

IX.

**CONGENITAL AND DEVELOPMENTAL ANOMALIES OF THE EYE**

Defects in Formation of Optic Vesicle

A. Anophthalmia - total absence of the eye; reported in calves, foals, dogs, cats, and swine

**Microphthalmia - abnormally small eye; has been seen in all species--highest incidence is in dogs (usually hereditary) and in swine (due to vitamin A deficiency); several other causes (i.e., Selenium toxicity in sheep). It is usually accompanied by 1 or more of a series of associated lesions including: hypoplasia of optic nerve, strabismus, nystagmus, detached retina, retinal rosettes, ectasia of sclera and choroid, coloboma of optic disc and/or retina.**

Synophthalmia (Cyclopia) - only one orbit present which is in center of skull; eyes usually fused together. Most common cause is ingestion of *Veratrum Californicum* by pregnant ewes on day 14 of gestation.

Defective Invagination of Optic Vesicle (during formation of optic cup)

A. Non-attachments of retina - most common in dogs, calves, man go Iris cysts

Colobomas - usually due to failure of fusion of embryonic fissure; most common in dogs (Collies) and cattle (.Charolais.); frequently associated with: choroidal hypoplasia or aplasia, scleral ectasia, orbital cysts

Neuroectodermal Dysplasia

**Often associated with multiple ocular defects (especially with microphthalmia with non attachment of retina); Mostly seen in dogs**

A. Retinal dysplasia

Disordered differentiation - histologically see rosettes, jumbled layers, focal gliosis, and/or folds. May see folds (ridges) and other lesions funduscopically

Vital etiology: in utero infection with BVD (cattle), Bluetongue (sheep), FeLV and panleukopenia (cats), canine herpes and canine adenovirus, and possibly parvovirus (dogs). Live virus vaccines in pregnant animals.

Other causes: irradiation, intrauterine trauma, Vitamin A deficiency

Hereditary in some dog breeds: in Sealyham Terriers and Bedlington Terriers, the retina is totally detached

IV.

(Total retinal dysplasia) at birth or shortly after and affected dogs are blind in Beagles and American Cocker Spaniels there are multiple, focal areas of dysplasia within otherwise normal retina (multifocal retinal dysplasia) in English Springer Spaniels and field trial Labrador Retrievers (+\_ chondrodysplasia) both total and multifocal retinal dysplasia have been described.

Photoreceptor dysplasias - the photoreceptors are congenitally maldeveloped or malformed, they subsequently degenerate and usually lead to atrophy of the remainder of the sensory retina. Hereditary in several dog breeds:

Rod-cone dysplasia in Collies and Irish Setters.

Rod dysplasia in Norwegian Elkhounds.

Cone dysplasia (hemeralopia) in Alaskan Malamutes and Poodles.

These conditions (and other hereditary retinal atrophies) have been called progressive retinal atrophy (PRA) for years.

Progressive retinal degeneration (PRD) is another term applied to progressive retinal deterioration in dogs (some say it should be used for conditions in which photoreceptors develop normally, but degenerate later. These conditions have also been called PRA). PRA has been reported in over 90 breeds. (Other hereditary but non-congenital (abiotrophic) disorders which fall under the general heading of PRA include rod-cone dystrophy in Poodles, (a type of PRD) and central PRA which is actually due to a retinal pigment epithelial dystrophy and occurs in Labs, Golden Retrievers, Border Collies, Rough Collies, Shetland Sheepdogs and other breeds.)

Lipidosis and pseudolipidosis - the dystrophic changes seen with lipodystrophy (lysosomal storage diseases) of the CNS also affect the ganglion cells of the retina. Lipidosis (ceroid lipofuscinosis) is seen in English Setters, Dalmatians, and Tibetan Terriers. Pseudolipidosis in Angus calves also affects ganglion cells.

C. Iris hypoplasia; Aniridia (no iris): in puppies, pigs, Belgian horses

Mesenchymal Defects

2 types: dysplasia or dysgenesis defective atrophy

A. Dysplasia or dysgenesis - often associated with neuroectodermal defects

1. Anterior Segment:

Goniodysgenesis - abnormal drainage angle formation; can result in glaucoma

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Corneal endothelial dysplasia - leads to corneal edema

Irido - corneal membranes - (anterior synechia)

Iris hypoplasia

Lens Luxation (Ectopia lentis) - due to focal or diffuse aplasia of zonules; hereditary in many terrier breeds

3. Choroidal Hypoplasia

Defective atrophy of mesenchyme

Goniodysgenesis - can result in glaucoma present at birth or later on; imperforate pectinate ligament (most common in Basset Hounds and Bouvier des Flandres), or drainage angle filled with a solid mass of mesenchymal cells.

Persistent Pupillary Membranes (PPM) - due to incomplete atrophy of the tunica vasculosa lentis, which nourished the lens during fetal development. PPM are seen in all species.

Manifested as tags or remnants of tissue, which may or may not be pigmented, attached to the iris and floating in the anterior chamber, or iris-to-iris strands, or iris to cornea (causing corneal opacities) or iris to lens. PPMs are especially common in Basenji dogs (hereditary in this breed).

Persistent Hyaloid Artery - during fetal development the hyaloid artery runs from the optic disc to the posterior of the lens and nourishes the lens. It regresses later in animals than in man and it is normally visible for the first few weeks after birth in many young animals. Insignificant remnants are common (especially in cattle called Bergmeister's papilla; conus papillaris).

#### Ectodermal Dysplasia

##### A. Cataracts - opacity of lens

Occur in most species, most frequent in foals (genetic in at least 2 breeds) and puppies (have been seen in over 80 breeds as a familial problem). Many causes including: genetic; physical, chemical, or infectious agents; irradiation; nutritional, or metabolic problems

Seen frequently in eyes with multiple anomalies. Opacity may be within the lens or may be due to persistence of fetal vascular remnants on the anterior capsule (PPM) or on the posterior capsule (hyaloid).

##### B. Abnormal lens size or shape

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1. Anterior or posterior lent'Iconus
2. Spherophakia - (round lens)
3. Coloboma of the lens - localized flattening or notching of its margin

Microphalda - small lens

Aphakia - absence of lens

Colmeal dystrophy (epithelial) results in opacity

(Other corneal anomalies include microcornea and megalocornea combination of ectodermal and mesenchymal defects)

Dermoids - congenital misplacement, essent'lally a piece of skin, in place of conjunct'lval and/or corneal epithelium. breed = Dachshund.

Eyelid Anomalies Occur in many species. The most commonly affected dog

Ankyloblepharon - fusion of the upper and lower eyelids along the lid margin. Normal in puppies and kittens for the f'lrst 10-15 days of life.

Macropalpebral f'Issure - abnormally large palpebral fissure which exposes the cornea and sclera. Common in brachycephalic dogs, spaniels, and some hound breeds. May be associated with ectropion.

Micropalp,brai f'Issure - abnormally narrow or small palpebral f'Issure.

Eyelid colobomas - can vary in extent from notches to complete lid involvement (= eyelid agenesis - seen mostly in cats).

Entropion - turning inward of the margin of the lid; may be congenital or acquired due to scar tissue contract'ion or muscle spasm.

Ectropion - turning outward of the lid margin, resulting in exposure of conjunct'lva; may be congenital or acquired.

Trichiasis - hair arising from normal sites contacts the cornea or conjunctive (i.e., with nasal folds). Especially common in hairy brachycephalic breeds.

Distichiasis - extra row (complete or partial) of cilia protruding from Meibomian gland openings along the eyelid margin - can cause chronic conjunctivitis and corneal lesions. Very common in some breeds of dogs, such as Cocker Spaniels, Golden Retrievers.

Ectopic cilia - single or multiple, may arise anywhere on conjunctiva, including on the

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third eyelid. Can be very difficult to see, yet cause extreme irritation and/or ulceration of cornea.

Trichomegaly abnormally elongated cilia. Probably genetic. Most common in American Cocker Spaniels.

Occlusion of Nasolacrimal ducts - congenital or acquired

Congenital absence (atresia) of lacrimal puncta - any species; most common in Terriers and Poodles.

### **Multiple Anomalies**

**Collie Eye Anomaly (CEA) - hereditary (autosomal recessive); high incidence in the breed. Involves sclera, choroid, retina, retinal vasculature and optic disc. Severity varies from no apparent visual deficit to total blindness.**

Defects include: Choroidal hypoplasia; Optic disc colobomas; Colobomas not involving disc (scleral ectasia, staphyloma); Retinal separation (detachment) - occurs in 5-10% of CEA cases; (Excessive tortuosity of primary retinal blood vessels); Other less common CEA anomalies include: enophthalmia, microphthalmia, intraocular hemorrhage, and mineralization of anterior corneal stroma

Sheltie Eye Anomaly (SEA) - Shetland Sheepdogs exhibit an ocular fundus anomaly similar, but not identical to CEA. Incidence is low in the breed.

### **C. Australian Shepherd eye anomalies (Merle Ocular Dysgenesis)**

**Multiple anomalies including: microphthalmia, microcornea asymmetrical globe size, colobomas, heterochromia of irides, oval shaped pupil (due to small iris colobomas), hypoplastic irides, cataracts in 60%, large equatorial staphylomas in 54%, retinal dysplasia, retinal separations (detachments) in 50% (intraocular hemorrhage with 1/3 of these). Microphthalmia with colobomas in this breed is hereditary, but the genetics are not well understood. The defects appear to be linked to the dominant merle gene, since severely affected dogs are homozygous merles and often have excessive white in their hair coats. A similar syndrome has been seen in Merle Shelties, Merle Rough Collies and Harlequin Great Danes. (Affected dogs are also often deaf in one or both ears).**

D. Belgian horses - autosomal recessive  
Aniridia (actually iris hypoplasia in most cases) - pupil appears circular  
Cataract

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Jersey calves - autosomal recessive; blind at birth

Iris hypoplasia - only small remnant of iris present  
Microphakia (small lens)  
Ectopia lentis

Cataract

Lambs - from ewes grazing on seleniferous areas

**Microphthalmia; persistent pupillary membranes; ectopia lentis or aphakia; optic nerve hypoplasia; colobomas; retinal separation (detachment)**

Chediak-Higashi Syndrome (CHS) - autosomal recessive trait

Reported in man, mink (Aleut'mn), mice (beige), cattle (Herefords), cats (Persians), killer whales, and foxes (silver and blue)

Defects include:

Enlarged lysosomes (with defective functioning) in many cell types including WBC. Impaired chemotaxis and delayed bacterial killing lead to increased susceptibility to infections.

Abnormal platelets (lack storage granules containing ADP and serotonin, thus aggregation is defective) resulting in bleeding problems. Diluted pigmentation of skin, hair and eyes – melanin granules are clumped together. In humans, cattle and cats, the irides are very pale, fundi are albinotic or subalbinotic, and affected individuals are photophobic. Most affected cats also have cataracts, but this is due to a separate gene.

Persistent Hyperplastic Primary Vitreous (PHPV), Persistent Hyperplastic Tunica Vasculosa Lentis (PHTVL).

Known to be hereditary in Doberman pinschers and Staffordshire bull terriers; has been reported in several other breeds.

**Lesions vary in severity, ranging from brown pigmented dots on the posterior lens capsule to large retrolental masses of fibrovascular tissue combined with abnormal lens shape (posterior lenticonus or lentiglobus, lens colobomas) and intra or retrolental free blood. Secondary cataracts are common and may progress. Persistent capsulopupillary vessels and hyaloid arteries are common.**

Aphakia and multiple ocular defects including anterior segment dysgenesis.

Has been reported in Doberman pinschers (thought to be autosomal recessive) and St. Bernards. (I have observed a similar condition in 2 Pugs.) The eyes are blind, either microphthalmic or buphthalmic. Anterior chamber is collapsed, with iris against cornea, there is no pupil, and no lens (aphakia). The retina is non-attached and dysplastic.

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**Multiple defects, including congenital cataracts, retinal folds and varying degrees of microphthalmia.**

**Reported in Akitas, Chow Chows (thought to be hereditary in these 2 breeds), in an Old English Sheepdog, and other breeds. Posterior lenticonus in some animals. Many of the Chow Chows also have PPMs.**

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OPHTHALMIC PATHOLOGY: Pathologic reactions of each part of the eye

I. Adnexa

See handout on congenital anomalies

A. Lids

See terminology handout: entropion, ectropion, blepharitis, hordeolum, chalazion

These conditions often result in irritation of and damage to cornea

Lacrimal Apparatus

Gland:

Dacryoadenitis (acute inflammation) - (occurs with canine distemper). Can cause decreased or complete lack of tear production. Usually secondary to acute conjunctivitis or to cellulitis (often from trauma). May abscess and rupture onto skin.

Chronic adenitis - dogs, decreased or absent tear production. Occasionally occurs; infiltrate of mononuclear cells is present; may be an autoimmune problem in some dogs.

Vitamin A deficiency - squamous metaplasia of ducts; sometimes atrophy of gland and thus xerophthalmia (no tear production) which leads to corneal problems.

Canals: Occlusion - may be congenital or acquired

Temporary occlusion - inflammation - i.e., with upper respiratory infections; Foreign bodies – may require surgical removal.

Atresia (congenital) or stenosis - due to deforming diseases: i.e., fibrous osteodystrophy, chronic purulent rhinitis and sinusitis, neoplasms of nose and sinuses, osteomyelitis.

Orbit

Principal pathologic manifestation is exophthalmos (protrusion of eyeball), usually due to:

Inflammation = cellulitis - uncommon, usually acute, usually bacterial; causes include: Strangles (Strep equi) in horses; foreign body in pharynx or conjunctiva; sinus infection; periodontitis of posterior maxillary molars in dogs; eosinophilic myositis; extension of inflammation through sclera; inflammation may extend into cranial cavity.

Trauma - swelling due to edema and hemorrhage. Can lead to cellulitis, especially in horses.

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Non-inflammatory edema - edema disease and mulberry heart disease of swine.

Neoplasia - Exophthalmos (and exposure keratitis) due to orbital lymphoma is a common present'rag sign in cattle. Other tumor types can also cause exophthalmos.

Enophthalmos (eye sunken back into orbit) can be due to dehydration, emaciation, or loss of muscle mass.

Nictitating Membrane (third eyelid)

Eversion of cartilage

Inflammation - especially of the (lacrimal) gland of the 3rd eyelid.

Neoplasia - especially adenoma of (lacrimal) gland; squamous cell carcinoma; melanoma; hemangioma and hemangiosarcoma; lymphoma

Lymphoid hyperplasia nodules (follicles) visible grossly; chronic inflammation. Follicular conjunctivitis.

Foreign Bodies may lodge behind it: grass awns, other plant material, etc., resulting in conjunctivitis and keratitis if they are not removed. Dogs are most commonly affected.

Cherry eye - prolapsed gland of the third eyelid.

Conjunctiva

Conjunctival epithelium is similar to stratified mucosae in other parts of body.

Stroma (propria) normally contains small accumulations of lymphocytes, and also many blood vessels.

Very sensitive to irritation

Acute inflammation: edema (chemosis), erythema (due to congestion of blood vessels), cellular infiltration of leukocytes

Chronic inflammation: can lead to any of the following: epithelial hyperplasia; keratinization (can result from drying or chronic irritation); proliferation of goblet cells (catarrhal inflammation) or loss of goblet cells; cellular infiltration - especially mononuclear cells; lymphoid follicle hyperplasia ("cobblestone appearance")

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Irritation usually causes an ocular discharge, which may be serous, catarrhal, or purulent.  
Cornea and Sclera  
See handout on anomalies

Cornea

Dystrophy and Degeneration - may be primary (some are hereditary) or secondary to chronic ophthalmitis, keratoconjunctivitis, or other causes, such as trauma, or long term use of topical steroids.

Vitamin A deficiency - metaplasia of epithelium

Desiccation (drying = Keratoconjunctivitis Sicca = KCS) leads to - degeneration and erosion of epithelium, acute keratitis; later, stroma vascularized and epithelium keratinized and may become pigmented.

Pannus - replacement of part of the cornea by vascularized connective tissue and transformation of the related epithelium to conjunctival type. The affected cornea is often infiltrated with inflammatory cells. Cornea becomes opaque. Sometimes becomes pigmented. (Specific disease in German Shepherds, names include [Degenerative pannus, chronic superficial keratitis, German Shepherd Dog Pannus], probably immune mediated and related to U-V light exposure. Similar condition is seen with some frequency in Belgian Sheepdogs, Belgian Tervurens, Dachshunds, and Pointers).

Calcium corneal degeneration - opaque calcium deposits; many predisposing causes, including trauma and low tear production.

Lipid keratopathy (corneal degeneration) - adult dogs. Etiology not understood. Some cases have hyperlipidemia which may be due to metabolic problems such as hypothyroidism, diabetes mellitus, etc. Often unilateral. Grossly

visible opacities in corneal stroma. The deposits are a mixture of neutral fats, fat laden macrophages, and crystals of cholesterol. Sometimes fibroblastic proliferation adjacent to the deposits.

Corneal dystrophy in Airedales, Siberian Huskies., Collies and other breeds - subepithelial or deeper stromal opacities, have been shown to contain lipids; hereditary basis.

An oval stromal opacity has also been described in dogs in a Beagle colony; hereditary basis.

Corneal dystrophy in Shetland Sheepdogs is a peculiar type with multiple rings, 1-3 mm diameter, in the superficial comeal layers. Erosions are often present within many rings.

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Anterior Corneal Dystrophy in American Dutch Belted Rabbits is characterized by thin and disorganized surface epithelium, abnormal thickened areas of epithelial basement membrane, and disorganized collagen lamellae in the subepithelial stroma.

Stromal dystrophy in Manx cats - hereditary (autosomal recessive). Stroma is thickened by edema and epithelium is disorganized by vesicles and bullae.

Endothelial dystrophy in Boston Terriers keratopathy, which can lead to ulceration.

leads to corneal edema and bullous

Endothelial dystrophy also occurs with some frequency in Chihuahuas, Dachshunds, Weimaraners and occasionally in other breeds - leads to edema, corneal ulcerations, and possibly blindness

Endothelial degeneration occurs in some geriatric dogs and causes varying degrees of corneal edema.

Inflammation - keratitis - the responses of the cornea differ from other tissues because it is normally avascular.

Endothelial injury - results in corneal edema (usually diffuse)

Epithelial damage - also leads to corneal edema (may or may not be restricted to area around injury). A corneal ulcer results if the full thickness of the epithelium is lost from an area. The ulcer may get progressively deeper (especially in cases of Pseudomonas infection, collagenase is produced) until a Descemetocoele or perforat'ion results.

Recurrent corneal erosions are a special type of superficial ulcerat'ion. Also called rodent or indolent ulcer. The lesions are not infected and are surrounded by a lip of loose epithelium. The underlying problem seems to be lack of hemidesmosomal attachment of epithelium to its basement membrane which may also be abnormal. common in older Boxers and Boston Terriers. Occasional in other breeds. Tend to be very slow healing and frustrating to treat.

Usual sequence of events in keratitis:

Corneal edema (causes opacity), migration of leukocytes into area (neutrophils first - can cause further destruction to cornea), migration of blood vessels in from limbus, formation of granulation tissue and then a fibrous scar, contraction and remodelling of scar tissue. Re-epithelialization also occurs if ulceration was present.

In cats, an eosinophilic keratitis manifested by a proliferative granulomatous process may represent an ocular form of eosinophilic granuloma. Some cases have been associated with herpes infection.

In various species with keratitis, if the irritation or infection is not eliminated, several

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different consequences may result, including:

- deposition of melanin in the cornea (pigmentary keratitis);
- in cats, formation of corneal sequestra (also described as partial mummification, cornea nigrum, focal degeneration, and isolated black lesions), sequestra have developed in some cats with experimental herpes virus infections; formation of dense scar tissue with epidermal transformation of the epithelium;
- induction of anterior uveitis which may lead to anterior synechia formation, glaucoma, or phthisis;
- perforation of the cornea

Keratoconjunctivitis

Conjunctivitis frequently occurs without corneal alterations, but severe conjunctivitis is often associated with keratitis. The conjunctiva and cornea are exposed membranes highly sensitive to irritation, consequently there are many causes of conjunctivitis and keratitis including allergy, irritant chemicals, foreign bodies, trauma, bacterial, helminth, and viral infections.

Sclera: Inflammation = Scleritis

There is a granulomatous inflammatory condition of the sclera which usually appears nodular grossly. It has been referred to by several names including: scleritis, sclerouveitis, episcleritis, nodular episcleritis, nodular fasciitis, fibrous histiocytoma, and collie granuloma. Histologically, it is a chronic inflammatory lesion with many macrophages and some lymphocytes present. There may be localized necrosis of the sclera, and the inflammation may also involve the uveal tract and/or the cornea. The severe or extensive form of this condition is seen commonly in Collies and rarely in other breeds. Smaller nodules near the lateral canthus are seen more commonly in cockers. The cause is unknown.

See handout on anomalies

Pathological reactions are limited in variety and conventional inflammatory phenomena cannot occur because there are no blood vessels and the intact capsule is impermeable to leukocytes.

If the capsule is perforated and bacteria enter, they may grow profusely, leukocytes enter, and an abscess results.

Lens is metabolically active and it depends on diffusion to and from the aqueous humor, therefore it is highly susceptible to alterations in the composition or accessibility of the aqueous and to degeneration during other ophthalmic diseases, such as glaucoma and uveitis. Cataracts may occur along with progressive retinal atrophies and some people think they occur secondary to the

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retinal degeneration. Degenerative or metabolic changes in the lens lead to loss of transparency if severe enough result in opacity (cataract). Hereditary cataracts occur in over 80 breeds of dogs and at least 2 horse breeds (Morgans and American Saddlebreds).

The lenticular tissue is capable of 2 main reactions: 1) proliferation of the subcapsular epithelium and 2) necrosis of the lens fibers, both of which may result in cataract. Proliferating epithelial cells lose their hexagonal form and become spindle shaped, and a mass of them beneath the anterior capsule appears like a wad of avascular young smooth muscle or scar tissue. The fibers formed by abnormally active epithelium don't assume lenticular characteristics. Sometimes aberrant lens fibers are produced beyond the equatorial zone beneath the posterior capsule. The aberrant fibers take the form of large, nucleated masses which are circular or ovoid and called "bladder cells." Degeneration of fibers is the uniform response of the cortex to injury. The fibers shrink or swell and fragment into globular forms. Eventually the degenerate substance liquefies. Leakage of lens proteins through the capsule then causes lens-induced uveitis. Calcium and cholesterol may precipitate in the degenerate mass.

Nuclear sclerosis is a normal aging phenomenon. The conversion of soft, gelatinous cortical fibers to the firm, sclerotic nucleus occurs throughout life and gradually decreases the transparency of the lens. This is why the lens looks gray in old animals (and people).

Rarely a lens may be traumatically perforated. This will result in a cataract, and most likely in an inflammatory reaction and removal of the lens material by macrophages (this inflammatory reaction is often very severe and damaging to the eye and is called phacoclastic uveitis, a type of lens induced ophthalmitis). Secondary glaucoma frequently ensues.

Luxation of the lens may be congenital, traumatically induced, or may occur secondary to congenital weakness of, or degeneration of the zonules, and to glaucoma. The dislocated lens usually becomes opaque with time. Dislocation into the anterior chamber frequently leads to glaucoma. Direct pressure of the lens on the endothelium will lead to opacity due to corneal edema. Posterior luxations can cause uveitis, and may lead to intraocular bleeding. An inflammatory reaction usually eventually develops around the lens and leads to adhesions.

## Uveal Tract

See handout on anomalies

### A. Iris

Cysts - occur in the iris and particularly on its posterior surface in both very young (congenital anomalies) and very old dogs (senile change). Cysts occur on both anterior and posterior surfaces of the iris in horses.

Degenerative changes - degeneration of the pigment epithelium may occur as a degenerative change, or as a consequence of glaucoma, recurrent inflammation and phthisis. There is depigmentation of the epithelium and the affected areas may appear thin

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and atrophic and may be mixed with foci of hyperpigmented, hypertrophied cells. The pigment mobilized by the degeneration can be found in large clumps in the iris stroma, free, or in phagocytes in the filtration angle and drainage channels, and sometimes on the peripheral parts of the corneal endothelium. Atrophy - of the iris occurs as a result of chronic glaucoma (especially at the pupillary border in the area of the sphincter muscle) and also occurs (often as a senile change) in horses and dogs without known cause. Leads to multiple thin patches or even holes in the iris. May follow the resorption of inflammatory exudate. iris atrophy can lead to a dilated pupil and poor pupillary light reflex.

Inflammation - The iris is quite vascular and therefore an inflamed iris may add much protein (including fibrin) and cellular exudate (leukocytes and sometimes erythrocytes) to the aqueous humor. Such exudation may be a response to diffusible toxins from a corneal ulcer or inflammation elsewhere in the eye. Any exudation from the iris can lead to fibrous, and later fibrous adhesions (synechia) between iris and lens or cornea.

Ciliary Body - is highly vascular with very permeable capillaries and epithelium which become even more permeable during inflammation (cyclitis) resulting in exudation of cells and protein.

Ciliary processes are very susceptible to direct or toxic injury in bacteremic disease. Vessels dilate, processes become edematous. Focal or diffuse infiltrations of leukocytes occur in the stroma, and leukocytes emigrate through the epithelium into the posterior chamber - there may be no other signs of intraocular inflammation than leukocytes in the filtration angle.

Proteinaceous exudate may lead to adhesions between adjacent ciliary processes or between processes and iris, and if abundant (as in ophthalmitis) can lead to production of a cyclitic membrane. In severe inflammations there may be extensive degeneration of the epithelium and dispersal of its pigment as melanin granules. As a result of chronic inflammation, and also as a senile change, the processes become fibrotic and hyalinized and the epithelium may focally proliferate or atrophy.

Both epithelial layers may proliferate, or over the processes the non-pigmented layer may grow to produce an adenomatous or cystic appearance, while over the pars plana it is the pigmented epithelium which usually proliferates focally in response to irritation.

Although excessive protein secretion and hyperplasia are often responses of the ciliary body to injury, diminished secretion and atrophy also may occur. Hypotony (intraocular pressure less than normal) may occur in episodes in acute inflammation and is the precursor of phthisis in chronic inflammation. Atrophy of the ciliary processes occurs in longstanding glaucoma and in phthisis.

Choroid - is extremely vascular; host to metastatic tumors and bacterial emboli; frequent site of granulomatous inflammation.

Choroiditis is especially important due to the consequences for the retina. Acute

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inflammation can lead to ret'mal degenerations and/or ret'mal separation (detachment) (often due to subret'mal exudate). Chronic inflammation leads to scarring with chorioret'mal adhesions and retinal degeneration, and the pigment epithelium of the ret'ma may be stimulated to proliferate, to produce melanin in normally amelanotic areas over the tapetum, and to migrate into the ret'ma or subret'mal space in areas of detachment.

Vitreous Body

Pathological change - liquefaction (which can occur rapidly) followed by detachment from the retina which is then itself predisposed to detachment. Once the vitreous is liquefied, infectious agents and inflammatory cells can move through it much faster.

Degenerative Conditions:

Asteroid hyalosis - occurs in dogs and horses; uni- or bilateral. Many small, round opaque bodies (cholesterol or calcium-lipid complex) present in the vitreous, which is in gel state. Frequent finding in old dogs. Often not associated with any ocular or systemic disease.

Synchysis scintillans - has been seen in dogs in association with retinal disease, and in horses and dogs unassociated with other disease. Clinically appears somewhat similar to previous condition, but the vitreous is liquefied, which allows the small cholesterol bodies to settle to the bottom of the vitreous cavity.

Retina

See handout on anomalies

Degeneration (Atrophy)

Genetically determined in some breeds of dogs and cats (see handout on congenital anomalies). Has also been reported in cattle. Can be caused by some chemicals, drugs, and nutritional deficiencies (taurine deficiency in cats, Vitamin A deficiency). Can be caused by some viruses. Occurs secondary to chronic glaucoma. May be a consequence of choroiditis.

Cystoid degeneration near the ora serrata is common in old dogs (and human beings) and is regarded as a normal aging change.

A. Pigment Epithelium (PE or RPE) - capable of 3 reactions.

Atrophy - usually focal; accompanied by depigmentation; occurs in immediate relation to zones of atrophy or degeneration of sensory retina, and in such zones the PE may disappear completely.

Hypertrophy and Hyperplasia - probably represent modulations of the same process and may include the epithelium over the ciliary body. Reactive epithelium

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frequently becomes pigmented over the tapetum. When the PE cells hypertrophy, they change shape and may develop more melanin. Hyperplasia occurs focally in the hypertrophic epithelium to form clusters or pyramids of PE cells. Pigment from them may be found in the sensory retina and sometimes in the vitreous. Individual PE cells may migrate into the sensory retina and vitreous. Hypertrophy and hyperplasia commonly occur in areas where the sensory retina has been detached. If the sensory retina is still attached and normal, changes occur in it secondary to the PE changes. Hypertrophy of PE may cause atrophy of the rods and cones, while hyperplasia may cause focal detachment of the retina.

Neural (sensory) Retina - pathological reactions to injury or inflammation similar to those of CNS.

Neuronal degeneration - Retinal ganglion cells undergo the same degenerative reactions to injury as cerebral neurons.

Gliosis - Retinal glial cells (astrocytes and modified astrocytes = Muller's cells) are capable of rapid and exuberant proliferation and intense gliosis is a response to injury.

Perivascular cuffing, - with leukocytes (usually mononuclear cells) occurs with retinitis.

Retinitis is almost always secondary to or coexistent with inflammatory lesions elsewhere in the globe (with the exception of canine distemper).

Retinal hemorrhage - may result from trauma, including concussion, from inflammation, from neovascularization which sometimes develops on the surface of the retina as a response to injury, or as a result of bleeding disorders or hypertension.

Small hemorrhages within the retina may quickly resorb, while large ones may extend into the vitreous and organize, forming traction bands that detach the retina.

Subretinal hemorrhages tend to be large and detach the retina. they tend to organize.

Edema of the retina may be seen ophthalmoscopically. It occurs in acute retinitis, early detachment, and sometimes from trauma.

#### Separation (Detachment)

Sensory retina is firmly attached only at ora serrata and optic disc. A potential space (vestige of optic vesicle cavity) exists between PE and the layer of rods and cones. Development of an actual space constitutes retinal separation. The sensory retina may be pushed away from the PE by subretinal infiltrates or exudates, it may be pulled away by contracting bands in the vitreous formed as a consequence of inflammation, or separation (detachment) may be due to congenital anomaly or to trauma.

Following separation, the outer segments of rods and cones atrophy rapidly, then the rest

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of the retina atrophies slowly, gliosis may occur and the vessels atrophy.

#### Optic Nerve

See handout on anomalies.

It is an extension of the brain - its structure and pathological reactions are similar to those of myelinated tracts of the brain and cord.

Lesions of the optic papilla are usually secondary to lesions in the globe, optic nerve, or brain.

Optic papillitis - part of retinitis and ophthalmitis; characterized by edema, perivascular cuffing and gliosis.

Papilledema - swollen papilla protrudes into vitreous cavity; may be inflammatory or due to altered pressure gradients between globe and optic meningeal fluid.

Optic meningitis - severe intraocular inflammations can extend to the optic meninges and from there to the meninges of the brain since they are continuous.

Optic nerve atrophy - may be anomalous or idiopathic, but usually due to retinal degeneration, inflammation, prolonged papilledema, glaucoma, or inflammatory or destructive lesions of optic nerves or tracts.

Acute optic neuritis occurs in several viral diseases. It may occur as an idiopathic condition, especially in dogs (possibly autoimmune problem in some dogs). Causes blindness that may be reversible with early treatment.

An exudative chronic optic neuritis of sudden onset occurs in horses - etiology unknown.

Injury to the optic nerve as a consequence of head trauma (such as herding dogs kicked by livestock, horses that rear and fall over backwards) can lead to visual impairment or blindness.

Panophthalmitis: inflammation involving all 3 layers of the eye.

#### IMPORTANT POINT:

The destructive effects of inflammation and subsequent reparative processes in the eyes may be more severe than those of the original infection or trauma. Fibroblastic organization of the inflammatory exudates may form opaque sheets of scar tissue which may obstruct vision, and/or block aqueous outflow leading to glaucoma, and/or produce separation (detachment) of the retina, all resulting in a non-functional eye.

End result may be phthisis bulbi (shrunken eye).

#### GLAUCOMA

Disease exhibiting sustained abnormal elevation of the intraocular pressure.

Primary - occurs in the absence of concurrent or antecedent ocular disease. In some cases an obvious anatomical obstruction to the outflow of aqueous cannot be demonstrated. Cause is often genetic or undetermined. Usually starts in one eye, then later the other eye becomes affected (usually 2 weeks to 2 years later). Reported in dogs (breeds most commonly affected include: Cocker Spaniels, Beagles, Toy and Miniature Poodles, Basset Hound, Bouvier, Norwegian Elkhounds, Samoyeds, Chow Chows, Australian Cattle Dogs), cats (Siamese, DSH), rabbits (New Zealand whites)

In some dogs breeds (terriers, Basset hound, Bouvier) malformations of the filtration angle predispose to the development of glaucoma. Sometimes these are listed under a separate category of congenital glaucoma.

Secondary - demonstrably obstructive. Most cases in animals fall in this category.

Causes of secondary glaucoma:

The filtration angle can be blocked by:

fibrin, hemorrhage

particulate matter such as:

inflammatory cells, neoplastic cells, colonies of bacteria or fungi, clumps of melanin

overgrowth by: endothelium, epithelium, neovascular membranes,  
or neoplastic cells.

synechiae

luxated lens (most common in: terriers, Poodles, Brittanys, Australian Cattle dogs)  
intumescent  
(swollen) lens

Sequelae - occur in all ocular tissues, but the degree of alterations depends on the severity and duration of increased pressure.

Optic nerve - Cupping of optic disc can be seen ophthalmoscopically and in histologic section. Nerve

fibers and collagenous structures in the optic nerve degenerate and cystic spaces form in it.

Retina - Optic fibers (in nerve fiber layer and optic disc) and consequently cell bodies of ganglion cells degenerate first. The remainder of the retina may also eventually atrophy. Separation (detachment) may occur.

Retinal Vessels - Blood stasis may occur. The vessels may become attenuated and may even disappear in chronic cases.

Choroid - May atrophy

Ciliary Body - May atrophy and eventually result in hypotony of the eye.

Iris - May atrophy. May be pressed against cornea and adherent to it.

Lens - May become cataractous due to degeneration. Zonules may stretch and rupture, allowing lens to luxate.

Cornea - Descemet's membrane and the endothelium may split. The cornea often becomes edematous and opaque. Bullae may develop in the epithelium and it may slough. Chronic edema may lead to corneal vascularization and pannus. The cornea may become pigmented.

Globe - Entire globe may expand (rat, rabbit, cat, dog, and young animals of other species), leading to thinning of sclera. Swollen globe = buphthalmic eye. Can result in exposure keratitis and ulceration due to incomplete blink.

EQUINE RECURRENT UVEITIS: (Recurrent Ophthalmitis; Recurrent Iridocyclitis; Periodic Ophthalmia; Moon Blindness)

Most important disease of equine eye. Characterized by acute flare-ups between quiescent periods of varying duration. History of recurrence necessary for diagnosis.

Clinically, the inflammation usually involves conjunctiva, cornea, iris and ciliary body (choroid may also be affected). Intraocular pressure may become less than normal. After repeated attacks, usually of increasing severity, the inflammation extends to the retina and vitreous, and cataracts form.

#### Histology

Early acute stage - congestion of sclera and conjunctiva; vascularization of cornea; iris and ciliary body show severe congestion and diffuse leukocyte infiltration (initially neutrophils, later chiefly lymphocytes); much fibrin and many leukocytes in aqueous.

As clinical signs subside - organization of exudate often results in posterior synechiae formation

During quiescent stages - much of exudate absorbed; leukocyte infiltration in uvea is reduced to focal accumulations of lymphocytes.

Later acute attacks - retinitis occurs; exudation from the choroid may cause retinal separation (detachment).

Eventually - organization of exudate throughout the globe may cause progressive shrinking with buckling of the sclera. End result may be phthisis bulbi.

Etiology is not known for certain: Appears to be a delayed hypersensitivity reaction either to infectious agents or to uveal tissue previously damaged by them. There is good evidence from experimental and naturally occurring cases that leptospirosis is at least one cause. Antibodies against some leptospiral antigens may cross-react against some normal corneal antigens.

Other possible causes include: *Onchocerca cervicalis microfilariae*, riboflavin deficiency, *Borrelia burgdorferi* (spirochete that causes Lyme disease) brucellosis, and viral infections.

1993

Dr. Linda L. Collier

## OCULAR MANIFESTATIONS OF SYSTEMIC DISEASE

Careful ocular examination can often help in arriving at or confirming a diagnosis since many ocular disorders are manifestations of a more generalized systemic problem. The eyes are windows to the body.

### DERMATOLOGIC DISEASES

Immediate Allergic Reactions - resulting from insect bites, foods, drug reactions.

Lid involvement is a frequent sign  
- urticaria, edema, itching

Chronic Allergic Reactions - seen in atopic animals during prolonged exposure to the sensitizing agent

Conjunctiva - congested vessels, may sometimes be chemosis and serous discharge, eyes are itchy

In prolonged cases, conjunctiva becomes markedly thickened and there is a heavy seromucoid discharge

Keratitis - may be a complication of chronic atopic conjunctivitis

Auto-immune diseases -

a) affect mucocutaneous junctions.

b)

Diseases such as pemphigus vulgaris, bullous pemphigoid. Uveodermatologic Syndrome: somewhat similar

to Vogt-Koyanagi-Harada syndrome (VKH) in man. Granulomatous inflammation in skin and eye is associated with destruction of melanocytes, leading to depigmentation of skin, hair, and eye (especially fundus); Uveitis is usually the first sign, before any depigmentation of eyes or skin is visible. Uveitis often starting as choroiditis results in serous or exudative retinal separation (sudden blindness), if untreated can progress to glaucoma and panophthalmitis. Seems to be due to immunoregulatory dysfunction. Most commonly affected breed is Akita. Also reported in Siberian Husky, Samoyed, Irish Setters, Chow Chow, Ainu, Shiba, German Shepherd.

Generalized Staphylococcal Infections of Young Pups (Puppy Pyoderma) (not always staph, may culture other bacteria that cause same signs)

Infection of tarsal (Meibomian) glands causes marked swelling of the lids and conjunctiva. Conjunctivitis and keratitis may develop as a result of allergy to the staph toxins Usually, the immune systems of these pups are not functioning normally. Hereditary basis.

5. Demodectic mange - often involves skin around the eyes.

## VIRAL DISEASES

### 1. Canine Distemper (CD)

#### Conjunctivitis

Acute or chronic; (serous .> catarrhal . .> mucopurulent discharge) often seen along with respiratory signs. Cytoplasmic inclusion bodies may be found in conjunctival epithelial cells after the 6th day of infection.

#### Cornea

Ulceration - has been associated with CD infection, but is probably secondary since there is no evidence that CD virus is capable of invading the intact corneal epithelium.

Keratitis sicca - may result from an acute inflammatory reaction in the lacrimal gland.

#### Retina

~ - commonly affected

Estimated that 60-80% of infected dogs may exhibit signs of retinitis. Generalized active retinitis may produce marked visual impairment or blindness

#### Ophthalmoscopic Observations:

##### Active Retinitis:

Non-tapetal Area - loss of normal pigmentation, retinal edema, perivascular infiltration. Lesions often are in peripheral fundus.

Tapetal Area - may be focal; less reflective grayish areas

Chronic retinal lesions: retinal atrophy and scarring;  
Non-tapetal area - depigmented area(s) (focal or generalized)

Tapetal area - lesions appear hyper-reflective, with or without abnormal pigmentation of the tapetal area.

#### Histologic Lesions:

Degenerative changes in photoreceptor, outer nuclear, bipolar, and/or ganglion cell layers. Secondary changes of the retinal pigment epithelium may occur. Lesions may be focal or widespread. May see inclusion bodies.

CNS- pathology resulting from inflammation and demyelination of the optic nerves and optic tracts may also occur and result in marked visual impairment or blindness.

## Infectious Canine Hepatitis (ICH)

Is caused by canine adenovirus type 1 (CAV-1)

Uveitis occurs in approximately 20% of dogs recovering from canine hepatitis. Due to a hypersensitivity reaction.

Variable degrees of corneal edema ("blue eye", due to damage to endothelial cells) are associated with the uveitis.

Some dogs vaccinated with modified live virus vaccine against CAV-1 also develop similar ocular complications.

May appear to be unilateral or bilateral.

In approximately 5 % of affected dogs, the acute uveitis leads to secondary glaucoma.

Histologic lesions:

- Corneal stroma is edematous

- Endothelial cell cytoplasm is vacuolated

- Intranuclear viral hepatitis inclusion bodies are seen in some endothelial cells

- Neutrophils and lymphocytes can be found in contact with diffuse areas of degenerating endothelial cells and immune complexes are present

- Extensive accumulations of inflammatory cells in the drainage angle, and inflammation and stromal hemorrhage in the iris can lead to glaucoma.

- May be choroiditis in addition to iritis and cyclitis.

Incidence of Postvaccinal ocular lesions can be greatly reduced by using CAV-type 2 vaccines instead of CAV-1.

Feline Infectious Peritonitis Clinically can look the same as Toxoplasmosis, Lymphosarcoma, FIV associated uveitis, or fungal diseases.

Caused by a coronavirus

Ocular lesions may or may not be present

Clinical signs:

Severe anterior uveitis with extensive flare, cellular accumulation in aqueous, and sometimes hemorrhage.

Iris very edematous. Organized fibrinous mass may accumulate in anterior chamber. Synechia soon develop. May develop keratitic precipitates. May see active retinitis (edema and hemorrhages), or chorioretinitis, that can result in retinal separation (detachment).

Histologic lesions:

Pyogranulomatous uveitis (immune mediated vasculitis) with predominantly mononuclear and plasma cells. Anterior uveal tract most severely affected in most cases.

Perivascular retinitis and cellular infiltration of the choroid present in some cases.

Feline Respiratory Diseases (VIRAL and NON-VIRAL)

Ocular involvement is frequently seen with feline upper respiratory diseases. Conjunctivitis with ocular discharge, nasal discharge, and sneezing have been associated with several agents: chlamydia, mycoplasma, herpes virus, calicivirus, and reovirus. The systemic signs associated with these infections in cats can be all very similar.

Carder states exist for chlamydia, calici and herpes viruses, which makes it very difficult to eliminate these problems from carteries.

Chlamydial Conjunctivitis (same agent that causes feline pneumonitis) - may see without respiratory signs

Often unilateral initially

May become chronic and persist as long as a year or more. Sometimes results in symblepheron.

Diagnosis based on positive indirect fluorescent antibody test on conjunctival scraping specimen, or on finding typical inclusion bodies (blue) in Giemsa stained conjunctival scrapings. May be difficult or impossible to find in chronic cases.

Treatment with chloromycetin or tetracycline ophthalmic ointment indicated. (Mycoplasmal conjunctivitis also responds to treatment with tetracycline ointment). Chronic cases may need systemic antibiotic treatment as well as topical.

Feline Herpes Virus (Rhinitis)

Several different ocular manifestations:

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Neonatal ophthalmia in 2-4 week old (or sometimes younger) kittens, may result in symblepharon formation

Acute conjunctivitis, often severe.

Ulcerative keratitis (dendritic ulcers) associated with conjunctivitis (which may be mild), with or without upper

respiratory infection; seen mostly in older cats incidence low, may recur following stress.

Stromal keratitis; older cats, low incidence, often chronic, may recur.

Feline Lymphosarcoma - Leukemia Complex (FeLLC)

May involve any or all of the ophthalmic structures.

Cats with FeLLC may present with isolated ocular lesions, or they may be concurrent with systemic illness.

Clinical Findings:

Anterior uveitis - In the older literature, this is said to be the most common finding. This has been challenged by a recent study that found anterior uveitis to be rare in FeLV positive cats that did not have intraocular

lymphosarcoma or secondary infections with FIP, mycoses, etc. Signs of anterior uveitis include: hypopyon, altered iris coloration, keratitic precipitates, hyphema, synechia, miosis, flare in anterior chamber, sometimes secondary glaucoma.

Retinal lesions - hemorrhage (due to anemia, thrombocytopenia; the recent study showed hemorrhage to be the most common eye lesion in non-lymphomatous FeLV infected cats), tortuous dilated vessels, edema, perivascular cuffing, and sometimes separation (detachment). Choroid may become involved.

Corneal abnormalities - sometimes seen. Keratitis, edema, vascularization, infiltration with neoplastic cells (appears as a widening opaque band).

Histologic findings:

Any or all parts of the eye may be infiltrated by neoplastic lymphoid cells.

Uveitis can occur without infiltration by tumor cells and may be part of an immune complex disease or due to secondary infections.

Feline Immunodeficiency Virus (FIV)

Uveitis (anterior and/or posterior) has been observed in cats with FIV. At this time it is not clear whether the FIV is capable of directly causing uveitis or if it is due to 20 infections resulting from a compromised immune system.

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#### Malignant Catarrhal Fever (MCF)

Viral disease of cattle (herpes virus).

Diffuse ophthalmitis (usually severe) often present. Exudative type.

Acute conjunctivitis with granulocytic and lymphocytic infiltration.

Intensive vasculitis of conjunctival and scleral vessels.

Keratitis - corneal edema, infiltration with inflammatory cells, vesiculation and erosion of epithelium.

Vascularization from the limbus. Sometimes calcium deposition in cornea.

Acute iridocyclitis with congestion, edema and exudation of much fibrin and large mononuclear cells.

Synechia may form.

Non-suppurative retinitis and optic neuritis (chiefly vasculitis).

#### Bovine Viral Diarrhea - Mucosal Disease (BVD-MD)

Intrauterine infection can result in calves born with retinal atrophy (secondary to retinitis), cataracts, optic neuritis and/or microphthalmia with retinal dysplasia.

#### Infectious Bovine Rhinotracheitis (IBR)

Disease of cattle caused by a herpesvirus. Can cause conjunctivitis and keratitis. Ovine Bluetongue

Vaccination of pregnant ewes with an attenuated vaccine may result in choroiditis, retinitis and retinal necrosis in the fetal lambs.

#### Hog Cholera

Inflammatory changes occur in the retina and uvea if the animal survives at least 7 days. Congestion, edema, infiltration by mononuclear cells, and sometimes hemorrhage occur in the iris and ciliary body. Choroidal infiltrations are focal and mild. There is acute retinitis with retinal gliosis and perivascular cuffing. Optic neuritis with diffuse glial proliferation may be prominent.

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#### African Swine Fever

Blindness with keratitis and phthisis bulbi have been reported. Pseudorabies in Swine Eye discharge, nystagmus, blindness due to retinal degeneration. Equine Infectious Anemia Subconjunctival petechial hemorrhages and icteric sclera.

#### BACTERIAL DISEASES

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#### Tuberculosis

Most frequently seen in cattle. Ocular tuberculosis also reported in ipj~, cats, dogs, foxes, mink, chickens., parrots, and primates. Congenital infection may occur.

Infection of conjunctiva and cornea reported in the cat.

#### Intraocular:

The tuberculous process usually begins in the choroid and the resulting granulomas result in retinal separation (detachment) and blindness. The iris and ciliary body may be involved with granulomatous inflammation. In late cases the whole globes may be filled with tuberculous tissue. Histologically, the lesions are like those of tuberculosis in other organs of the species concerned.

#### Listeriosis

Bacterial infection of ruminants and swine.

The cerebral infection form in cattle and sheep may also have ocular involvement.

Inflammation of the eye is purulent.

Keratitis and Hypopyon (due to uveitis) clinically

Uve'ltis may be seen histologically

#### Canine Bruce!1osis

Sometimes causes recurrent uveitis and corneal opacity

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major ocular changes that are seen

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## Leptospirosis

Episcleral injection, yellowing of sclera and mucous membranes, conjunctival petechiae and subconjunctival hemorrhage may occur. Sometimes causes anterior uveitis. Can result in equine recurrent uveitis.

## Borrelia bergdorferi (Lyme disease)

In man, causes a variety of ocular lesions including optic neuritis and/or retinitis that can cause blindness, uveitis, and/or keratitis. Reportedly associated with uveitis in dogs and horses (some cases of ERU).

## RICKETTSIAL DISEASES

### Ehrlichiosis - Ehrlichia sp.

Hyphema and subconjunctival hemorrhages in cattle, sheep, and dogs. Other less common lesions: conjunctivitis, corneal opacities, anterior uveitis, and/or chorioretinitis.

### 2. Rocky Mountain Spotted Fever

May cause uveitis.; hemorrhages in conjunctiva or within eye.

## MYCOTIC DISEASES

### 1. Aspergillosis - (ocular infection most commonly *A. fumigatus*)

Most frequently encountered in birds (especially chickens and turkeys) in which it is part of systemic involvement.

May cause keratitis and/or endophthalmitis. Endophthalmitis has been reported in the horse, but is rare.

Keratomycosis (corneal infection) appears to be increasing in animals, especially in the horse. This is important to remember when treating corneal ulcers in horses, which often have mixed bacterial and fungal infections.

### Histoplasmosis - *Histoplasma capsulatum*

Intraocular lesions uncommon in animals. May cause granulomatous inflammation in any of the 3 tunics of the eye. Choroid seems to be most commonly affected. Rarely causes eyelid (skin) lesions.

### Cryptococcosis - *Cryptococcus neoformans*

Can cause eyelid (skin) lesions.

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Can produce a granulomatous retinitis and/or choroiditis.

Subretinal granulomas may develop and lead to solid or serous retinal (detachment).

Blastomycosis - *Blastomyces dermatitidis*

Causes pyogranulomatous inflammation in any or all of the 3 tunics of the eye.

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separation

May cause a granulomatous anterior uveitis with infiltration of inflammatory cells into the cornea and drainage angle. An extensive, deep, interstitial keratitis may be associated with the anterior uveitis. May also cause granulomatous choroiditis and retinitis and retinal separation (detachment). There may be much exudate in both anterior chamber and vitreous cavity. Ocular damage is usually severe.

## PROTOZOAL DISEASES

Toxoplasmosis

*Toxoplasma gondii* - very small protozoan (coccidia)

In dogs and cats:

Intraocular lesions may involve uveal tract and/or retina.

Retinitis may be focal or generalized.

Exudative retinal separation (detachment) and retinal necrosis may occur.

Anterior uveal tract more frequently involved with granulomatous uveitis than is choroid.

*Toxoplasma* organisms in the extraocular muscles may cause inflammation and necrosis.

Leishmaniasis - *Leishmania* sp.

Keratitis and conjunctivitis are predominant signs.

Inflammation of the sclera, anterior uveal tract, extraocular muscles and eyelids may

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Coccidioidomycosis - *Coccidioides immitis*

Often produces exudative retinal separation (detachment) with a massive accumulation of inflammatory cells in the subretinal space. Ocular damage is often severe.

## NEMATODAL DISEASE

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Visceral Larva Migrans - *Toxocara canis*

Larval granulomatosis of the retina and choroid has been observed in dogs. Solitary granulomas 1/4 to 1/6 the diameter of the optic disc have been observed ophthalmoscopically.

**PUBLIC HEALTH SIGNIFICANCE:** This is an uncommon, but very severe ocular problem in children, often causing blindness in affected eyes. Good reason to urge clients to keep their dogs free of this parasite so soil will not be contaminated with parasite ova in areas where children play.

*Onchocerca* - microfilaria sometimes in eye, or subconjunctival (nodules near limbus).

Thought to be the causative agent in at least some cases of equine recurrent uveitis.

*Thelazia*

Found on conjunctiva (sometimes on cornea) of many species. Benign nature. Usually mild conjunctivitis.

Heavy investigations can cause severe conjunctivitis and keratitis. May hide in nasolacrimal ducts and be difficult to see and diagnose.

*Setaria* - normally in abdomen; microfilaria can aberrantly be found in eye.

*Diroffia immitis* - heartworms; aberrant microfilaria rarely found in eye.

## NEOPLASTIC DISEASE

Lymphosarcoma

Ocular involvement not uncommon in animals, and ocular lesions may be the first observed signs.

Nictitating Membrane may become infiltrated.

Retrobulbar tumor may cause exophthalmus - most commonly seen in cattle.

Cornea may be involved:

Keratitis, corneal edema, vascularization, keratic precipitates, and intrastromal hemorrhage.

An opaque band (of neoplastic lymphoid cells) may migrate centrally from the limbus.

Uveal Tract:

Anterior uvea most commonly involved, mainly base of the iris and the anterior portion of the ciliary body. Choroid is sometimes involved. Clinically may present with signs of acute anterior uveitis.

Hemorrhage may be present in eye.

Retina may be involved:

Hemorrhages:

Dilated and tortuous vessels with perivascular sheaths. and non-tapetal areas in advanced stages of the disease. separations (detachments).

Altered color in tapetal May cause focal retinal

Secondary glaucoma frequently develops.

2. Various other types of malignant neoplasia may metastasize to the eye.

(NEOPLASTIC) / INFLAMMATORY DISEASE

Granulomatous Meningoencephalomyelitis (GME) (previously called Reticulosis of CNS) in dogs and cats

Severe visual deficit or blindness may occur as a result of optic neuritis or involvement of the optic tracts. Optic disc and retina may be involved. Optic nerves may be grossly enlarged. Histopath: intense perivascular cuffing with macrophages, lymphocytes, monocytes, and plasma cells. Ideopathic, may be immunologic basis.

METABOLIC DISEASES

Diabetes Mellitus

Cataracts, (usually with a history of very rapid, bilateral development) are commonly seen in diabetic dogs and cats. Normally glucose is metabolized by hexose kinase -glycolytic pathway. Too much glucose in diabetic lenses: aldose reductase converts it to sorbitol (an alcohol) which is hydrophilic and creates an osmotic problem, causing the lens to imbibe water. Moderate to severe lens-induced uveitis commonly develops weeks to a few months after the cataracts form.

Over time, dogs may develop retinal capillary microaneurysms, leading to small hemorrhages and exudates, often not clinically observable. Diabetic animals don't usually live long enough to develop severe diabetic retinopathy (a major problem in diabetic people).

Hyperlipoproteinemia or Hyperlipidemia

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Can cause lipemic aqueous, lipemia retinalis, and lipid Schnauzers most commonly affected.

## NUTRITIONAL DISEASES

keratopathy.

Miniature

Vitamin - A Deficiency

Prenatal deficiency can result in varying degrees of microphthalmia, (or even anophthalmia) and hypoplastic optic nerves in swine.

Postnatal deficiency in calves can result in osteogenic disturbances leading to compression on the optic nerves, degeneration, and complete blindness in many cases. Papilloedema is a common clinical finding.

Deficiency at any age in any species may result in dystrophic metaplastic changes in the epithelia of the cornea and conjunctiva, and anatomical degeneration of the retina. Biochemical degeneration in the retina manifested as nyctalopia (night blindness) is one of the earliest manifestations of the deficiency.

Degeneration (squamous metaplasia) of the lacrimal glands leads to keratoconjunctivitis sicca (KCS).

MISCELLANEOUS (Diseases that result in hemorrhage)

Canine Macroglobulinemia, hypergammaglobulinemia, monoclonal gammopathies (plasma cell myeloma) -- hyperviscosity syndrome.

Retinal hemorrhages; excessively dilated, tortuous and congested retinal veins; and serous retinal separation (detachment).

Conjunctival hemorrhage in some cases.

### 2. Clotting Disorders

Conjunctival, uveal, and retinal hemorrhage have been associated with immune-mediated thrombocytopenia, disseminated intravascular coagulopathy (DIC), coumarin toxicity, and other clotting disorders.

### 3. Systemic Hypertension

Seen mostly in cats. Can cause retinal hemorrhages and retinal separations (detachments). Usually secondary to renal disease.

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Miniature

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