



WEDNESDAY SLIDE CONFERENCE 2026-2027

Conference #5

16 September 2026

CASE I:

Signalment:

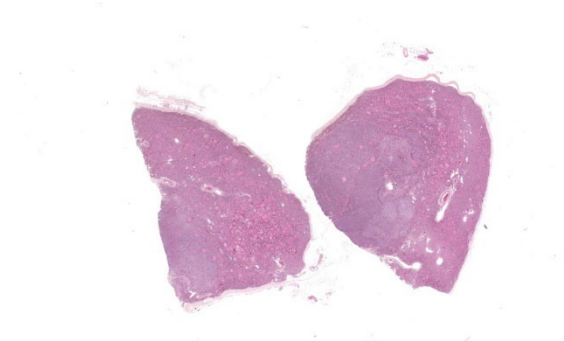
34-year-old, male gelded, Quarterhorse Paso X, *Equus caballus*, equine

History:

The horse was used as part of the DVM program teaching herd at Ross University School of Veterinary Medicine and was euthanased due to the presence of large oro-nasal squamous cell carcinoma with metastasis to the submandibular lymph nodes and oesophagus. The tumour was associated with maxillary in-



1-1. Thyroid gland, horse: On cut section, the left thyroid lobe contained a well demarcated, pale pink, multinodular, 1.5 – 2 cm diameter mass (*Photo courtesy of: Department of Biomedical Sciences, Ross University School of Veterinary, Medicine, www.veterinary.rossu.edu*)



1-2. Thyroid gland, horse: On cut section, the left thyroid lobe contained a well demarcated, pale pink, multinodular, 1.5 – 2 cm diameter mass (*Photo courtesy of: Department of Biomedical Sciences, Ross University School of Veterinary, Medicine, www.veterinary.rossu.edu*)

cisor loss and dysphagia. At autopsy, a clinically silent mass was found in the left thyroid lobe.

Gross Pathology:

On cut section, the left thyroid lobe contained a well demarcated, pale pink, multinodular, 1.5 – 2 cm diameter mass.

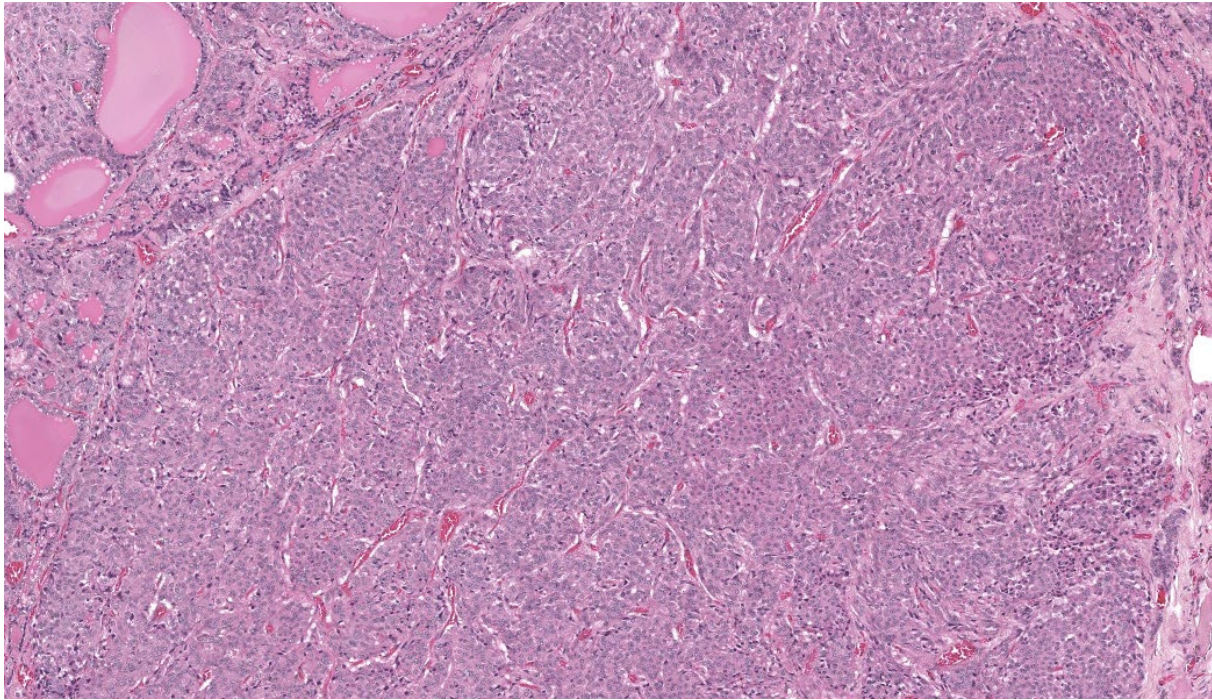
Laboratory Results:

Special Stains

Follicular luminal material (colloid) within and around the thyroid neoplasm were positive for PAS.

Immunohistochemistry

The neoplasm and parafollicular C cells cytoplasm were moderately positive for calcitonin, and faintly positive for chromogranin A, and



1-3. Thyroid gland, horse: Neoplastic cells are arranged in nests and packets (HE, 152X).

negative for thyroglobulin. Follicles entrapped within and around the mass were positive for thyroglobulin.

Microscopic Description:

Left thyroid gland: Compressing adjacent thyroid follicles is a multinodular, poorly to moderately demarcated, segmentally infiltrative, unencapsulated mass. It is composed of small sheets and closely packed nests, packets and variably sized follicles (containing homogeneous colloid like material) on a fine fibrovascular stroma. The cells are polygonal with indistinct borders and have moderate amounts of finely granulated eosinophilic cytoplasm with a central, round, euchromatic nucleus with 2-3 prominent nucleoli. Anisocytosis is mild and anisokaryosis is moderate with infrequent karyomegaly. There are rare mitoses.

Contributor's Morphologic Diagnoses:

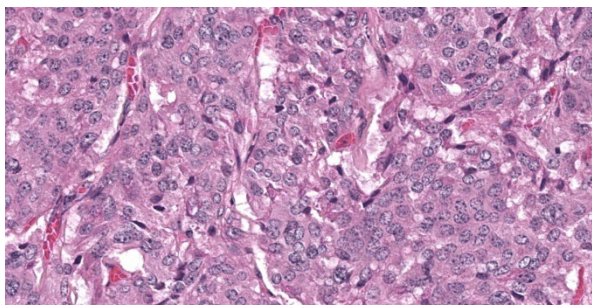
Thyroid C cell carcinoma.

Contributor's Comment:

Primary neoplasms of the thyroid gland have

been histologically classified epithelial, mesenchymal, mixed epithelial-mesenchymal and unclassified.¹⁰ Epithelial tumors can originate from the follicular cells involved in thyroid hormone synthesis or from the calcitonin producing parafollicular C cells (thyroid C cell tumours) although a mixed form is recognised in humans and has been reported in the horse.^{5,7} Classically, C cell tumours are described as being more common than thyroid tumours in older horses but non-functional thyroid adenomas and adenocarcinomas were more common in two recent small case series.^{8,4}

Within the domestic species, thyroid C cell tumours most commonly develop in bulls, dogs and adult to aged horses.^{5,3} In horses, they present as unilateral masses and are usually not associated with endocrine disturbances and clinical signs such as dysphagia, oesophageal obstruction (choke), dyspnoea, tracheal compression and stridor^{7,4,1} relate to a space occupying lesion in a cranial cervical location.



1-4. Thyroid gland, horse: High magnification of neoplastic cells. (HE, 152X)

Surgical excision is the treatment of choice in horses with clinical signs and usually has a good outcome.⁴

Grossly, C cell tumours appear as nodular or multinodular masses in one or both thyroid lobes.⁵ Smaller masses either represent nodular hyperplasia or adenomas and larger masses with necrosis and haemorrhage are more likely to be malignant with local tissue invasion and potential spread to regional lymph nodes and the lungs, although metastasis is rare in horses with C cell carcinomas.^{6,5,1}

Histologically, C cell adenomas are larger than a thyroid follicle (in comparison with nodular hyperplasia) and are composed of an unencapsulated expansile mass of polygonal cells with eosinophilic to amphophilic cytoplasm and indistinct neuroendocrine packaging. C cell carcinomas are more pleomorphic with a higher mitotic count and show evidence of local infiltration (as seen in some sections of this case) or lymphovascular invasion. Cytological evaluation of thyroid tumours is also reported to be clinically useful in diagnosing malignant neuroendocrine (and endocrine) tumours.²

Both carcinomas and adenomas may contain follicular structures that represent entrapped thyroid follicles containing PAS positive colloid, or follicles originating from neoplastic C cells and can therefore mimic a follicular-

compact thyroid tumour (as seen in this case).

⁶ Ambiguous cases may require immunohistochemistry.^{6,9,2} C cell tumours are of neural crest origin and should stain positive for calcitonin and chromogranin A and synaptophysin which are markers for neuroendocrine tissue.^{5,2} Additionally, C cell tumours should be negative for thyroglobulin, except for any entrapped thyroid follicles and similarly follicles within follicular-compact thyroid tumours are expected to be positive for thyroglobulin.⁶

Contributing Institution:

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JPC Diagnoses:

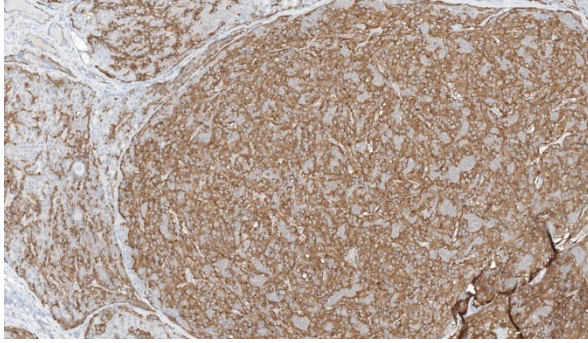
Thyroid gland: C-cell tumor

JPC Comment:

This week's conference was moderated by JPC alum, Deputy Director of the Biologic Instrumentation Center of the Armed Forces Radiobiology Research Instrumentation (AFRRI) and a member of the Davis-Thompson Foundation's Executive Board and Faculty of Discussants, Dr. Kelsey Fiddes.

It should be noted that in humans, C-cell carcinomas are referred to by the alternate name as medullary thyroid carcinomas; in the older literature, especially in cattle, where this is a fairly common neoplasm, this term will often be encountered.

Whenever a C-cell tumor is mentioned, the prudent pathologist should always consider the possibility of Multiple Endocrine Neoplasia (MEN), as these tumors are a very common constituent of the various syndromes that have been identified in humans and animals.



1-5. Thyroid gland, horse: Neoplastic cells are strongly positive for synaptophysin. (anti-synaptophysin, 215X)

Multiple endocrine neoplasia is a rare, genetically based condition in humans and animals, which involves the development of concurrent neoplasms in multiple (two or more) endocrine organs. In humans, in which multiple MEN syndromes have been identified, there are four distinct syndromes, all of which are of autosomal dominant inheritance.¹¹

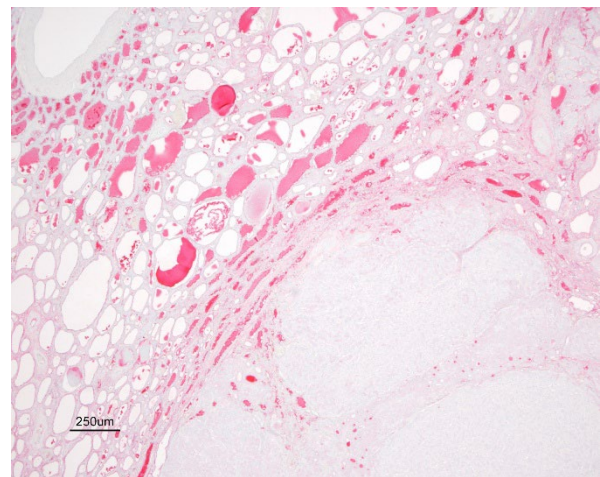
In humans, four syndromes of MEN exist. In MEN1, tumors of the parathyroid gland (95% of affected individuals), pancreatic islets (30-80%) and the anterior pituitary gland (15-50%), and constitutes a total 10% of individuals diagnosed with primary hyperparathyroidism before 30 years of age.¹¹ This syndrome is associated with over a thousand germline inactivating mutations of MEN1, the tumor suppressor gene, which encodes for menin, a protein that regulates transcription and cellular proliferation in endocrine tissues.¹¹

Medullary thyroid carcinoma is commonly associated with MEN2 and MEN3 and is present in 95% of individuals diagnosed with this syndrome.¹¹ Additional tumors in these syndromes include pheochromocytomas (50%) and parathyroid neoplasms (20-30%).¹¹ These syndromes are associated with mutations in

the RET (rearranged during transfection) protooncogene, which encodes a membrane-bound tyrosine kinase cell surface receptor.¹¹

MEN4 is the most recently identified (2006) syndrome, with limited numbers of cases being reported. In this syndrome, the tumor palate includes that of MEN1, with additional tumors in the kidneys and reproductive organs. This condition is associated with eight different point mutations in the CDNK1B gene.¹¹

MEN has been reported rarely (accounting for less than 2% of all endocrine tumors) in dogs, cats, cattle, horses, and rats. Isolated cases in a variety of other species have also been reported.¹² In animal species, MEN is best described in bulls. The syndrome parallels MEN2/3 in humans, with C-cell tumors, pheochromocytomas, which are often bilateral, and pituitary adenomas.¹³ Parathyroid tumors have not been reported as part of this syndrome. In most of these cases, genetic muta-



1-6. Thyroid gland, horse: Neoplastic cells are immunonegative for thyroglobulin. (anti-thyroglobulin, 215x) (Photo courtesy of: Department of Biomedical Sciences, Ross University School of Veterinary, Medicine, www.veterinary.rossu.edu)

tions have not yet been identified. The high incidence of C-cell tumors in rats has not been associated with mutations in the RET gene.¹¹

The initial report of MEN in horses was published by de Cock et al.¹³ in 1999. In this report, six individuals (representing 26% of cases in horses with endocrine tumors) possessed both C-cell tumors and pheochromocytomas, similar to MEN2/3 in humans.

The JPC morphologic diagnosis of C-cell tumor is not a typo, but a conscious choice. C-cell tumors, like other neuroendocrine tumors, may be histologically deceptive, as they rarely display obvious signs of malignancy, and this is one of those cases. Criteria of malignancy for these tumors include invasion of the thyroid capsule and extension into surrounding tissue (“fixed” tumors), and more obvious signs to include lymphovascular invasion or metastasis to lymph nodes in the region. Unfortunately, none of those are evident in this sample. Like many neuroendocrine tumors, there were karyomegalic cells and some participants felt there was nuclear molding, but those features may be seen in both benign and malignant parafollicular cell neoplasms. Some pathologists might call this C-cell adenoma, but the experience of seeing histologically “benign” neoplasms metastasize (especially in the dog), should give a pathologist at least a moment’s pause before closing the door on aggressive behavior. For this reason, without the more obvious histologic indicators of malignancy (for which we would happily render a diagnosis of “C-cell carcinoma”, we prefer a somewhat less specific diagnosis of “C-cell tumor” in this case.

References:

1. Elce YA, Ross MW, Davidson EJ, Tulleners EP. Unilateral thyroidectomy in 6 horses. *Vet Surg*. 2003;32: 187-190.
2. Froment R, Allano M, Chiasson A, Doré M, Gara-Boivin C. Pathology in Practice. *J Am Vet Med Assoc*. 2016;248: 1355-1357.
3. Kuwamura M, Shirota A, Yamate J, Kotani T, Ohashi F, Sakuma S. C-cell adenoma containing variously sized thyroid follicles in a horse. *J Vet Med Sci*. 1998;60: 387-389.
4. Marcatili M, Voss SJ, Pollock PJ. Standing thyroidectomy in 10 horses. *Vet Surg*. 2018;47: 86-92.
5. Rosol TJ, Gröne A: Endocrine Glands. In: Pathology of domestic animals, ed. Maxie GM, 6 ed. Elsevier, St. Louis, Missouri, 2016
6. Rosol TJ, Meuten DJ: Tumors of the Endocrine Glands. In: Tumors in Domestic Animals, ed. Meuten DJ, 5 ed. Wiley & Sons, Ames, Iowa, 2017
7. Saulez MN, Viljoen A, Kafka U, Rubio-Martinez L, van Wilpe E, Steyl J. The use of nuclear imaging for a mixed C cell microfollicular carcinoma of the thyroid gland in a mature horse. *Equine Veterinary Education*. 2013;25: 118-125.
8. Troillet A, Böttcher D, Brehm W, Scharner D. Retrospective Evaluation of Hemithyroidectomy in 14 Horses. *Vet Surg*. 2016;45: 949-954.
9. Ueki H, Kowatari Y, Oyamada T, Oikawa M, Yoshikawa H. Non-functional C-cell adenoma in aged horses. *J Comp Pathol*. 2004;131: 157-165.
10. von Sandersleben J, Hänichen T. Tumours of the thyroid gland. *Bull World Health Organ*. 1974;50: 35-42.

CASE II:

Signalment:

12-Year-old, Female, Spayed, Miniature Schnauzer, *Canis familiaris*, canine.

History:

This dog had a history of lens subluxation, glaucoma, hyphema, and corneal neovascularization. The most recent/highest IOP (mmHg) are 30 OD and 26 OS.

Gross Pathology:

The entire uveal tract was lined by thick bands of white to tan material. All chambers of the globe were filled with translucent gelatinous material.

Laboratory Results:

Not provided

Microscopic Description:

There were thick bands of epithelioid macrophages mixed with neutrophils forming a carpet-like covering over thick bands of fibrovascular stroma that contained plasma cells and lymphocytes and lined the anterior and poste-



2-1. Eye, dog: The entire uveal tract was lined by thick bands of white to tan material. All chambers of the globe were filled with translucent gelatinous material. (Photo courtesy of: Michigan State University Veterinary Diagnostic Laboratory, <https://cvm.msu.edu/vdl>)

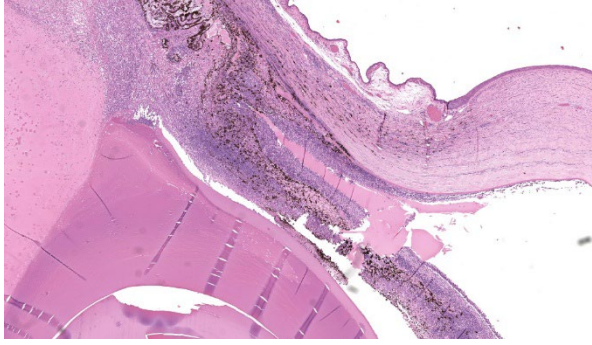


2-2. Eye, dog: At subgross magnification, there is exudate in the anterior and posterior chambers. The iris and ciliary body is expanded by a dense cellular infiltrate, and one leaflet of the iris is attached to the lens. The exudate extends along the surface of the detached retina. (HE, 16X)

rior surfaces of the iris. These epithelioid macrophages occasionally contained variably sized eosinophilic globules, most consistent with lens material. The carpet of epithelioid macrophages also extended to the inner cornea and covered the inner retina and optic nerve head. The bands of fibrovascular stroma bridged from the base of the iris over the collapsed ciliary cleft to the termination of Descemet's membrane, extended around the posterior aspect of the iris and ciliary body surface, and bridged to the lens capsule, resulting in peripheral anterior and posterior synchchia.

There was moderate cataractous change, characterized by liquefaction and fragmentation of lens fibers, formation of Morgagnian globules and bladder cells, hyperplasia of lens epithelium, and posterior lens epithelial migration. Focally, the lens capsule was ruptured at the equator, and the ruptured lens capsule margin and the exposed lens fibers were infiltrated by degenerate neutrophils and epithelioid macrophages containing intracytoplasmic eosinophilic globules (phagocytized lens protein).

There were perivascular infiltrates of lymphocytes and plasma cells within the iris stroma, choroid, retina, and sclera, and multifocally in the optic nerve. Segmentally, the photoreceptor segments were lost, shortened, and tat-



2-3. Eye, dog: A dense cellular infiltrate expands the iris and ciliary body and extends across the drainage angle. (HE, 41X)

tered. Focally, there was loss of cellular architecture in the peripheral neural retina and replacement by flocculent eosinophilic material, karyorrhectic debris, high numbers of degenerate neutrophils, and macrophages.

The anterior and posterior chambers and vitreal space were filled with eosinophilic proteinaceous fluid and scattered degenerate neutrophils and macrophages. There were variably sized small eosinophilic globules free in the posterior chamber and vitreal space, particularly surrounding the lens capsule.

There was moderate neovascularization of the corneal stroma accompanied by moderate perivascular infiltrates of neutrophils, lymphocytes and plasma cells. The axial corneal epithelium was moderately hyperplastic and exhibited rare keratinization.

Contributor's Morphologic Diagnoses:

Eye, OD:

Severe pyogranulomatous and lymphoplasmacytic panuveitis and endophthalmitis with epithelioid macrophage carpeting and intravitreal free lens protein, suggestive of asymmetric uveitis

Preiridal, postiridal, cyclitic, and retrocorneal fibrovascular membranes, with peripheral anterior and posterior synechia

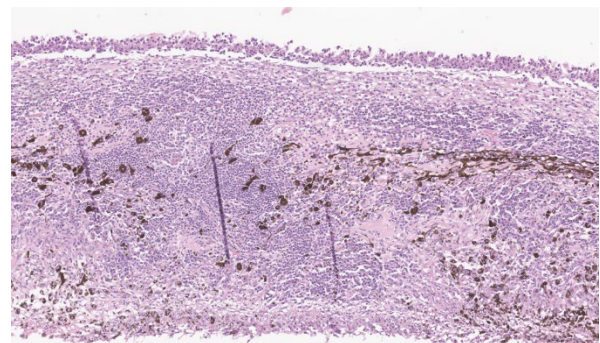
Lens capsule rupture, pyogranulomatous phakitis, and moderate cortical cataractous change

Mild multifocal lymphoplasmacytic optic neuritis and retinitis with focal retinal necrosis
Moderate neutrophilic and lymphoplasmacytic keratitis with stromal vascularization and moderate regional corneal epithelial hyperplasia and keratinization

Contributor's Comment:

Unlike other organs, the eye protects vision by restricting local immune and inflammatory responses, a concept known as immune privilege.⁶ Lens-Induced Uveitis (LIU) is a response to leakage of lens material, which is often seen in canine cataracts.^{2,5}

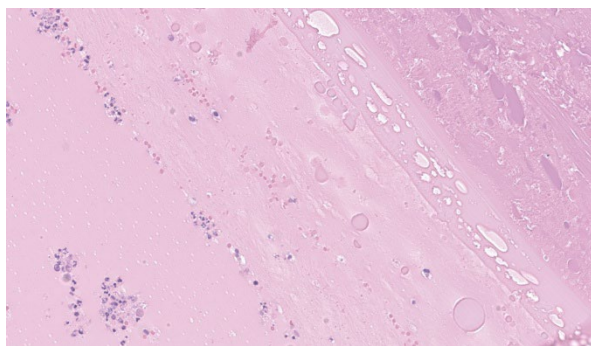
It had been speculated that small amounts of lens protein escaping from the normal intact lens helps maintain low-dose immunologic tolerance. Increased exposure to lens material, whether from lens trauma, surgery, or cataracts, can overwhelm this tolerance and induce an intraocular or systemic immune response.² In one human study, they found that anti-lens antibodies were not only present in cataract patients but were also found in other inflammatory eye disease, including uveitis and cyclitis, while patients with lens-induced uveitis



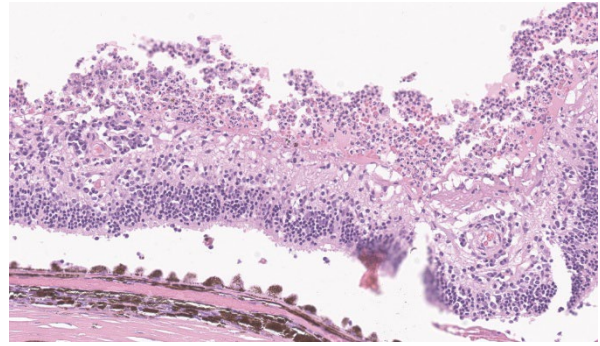
2-4. Eye, dog: The iris is expanded by numerous macrophages, lymphocytes, and plasma cells. There are pre- and-post-iridal membranes which are covered by a carpet of epithelioid macrophages. (HE, 192X)

had a high titer.⁴ This study supports the speculation of low-dose immunologic tolerance and hypersensitivity reaction to lens protein. The inflammation pattern of LIU is typically lymphoplasmacytic to neutrophilic (if there is an infectious agent), while granulomatous inflammation is usually not seen in LIU, except in a condition called “asymmetric uveitis.”¹ Diagnosis of asymmetric uveitis is based on histological findings of carpet of epithelioid macrophages covering the surface of the anterior uvea and sometime extending to blanket the inner retina or the inner aspect of Descemet’s membrane, in conjunction with cataract. Phagocytized lens fiber material is often, but not always, seen within epithelioid macrophages. Retinitis and segmental retinal necrosis can also be observed.¹ All these characteristic histologic features were present in the submitted case.

Upon communication with the Comparative Ocular Pathology Laboratory of Wisconsin (COPLOW), canine asymmetric uveitis is a disease entity that is suspected to be a hypersensitivity reaction to lens protein. Despite being diagnosed at COPLOW and MSU fairly



2-5. Eye, dog: There are balloon cells and Morgagnian globules along the posterior aspect of the ruptured lens at right. On the left, the posterior capsule is filled with eosinophilic proteinaceous fluid with floating aggregates of lens protein being phagocytosed by aggregated macrophages. (HE, 467X)



2-6. Eye, dog: The retina is detached, and there is hyperplasia of the underlying retinal pigmented epithelium. The retina shows vacuolation, loss of nuclei within the ganglion and inner nuclear layer, and blending with the other nuclear layer. Rods and cones are atrophic. The inner surface of the retina is covered by a carpet of epithelioid macrophages. (HE, 381X)

frequently, this diagnosis has not yet been reported in the veterinary literature. This condition can later develop in the contralateral eye if cataracts develop. The interval between the enucleation of the first eye and the clinical onset in the second eye varies from nearly immediately to four years.¹ Therefore, close monitoring of the contralateral eye clinically is recommended.

This disease entity is often associated with diabetic cataracts, but it can be observed with any cataractous change. Miniature Schnauzers, like this case, are predisposed to developing both hereditary and diabetic cataracts, and as a result seem to be over-represented in bilateral, simultaneous asymmetric uveitis.^{2,3}

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JPC Morphologic Diagnosis:

Eye: Panophthalmitis, lymphoplasmacytic and histiocytic, chronic, diffuse, marked, with

fibrovascular membranes, synechiae, cataractous change, lens rupture, and retinal detachment with necrosis.

JPC Comment:

The contributor provides a concise, but through review of the histologically unique condition of asymmetric uveitis. Although phacoclastic uveitis is not a new entity for the WSC (there are several cases in the WSC archive, to include several traumatic lens ruptures – one by cactus spines, and several in rabbits with intralenticular *Encephalitozoon cuniculi*), we have not previously had a case with the characteristic carpeting of intraocular tissues by epithelioid macrophages consistent with asymmetric uveitis.

The contributor is correct in that there is limited material available on this particular condition, and that the subject matter experts at the Comparative Ocular Pathology Laboratory of Wisconsin (COPLOW) are the only organization that currently recognizes this as a discrete entity. The Department of Veterinary Pathology of the JPC utilizes this outstanding group of pathologists as our consultant on complex ocular cases, and for many years we have fervently believed in their diagnostic acumen and see no reason to question it over this entity. We are hopeful that this first entry of asymmetric uveitis will alert more pathologists to its existence. Additionally, the first reference, *Veterinary Ocular Pathology: A Comparative Review* by Richard Dubielzig et al.¹, is an excellent, well-illustrated reference texts which reviews (and illustrates) the entities within the COPLOW database at the time of its publication (2010). We live in hope that a new edition with an updated review is forthcoming. COPLOW also maintains an outstanding website ([\[med.wisc.edu/lab/coplow/\]\(https://www.med.wisc.edu/lab/coplow/\)\) with an online atlas, links to ocular pathology rounds, and many other resources that make it a mandatory, routine place for any ocular-oriented pathologist to visit. COPLOW also maintains an excellent presence on social media, to include their Facebook page.](https://www.vet-</p></div><div data-bbox=)

A few additional details are likely in order on canine asymmetric uveitis for those who may be encountering it for the first time. This is often a disease of small breed dogs with Poodles overrepresented in cases of non-diabetic asymmetric uveitis. Diabetic asymmetric uveitis is seen in Miniature Schnauzers¹ and dachshunds⁸ whose predisposition to the development of diabetic cataracts predisposes them to this particular sequela. The histologic changes in the two variants of this entity are very similar.¹

Another important detail is that many affected globes, if serially sectioned, will demonstrate a penetrating injury to the lens¹ (a lesion that is very visible in this particular case).

But why is the identification of this condition important? Well, it's in the name. Often, early identification of the lesion may allow for aggressive anti-inflammatory therapy which



2-7. Eye, dog: A layer of epithelioid macrophages carpeting the anterior surface of the iris (and the pre-iridal fibrovascular membrane) demonstrates strong cytoplasmic immunoreactivity for IBA-1. (anti-IBA-1, 860x)

may preserve sight in the remaining eye, which is not as severely affected. In the COPLOW collection as published in 2010, 10/23 cases had the second eye ultimately submitted (with similar lesions), with a clinical onset of signs in the remaining eye ranging from a matter of days to over 4 years.

For those who are immunologically inclined, the antigenic substances in the eye were identified in 1977 by Rahi et al in a series of experiments in rabbits. The three crystallins with lens protein (alpha-, beta- and gamma-crystallin) were identified as immunogenic, with their immunogenicity and the appearance of antibodies well correlated to their alphabetized names, with alpha-crystallin being the most immunogenic and resulting in the earliest demonstration of antibody production. These proteins generate a profound antibody response, but a weak cell-mediated (T-cell response.)

On a comparative note (and to avoid confusion), the term used in humans for phacoclastic uveitis in human is “phacoanaphylaxis”, which is a bit of a misnomer as previous sensitization to crystallin protein is not required for the manifestation of this disease,⁸ nor will it cause traditional anaphylaxis in affected individuals.

References:

1. Dubielzig RR, Ketrin KL, McLellan GJ, Albert DM eds. *Veterinary Ocular Pathology: a Comparative Review*. Saunders-Elsevier: St Louis MO. 2010:263-266.
2. Gelatt KN, Ben-Shlomo G, Gilger BC, Hendrix D V.H., Kern TJ, Plummer CE. *Veterinary ophthalmology Vol. 2*, 6th ed. Wiley Blackwell. New Jersey; 2021:1277-1278, 1326-1339
3. Holder AL, Kennedy LJ, Ollier WE, Catchpole B. Breed differences in development of anti-insulin antibodies in diabetic dogs and investigation of the role of dog leukocyte antigen (DLA) genes. *Vet Immunol Immunopathol.* 2015;167(3-4):130-8.
4. Patel M, Shine B, Murray PI. Antilens antibodies in cataract and inflammatory eye disease: an evaluation of a new technique. *Int Ophthalmol.* 1990;14(2):97-100.
5. Wilcock BP, Njaa BL. Special senses. In Maxie G, ed. *Jubb, Kennedy, and Palmer's Pathology of Domestic Animals Vol 1*, 6th ed. Elsevier, Inc. St. Louis; 2016:457-459.
6. Zhou R, Caspi RR. Ocular immune privilege. *F1000 Biol Rep.* 2010;2:3.
7. Rahi AH, Misra RN, Morgan G. Immunopathology of the lens. I. Humoral and cellular immune responses to heterologous lens antigens and their roles in ocular inflammation. *Br J Ophthalmol.* 1977 Mar;61(3):164-76.
8. Grahn B, Peiffer R, and Wilcock B. *Histologic Basis of Ocular Disease in Animals*, Wiley Blackwell.

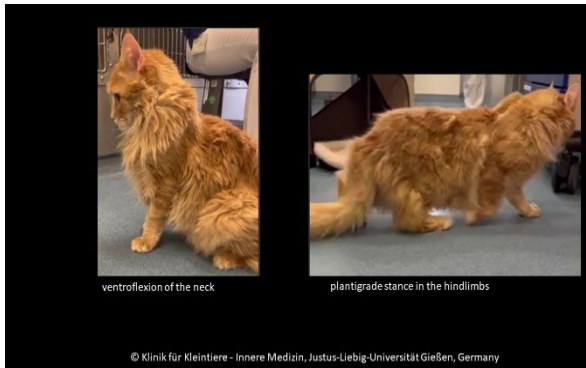
CASE III:

Signalment:

10-year-old, male-neutered, Maine Coon cat, *Felis silvestris*, cat

History:

The animal was presented due to apathy, weakness and the suspicion of myopathy. Clinical examination also revealed plantigrade stance of the hind limbs and ventroflexion of the neck. Blood analysis demonstrated severe



3-1. Presentation, cat. Clinical examination revealed plantigrade stance of the hind limbs and ventroflexion of the neck. (Photo courtesy of: Institut fuer Veterinaer-Pathologie, Justus-Liebig-Universitaet Giessen, http://www.uni-giessen.de/cms/fbz/fb10/institute_klinikum/institute/pathologie)

hypokalemia, hyponatremia, hypocalcemia, hypomagnesemia, and marked hypertension. Creatinine kinase was markedly elevated as was aldosterone (10 times higher than normal!). Based on the interpretation of all findings, clinically manifest hyperaldosteronism was diagnosed. Ultrasonography and CT scan revealed a round mass 3 cm in diameter in the region of the right adrenal gland, compressing the caval vein.

Surgical resection of the mass was attempted unsuccessfully as the caudal vena cava was in too close proximity. The cat was euthanized, the mass was resected post mortem and submitted for histopathological examination.

Gross Pathology:

Right adrenal gland (per contributor): 2.5 cm in diameter whitish-brown lobulated mass replacing the normal adrenal gland tissue.

Laboratory Results:

Potassium:	1.8 mmol/l
Sodium:	147.5 mmol/l
Magnesium:	0.29 mmol/l
Calcium:	1.00 mmol/l
Chloride:	116 mmol/l

Creatinine kinase:	71400 U/l
Aldosterone:	6149.40 pmol/l

Immunohistochemistry (neoplasia)

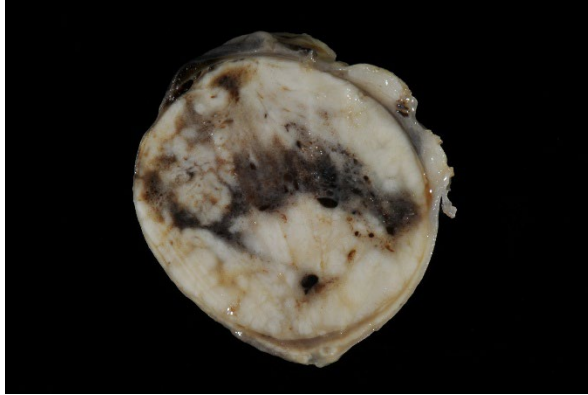
Melan A:	negative
Cytokeratin:	negative
Synaptophysin:	negative
Chromogranin:	negative

Microscopic Description:

Adrenal gland: Compressing the adrenal tissue leaving only a small rim of adrenal cortex and medulla is a round, approximately 2 cm in diameter, densely cellular, well-demarcated, encapsulated tumor composed of packets, nests and cords of neoplastic cells on a fine fibrovascular stroma. Neoplastic cells are polygonal with distinct cell borders, moderate amounts of often microvacuolated eosinophilic cytoplasm, and a round to oval nucleus with finely stippled chromatin and one distinct nucleolus. In some cells, the cytoplasm is replaced by larger vacuoles (lipoid degeneration). Anisocytosis and anisokaryosis are mild, and the mitotic count is 3 mitoses per 2.37 mm^2 (10 high power fields). Within the tumor there are many dilated blood-filled



3-2. CT scan, cat. A CT scan revealed a 3 cm round mass in the region of the right adrenal gland, compressing the caval vein (Photo courtesy of: Institut fuer Veterinaer-Pathologie, Justus-Liebig-Universitaet Giessen, http://www.uni-giessen.de/cms/fbz/fb10/institute_klinikum/institute/pathologie)



3-3. Adrenal gland, cat. A 2.5 cm whitish-brown lobulated mass replaces the normal adrenal gland. (Photo courtesy of: Institut fuer Veterinaer-Pathologie, Justus-Liebig-Universitaet Giessen, http://www.uni-giessen.de/cms/fbz/fb10/institute_klinikum/institute/pathologie)

veins (telangiectasis), and focally there is a small area of hemorrhage and necrosis surrounded by hemosiderin-laden macrophages.

Contributor's Morphologic Diagnoses:

Adrenal gland: Cortical adenoma

Contributor's Comment:

Adrenal cortical adenomas are commonly diagnosed in older dogs and rarely in horses, cattle, and sheep. These tumors are often associated with hypercortisolism.^{4,6,7} In cats, adrenal cortical tumors are very rare, but recent studies have provided more information about the disease in felines.^{1,3} Hyperaldosteronism associated with functional adrenocortical tumors is more commonly diagnosed in cats than hypercortisolism.¹

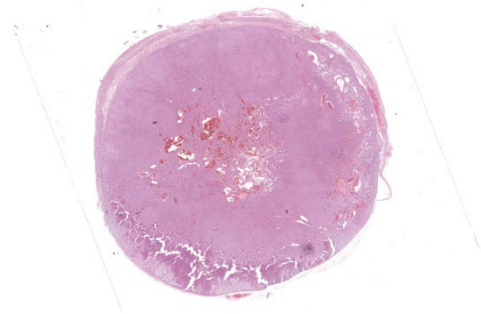
Conn's syndrome is the synonym for hyperaldosteronism and the disease was named after the endocrinologist Jerome Conn (1907-1994), who first described primary hyperaldosteronism in humans in 1955.³

Cats show muscle weakness, inability to lift the head, plantigrade stance of the hind limbs,

or ocular lesions due to hypertension. Severe mineral imbalances with characteristic hypokalemia, increased creatinine kinase activity and elevated aldosterone levels are pathognomonic. Often abdominal masses in the adrenal region can be localized by palpation or diagnostic imaging. The disease appears to be underdiagnosed in cats.^{1,3}

At necropsy, an adrenal mass should be found unilaterally or bilaterally. Tumors may be located in the cortex, well demarcated with a capsule and compressing the normal tissue. The cells are often arranged in broad trabeculae or nests with a delicate fibrovascular stroma. They have abundant lightly eosinophilic or vacuolated cytoplasm. Dilated vessels/telangiectasia and hemorrhages or hemosiderosis may be present.^{4,6,7} Immunohistochemical demonstration of aldosterone-positive cells has been described⁵, but was not performed in our case.

Surgical therapy is suggested to be curative in many cases.² Several complications may occur, and systemic hypertension may lead to



3-4. Adrenal gland, cat. A nodular neoplasm expands the adrenal gland and compresses the overlying cortex. The adrenal medulla is not evident in this section. (HE, 8X)

chronic vascular lesions and severe circulatory disturbances.⁵

In our case of Conn's disease, unfortunately, the carcass was not submitted for necropsy. The applied immunohistochemical methods support the diagnosis of adrenocortical adenoma.

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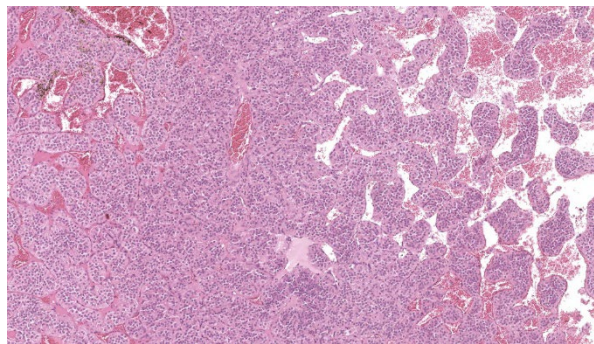
JPC Diagnoses:

Adrenal gland: Adrenocortical adenoma.

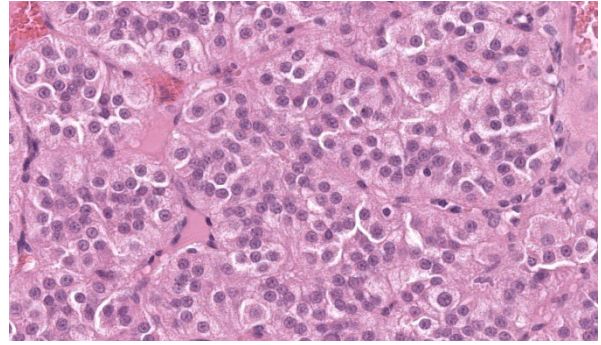
JPC Comment:

As the contributor notes, primary hyperaldosteronism is the most common disorder of the adrenal cortex in the cat, eclipsing hypercortisolism (which was discussed in case 1 of conference 2 of this Wednesday slide conference year). The contributor has provided a concise review of feline primary hyperaldosteronism above, but a review of aldosterone's effects in the normal animal may be in order.

Whereas cortisol and sex steroids are in all three zones of the adrenal cortex through the



3-5. Adrenal gland, cat. Neoplastic cells are arranged in nests and packets (left) and trabeculae (right) (HE, 1440X)



3-6. Adrenal gland, cat. High magnification of neoplastic cells with moderate amounts of vacuolated cytoplasm. (HE, 875X)

effects of cytochrome P450 enzymes on cholesterol, aldosterone is produced only in the zona glomerulosa.⁸ (While the primary production of aldosterone is within the adrenal cortex, limited amounts are also produced in the brain, heart, and blood vessels, which act in an autocrine mode.)⁹ Like other steroid hormones, it is metabolized in the liver and excreted in the bile and feces in this species.⁸

In contrast to the other steroids produced by the adrenal cortex, which are regulated by secretion of ACTH from the pituitary gland, aldosterone release is controlled by the renin-angiotensin system and circulating levels of potassium. The renin-angiotensin system stimulates aldosterone-induced sodium retention during periods of hypovolemia, and decreased secretion of this hormone is seen during periods in which the blood volume is elevated. In addition to the renin-angiotensin system, potassium stimulates aldosterone synthesis and secretion via direct effect on cells of the zona glomerulosa.⁸ Aldosterone secretion may also be mildly influenced by ACTH, and natriuretic hormone.⁸

Epithelial cells within the kidney, and salivary glands, possess cytoplasmic receptors for aldosterone. Following its passage through the plasma membrane, it binds to these receptors.

In the distal convoluted tubules, the now-intact aldosterone receptor complex stimulates a Na-K ATPase in the cell membrane, resulting in an active increase in sodium reabsorption and passive potassium excretion based on the amount of sodium resorption.⁸

Elsewhere, beyond its results on circulating blood vessels, aldosterone may act locally on endothelial cells and cardiac tissue to increase total peripheral resistance. This may explain the microangiopathies mentioned by the contributor, especially in long-standing cases of hyperaldosteronism.⁸

References:

1. Daniel G, Mahony OM, Markovich JE, Appleman E, Monaghan KN, Lawrence YA, Fiocchi EH, Weaver K, Johnston A, Barton B. Clinical findings, diagnostics and outcome in 33 cats with adrenal neoplasia (2002-2013). *J Feline Med Surg*. 2016;**18**:77-84.
2. Del Magno S, Foglia A, Rossanese M, Montinaro V, Cola V, Pisoni L, Rossetti D, Cantatore M, De La Puerta B, Nicoli S, Pisani G, Collivignarelli F, Romanelli G, Cinti F, Olimpo M, Fracassi F. Surgical findings and outcomes after unilateral adrenalectomy for primary hyperaldosteronism in cats: a multi-institutional retrospective study. *J Feline Med Surg*. 2023;**25**:1-7.
3. Djajadiningrat-Laanen S, Galac S, Kooistra H. Primary hyperaldosteronism: expanding the diagnostic net. *J Feline Med Surg*. 2011;**13**:641-50.
4. Kiupel M, Capen C, Miller M, Smedley R. Histological classification of tumors of the endocrine system of domestic animals. WHO, Washington, DC: Armed Forces Institute of Pathology; 2008, second series, vol. 12.
5. Mau J, Dietert K, Rohwedder T, Deutschland M, Böttcher P, Klopffleisch R, Bertram CA. Conn's syndrome in two cats with unusual complications. *Prakt Tierarzt*. 2020;**101**:342-358.
6. Rosol T, Groene A. Endocrine glands. In: Maxie MG, ed. *Jubb, Kennedy, and Palmer's Pathology of Domestic Animals*. 6th ed. Philadelphia, PA: Elsevier; 2016; vol. 3:270-357.
7. Rosol T, Meuten DJ. Tumors of the endocrine glands. In: Meuten DJ, ed. *Tumors in domestic animals*. 5th ed. Ames, IA: Wiley Blackwell; 2017:766-833.
8. Kooistra HS. Primary hyperaldosteronism in cats: An underdiagnosed disorder. *Vet Clin Small Anim* 2020; 50: 1053-1063.
9. Connell JM, MacKenzie SM, Connell JM, Davies E. Non-adrenal synthesis of aldosterone: a reality check. *Mol Cell Endocrinol*. 2012 Mar 24;350(2):163-7.

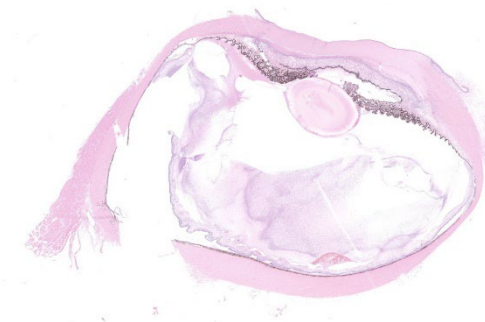
CASE IV:

Signalment:

Four-month-old female castrated Berkshire pig

History:

Eighteen fair pigs were purchased from multiple sources. All pigs are showing respiratory signs and coughing. Twelve have responded to



4-1. Eye, pig: At subgross magnification, there is exudate within both the anterior and posterior segments. (HE, 15X)

antibiotic treatment, two are still sick, and four are dead. Three of the dead pigs stopped eating and died over 10 days despite antibiotic treatment. This animal was wobbly, ataxic, and dragging her legs several days prior to being found dead.

Gross Pathology:

The eye is grossly unremarkable. Other pertinent gross findings include pale yellow to orange fluid in the pericardial sac and abdominal cavity that contains tan, friable, stringy material that attaches to the adjacent organs (heart or serosal organs respectively). The right coxofemoral joint contains tan, mucoid joint fluid and flocculant white strands, and similar material is present in the tarsal and metatarsal joints bilaterally.

Laboratory Results:

Mycoplasma culture: Growth of *Mycoplasma hyorhinis*

Respiratory culture:

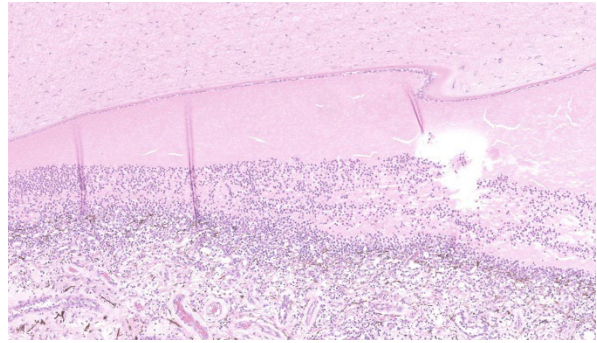
Moderate *Streptococcus suis*

No growth of *Salmonella* species

PRRS virus PCR: Positive

Microscopic Description:

The vitreal space of the eye is filled with proteinaceous eosinophilic fluid, fibrin, and large numbers of neutrophils and foamy macrophages that contain dozens of small, round basophilic organisms that are gram-positive on a Gram stain. The inflammatory population extends into the ciliary body and retina. The retina is detached and multifocally obscured by eosinophilic amorphous material (necrosis), thin wispy eosinophilic material (fibrin), neutrophils, histiocytes, and lymphocytes. Fragments of retina and retinal vessels are frequently separated from the intact retina and surrounded by necrosis and similar inflamma-



4-2. Eye, pig: The anterior segment is filled with proteinaceous fluid and large numbers of necrotic neutrophils, which carpet the anterior surface of the iris. (HE, 161X)

tory cells. The inflammatory population extends into the subretinal space, the sclera, and the conjunctiva.

Contributor's Morphologic Diagnoses:

Eye:

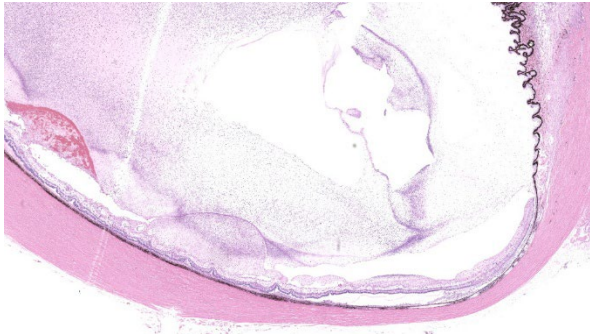
Severe fibrinosuppurative endophthalmitis and moderate lymphohistiocytic panuveitis

Severe diffuse retinal necrosis

Contributor's Comment:

Polyserositis is a condition affecting multiple organ systems of young pigs, typically from age 4-8 weeks. Polyserositis is a condition of economic concern, as it is associated with high morbidity and high mortality. There are several etiologic agents that can cause polyserositis, including *Glaesserella parasuis* (formally *Haemophilus parasuis* and the agent responsible for Glässer's disease), *Streptococcus suis*, and *Mycoplasma hyorhinis*.¹ In all cases, the mechanisms of action are vasculitis and acute inflammation, which leads to leakage of the vessels into third spaces.¹⁻³ Although this review focuses on *Streptococcus suis*, many points are true for the other common bacterial causes as well.

It is important to note that most healthy pigs carry *Streptococcus suis*.³ Disease occurs



4-3. Eye, pig: The vitreous contains a cellular exudate which extends underneath the detached retina at right. (HE, 25X)

when the bacterium is introduced to immunosuppressed animals or in instances of stress such as overcrowding and poor ventilation. Transmission is through aerosolized mucus droplets that enter the body via the oral or respiratory tract.¹

A presumptive diagnosis of polyserositis is often based on clinical signs, animal age, and gross findings. Necropsy can be highly suggestive of the condition. Tissue bacterial cultures are required to identify the exact etiologic agent and are often used to determine antibiotic susceptibility.³

Gross findings are often very distinct for this disease and include fibrinous peritonitis, pleuritis, and/or pericarditis as well as edema fluid in one or more cavities. The surfaces of the joints and meninges can also be affected. Clinically, these findings may result in trouble breathing, coughing, inadequate cardiac function, high fever, and lameness or neurological diseases.⁴ These bacteria can be found in conjunction with viruses such as Porcine Respiratory and Reproductive Syndrome virus (PRRSV) or porcine circovirus-2 (PCV-2), which can cause further mucociliary apparatus dysfunction.⁵ While the animal in this case was positive for PRRSV, the vaccination status of this animal was unknown. If vaccinated

recently, the positive PCR result could be a result of recent vaccination rather than a true contributor to disease.

Histologic lesions may be reflective of the gross findings; there is often chronic multiorgan inflammation and fibrin. Vasculitis may or may not be present depending on the chronicity and severity of the disease. Bacterial organisms may or may not be seen. In this case, Gram positive round to elongated bacteria were identified, consistent with *Streptococcus suis*.⁶

Disseminated septicemia is common in polyserositis but spread to the eyes is uncommon. There is one case report of disseminated *Streptococcus suis* to the eye of a man following the consumption of contaminated raw pork.⁷ This slide represents an interesting case of a common disease in an uncommon location.

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JPC Diagnoses:

Eye: Endophthalmitis, fibrinosuppurative, subacute, diffuse, severe, with vasculitis, Fildesian synechia, retinal detachment and necrosis, and intra- and extracellular cocci.

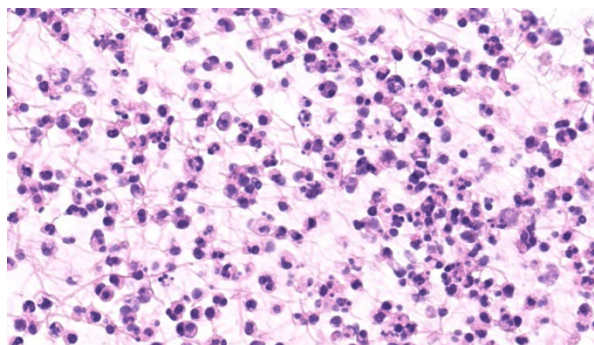
JPC Comment:

The contributor provides a concise description of polyserositis in swine. This condition is typically associated with three particular agents in swine: *Streptococcus suis*, *Glasserella* (formerly *Hemophilus*) *parasuis*, and *Mycoplasma hyopneumoniae*. The disease

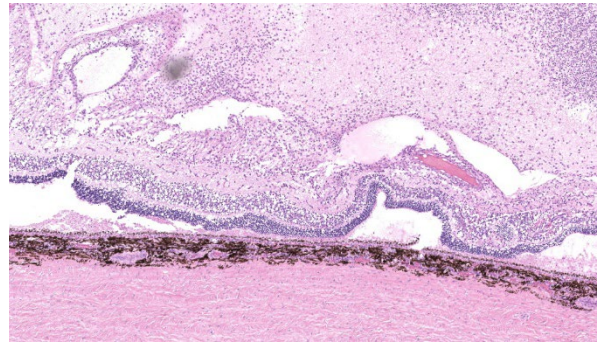
known as polyserositis is often associated with systemic sepsis and abundant deposition of fibrin within the “potential spaces”, which typically include the pleura, peritoneum (which may extend along the vaginal tunics in boars), pericardial space, meninges, and joints. They are also each a cause of pneumonia in this species, which may not involve the potential spaces.

Their involvement in ocular disease in swine is less well documented. Of the three, *Mycoplasma hyorhinis* is the agent most well associated with ocular disease in pigs. First identified from conjunctival isolates in swine in 1976, outbreaks of conjunctivitis in three unrelated swine farms in the Midwest were documented by Resende et al. in 2019.⁹ Affected pigs demonstrated initial lymphofollicular hyperplasia of the palpebral and bulbar conjunctiva, which progressed to diffuse lymphoplasmacytic inflammation. In the following year, isolates of this agent, which had initially been thought to be *M. hyorhinis*, were identified through MALDI-TOF as a unique *Mycoplasma* species.¹⁰

Mycoplasma spp. also result in conjunctivitis in several other species. *M. synoviae* and *Mycoplasma gallisepticum* are well known as causes of conjunctivitis in turkeys, and *M. gal-*



4-4. Eye, pig: The vitreous exudate contains innumerable necrotic and fewer viable neutrophils and abundant polymerized fibrin. (HE, 25X)



4-5. Eye, pig: The fibrinosuppurative exudate is present on both sides of the detached retina. There is diffuse retinal traction with loss of nuclei in the ganglion and inner nuclear layer and loss of rods and cones. (HE, 25X)

lisepticum causes a similar lymphoplasmacytic conjunctivitis in finches and other songbirds. *M. bovoculi* and *M. bovis* may result in conjunctivitis in cattle, and *M. conjunctivae* has been reported to cause conjunctivitis and keratoconjunctivitis in small ruminants. *M. felis* may result in disease in cats, and *M. genitalium* has been reported to cause conjunctivitis in human patients with concurrent urethritis.

With regards to a more widespread evaluation of ocular pathology in pigs, the subject has rarely appeared in the Wednesday slide conference, with the sole previous submission of a pig eye occurring in 1982, in a pig with pseudo-rabies-induced conjunctivitis (the connection between alpha herpes virus infection and keratoconjunctivitis is well known in numerous species).

Eye disease is not commonly reported in swine, but is certainly important in any production species, as pigs with ocular disease will likely have a decreased feed-to-gain ratio due to discomfort, decreased ability to find/compete for feed, and other reasons. While husbandry issues (ammonia) are likely the most common cause of ocular disease in

pigs (salt toxicity may also result in blindness), a wide range of other infectious agents are reported.¹ The systemic effects of a range of viral disease may affect the eye, to include pseudorabies, African swine fever, classical swine fever, porcine cytomegalovirus, and influenza A.¹ Bacterial agents affecting the eye (beyond those discussed above) include *Chlamydia* sp. *Staphylococcus hyicus*, and the effects of atrophic rhinitis.¹ Riboflavin deficiency may result in cataracts, and finally a range of toxins may result neurologic disease resulting in blindness (arsenic, lead, mercury).

One helpful clue as to etiology for the observant pathologist (and mentioned in the contributor's morphologic description) are the multiple foci of polymerized fibrin in the retina. While this is suggestive of vasculitis in itself (and supportive of a diagnosis of *S. suis* infection in this case), close inspection of retinal vessels will demonstrate more definitive signs of vasculitis (hypereosinophilia of vessels wall, necrosis and cellular debris within the vessel wall itself, and perivascular hemorrhage and fibrin polymerization.) Like many pathogenic streptococci, *S. suis* possesses lipoteichoic acid on its surface, which, along with facilitating adhesion to host tissues and biofilm formation, is a potent stimulator of the immune system, resulting in cellular damage and tissue inflammation similar to that seen in the lipopolysaccharide (endotoxin) of gram-negative bacilli. The effects of lipoteichoic acid is extremely damaging to blood vessels, and vascular damage similar to than seen with traditional endotoxemia may be seen in streptococcal infections as well.

References:

1. Zimmerman JJ, ed. *Diseases of Swine*. 10th ed. Wiley-Blackwell; 2012.
2. Glässer Disease in Pigs - Generalized Conditions. Merck Veterinary Manual.

Accessed June 27, 2025. <https://www.merckvetmanual.com/generalized-conditions/glasser-disease/glässer-disease-in-pigs>

3. Streptococcus suis Infection in Pigs - Generalized Conditions. Merck Veterinary Manual. Accessed June 27, 2025. <https://www.merckvetmanual.com/generalized-conditions/streptococcal-infections-in-pigs/streptococcus-suis-infection-in-pigs>
4. Staats JJ, Feder I, Okwumabua O, Chengappa MM. Streptococcus Suis: Past and Present. *Veterinary Research Communications*. 1997;21(6):381-407. doi:10.1023/A:1005870317757
5. Obradovic MR, Segura M, Segalés J, Gottschalk M. Review of the speculative role of co-infections in Streptococcus suis-associated diseases in pigs. *Vet Res*. 2021;52(1):49. doi:10.1186/s13567-021-00918-w
6. Reams RY, Glickman LT, Harrington DD, Thacker HL, Bowersock TL. *Streptococcus Suis* Infection in Swine: A Retrospective Study of 256 Cases. Part II. Clinical Signs, Gross and Microscopic Lesions, and Coexisting Microorganisms. *J VET Diagn Invest*. 1994;6(3):326-334. doi:10.1177/104063879400600308
7. Li Z, Xu M, Hua X. Endogenous endophthalmitis caused by Streptococcus suis infection: a case report. *BMC Ophthalmol*. 2022;22(1):165. doi:10.1186/s12886-022-02389-9.
8. Friis NF. A serologic variant of Mycoplasma hyorhinis recovered from the conjunctiva of swine. *Acta Vet Scand*. 1976;17(3):343-53.

9. Resende TP, Pieters M, Vannucci FA. Swine conjunctivitis outbreaks associated with *Mycoplasma hyorhinis*. J Vet Diagn Invest. 2019 Sep;31(5):766-769.
10. Hennig-Pauka I, Sudendey C, Kleinschmidt S, Ruppitsch W, Loncaric I, Spargser J. Swine Conjunctivitis Associated with a Novel Mycoplasma Species Closely Related to *Mycoplasma hyorhinis*. Pathogens. 2020 Dec 25;10(1):13. doi: 10.3390/pathogens10010013. PMID: 33375690; PMCID: PMC7824142.