WEDNESDAY SLIDE CONFERENCE 2012-2013
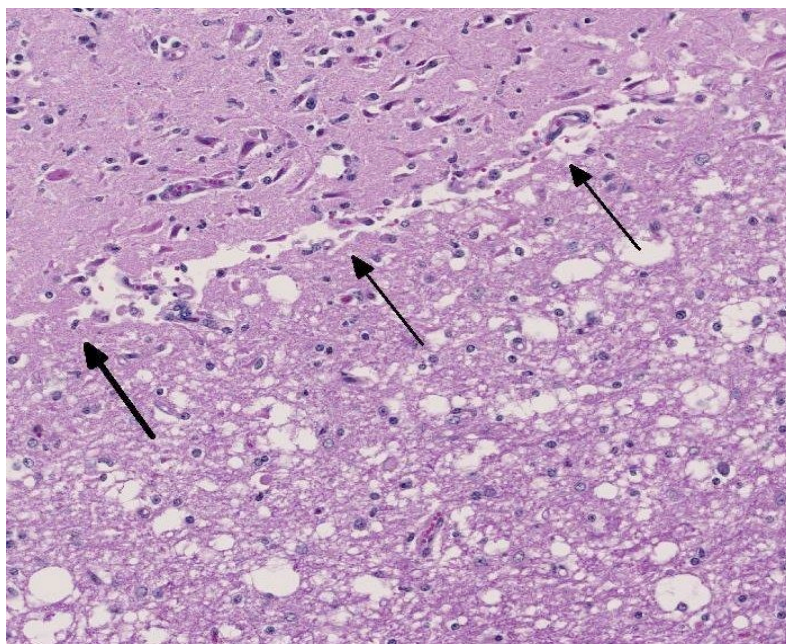
Conference 21

10 April 2013

CASE I: 11120715 (JPC 4020064).

Signalment: 20-month-old, Charolais bull, *Bos taurus*.

History: The bull presented to Veterinary Teaching Hospital with 7-day history of acute onset blindness.

1-1. Ox, cerebrum: Scattered throughout the superficial cortex, there are focally extensive areas of laminar necrosis, with adjacent vacuolation of neuropil. (HE 116X)

This patient is the most severely affected of 12 bulls exhibiting clinical signs (from total of 20). All bulls are housed on separate, but adjacent lots. The water source is pond and associated creek. The animals are fed 15-25lbs/head/day of a mixture of distiller's grain, corn gluten, corn, soybean hulls and wheat ration with a small amount of hay (native grass). Some of the bulls were treated with thiamine, Nuflor, banamine and a multivitamin injection. There was no response to therapy. This patient was euthanized and submitted for necropsy to investigate cause of disease in herd.

Gross Pathology: Necropsy is performed on a 20 month-old (per history), white, 640 kg, Charolais bull in good body condition with no appreciable autolysis. Following comprehensive examination of the carcass and all major organ systems, there are no significant gross lesions (including the brain).

Laboratory Results:
Feed analysis, sulfur, 4200ppm
Water analysis, sulfates, <7mg/L
Blood lead, negative

Histopathologic Description: Histologic changes were confined to the cerebrum and overlying meninges. Within the deep cortical lamina, and segmentally, extending out to affect the more superficial laminae, the neuropil is moderately to markedly vacuolated and rarefied (necrosis) with infiltration of the neuropil by moderate to marked numbers of small glial cells, moderate numbers of gitter cells and fewer gemistocytic astrocytes. Cortical neurons are shrunken, angular, and hypereosinophilic with pyknotic nuclei (necrosis) and are often cuffed by glial cells (satellitosis). Vessels within the affected areas are lined by plump, hypertrophied endothelial cells and are frequently cuffed by large macrophages. The overlying meninges are infiltrated by low to moderate numbers of large, perivascular to diffusely distributed macrophages and mildly expanded by edema.

Contributor's Morphologic Diagnosis: 1. Cerebrum: Severe, subacute, locally extensive laminar cortical (neuronal) necrosis (polioencephalomalacia).
2. Meninges: Mild to moderate histiocytic meningitis.

Contributor's Comment: Histologic lesions in the cerebrum of this bull were characteristic of nutritional polioencephalomalacia (PEM).

Nutritional PEM has traditionally been associated with thiamine (vitamin B1) deficiency in numerous animal species, particularly small carnivores and ruminants. While the pathogenesis and direct association with thiamine deficiency is well established in carnivores, the pathogenesis remains somewhat more obscure in ruminants who may be thiamine responsive early in disease, but often have striking PEM without a demonstrable deficiency in tissue thiamine, or blood transketolase levels.

In the early 1980s, nutritional PEM was first associated with elevated sulfur levels in a group of cattle in Missouri receiving sulfated feeds to limit feed consumption and has since been demonstrated in cattle, sheep, and goats receiving elevated sulfur from a variety of feed materials including sulfated feeds (calcium sulfate), high-protein forage (alfalfa), corn meal by-products, molasses based liquid feeds, sulfur containing plants, such as genus Brassica, and excessively sulfated water.[1]

The pathogenesis of sulfur-related PEM is related to ruminal microbes reducing ingested sulfur to highly toxic hydrogen sulfide, which then interferes with cellular energy metabolism.[2] Presumptively, the continuous energy requirement of cerebral neurons make them particularly susceptible. Additionally, sulfite, an intermediate in sulfate reduction, can cleave thiamine;[1] however, the contribution of this phenomenon to PEM in ruminants is not well established given the typically normal thiamine levels in these animals.

Clinical course in ruminants ranges from acute, characterized by acute cortical blindness, depression, dullness to recumbency, convulsions, opisthotonos, coma and death, to more subacute, characterized primarily by blindness and ataxia. Grossly cerebral edema, swelling, pallor and softening of the cerebrum with variable laminar paleness of the gray matter at the junction between gray and white is seen in acute deaths and tissues may autofluoresce under UV light. If survival is prolonged gross changes may progress to yellow-brown discoloration and cavitation of the gray matter and the tissue will fail to autofluoresce.[2] Histologic lesions of PEM may be somewhat varied in their distribution, being more pronounced in the cerebral cortices of ruminants, and in periventricular nuclei of carnivores. Laminar cortical necrosis of neurons especially within the deeper laminae with malacia is classic. This change is also seen in cases of lead toxicity, hypoxia, and water deprivation-salt intoxication.[1]

Unlike in ruminants, the pathogenesis of nutritional PEM in carnivores (Chastek paralysis) is well established. Thiamine is an essential dietary vitamin in carnivores, and cases of PEM are associated with ingestion of high levels of thiaminase containing fish diets (cats) or consumption of excessively heated meats that destroy thiamine (dogs). Less commonly, consumption of the food preservative sulfur dioxide has been documented. The course of disease and clinical signs are similar to ruminants, with lesions more typically present bilaterally and symmetrically in the brain stem nuclei, most commonly the inferior colliculi. Less commonly the cerebral cortex and cerebellar vermis may be affected. Vascular dilation and hemorrhage may be a prominent feature.[3]

The clinical disease, histopathologic lesions and demonstration of elevated sulfur levels in the feed support a classic sulfur-related PEM in this bull. The source of sulfur is most likely the corn by-products (distiller's grain) that can contain

excessively high sulfur. The National Research Council states the daily requirement for adult beef cattle is 1500-2000 ppm sulfur within the ration with a daily maximum tolerated dietary dose of 0.4% (4000 ppm).[4]

JPC Diagnosis: Brain, cerebrum, cortex: Necrosis, laminar, multifocal, with diffuse spongiosis.

Conference Comment: Conference participants discussed the causes of PEM in ruminants, as reviewed by the contributor in the above comments. Participants further discussed causes of polioencephalomalacia in other veterinary species, noting that the term "polioencephalomalacia" is generally used to describe softening in the cerebrocortical grey matter with a laminar distribution. There are several conditions associated with this pattern of necrosis, which is also referred to as "laminar cortical necrosis" or "cerebrocortical necrosis." It is a characteristic lesion due to hypoxia/ischemia, such as that caused by feline ischemic encephalopathy due to aberrant migration of *Cuterebra* larva and neonatal maladjustment syndrome of foals, salt poisoning in swine, lead poisoning in cattle, and cyanide poisoning in a variety of species.[1]

Contributing Institution: Department of Veterinary Pathobiology
Center for Veterinary Health Sciences
Oklahoma State University
Rm 250 McElroy Hall
Stillwater, OK 74078 USA
www.cvhs.okstate.edu

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CASE II: 40282/14C (JPC 4019898).

Signalment: 8-year-old female, Irish Sport Horse, *Equus caballus*, horse.

History: Unilateral left epistaxis for two months, pallor of oral and conjunctival mucosa, anorexia.

Gross Pathology: Necropsy revealed dried blood on the muzzle, pallor of conjunctival and oral mucosa, bloody and foamy tracheal and bronchial edema, atrophy of the left laryngeal muscles, bloody content in the stomach, and, on the caudodorsal wall of the medial compartment of the left guttural pouch, a proliferative and hemorrhagic lesion with erosion and thrombosis of the internal carotid artery.

Laboratory Results: Microbiological culture of the proliferative lesion of the guttural pouch was positive for *Aspergillus fumigatus*.

Histopathologic Description: Guttural pouch, internal carotid artery and nerves: The guttural pouch mucosa is severely and diffusely eroded and ulcerated and is replaced by a thick coagulum of fibrin, necrotic debris, degenerate neutrophils and hemorrhage.

The necrotic process extends into, and replaces, up to one third of the internal carotid artery wall and extends within the lumen forming a thrombus. Palisading on the surface of the coagulum and in association with the necrotic material there are myriad 5 to 8 μm thick, septate, dichotomously branched, PAS-positive fungal hyphae with parallel walls, often associated with abundant brown pigment and numerous bacterial colonies. The remaining two thirds of the arterial wall are characterized by diffuse erosion of the endothelium, severe thickening of the intimal, medial and adventitial layers due to fibroblasts, myofibroblasts and muscular cells proliferation, deposition of collagenous and mucinous extracellular matrix, multifocal fibrin deposition, edema and a multifocal inflammatory infiltrate mainly composed of karyolytic and karyorrhectic neutrophils associated with cellular and nuclear debris (necrosis).
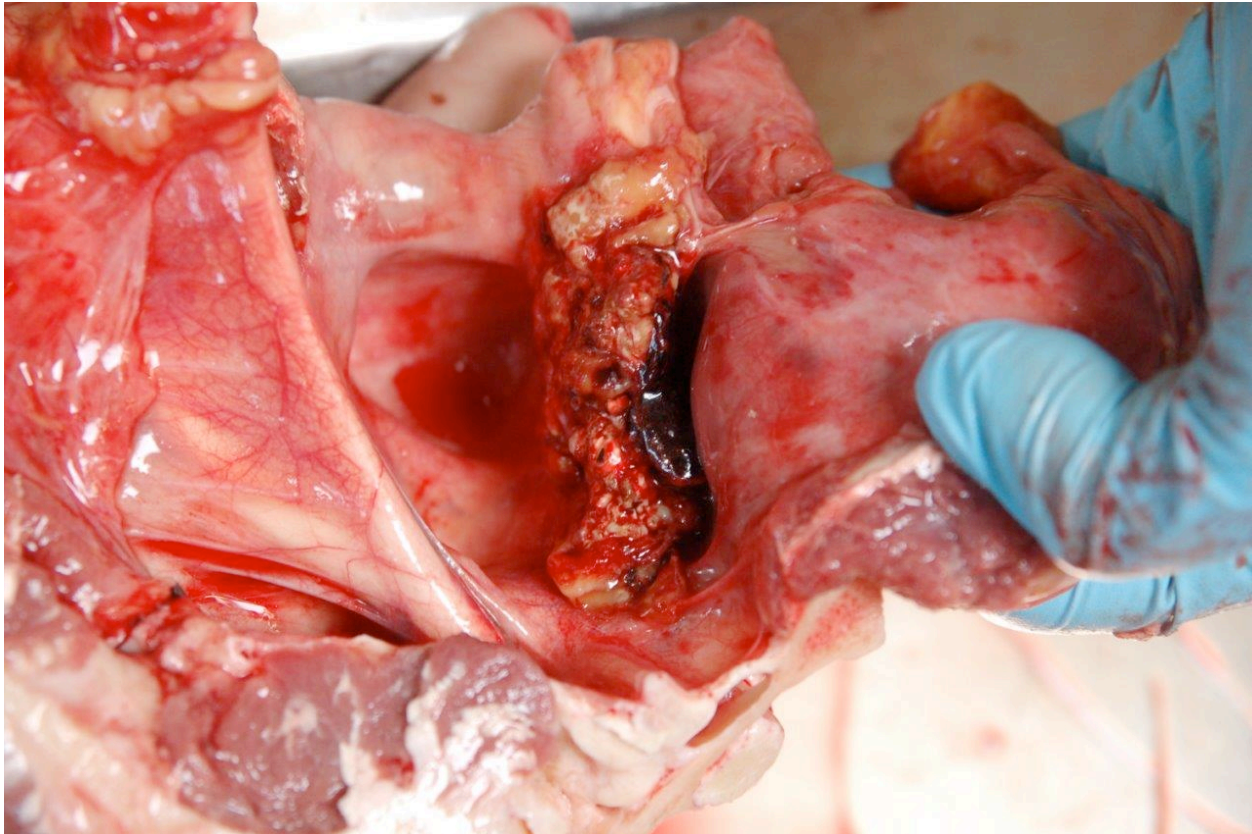
2-1. Horse, guttural pouch: The edge of the guttural pouch is thickened by abundant granulation tissue which is covered by a thick mat of fibrin and necrotic tissue. There is thrombosis of the internal carotid artery (not visible in the photo) (Photo courtesy of the Department of Comparative Biomedicine and Food Science (BCA), University of Padua, Viale dell'Università 16, 35020 Legnaro, Padova – Italy. http://www.bca.unipd.it/)
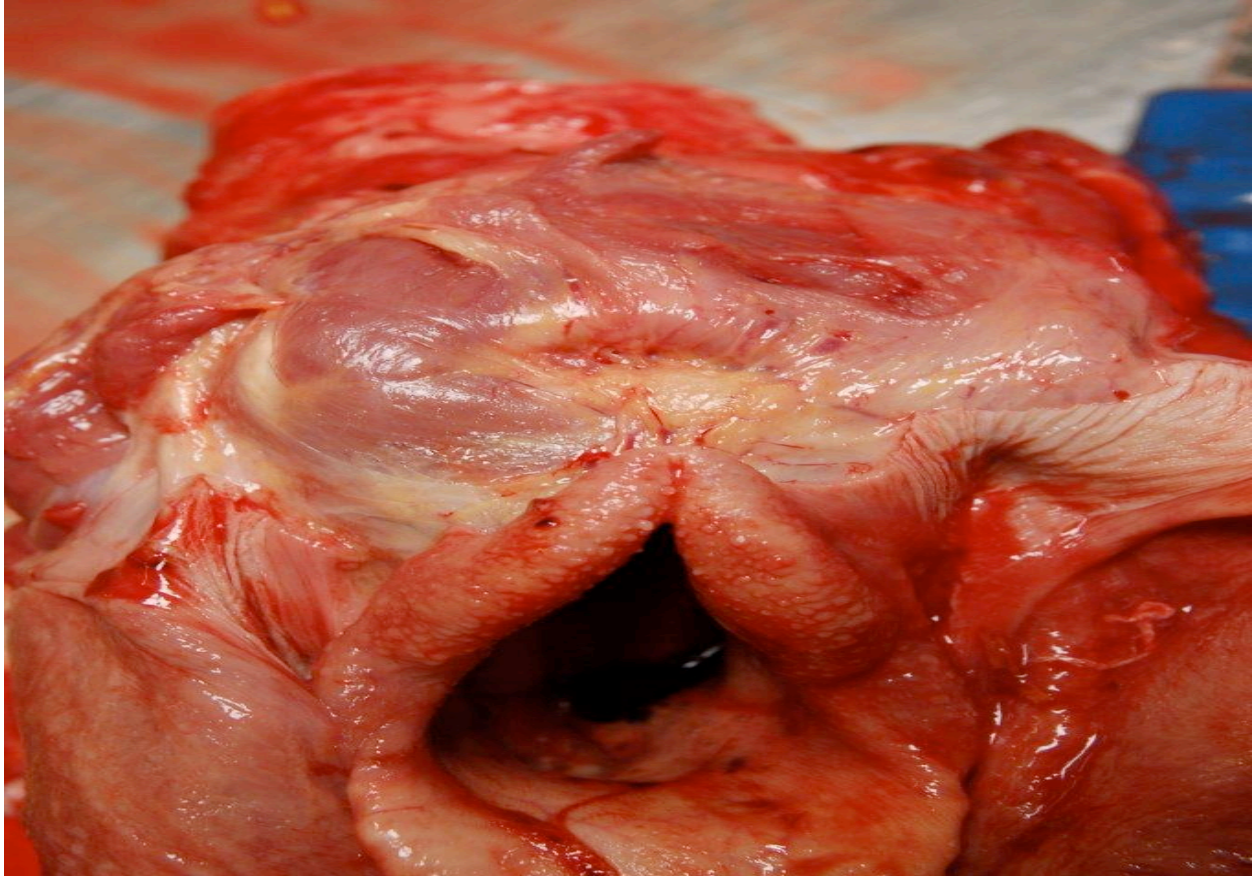
2-2. Horse, guttural pouch: There is atrophy of the left cricoarytenoideus muscle (laryngeal hemiplegia), as well as diffuse lymphofollicular largyngitis. (Photo courtesy of the Department of Comparative Biomedicine and Food Science (BCA), University of Padua, Viale dell'Università 16, 35020 Legnaro, Padova – Italy. http://www.bca.unipd.it/)

The necrotic process extends also into the subepithelial connective tissue where it is associated with a severe and multifocal to coalescent inflammatory infiltrate composed of neutrophils, macrophages, eosinophils, lymphocytes, plasma cells with occasional fungal hyphae. There is severe and diffuse edema and multifocal hemorrhages. There is multifocal thrombosis.

The nerves within the subepithelial connective tissue are characterized by loss of myelin sheaths, spheroid formation, multifocal areas of coagulative necrosis associated with karyolytic and karyorrhectic neutrophils, macrophages, lymphocytes and plasma cells and severe multifocal hemorrhages.

Contributor's Morphologic Diagnosis: 1. Guttural pouch: Eustachitis, severe, diffuse, chronic, ulcerative, fibrino-necrotizing, suppurative and macrophagic with intralesional fungal hyphae and bacterial colonies.

2. Internal carotid artery: Arteritis, severe, chronic, fibrino-necrotizing, suppurative and proliferative with thrombus formation and fungal hyphae.
3. Nerves: neuritis, severe, multifocal chronic, suppurative and necrotizing with demyelination and multifocal hemorrhages, *Equus caballus*, horse.

Contributor's Comment: Guttural pouch mycosis is a rare fungal disease of the upper respiratory tract of horses.[1,4,11] There is no apparent age, sex, breed or geographic predisposition to this disease although it is seen most frequently in stabled horses in temperate climates during the warmer months of the year and is seldom recorded in warmer climatic regions. Guttural pouch mycosis shows no predilection for either the right or the left guttural pouch.[1,6,7,8,10,11]

The pathogenesis has not been ascertained; however, it has been speculated that the mucous membrane layer of the guttural pouch is disrupted by trauma, local inflammation, a primary bacterial infection, or all three. This disruption allows opportunistic fungi
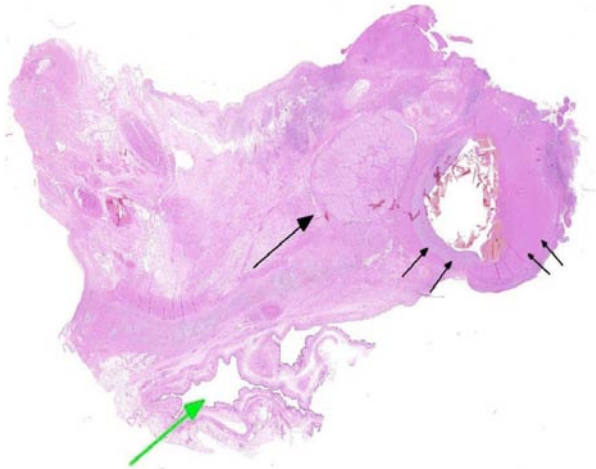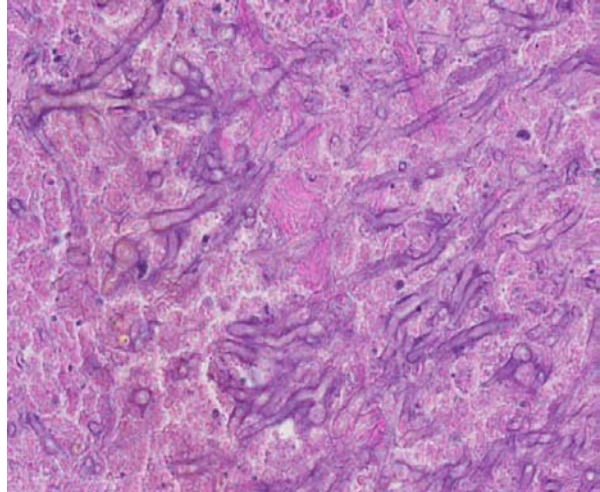
2-3. Horse, guttural pouch: The section contains a section of the guttural pouch (green arrow), a large nerve (black arrow), and the internal carotid artery (multiple small arrows). (HE 0.63X)

2-4. Horse, guttural pouch: Within the necrotic wall of the thrombosed internal carotid artery, there are numerous fungal hyphae which exhibit parallel walls, septae, and dichotomous branching. (HE 400X)

that are present in the normal equine airway, such as *Aspergillus* spp., to invade into the deeper tissues, including local arteries and nerves.[5]   Different species of *Aspergillus* can be isolated such as *A. fumigatus, A. versicolor, A. nidulans* and *A. niger*, but *A. fumigatus* is the most frequently isolated. [10]

The clinical signs of guttural pouch mycosis can be explained by the fact that fungal growth, and the inflammation associated with it, has a predilection for the roof of the medial and, occasionally, the lateral compartments of the guttural pouch. This area is anatomically associated with the external and internal carotid arteries, internal maxillary artery, glossopharyngeal nerve (cranial nerve IX), vagus nerve (X), spinal accessory nerve (XI), hypoglossal nerve (XII), sympathetic nerves, and stylohyoid bone.[1,4,6,7,10,11] Due to this close association, a horse with guttural pouch mycosis can show signs of epistaxis, dysphagia, parotid pain, abnormal head posture, nasal discharge, head shyness, abnormal respiratory noise, sweating and shivering, Horner's syndrome, colic, tongue atrophy and facial paralysis.[1,4,6,7,10,11]

Radiographs and clinical pathologic analyses have been determined to be of little value, as radiographic change with guttural pouch mycosis is minimal and clinical pathologic analyses typically will show an anemia, only if a recent significant bleeding episode has occurred.[11]

Gross pathologic examination of the mycotic guttural pouch characteristically reveals a yellow-brown to black mottled dry diphtheritic membrane with dry, dull white fungal plaques growing on it.[1] This membrane and fungal plaques are typically adhered to the tissues of the roof of the medial pouch and found in association with the internal carotid artery, with possible extension onto the roof of the lateral pouch and ventrally to the stylohyoid bone.[6]

If untreated, spontaneous resolution of guttural pouch mycosis has been observed but it may also result in fatal hemorrhage or irreversible neurological signs.[9] Medical treatment generally gives unsatisfactory and doubtful results.[8,9] Therefore, a surgical treatment option is still recommended and is usually successful even though progression of the disease has been described after surgical treatment.[5,8,9] Surgical treatment consisting of a vascular occlusion for prevention of hemorrhage is the recommended procedure and the occlusion must be performed on the cardiac and cerebral sides of the lesion to prevent haemorrhage.[3,5,8,9,12] Complications reported with this technique include recurrence of moderate to profuse epistaxis and retrograde infection.[8,9]

JPC Diagnosis: Guttural pouch: Eustachitis, fibrinosuppurative and necrotizing, diffuse, severe, with multifocal arteriolar and venous vasculitis and thrombosis, necrotizing neuritis, and numerous fungal hyphae.

Conference Comment: Guttural pouches are ventral diverticulae of the auditory tubes in equids. Bacterial infection of the guttural pouch is referred

to as guttural pouch empyema, and is most often caused by *Streptococcus equi* or other streptococci. Compared to guttural pouch empyema, guttural pouch mycosis tends to feature more extensive inflammation that invades deeper tissues, and thus leads to more severe complications. In addition to the extension into the nerves and arteries described above, guttural pouch mycosis may also result in osteitis and fusion of the stylohyoid and petrous temporal bones.[2]

Conference participants considered the report of left laryngeal muscle atrophy in this horse, and speculated it may be due to damage to the left recurrent laryngeal nerve from extension of the guttural pouch mycosis. In horses, laryngeal paralysis is usually a left-sided hemiplegia caused by idiopathic degeneration of the left recurrent laryngeal nerve. Although it is thought that neuritis due to extension from guttural pouch disease may play a role in laryngeal paralysis, the extent to which this occurs has yet to be determined. Other possible, but unproven, causes of laryngeal hemiplegia are trauma, vitamin deficiency, or neurotoxins. Bilateral laryngeal paralysis is more often due to hepatic encephalopathy and general anesthesia.[2]

There is some slide variation, with some slides exhibiting the described neuritis, which is considered to be secondary to the profound inflammation in surrounding tissue.

Contributing Institution: Department of Comparative Biomedicine and Food Science (BCA) University of Padua
Viale dell'università 16, 35020 Legnaro, Padova – Italy
http://www.bca.unipd.it/

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CASE III: 12-26 (JPC 4019359).

Signalment: 1-year-old male quarter horse (*Equus caballus*).

History: The body of a 1-year-old quarter horse colt was submitted for postmortem examination. The animal had been observed the day before and was reported to be healthy. The next day the colt was found dead with no evidence of a struggle. No other animals on the premises were sick.

Gross Pathology: Received the body of a 1-year-old, bay, quarter horse colt for postmortem examination. The body was in good nutritional condition and there was evidence of dehydration. Mild autolysis was noted. Over the left side and dorsal aspect of the thorax, there were locally extensive areas of subcutaneous hemorrhage and edema. Within the thoracic cavity, there were multifocal to coalescing ecchymoses located immediately below the costal pleura. The trachea contained a moderate amount of stable white froth consistent with pulmonary edema. The lungs had failed to completely collapse and multifocal areas of hemorrhage were noted on the pleural surface and within the pulmonary parenchyma. Foci of pulmonary hemorrhage measured up to 0.8 cm in diameter. Within the pericardial sac approximately 10 ml of serosanguinous fluid was noted. On the epicardial surface of the heart, there were innumerable petechiae. On the endocardial surface,

extensive ecchymotic hemorrhage was noted in both the right and left ventricles. On the capsular surface of the spleen, numerous petechiae were noted. The liver was diffusely congested. Bilaterally the renal medulla was dark red and congested. Multifocally and randomly distributed within the renal cortices there were numerous, 1-3 mm, white foci.

**Laboratory Results:** 4+ *Actinobacillus equuli* isolated from the kidney.

Histopathologic Description: Kidney: Randomly scattered within the cortex and occasionally extending into the medulla, there is a severe inflammatory process characterized by the presence of numerous microabscesses. The inflammation frequently centers on and effaces the glomeruli and is seen to extend into the adjacent tubules and interstitium. Glomeruli, which remain intact, are characterized by congestion, and numerous bacterial emboli and fibrin microthrombi within the glomerular capillaries. This is further accompanied by necrosis, hemorrhage and marked neutrophilic inflammation resulting in the formation of abscesses. In some areas the bacterial colonies and neutrophilic inflammation extend into the adjacent proximal tubules and there is degeneration and necrosis of the tubular epithelium. Focally suppurative inflammation extends into the renal capsule (not present in every slide). The bacterial colonies are large and are characterized by a myriad of 1X2 μm coccobacilli. While bacterial emboli are most

3-1. Lung, quarter horse: The lungs had failed to completely collapse and multifocal areas of hemorrhage were noted on the pleural surface and within the pulmonary parenchyma. Petechiae were also seen on the thoracic pleura and pericardium. (Photo courtesy of the Diagnostic Services Unit, University of Calgary Veterinary Medicine, Clinical Skills Building, 11877 85 St. NW, Calgary AB T3R 1J3, http:// vet.ucalgary.ca/
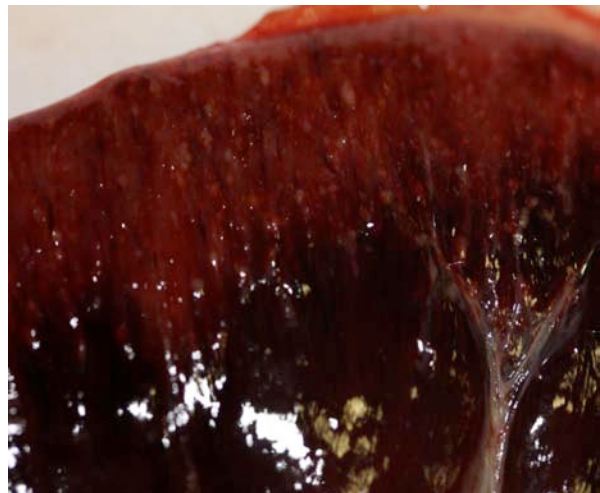

3-2. Kidney, quarter horse: Bilaterally the renal medulla was dark red and congested. Multifocally and randomly distributed within the renal cortices there were numerous, 1-3 mm, white foci. (Photo courtesy of the Diagnostic Services Unit, University of Calgary Veterinary Medicine, Clinical Skills Building, 11877 85 St. NW, Calgary AB T3R 1J3, http:// vet.ucalgary.ca/
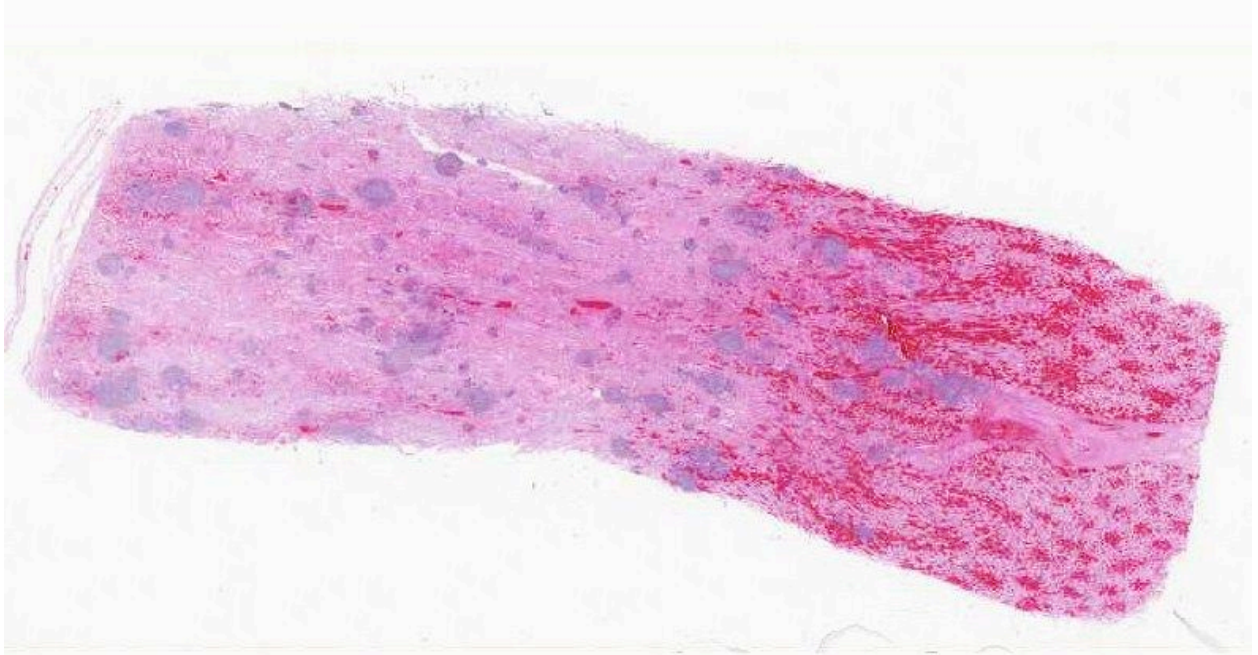
3-3. Kidney, quarter horse: Scattered throughout the cortex, and to a lesser extent in the medulla, there are numerous microabscesses, often centered on glomeruli. (HE 0.63X)

prominent within glomerular capillaries they are also observed within intertubular capillaries. Marked medullary congestion is a feature. Gram stain reveals the presence of innumerable gram-negative coccobacilli.
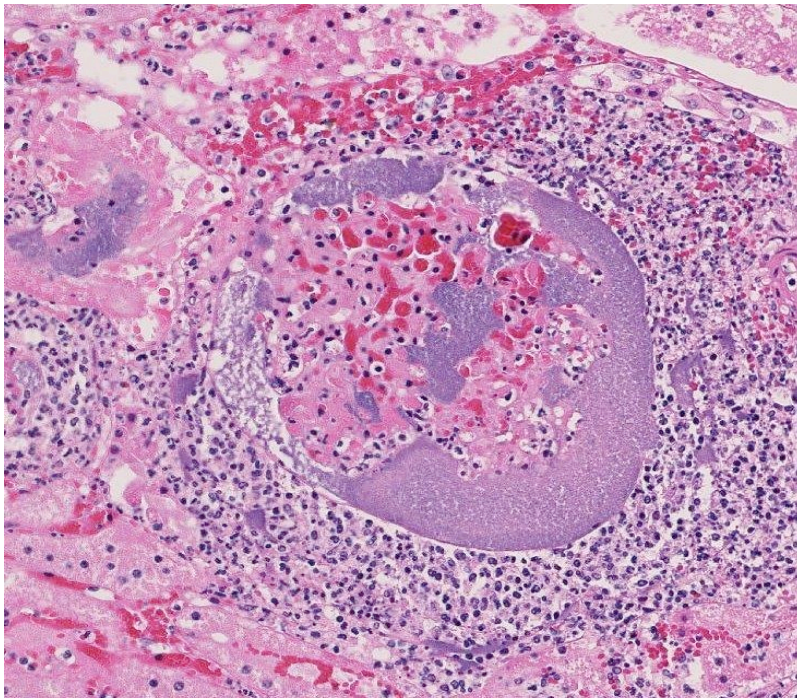
3-4. Kidney, quarter horse: Large colonies of bacilli (Actinobacillus equuli) fill Bowman's capsule and are present in surrounding areas of necrosis and suppurative inflammation. (HE 280X)

Similar bacterial emboli were noted in many other organs including the liver, lung, spleen, lymph nodes, brain and spinal cord consistent with septicemia (not shown in this slide).

Contributor's Morphologic Diagnosis: Nephritis, suppurative, embolic, acute, severe with intralesional coccobacilli.

Contributor's Comment: Actinobacillosis, also known as sleepy foal disease, is an acute and highly fatal septicemia of newborn foals caused by *Actinobacillus equuli*. In many countries it is the most important cause of equine neonatal deaths.[6,9] *A. equuli* is a small, nonmotile, gram-negative, pleomorphic rod. This is a diverse species with at least 28 different antigenic groups.[2] Certain strains of *A. equuli* form part of the normal flora of the gastrointestinal and

3-5. *Kidney, quarter horse: A tissue Gram stain discloses of the gram-negative nature of the bacilli, compatible with A. equuli. (Photo courtesy of the Diagnostic Services Unit, University of Calgary Veterinary Medicine, Clinical Skills Building, 11877 85 St. NW, Calgary AB T3R 1J3, http:// vet.ucalgary.ca/*

respiratory tracts of horses.[3,4] There is a high degree of strain variability within horse populations and within individual horses over time.   It is currently unknown whether there are specific strains of *A. equuli* with greater virulence for foals and/or adult horses or whether such strains are common inhabitants of the equine gastrointestinal and respiratory tracts.[4]

Typically actinobacillosis is a disease of newborn foals and the pathogenesis of the infection remains speculative.   It is postulated that one of the main sources of infection is from the gastrointestinal or respiratory tracts of the mare, although some foals may be infected in utero via placental transmission of the organism resulting in abortion. The majority of foals are likely infected at or during parturition through inhalation, ingestion, or via the umbilicus.[3] Colostrum deprivation is often implicated in cases of actinobacillosis in the early neonatal period; therefore, components of the colostrum from the

mare are thought to be passively protective to the foal.[3,8]

Foals may either die of acute fulminating septicemia in the early neonatal period or survive for several days allowing the organism to localize to multiple organ systems.   Aborted foals and those with fulminating septicemia generally do not have distinctive gross lesions at postmortem.   Animals that survive 2-4 days post-infection often develop miliary microabscesses and fibrinopurulent arthritis. Microabscesses, which are of embolic origin, are most easily observed in the renal cortices and are characterized by the presence of numerous, 1-3 mm, white foci.[6,9] In fact, *A. equuli* is the most common cause of embolic suppurative nephritis in horses. Typical histopathologic features in the kidney include the presence of numerous bacterial colonies within the glomerular and intertubular capillaries admixed with hemorrhage, necrotic debris and intense suppurative inflammation.   The inflammation frequently obliterates the glomerulus.[9]

While the lesions in the current case are classical for infection with *A. equuli*, the unusual feature in this case is the older age of the horse. As previously mentioned, actinobacillosis is primarily a disease of neonatal foals and the organism is seldom of significance in older horses.[6,9] Although infections in adult horses are uncommon, cases of arthritis, endocarditis, orchitis, periorchitis, pleuropneumonia and enteritis have been reported.[4] In addition, both acute and chronic forms of *A. equuli* peritonitis have been described in adult horses. In acute infections, horses present with abdominal pain, ileus, lethargy and inappetance. In chronic cases, weight loss is the most common clinical signs. The source of infection has not been identified, but some have postulated that migrating strongyle larvae from the intestinal tract may play a role. Although *A. equuli* peritonitis is a rare disease in horses, clinicians and pathologists need to be aware of this condition as it is potentially treatable.[4,6]

While *A. equuli* is typically recognized as an opportunistic pathogen of horses, historically *A. equuli* has also been recognized as a rare opportunistic pathogen of pigs. The infection in pigs has been typically associated with abortion, septicemia and polyarthritis.[8] Interestingly, there have been two recent reports of *A. equuli* associated disease in pigs in North America and one outbreak was associated with a high level of morbidity and mortality in sows as the result of septicemia.[7,10] While in foals the primary source of infection is believed to be the mare, there is conflicting evidence concerning the role of the adult horse as a source of infection in pigs.[10] Furthermore, it has been suggested that the rarity of *A. equuli* infections in North American pigs may be the result of the separation of pigs and horses in modern farming systems.[5] A single report of *A. equuli* septicemia has been reported in the human medical literature.[1]

JPC Diagnosis: Kidney: Nephritis, embolic and suppurative, multifocal, severe, with numerous large colonies of bacilli.

Conference Comment: *Actinobacillus* species are within the family *Pasteurellaceae*. Most of the bacteria in this family are commensal, often colonizing the mucosal tissues of both humans and animals; however, there are several species of *Actinobacillus* that are of importance in veterinary medicine, including the following pathogens:[5]

Actinobacillus species	Associated species: disease
A. lignieresii	Cattle: Lesions in the tongue, lymph nodes, rumen, and skin Sheep: Lesions in the skin Pigs: Granulomatous mastitis
A. pleuropneumoniae	Pigs: Pleuropneumonia
A. suis	Piglets, foals: Septicemia, pneumonia Pigs, horses: Pneumonia
A. equuli	Foals: Septicemia Piglets: Septicemia Pigs: Arthritis, enteritis Calves: Enteritis Mares: Abortion
A. seminis	Rams: Epididymitis Lambs: Polyarthritis

Two subspecies of *Actinobacillus* equuli have been identified, *A. equuli* subsp. *equuli*, and *A. equuli* subsp. *haemolyticus*.[2] The former appears to be pathogenic, while the latter's pathogenicity appears to be associated with its expression of a repeats-in-structural toxin (RTX) called Aqx, which is cytotoxic for equine leukocytes. RTX toxins, which are expressed by many species in the family *Pasteurellaceae*, are pore-forming proteins that, when present in high concentrations, bind to β_2-integrins and cause cell lysis and necrosis or, when present in low concentrations, lead to apoptosis by inducing apoptotic signaling cascades. Ultimately, the cellular destruction results in inflammation and disease. RTX toxins bind to specific β_2-integrins, such as CD18, and therefore play an important role in the host and host cell specificity of pathogenic *Pasteurellaceae*.[2]

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CASE IV: TAMU-1 2012 (JPC 4019888).

Signalment: 8-month-old male black and white Micro Pig (*Sus scofra*).

History: Wilber presented with dyspnea from potential aspiration. He has had CNS deficits for 2 months, since overeating at Thanksgiving. Recently, he was treated for a facial abscess. Profound hypoglycemia, hypokalemia, depression, bradycardia and hypothermia were recorded. He seizured and went into cardiac arrest.

Gross Pathology: Mild pneumonia was detected in this emaciated, 2.3kg pig. Animal had hydrocephalus.

Histopathologic Description: A section of the thinned cerebral cortex is presented. A laminar pattern of neuronal necrosis and loss is seen. Remaining is a neuropil of gliosis with astrocytes activated microglia and scattered oligodendroglia. Gitter cells are scattered and also form nests about aciculate "cholesterol clefts." Foci of calcified debris and cells and arterioles with a rim of calcium at the medial/intimal interface are noted. Scattered mononuclear cells infiltrate with a few neutrophils and thin cuffs of mononuclear cells are noted. Remaining neuropil is often rarified or has microcavitation (edema) with rare spheroids.

**Contributor's Morphologic Diagnosis:** Chronic encephalopathy with laminar cortical necrosis; hydrocephalus ex vaccuo.
Cause: Potato chip binging, salt intoxication.

Contributor's Comments: Micro pigs are one of a recent proliferation of pocket pets to appear on the market. Sometimes called "teacup pigs" because when born they can fit in a teacup, they grow to be the height of a medium-sized dog and weigh as much as 65 pounds.

This is a unique lesion and becomes intriguing when you are told that little Wilber loved potato chips, and at Thanksgiving was waylaid by a bag of Lays. He survived the "salt intoxication" with deficits for 2 months. The gross images of his brain demonstrate injected cerebral vessels and cortex collapse. On cross section, the laminar necrosis is seen nicely. While the morphologic can be followed by a chain of descriptors, this is an encephalopathy. Calcification of neuropil necrosis is common, but the pattern of vessel calcification is interesting. The nests of Gitter cells with cholesterol clefts are reminiscent of lipogranulomas. The mononuclear cells are mostly macrophages like is seen in cases of chronic polioencephalopathy and many infarcts; therefore, encephalitis is probably not a valid morphologic. I am not aware of a similar case being described although a comment on similar chronic lesions is in texts.[5] One must wonder if seizures have a role in developing some of the cortical necrosis.
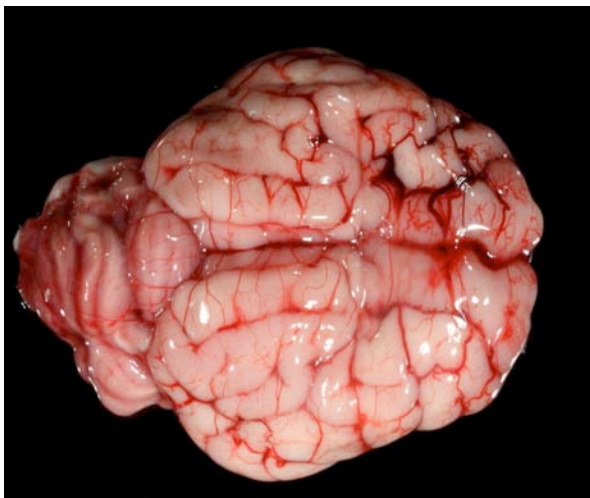

4-1. Cerebrum, micropig: The cerebrum displays mild flattening of the gyria and a loss of sulcal depth, as well as multifocal cloudiness of the meninges. (Photo courtesy of the Deptartent of Veterinary Pathobiology, College of Veterinary Medicine and Biomedical Sciences,Texas A&M University, College Station, TX 77843-4467)
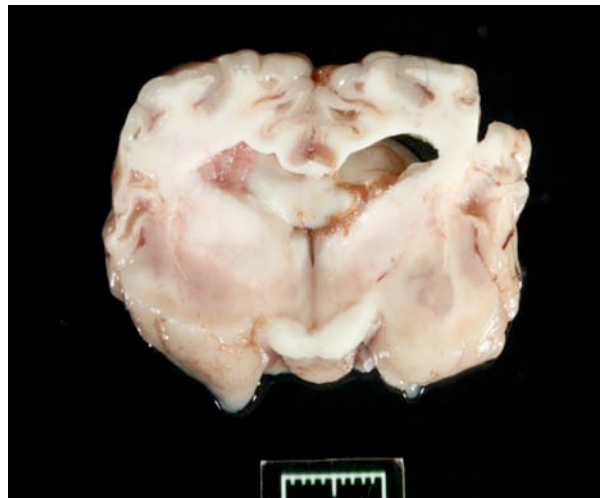

4-2. Cerebrum, micropig: There is diffuse thinning of the superficial gray matter, as well as mild dilation of the lateral ventricles as a result of hydrocephalus ex vacuo. (Photo courtesy of the Deptartment of Veterinary Pathobiology, College of Veterinary Medicine and Biomedical Sciences, Texas A&M University, College Station, TX 77843-4467)
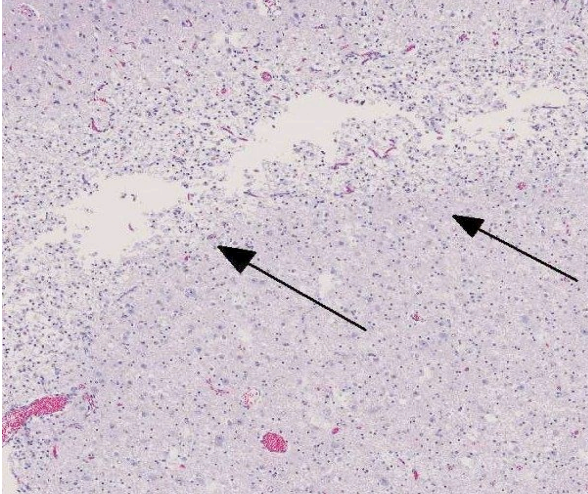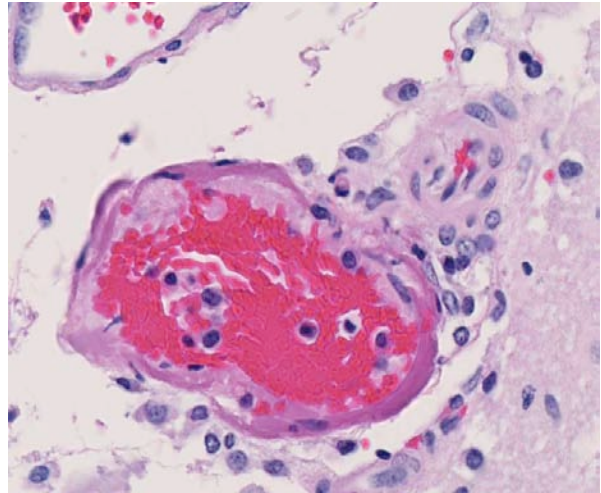
4-3. Cerebrum, micropig: Scattered throughout the superficial cortex, there are areas of laminar necrosis (arrows). (HE 24X)
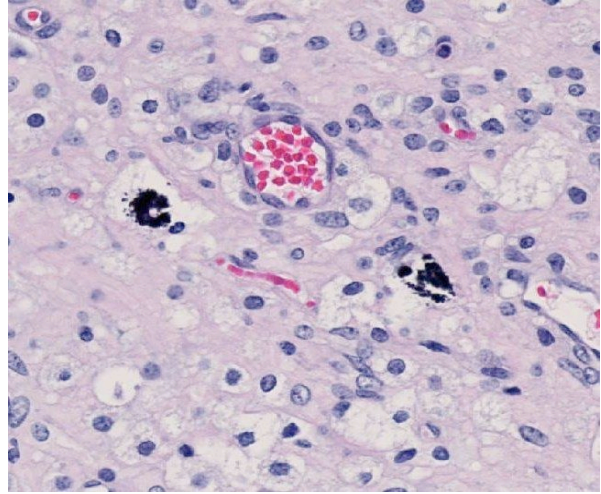
4-4. Cerebrum, micropig: Areas of necrosis within white matter often have foci of mineral scattered among numerous foamy gitter cells. (HE 220X)
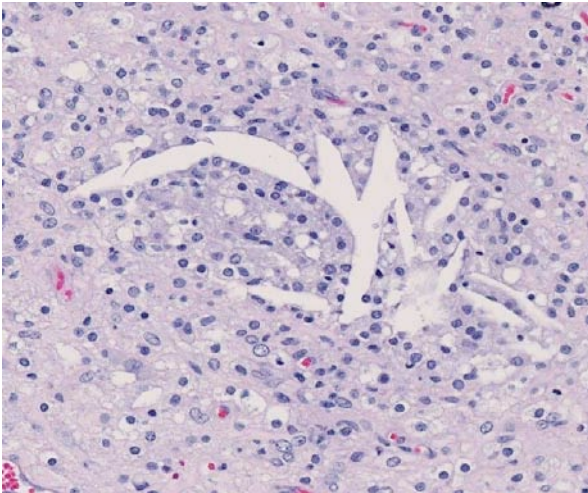
4-5. Cerebrum, micropig: Occasionally, areas of white matter necrosis contain acicular cholesterol clefts. (HE 136X)

4-6. Cerebrum, micropig: Throughout the section, blood vessels occasionally exhibit fibrinoid change. (HE 320X)

Salt poisoning of young pigs is well known in its acute form and occurs when high salt diets are given when inadequate water is available.[2,5] Upon the later consumption of water, the salt in the cortical tissues cannot be cleared before water enters to cause the laminar necrosis. Evidence of presumed previous eosinophil cuffing is nowhere to be seen at this time. It is thought that eosinophil cuffs are associated/induced by sodium excess in tissues but may not be seen and cuffs are not present several days after survival.[2,5] Laminar necrosis in cases of salt intoxication does not fluoresce (JFE).

Swine are considered the most sensitive species to salt intoxication.[3] Potato chips have been reported before in this disease in pigs and survivors with CNS deficits are reported.[2,4] It has been shown that diets high in salt lead to increased salt in the pig brain with the highest concentrations being in the cerebral and cerebellar hemispheres.[1,6]

JPC Diagnosis: 1. Brain, cerebrum: Necrosis, cortical, laminar, with multifocal cholesterol clefts and spongiosis, Micro Pig, porcine.
2. Brain, cerebrum, arteries and veins: Mineralization, diffuse, moderate, with multifocal fibrinoid necrosis.

Conference Comment: Conference participants found the proposed etiology in this case of great interest, especially since there was no report of concurrent water deprivation. Although in the face

of water deprivation, salt toxicity can occur in pigs with the intake of normal salt amounts (0.25-1%), much higher salt levels (up to 13%) can be tolerated as long as water intake is adequate.[4] It would be interesting to know if Wilber did in fact have a reduced water intake in conjunction with his potato chip binge. Additionally, some participants noted the absence of eosinophils that are often observed in swine salt toxicity; however, as the contributor states, although eosinophilic cuffs around vessels in the cerebral cortex usually develop within 48 hours, they tend to no longer be present after three to four days.[6] Conference participants found the mural mineralization and occasional fibrinoid necrosis of the vessels (not visible on all slides) interesting, but could not determine the cause.

For an acute case of salt toxicity in a pig, participants are urged to review conference 22, case 1 from the 2008-2009 WSC.

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Contributing Institution: Dept. of Veterinary Pathobiology
College of Veterinary Medicine and Biomedical Sciences
Texas A&M University
College Station, TX 77843-4467