxia and weakness. Pneumonia occurs less frequently but can be the main presenting feature or occur in combination with the joint or neurologic lesions. The distinctive pulmonary lesion includes alveoli filled with densely eosinophilic fluid, type II pneumocyte hyperplasia, and alveolar septa thickened by lymphocytes. Type II pneumocyte hyperplasia is not a prominent feature in the pneumonia of ovine progressive pneumonia.[1]

In contrast to other lentiviruses in animals (including the various species specific immunodeficiency viruses of simians, humans, felines, and bovines), the SRLs do not cause immunosuppression as a primary feature. However, secondary bacterial infection by *Pasteurella multocida* or *Arcanobacterium pyogenes*, as well as parasitic infection by *Dictyocaulus* sp. or *Protostrongylus* sp., can commonly be seen in association with SRL infection.[1]

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