

# Feline Red Eye: Delving Deeper

Jessica Meekins, DVM, DACVO reviews intraocular causes of “red eye” in cats including uveitis, glaucoma, and hyphema.

## Speaker Bio:

Jessica Meekins, DVM, DACVO is an Associate Professor of Ophthalmology at Kansas State University. She received her undergraduate degree in biology before attending veterinary school at the Ohio State University. She then completed a one-year rotating internship at a private specialty hospital in Albuquerque, New Mexico before being accepted into the ophthalmology residency program at Purdue University. She became a board certified diplomate of the American College of Veterinary Ophthalmologists in 2012, and she has been on faculty at K-State for 9 years. Dr. Meekins’ clinical and research interests include management of viral surface ocular diseases in cats and comparative exotic animal ophthalmology. She is also interested in clinical teaching and the integration of competency-based veterinary education into instruction and assessment of students participating in clinical rotations.

## Learning Objectives:

1. Recognize the cardinal signs and possible causes of uveitis, and recall why specific testing beyond the basic ocular diagnostics may be warranted
2. Determine whether an eye with glaucoma is treatable or requires end-stage surgical intervention
3. Identify hyphema as a specific manifestation of "red eye" in a cat, and recall the recommended diagnostic approach based on the most likely etiology
4. Recognize the indications for specific basic ocular diagnostic tests during the initial workup of a red eye
5. Recall, for each disease condition, when to recommend treating in-house vs. referring to a specialist
6. Manage client expectations regarding cost, prognosis, and outcome

# Feline Red Eye: Delving Deeper

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*Jessica Meekins, DVM, MS, Diplomate ACVO*

Hello, my name is Jessica Meekins. And I'm an associate professor of ophthalmology at Kansas State University. It's my pleasure to provide a continuing education presentation on the topic of feline red eye, with a specific focus on diseases that affect the inside of the eye. In a separate presentation, I'll also address the topic of surface ocular causes of feline red eye.

- Clinically relevant A&P review
- Basic ocular diagnostic tests for a red eye
- Uveitis
  - Infectious, Neoplastic, Idiopathic
- Glaucoma
  - Uveitis, Neoplasia, Aqueous misdirection
- Hyphema
  - Systemic hypertension
  - Primary ocular
- Summary/My approach

I'll start our discussion by providing you with a brief overview of the clinically relevant anatomy of the internal eye. We'll then discuss the basic ocular diagnostic tests that are important to perform in any cat presenting with a red eye. I'll also provide some insight into client communication tips that I use and that may be helpful as you try to explain these tests to your clients and to prioritize them for your patients. In terms of specific diseases that affect the inside of the feline eye and result in a red eye, we'll cover three main areas. First, we'll have an in-depth discussion of uveitis and its causes. Then, we'll cover the different types of glaucoma in cats. And finally, we'll review hyphema and how to differentiate between a systemic cause, specifically hypertension, and a primary or local to the eye cause. Throughout our discussion, I'll provide additional tips on client education that I use for each disease and discuss what you can tackle out in practice versus what you should consider referring to an ophthalmology specialist if that's an option. I'll end with a summary of the most important concepts covered during the presentation and include the key points of my approach to working up a cat presenting with a red eye localized to the inside of the eye.

## Clinically Relevant Anatomy and Physiology: Intraocular

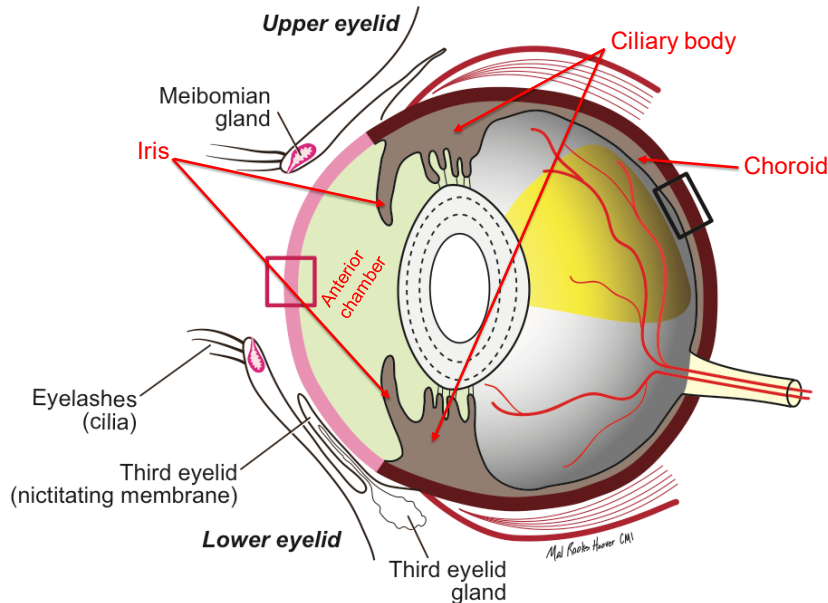


Figure 1

The main focus or target structures of intraocular diseases that can cause feline red eye are the uveal tract, composed of the iris and ciliary body anteriorly, and the choroid posteriorly, and the anterior chamber, including the fluid drainage pathway located at the iridocorneal angle.

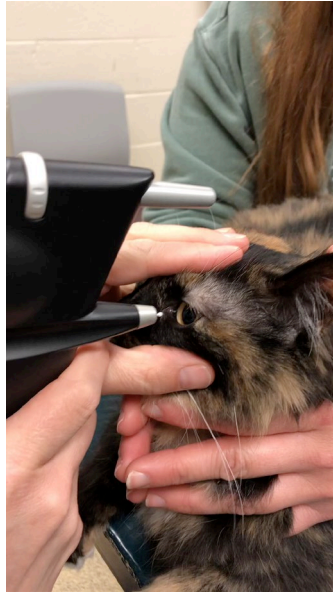
The uveal tract is the middle or vascular tunic of the eye. Blood vessels from component parts of the uveal tissue make up the blood ocular barrier that provides protection to the eye as a delicate sensory organ. Uveitis occurs when there is a breakdown of this protective barrier, either due to local ocular diseases or as an ocular manifestation of systemic disease.

Feline glaucoma develops when the fluid that is normally produced inside the eye to nourish the avascular lens and cornea can no longer drain effectively out of the eye, leading to pressure buildup that is painful and damaging to the retina and optic nerve. And this is impactful for vision. Aqueous humor is produced at the ciliary body epithelium, circulates within the eye and through the pupil to then gain access to the iridocorneal angle to be drained from the eye. There's constant turnover with old aqueous humor being drained out and new aqueous humor being produced.

Problems with fluid drainage occur usually in two main places, either at the level of the drainage angle within the anterior chamber, or at the pupil when this pathway to the chamber is somehow obstructed. Hyphema arises due to disruption of the blood vessels inside the eye, and as such, hyphema can come from only a few places. These include the uveal tract or the retinal blood vessels.

We'll really briefly review the patho-mechanisms of each intraocular disease that results in a red eye as we review each topic separately.

## Diagnostic Tests: Intraocular Pressure\*



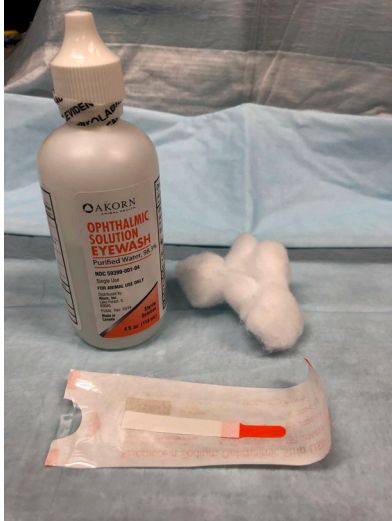
Intraocular pressure measurement and fluorescein staining are the two basic ocular diagnostic tests that are most important to perform in any cat presenting with a red eye. Of the big three basic ocular diagnostic tests, which include Schirmer tear test to measure tear production, intraocular pressure measurement, and fluorescein staining to check for corneal ulcers, the one test I don't routinely perform in cats is tear measurement, because they are rarely affected by quantitative tear film abnormalities, also known as dry eye disease.

There are specific signs of intraocular disease that would trigger the recommendation to prioritize tonometry or intraocular pressure measurement for your patients. A cloudy cornea, infiltrate in the anterior chamber, and a fixed and dilated pupil are three specific signs that would prompt me to recommend tonometry to a client. When I make this recommendation, I find it important to explain that tonometry is a screening for glaucoma and uveitis, both causes of red eye in a cat.

At K-State, we use the rebound tonometer. And as seen in the video, a small probe is deployed from the instrument to gently make contact with the cornea. The instrument is then measuring the velocity of the probe as it returns to home base to extrapolate an intraocular pressure and display it on a digital readout screen.

Cats are measured under the dog setting, denoted here by the letter d on the left-hand side of the display. And it's important to remember that the intraocular pressure range in cats is shifted a little bit higher than dogs, with normal ranging from between 10 and 15 to 30 millimeters mercury.

## Diagnostic Tests: Fluorescein Staining



Fluorescein staining should be performed in cats with evidence of surface ocular causes of red eye. I'm sure most or all of you have performed fluorescein staining many times and have likely developed your own technique for this diagnostic test. I prefer to apply eyewash directly to the fluorescein strip in order to create a drop that can then be placed in the eye as if from a dropper bottle. And if the drop doesn't roll from the strip as you plan, the tip can be gently touched to the bulbar conjunctiva that covers the sclera as shown the video. I try to avoid touching the tip directly to the cornea as this can leave a denser footprint of stain that can sometimes be misinterpreted as uptake. Instead of using the dropper bottle, the eyedropper bottle, or the eyewash bottle, I will soak cotton balls and use them to squeeze a smaller volume with less intense spray effect when I'm rinsing the stain from the eye. I find that, in general, cats tend to tolerate the cotton ball soaking technique better than rinsing directly from the eye wash bottle. In general, I discourage the use of a syringe with eyewash and the steam inside the syringe just to apply steam to an eye as it's really easy to inadvertently overly dilute the stain and cause a false negative result. If you have developed that habit and prefer the syringe method, I suggest using a fixed volume of no more than 0.2 to 0.3 milliliters of fluid. And this would be a closer to the volume of a few drops. Fluorescein staining is an essential diagnostic for screening of surface ocular causes of feline red eye. And it also provides helpful information on the status of the cornea prior to instituting certain therapies that would be contraindicated in the presence of an ulcer. The best example of such circumstance would be knowing the fluorescein stain status prior to prescribing topical steroids in a cat with uveitis.

## Uveitis: What is It?

- **Inflammation of the middle/vascular tunic of the eye**
  - Iris and ciliary body: anterior uveitis or iridocyclitis
  - Choroid: posterior uveitis or chorioretinitis
  - Anterior + posterior = panuveitis
- ***Must* rule-out systemic disease as the cause**
- **Most cases are idiopathic/primary ocular**

As mentioned, uveitis is defined as a breakdown of the blood ocular barrier within the uveal tract as a result of inflammation. Involvement of the iris and ciliary body or anterior uvea is referred to as anterior uveitis or iridocyclitis. And involvement of the choroid or posterior uvea is called posterior uveitis or choroiditis. If all components of the uveal tract are affected, this is referred to as panuveitis. While there are specific disease processes local to the eye that may cause uveitis and the majority of uveitis cases in cats are ultimately deemed to be idiopathic, this must be a diagnosis of exclusion by first ruling out systemic disease as the cause of the uveitis. The eyes are connected to the body by the blood supply within the uveal tract. And when the protective blood ocular barrier is compromised, this can be an indication of systemic disease manifesting within the eye. It's like the old canary in the coal mine adage, where the eyes may provide early warning signs of a bigger problem throughout the body.

## Uveitis: Typical Presenting Complaint → 'Check Eye'

- **Anterior uveitis:**
  - Squinting, redness, discharge, cloudiness/appearance change to the eye
- **Posterior uveitis:**
  - Blindness or vision impairment
  - Dilated pupil(s)
- **Panuveitis:**
  - Any combination

The majority of cats with uveitis as a source of red eye have a very generic or non-specific presenting complaint of check eye. Rather than feeling a sense of dread when you see that show up on your appointment schedule, because I know eyes aren't for everyone, my goal is to help you feel confident in your ability to accurately assess that patient and come up with a reasonable diagnostic and treatment plan. The client will typically describe signs such as squinting, redness, obviously, the focus of this presentation, ocular discharge, and cloudiness or an appearance change to the eye when presenting their cat for an eye problem, that's ultimately diagnosed as uveitis. And the clinical signs of anterior uveitis are generally quite outwardly obvious.

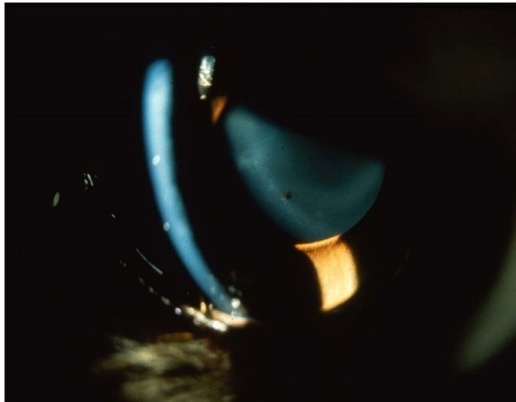
Posterior uveitis, on the other hand, is usually accompanied by blindness or vision impairment. And sometimes owners will appreciate dilated pupils. If panuveitis is present, there could be a combination of these signs reported by the client.



## Uveitis Signs: Anterior

- Aqueous flare

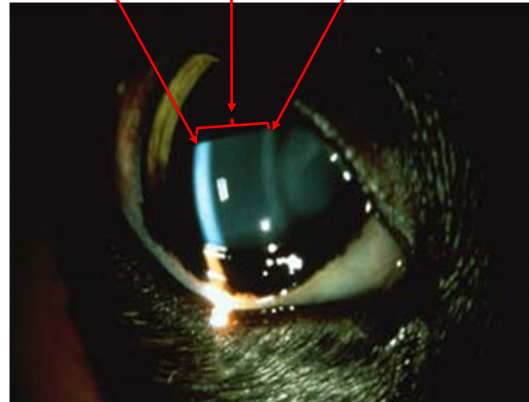
Normal



Cornea

Lens

Flare



The clinical signs we look for to confirm the diagnosis of anterior uveitis are generally easier to recognize than for a posterior uveitis. This is because the ophthalmoscopy that is performed to confirm posterior uveitis is more challenging as an exam technique to master when compared to direct physical exam of the anterior portion of the eye. We'll discuss the key clinical signs of anterior uveitis first. And then we'll focus on what you'll be looking for on fundic exam that would indicate posterior uveitis.

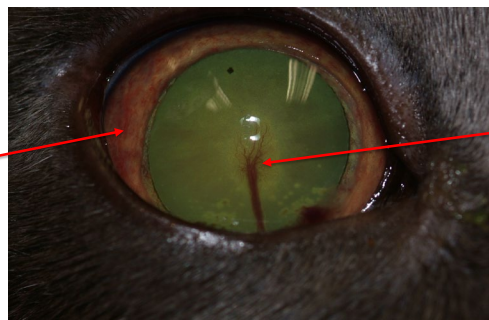
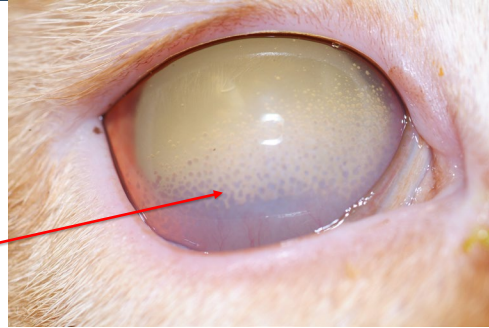
Aqueous flare is considered the pathognomonic sign for anterior uveitis. No other disease process can cause flare. What you're looking for is a diffuse haziness or cloudiness within the anterior chamber, which indicates the presence of proteins in the aqueous humor, scattering light as it passes through. The aqueous humor is normally optically clear, so you don't really see it when you're examining a normal eye.

On the image to the left of the slide, you can see two beams of light, one striking the cornea and one striking the iris/lens interface. The space in between is clear and dark but is actually filled with normal aqueous humor fluid. On the image at the right of the slide, you can see that a homogeneous haze is occupying the anterior chamber space, almost as if the beams of light on the cornea and iris/lens interface are connected by a gray bar. This is sometimes described as headlights in fog and represents the Tyndall effect, whereby light is scattered by particles or protein within a fine suspension, the aqueous humor.

## Uveitis Signs: Anterior

### ● Other:

- Low intraocular pressure
- Constricted pupil
- Anterior chamber infiltrates
  - WBCs
    - KPs\*
  - RBCs
  - Fibrin
- Rubeosis iridis
  - Iris color change



Fibrovascular membrane extending from iris surface onto lens capsule

Ocular hypotony or a low intraocular pressure is a semi objective diagnostic finding in anterior uveitis. As we initially discussed, measurement of IOP is an important component of the basic ocular diagnostic testing plan performed for any patient with a red, cloudy, or painful eye. With uveitis, the intraocular pressure is low due to decreased production of aqueous humor by the ciliary body. The ciliary body epithelium experiences dysfunction in an inflammatory environment.

While only uveitis can cause a low intraocular pressure, the number obtained by the tonometer must be evaluated in combination with compatible clinical signs. The eye experiences an overall decrease in aqueous humor production as it ages. And so sometimes a little bit below the low end of the reference range can be normal for an older animal.

Another sign of anterior uveitis that we look for is miosis or an abnormally small pupil. This occurs due to the effects of inflammatory mediators on the iris tissue. An important part of the neuro-ophthalmic examination is evaluation of pupil size and symmetry, in addition to evaluation of the pupillary light reflexes. This allows the examiner to screen for subtle signs of anisocoria or variation in pupil size between the eyes.

When anisocoria is recognized, the first step is to determine which pupil is the abnormal pupil. This can sometimes pose a challenge when the other ocular clinical signs are mild. One way to answer the question of which pupil is the abnormal pupil is to evaluate pupil size in different lighting situations.

The pupils should be mid-range to slightly miotic in a well-lit or excessively lit room. And they should dilate in a darkened room. Darkening an exam room area should enhance anisocoria with a miotic pupil, because the abnormally small pupil will fail to physiologically respond to the decrease in ambient light.

Conversely, if a pupil were abnormally dilated or mydriatic, a well-lit room should enhance that anisocoria because the dilated pupil won't respond appropriately to the increase in ambient light.

Other commonly encountered clinical signs of anterior uveitis may include the accumulation of materials, such as hypopyon, hyphema, and fibrin, which is consolidated or organized inflammatory material, in the anterior chamber, or the deposition of white blood cell clumps on the corneal endothelium called keratic precipitates or KPs and demonstrated in the top clinical photo. Rubeosis iridis, which is the deposition of a fibrovascular membrane on the surface of the iris that results in an iris color change is another clinical sign that occurs only with uveitis. The bottom clinical photo illustrates the change in iris color in this cat affected by uveitis to more of a red hue. There's also a prominent example of a fibrovascular membrane that resulted in iris color change, extending from the iris to the surface of the lens ventrally at the 6 o'clock position.

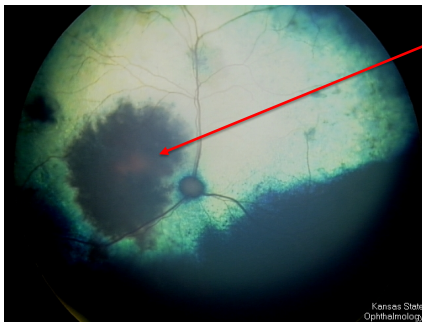
Together, these signs are really the most important clues to lead you to a preliminary diagnosis of anterior uveitis. And while not all signs are necessarily present simultaneously, any combination of one or more signs is usually enough to make the diagnosis.

## Uveitis Signs: Posterior

- Blindness or vision impairment
- Abnormalities in PLR
- Perform ophthalmoscopy!

Chorioretinitis =  
focal/multifocal/'micro'-retinal detachments

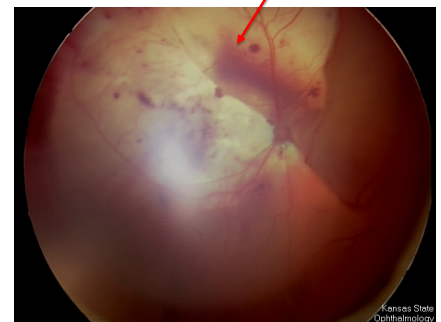
Complete retinal  
detachment



Subclinical



Subclinical



Blind

Posterior uveitis can be more difficult to recognize, depending on the degree of anterior uveitis that can be causing opacity in the front aspect of the eye and obscuring your view of the back of the eye, as well as on the experience level of the examiner performing and interpreting fundoscopy.

Depending on the severity of posterior uveitis, there may be signs of its presence during the initial neuro-ophthalmic assessment. For instance, an eye with a retinal detachment or significant posterior inflammatory infiltrates should have a diminished or absent menace response and abnormalities in the resting pupil size and pupillary light reflexes. Vision status as perceived by the owner can be quite variable and is dependent on both the location and the severity of inflammation within the eye or eyes.

Cats are very adept at adjusting to even advanced vision loss such that some owners are often unaware of marked vision impairment until it's brought to their attention based on the results of an ophthalmic examination. Ophthalmoscopy or fundoscopy should be performed in any cat with abnormalities in the neuro-ophthalmic assessment. Significant manifestations of posterior uveitis include retinal detachment, retinal hemorrhage, and inflammatory infiltrates within or below the retina, resulting in altered tapetal reflectivity.

These fundoscopic images provide examples of posterior uveitis of varying magnitude. In the images on the left and center, chorioretinitis is manifesting as large areas of subretinal cellular infiltrate with similar but much smaller areas of inflammatory infiltrate scattered around the periphery of the fundus. So these are examples of posterior uveitis or chorioretinitis.

In any area where material is accumulating below it, the retina becomes separated. And this is technically a focal area of retinal detachment. Because the majority of the retina in these examples is spared, the retina retains its function and thus, chorioretinitis of this magnitude is subclinical and would incidentally be

observed during a complete ophthalmic examination of a cat with non-specific signs of weight loss, anorexia, decreased appetite, and lethargy.

The patient affected by chorioretinitis may present first to the general practitioner or to an internal medicine specialist and then subsequently undergo a complete ophthalmic exam as part of the thorough physical examination. And this is all part of the workup for a cat with non-specific or no-ocular clinical signs of disease. On the other hand, an extensive geographic retinal detachment as shown in the right-hand image on the slide would result in a blind eye with a dilated and unresponsive pupil. And this is the type of case that would first present to an ophthalmologist for evaluation of the vision loss. Then a diagnostic workup for uveitis would be recommended based on those fundic exam findings.

## Uveitis: Next Steps after Confirming Diagnosis with an Eye Exam

- **Thorough medical history**
  - Coughing/Sneezing/Vomiting/Diarrhea
  - Vaccine and FIV/FeLV status; preventatives?
  - Environment (indoor/outdoor)?
  - Travel history
- **General physical examination!**
  - TPR
  - Thoracic auscultation
  - Abdominal palpation
  - Peripheral LN palpation
- **Uveitis is sometimes diagnosed 'after the fact'**
  - Cat presenting for 'ADR'

Because of the clinical signs of uveitis that can be very subtle, the history may vary widely from a sudden onset change in appearance of the eyes to a more slowly progressive change occurring over several weeks. Obtaining a thorough medical history should include questions about any non-ocular systemic clinical signs, such as coughing, sneezing, vomiting, or diarrhea, vaccination and retrovirus status, the use of preventatives, environment of the animal, as well as travel history. The very important initial diagnostic step, the most important after identifying uveitis is a complete general physical examination. The general physical examination is aimed at identifying any non-ocular abnormalities that may help narrow the list of potential uveitis etiologies. A TPR or a temperature, pulse, respiration rate, through thoracic auscultation, and abdominal and peripheral lymph node palpation should all be performed as part of a complete physical examination.

Cats generally present to me as a specialist with ocular signs that after the confirmation of uveitis prompt a complete physical examination. As mentioned previously, however, cats being evaluated for non-specific general health concerns, such as weight loss and decreased appetite, may have uveitis diagnosed after the fact during a complete physical exam as part of the workup for those non-specific presenting complaints. This emphasizes the importance of a complete ophthalmic exam in any cat presenting for the classic ADR complaint. When uveitis is diagnosed in this way, the index of suspicion for an ocular manifestation of systemic disease should be significantly increased.

## Uveitis: Diagnostics



### ● For every case:

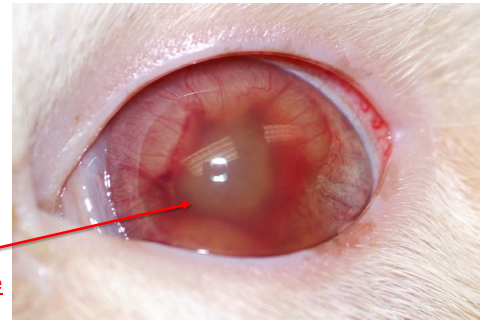
- CBC
- Serum chemistry
- Urinalysis
- FIV/FeLV combo test
- Select infectious disease screening\*
  - Fungal urine or serum antigen
  - Serology

### ● For select cases, based on PE findings

- Thoracic radiographs
- Abdominal radiographs, ultrasound
- Aspirates of cutaneous lesions, lumps, bumps
- LN aspirates (if prominent/enlarged)

For blind, painful eyes: Enucleation *with histopathology*  
Diagnostic *and* therapeutic!

Complete posterior synechiae, dyscoria, iris bombe  
Rubeosis iridis



If any abnormalities are encountered during general physical examination in a cat with uveitis, diagnostics can be targeted at further characterizing these findings. It's prudent to start with a minimum database, including a CBC, serum biochemical profile, and urinalysis in every case in order to identify any non-specific changes that may accompany certain causes of uveitis, as well as to provide baseline information on patient status prior to implementing treatment. Selected infectious disease screening tests may also be performed in a case-by-case basis.

An FIV/FeLV combo test should be done even if the cat is previously tested negative at some point in life. And this is particularly important if the cat has outdoor access and increased risk of exposure to these highly transmissible retroviruses due to contact with other cats. Thoracic and abdominal imaging, aspirates, and impression smears may be pursued depending on physical exam findings. Other testing can then be prioritized based on the clinician's index of suspicion for specific etiologies.

A number of academic and private sector diagnostic laboratories offer a broad array of antigen testing, serology, and molecular diagnostics. In some instances, when uveitis has led to a permanent blindness and a painful eye, enucleation with histopathology can be performed for both diagnostic and therapeutic purposes. It's important to remember though that histopathology can sometimes be inconclusive in pointing to a specific diagnosis. So this approach is often reserved for eyes that are permanently blind and painful due to sequela of uveitis, rather than being used as an initial diagnostic step.

The clinical photo in the bottom of the slide provides an example of an eye that has experienced complications of uveitis, including complete synechiae with dyscoria and iris bombe. Iris bombe refers to a billowing forward of the body of the iris due to synechiae. This eye was blind and painful due to secondary

glaucoma as a complication of uveitis, as well as medically refractory uveitis, so enucleation was recommended for both diagnostic and therapeutic purposes.



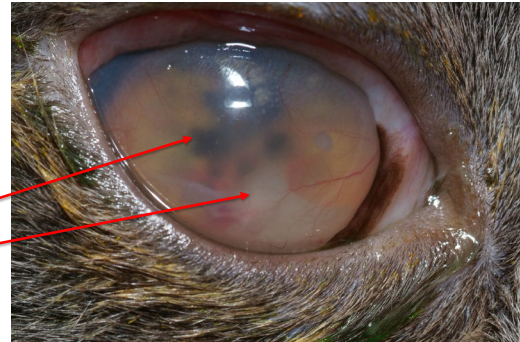
## Uveitis Causes: Ocular Manifestations of Systemic Disease

### ● Infectious

- Viral (FIV, FeLV, FIP)
- Fungal (histoplasmosis\*, blastomycosis, cryptococcosis, coccidioidomycosis)
- Bacterial (*Bartonella henselae*)
- Protozoal (toxoplasmosis, cytauxzoonosis)

### ● When to think infectious?

- Signalment
  - Indoor/Outdoor
  - Vaccine and preventative status
- Exposure risk
- Assume infectious until diagnostics prove otherwise!



Dyscoria and synechia

Fibrin and hypopyon

Ruling out infectious cause is one of the main objectives in the diagnostic approach to uveitis workup. There are many possible infectious etiologies for feline uveitis. And the geographic specificity of select organisms should be considered when building a list of potential infectious agents. Viral, fungal, bacterial, and protozoal organisms are part of a list that is by no means meant to be exhaustive. In general, younger cats and those that have access to the outdoors are considered at an increased risk of infectious uveitis, though a fair number of cats housed exclusively indoors are diagnosed with systemic infections causing uveitis as well. Uveitis can affect cats of any age or breed. However, certain age groups, kitten versus adult cat, or specific risk factors, indoor versus outdoor, vaccine and preventative status, may influence the initial clinical suspicion of a uveitis etiology. A good general rule is to assume that uveitis could be infectious until proven otherwise.

This clinical photograph depicts some of the typical signs of active uveitis that we may see, including an accumulation of fibrin and hypopyon in the anterior chamber and other signs that point to more chronic inflammation such as synechia and dyscoria.

## Uveitis Causes: Ocular Manifestations of Systemic Disease



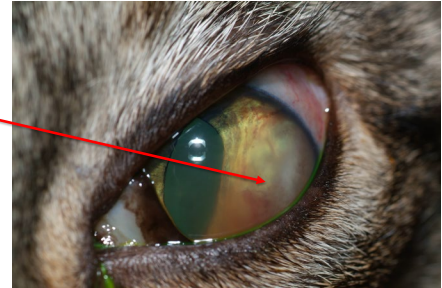
### ● Neoplastic

- Lymphoma
- May be primary ocular (PSOL)
  - Most often multicentric (abdominal)

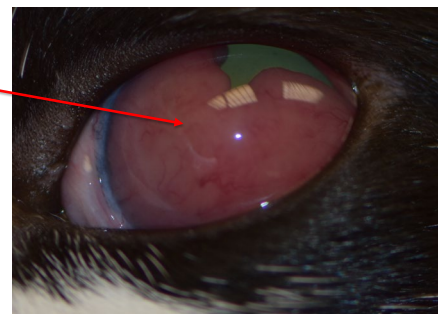
### ● When to think neoplastic?

- Signalment
- Comorbidities
  - FeLV status
- Clinical appearance
  - Solitary intraocular (uveal) mass with accompanying inflammation

Iridial swelling/mass



Uveal mass filling anterior chamber



Besides a systemic infection manifesting in the eye, other major systemic disease to consider as a cause of uveitis is neoplasia. Intraocular neoplasia is divided into primary and metastatic or secondary. While primary intraocular tumors such as diffuse iris melanoma may cause uveitis later in the course of disease, most of the time in cats, we deal with metastatic neoplasia to the eye. The best example of this type of uveitis occurs with lymphoma, although any distant site tumor may spread to the eye. While lymphoma can rarely be confined only to the eye, most often ocular involvement is an indicator of multicentric disease with spread to the eye.

Considering that cats are more commonly affected by alimentary, hepatosplenic, or genitourinary lymphoma rather than lymphoma with peripheral lymphadenopathy as in dogs, imaging in the form of thoracic radiographs, and most importantly, an abdominal ultrasound is indicated in any cat presenting for evaluation of a red eye due to an intraocular mass. As with infectious uveitis, a signal that can help narrow the differential considerations when suspecting neoplastic feline uveitis. It makes sense that most cats will be older, and in the case of lymphoma, may have feline leukemia virus as a comorbidity and risk factor for the induction of lymphoma. In cats, lymphoma that affects the eye often manifests with a mass effect in the uveal tissue as illustrated in the two clinical photos on the slide.

## Uveitis: Primary Ocular

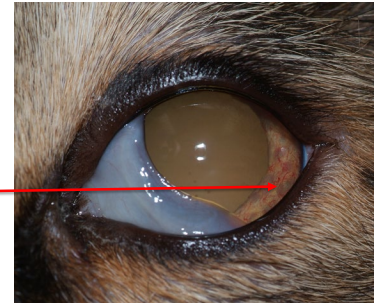
- **Idiopathic lymphocytic-plasmocytic**

- Most common etiology
- Unilateral or bilateral
- Gray iridial nodules
- Sequelae:
  - Cataract and lens luxation
  - Secondary glaucoma

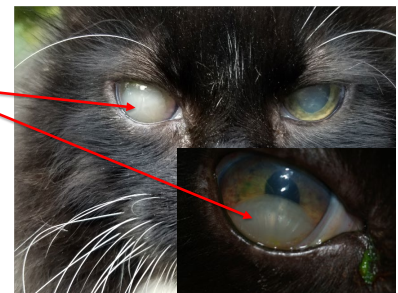
- **When to think idiopathic?**

- Otherwise healthy cat (normal general PE)
- Negative infectious disease screening tests
- Responsive to symptomatic therapy

Gray iridial nodules,  
Rubeosis iridis



Anterior luxation  
of cataractous lens



A large portion of adult cats, particularly indoor-only cats, are diagnosed with idiopathic lymphocytic-plasmocytic uveitis, which is essentially a form of immune-mediated uveitis. Disease can occur in one or both eyes and the trigger for this attack of the host immune system against the eye is not very well understood.

Idiopathic uveitis is considered a local ocular problem. And fortunately, cats diagnosed with idiopathic uveitis are not necessarily at an increased risk of developing systemic autoimmune disease. Pictured on the top clinical photo is the typical appearance of chronic idiopathic uveitis eye or this lymphocytic-plasmocytic uveitis with multiple gray nodules scattered throughout the iris tissue. If these lesions were to be evaluated histologically, the nodules are composed of clusters of lymphocytes and plasma cells that resemble lymphoid follicles. Though confined to the eye and therefore not indicative of a broader systemic problem, chronic idiopathic uveitis can have several painful and potentially blinding sequelae. Cataract development and lens luxation as depicted in the bottom clinical photo, as well as secondary glaucoma are the most important potential sequela of uveitis in cats. Idiopathic uveitis must remain a diagnosis of exclusion after eliminating any potential systemic diseases that could be manifesting within the eye. But there are several things to consider when building the case for a diagnosis of idiopathic uveitis.

I think of an idiopathic etiology, specifically when I'm managing an otherwise healthy cat that's negative on select infectious disease screening tests and responsive to symptomatic therapy. While it would be logical to assume that a unilateral uveitis case is more likely due to a primary ocular problem and a bilateral uveitis case is more likely due to systemic disease, this can be a general good rule of thumb, but it isn't always borne out in my clinical experience. I've managed some cats with systemic disease causing

uveitis that is unilateral. And I've also managed a fair number of cats with bilateral idiopathic uveitis, as is the case in the cat on the bottom clinical image. So unfortunately, that is not a hard and fast rule when you talk about laterality influencing your suspicion regarding etiology.

## Uveitis Treatment

- Specific treatment based on diagnosed etiology
- Symptomatic treatment
  - Goals:
    - Decrease inflammation
    - Eliminate pain
    - Prevent sequelae

Mature/complete  
cataract and posterior  
synechiae/dyscoria



Feline Red Eye: Delving Deeper

Controlling inflammation and alleviating pain, as well as minimizing the development of sequelae are the goals of symptomatic uveitis therapy. Specific therapy, such as antimicrobials for infectious uveitis or chemotherapy drugs for neoplastic metastatic uveitis should be implemented in addition to symptomatic therapy when a specific cause is identified during the diagnostic workup. This clinical photo demonstrates an eye that has experienced several complications of unilateral uveitis, including a mature cataract and multifocal posterior synechia with dyscoria.

## Uveitis Treatment



### ● Topical

- For anterior uveitis
- Steroid
  - Prednisolone acetate 1%
  - Dexamethasone (NeoPolyDex)
- Atropine 1%
  - Pain relief
  - Prevent synechiae
  - Stabilize BAB
  - Measure IOP first!

### ● Systemic

- For posterior (and/or anterior) uveitis
- Anti-inflammatory
  - Steroid\* -or-
  - NSAID\*
    - Meloxicam
    - Robenacoxib
  - Antibiotics- empiric
    - Clindamycin (Toxoplasmosis)
      - 12.5 mg/kg PO BID x 28 days
    - Azithromycin (Bartonellosis)
      - 10 mg/kg PO q 24 hours x 21 days

Route of administration and type of drug are two important considerations when building the symptomatic treatment plan for a feline uveitis. Anterior uveitis is generally easier to treat when compared to posterior uveitis. Topical ophthalmic preparations, such as drops, gels, and ointments are only able to penetrate to the level of the lens inside the eye. So this route of treatment is ideal for anterior uveitis. But posterior uveitis requires systemic therapy in order for the drug to reach its target within the back of the eye at the level of the choroid. Options for systemic anti-inflammatory therapy are limited in cats, largely due to their decreased capacity for hepatic glucuronidation and inability to metabolize certain drugs effectively. Non-steroidal anti-inflammatory drugs and steroids are used to control inflammation in cats with uveitis. In general, steroids are the preferred choice of anti-inflammatory drug for their increased potency in more rapidly and effectively controlling active uveitis.

When signs of active anterior uveitis are identified on ophthalmic examination, topical steroids such as prednisolone acetate and dexamethasone contained within the neopolydex combination or preparation should be prescribed unless there's a specific contraindication to their use. NeoPolyBac with hydrocortisone is not effective for the treatment of anterior uveitis simply because hydrocortisone does not penetrate inside the eye. NSAIDs commonly used in feline ophthalmology for topical use are flurbiprofen, diclofenac, and ketorolac. And I tend to use these three fairly interchangeably based on cost, availability, and patient tolerance. These drugs are most appropriately used in cats with an ocular comorbidity that prevents the use of topical steroids, such as a corneal ulcer or an increased risk of reactivation of latent herpesvirus. Or they could also be used in combination with topical steroids for an enhanced anti-inflammatory effect in more severe or medically refractory cases. The frequency of topical

therapy is dictated by the severity of the inflammation and generally ranges from two to four times per day to start.

Atropine is another useful addition to drug therapy in patients with uveitis. Spasms of the ciliary body muscle are responsible for the pain that accompanies uveitis. And atropine alleviates that pain by temporarily paralyzing the robust intraocular muscle. Atropine also serves an important role in minimizing sequela of uveitis by dilating the pupil to decrease the risk of posterior synechiae formation and also by stabilizing the blood aqueous barrier. From a practical perspective, it's also important to consider that atropine has a bitter taste and can cause some cats to salivate profusely. It's very important to warn clients about this before prescribing atropine. Because pupil dilation is contraindicated in the eyes of glaucoma, it's also important to measure intraocular pressure and confirm it's appropriately low for the degree of uveitis before administering atropine.

For systemic treatment in the United States, NSAID options for cats are limited to meloxicam and robenacoxib, which was introduced in Europe in 2009 and subsequently FDA approved for use in cats in the United States in 2011. Unlike meloxicam which is approved as a single dose, robenacoxib can be administered once daily for up to three consecutive days. The other option for systemic anti-inflammatory therapy in cats is corticosteroids. And it's fairly common to prescribe an anti-inflammatory dose of oral prednisolone in cats with posterior uveitis, especially when an infectious etiology is deemed unlikely.

Systemic antibiotics are prescribed as empiric treatment for common bacterial infections that may cause uveitis. I often prescribe them while I'm awaiting the results of infectious disease screening tests, or if an infectious disease workup has been declined by the owner. Clindamycin and azithromycin at the doses listed on the slide are commonly prescribed when there's a clinical suspicion or a diagnostic confirmation of toxoplasmosis or bartonellosis respectively.

## Uveitis: When to Refer?



- Progressive, medically refractory ocular clinical signs or sequelae
- Worsening of existing or development of new non-ocular signs
  - Decreased appetite or anorexia
  - Weight loss
  - Vomiting or diarrhea
  - Coughing
  - Neurologic signs
- Inability to perform necessary advanced imaging in-house

In my opinion, the decision to refer a feline uveitis case is based on a few criteria. First, if you observe progressive medical and medically refractory uveitis signs or sequela in a cat, referral may be indicated in order to have a specialist help guide the treatment plan. Second, if the cat develops a worsening of existing or new non-ocular clinical signs, such as decreased appetite, or anorexia, weight loss, vomiting, diarrhea, coughing, neurologic signs, this would justify referral, specifically referral to a multi-specialty institution with several disciplines represented under one roof would be ideal in order to develop a diagnostic and treatment plan customized to that patient. And along that line of reasoning, if your clinic or hospital has equipment limitations that restrict your ability to complete the necessary diagnostics, such as advanced imaging in-house, that would be a reason to consider referral as well.



## Uveitis: Client Communication Tips



- **The majority of feline uveitis cases are idiopathic**
  - This is a **diagnosis of exclusion**
- **Why perform diagnostic workup?**
  - To rule out potentially life-threatening systemic causes
- **Why treat?**
  - To decrease the risk of blinding and painful sequelae

The main focus of my discussion with a client whose cat has been diagnosed with uveitis involves explaining the disease, its potential eye-related complications, and then the reasoning behind performing a diagnostic workup, which is arguably the most important aspect of the conversation. I lead with the fact that the majority of feline uveitis cases are idiopathic, but that this is a diagnosis of exclusion that requires at least some testing to ensure that the cat is not experiencing a more serious systemic problem that could impact its overall health. That blends naturally into the discussion of what diagnostic tests to prioritize.

Not every client will have an unlimited budget, and in fact, few do, particularly when considering the costs associated with even an abbreviated uveitis workup. A minimum database, combo test, and selected infectious disease screening tests all add up, not to mention the cost of imaging and other diagnostics if non-ocular abnormalities requiring workup are identified on the general physical exam. Infectious disease testing is one area that requires a lot of customization based on the individual case and where you're practicing.

I see a lot of disseminated histoplasmosis in Kansas. And before joining the faculty at Kansas State, I diagnosed many cases of disseminated blastomycosis during my time practicing in the Ohio River Valley. If you practice in the Pacific Northwest, chances are you almost never see a case of systemic fungal infection. And if that's the case, if that's so, then lucky you. Having a good working knowledge of the infectious diseases endemic to your area of practice will help you to better manage your uveitis cases and to sort of strategize working with your clients' budgets.

After discussing the why of the disease and figuring out what has caused it, I also spend some time discussing why it's important to treat. That concept is pretty easy to grasp if you've diagnosed an

infectious disease that can be targeted with specific therapy. It's also an easy sell if the cat is experiencing signs of ocular discomfort, vision loss, or other easily appreciable ocular signs. Some cats though display signs of uveitis that are much more subtle and not as obvious to the owner. And so I always emphasize that just as we're recommending diagnostics in an effort to discover any health-threatening cause of uveitis, we're treating symptomatically in an effort to mitigate the risk of blinding and painful sequela of uveitis for the eye.

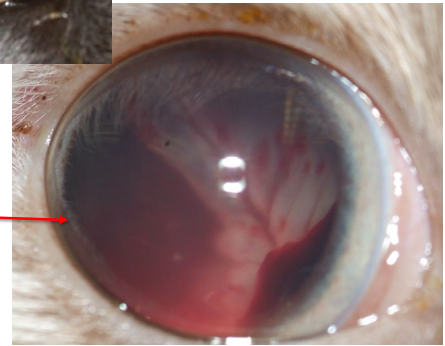
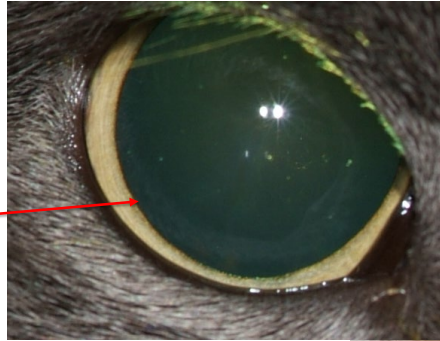
- A collection of diseases with the common risk factor of elevated intraocular pressure
- Most often secondary in cats
  - Chronic uveitis
  - Intraocular tumor
  - Aqueous misdirection
  - \*Hyphema
- Occasionally primary (hereditary)
  - Burmese and Siamese breeds

Shifting gears a little bit to another topic within the intraocular causes of red eye discussion, glaucoma is defined as a collection of diseases with the common risk factor of an elevated intraocular pressure. While we occasionally see primary or hereditary glaucoma in certain purebred cats, secondary glaucoma is much more common. The main causes of secondary glaucoma include chronic uveitis, intraocular tumors, aqueous misdirection, and hyphema, which we'll cover as a separate topic at the end of the presentation. We'll discuss each of these other causes of secondary glaucoma in some detail now.

## Glaucoma: Typical Presenting Complaint → 'Check Eye'

### ● Clinical signs:

- *Dependent on underlying cause*
- Enlarged eye (buphthalmos)
- Dilated pupil
- Cloudy eye
- Vision loss\*



Complete retinal detachment visible through fixed and dilated pupil  
Pre-, intra-, and sub-retinal hemorrhages

As with cases of uveitis, the presenting complaint for cats ultimately diagnosed with glaucoma is the dreaded check eye that appears on your appointment schedule. Clinical signs of glaucoma in cats can vary quite widely based on the underlying cause. And glaucoma tends to be more insidious in cats when compared to their canine counterparts.

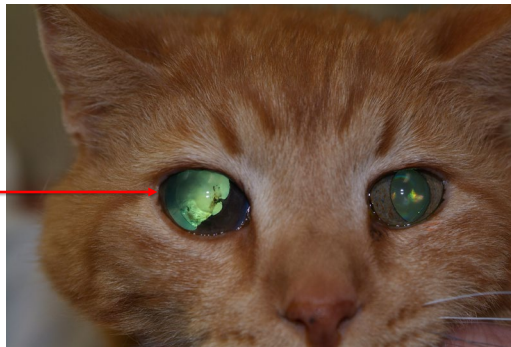
Broadly speaking, clinical signs of buphthalmos which is an enlargement of the eye, redness, again, the focus of this presentation, pupil dilation, and cloudiness, as well as vision loss, are the main findings reported in feline glaucoma. Because cats are so adaptable to vision loss and able to rely on other senses to navigate their surroundings, many times clients observe pupil dilation and cloudiness before they ever appreciate signs of vision loss or blindness. I've had several clients over the years who are very surprised when I explained to them that their cats were completely blind, because they were perceived to be doing so well and adjusted at home. I've even had a cat with congenital blindness jumped from the floor of the exam room to perch on the table in the exam room without missing a beat never having been in that room before. And that just illustrates how amazing cats are and adaptable to their circumstances.

A good example of a fixed and dilated pupil, getting back to clinical signs, is illustrated in the top image. And the bottom image shows a case of an example of red eye presentation that's pretty classic when we're considering red eye due to intraocular disease. This cat had a complete retinal detachment with associated hemorrhage and was blind, though the client brought the cat in more due to a noticeable appearance change to the eye than for any concerns about vision, believe it or not.

## Glaucoma: Diagnostics

- **Tonometry**
- **Compatible clinical signs**
- **Determine whether the eye is buphthalmic**
  - Influences treatment recommendations → end stage (enucleation), *not* medical therapy

Buphthalmos  
Synecchia/dyscoria  
Iris hyperpigmentation



Feline Red Eye: Delving Deeper

Tonometry or measurement of the intraocular pressure is an important tool in the diagnosis of glaucoma. It's used along with compatible clinical signs such as episcleral injection resulting in a red eye, corneal edema or cloudiness, and a fixed and dilated pupil to make the diagnosis of glaucoma. As we discussed at the beginning of the presentation, normal IOP in a cat ranges from around 10 to 15 into the low 30s in units of millimeters mercury.

Additionally, determining whether-- importantly, whether the eye is buphthalmic is an extremely important aspect of your assessment when performing the initial evaluation of a cat with glaucoma. Chronic glaucoma is the only condition that can lead to buphthalmos. And this finding means that the eye is permanently blind.

Recognizing buphthalmos should automatically prompt you to guide the discussion with the client regarding treatment options toward an end stage procedure, which in a cat is enucleation. While it's not necessarily harmful to try medical therapy in a buphthalmic eye, the damage is irreversible, and the eye will never regain vision. Additionally, most buphthalmic eyes are refractory to medical therapy, at least in the long term. And advocating for your patient means you must explain to the client that enucleation is the best option to relieve discomfort in a permanently blind and painful eye.

As you can see in the clinical photo, the right eye of this cat is buphthalmic with posterior synechiae and dyscoria, as well as hyperpigmentation of the iris. Despite many abnormalities within this eye, the cat is not showing any outward signs of ocular pain in the form of blepharospasm or ocular discharge.

## Glaucoma: Secondary

### ● Uveitis

- IOP should be LOW
- Acutely: cells and inflammatory material block fluid outflow (temporary)
- Chronically: scarring blocks fluid outflow (permanent/irreversible)



Buphthalmos, fixed and dilated pupil

Miosis, rubeosis iridis (iris color change)

Uveitis is the most common cause of secondary glaucoma in cats. In an environment laden with inflammatory mediators, the ciliary body inside the eye and its ability to produce aqueous humor decreases, resulting in a low intraocular pressure. IOP is usually below 10 and can even go into the single digit readings, depending on the severity of inflammation with uveitis. If you measure IOP in an eye with significant signs of active uveitis and obtain readings in the teens or 20s, that is concerning for impending glaucoma. This is true even though that IOP is technically within the normal range. It's very important to interpret IOP in conjunction with clinical signs to determine if the eye is responding in an appropriate way physiologically.

Uveitis leads to glaucoma via several mechanisms. Acutely, the material such as fibrin and cells that leak into the anterior chamber can physically block the fluid drainage angle located within the chamber. This IOP elevation is temporary and reversible if the uveitis can be controlled with medical therapy. More chronically, scarring causes irreversible obstruction of fluid outflow. And this can occur at the level of the pupil with complete posterior synechiae and iris bombe or that billowing forward of the iridial tissue because fluid is being trapped behind it. Or it could also happen at the level of the angle opening within the anterior chamber via the formation of an inflammatory membrane that carpets the surface of the iris and grows across the opening of the fluid drainage angle.

The clinical photograph shows two extremes of the clinical sign spectrum in a cat affected with bilateral uveitis. The right eye is buphthalmic with a fixed and dilated pupil and an intraocular pressure of 50. And the left eye is normal sized, the miotic pupil and evidence of a red eye in the form of rubeosis iridis with an IOP of 6.

## Glaucoma: Secondary (Uveitis)

### ● Treatment

- For eye with vision: uveitis therapy, ocular hypotensive drugs
- For permanently blind, painful eyes: enucleation

### ● Prognosis

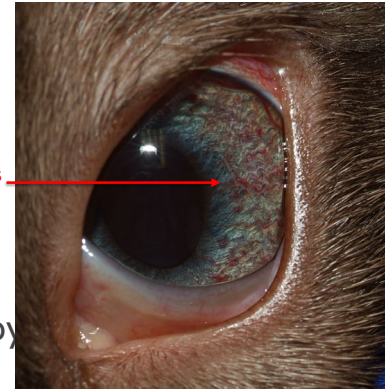
- Guarded for vision and globe retention

### ● Referral?

- As for uveitis cases- worsening despite appropriate therapy

### ● Client education

- Secondary glaucoma is painful and impacts quality of life
- Cats often do not exhibit obvious signs of ocular pain, especially if chronic



Rubeosis iridis/iris  
color change

In addition to anti-inflammatories, the treatment of glaucoma secondary to uveitis involves ocular hypotensive drugs for eyes with vision. Remember not to administer atropine in an eye with uveitis and an inappropriately high intraocular pressure even if that pressure is within the normal reference range as dilating the pupil can worsen the glaucoma. The medication options I use for anti-glaucoma therapy in cats include dorzolamide and timolol. These drugs can be used separately or together in a combination formulation that's available commercially.

Dorzolamide is a carbonic anhydrase inhibitor that works by decreasing aqueous humor production. And it's typically prescribed at a three times a day frequency. Timolol is a non-selective beta blocker that also works by decreasing the aqueous humor production. And it typically is prescribed at twice a day. Systemic absorption of topically applied medications is generally considered negligible. However, given the small body size of cats, systemic side effects of some topical drugs must be considered. A recent paper reported the development of hypokalemia in approximately 30% of cats treated with topical dorzolamide. And 83% of those hypokalemic cats demonstrated clinical signs that included GI upset and alterations in mentation or energy level. As a carbonic anhydrase inhibitor, one of the main risks of administration is the development of metabolic acidosis and hypokalemia. The degree of hypokalemia and the severity of clinical signs in the cases reported to develop side effects varied and were not necessarily correlated. Timolol is also used with caution in cats if a cat has a history of asthma due to the potential for the drug to exacerbate that condition. So though we generally consider topical medications to have minimal systemic side effects, there are a few exceptions specific to cats.

Latanoprost, which is a prostaglandin analog very commonly used to treat primary glaucoma in dogs, is generally considered ineffective in the treatment of feline glaucoma, particularly secondary glaucoma. So

we really focus on dorzolamide and timolol for medical therapy of feline glaucoma. For permanently blind and buphthalmic eyes as we discussed previously, enucleation would be the best option.

Prognosis is considered guarded in cats with glaucoma secondary to uveitis. And this is referring specifically to the prognosis for the eye and saving vision. If the uveitis is medically responsive prior to the onset of irreversible sequelae, such as rubeosis iridis and fibrovascular membrane development over the drainage angle, which is suspected in the case in the slide, glaucoma might be prevented or it may resolve without causing chronic issues. If sequelae such as the synechiae are already recognized at the time of diagnosis, there's often little that can be done to prevent the development of glaucoma.

That being said, some eyes can remain visual and comfortable with controlled intraocular pressures even if some irreversible changes associated with the uveitis have occurred. So I find the best approach to be monitoring and treatment in those particular cases. Fortunately, though the prognosis for the glaucomatous eye due to uveitis is guarded, cats do amazingly well with unilateral vision if it's one eye and even with complete blindness if both eyes are affected.

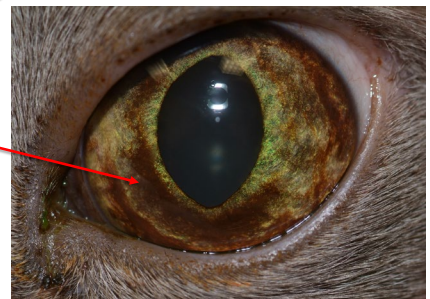
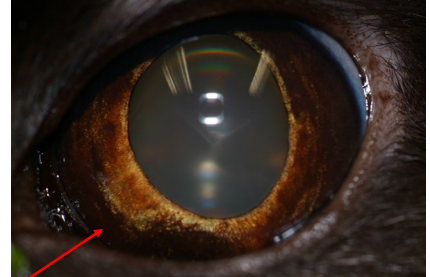
If the underlying cause of glaucoma is primary ocular, the cat can live a happy pain-free life as long as the glaucoma is addressed. Referral of cases of glaucoma secondary to uveitis is generally indicated for similar reasons as for uveitis cases when clinical signs worsen despite appropriate therapy. Otherwise glaucoma secondary to uveitis is truly a condition that is very manageable by the general practitioner. Because feline glaucoma can be very insidious, clinical signs referable to ocular pain are often quite subtle. I'll use the comparison of a migraine headache sensation when I describe to clients what chronic glaucoma feels like. That is not in any way meant to make the client feel badly or feel guilty about the diagnosis for their cat, but rather to try to drive home the importance of choosing the option of enucleation in order to restore the cat's pain-free good quality of life in a permanently blind eye.



## Glaucoma: Secondary

- **Neoplasia**

- Diffuse iris melanoma (FDIM)
- Most common primary intraocular tumor in cats
- Slowly progressive
- Risk of secondary glaucoma late in disease course



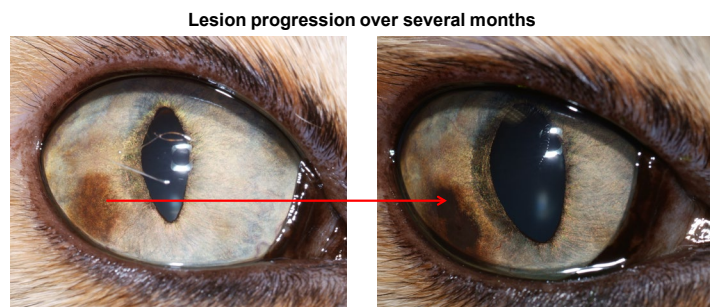
Diffuse, coalescing hyperpigmentation of iris surface

Intraocular neoplasia is another cause of feline secondary glaucoma that the general practitioner really should be aware of. Of the few primary intraocular tumors that develop in cats, diffuse iris melanoma is the most common. This is a slowly progressive melanocytic neoplasm that manifests as a diffuse coalescing area of hyperpigmentation on the surface of the iris as seen in these clinical photos. There have been several publications over the years, dating as far back as the 1980s, describing the clinical features and biologic behavior of this particular tumor. Over the years and with more recent information, our understanding of the behavior of diffuse iris melanoma has really evolved. Certainly as the tumor grows, the risk for secondary glaucoma increases. And the presence of glaucoma is really a poor prognostic indicator in cats affected by this tumor.

## Glaucoma: Secondary (Neoplasia → FDIM)

### ● Treatment

- Careful monitoring with serial photo-documentation
- Enucleation if certain signs develop
  - Progressive growth/expansion/multifocal, coalescing areas to iris base
  - Raised, 'velvety' surface
  - Exfoliation of pigmented cells into anterior chamber
    - Deposition on posterior cornea or anterior lens
  - Dyscoria or diminished PLR
  - Secondary glaucoma
    - Ideally prior to this development



My approach to the management of diffuse iris melanoma is careful monitoring with serial photo documentation. I like to rely on clinical photos as a more objective form of monitoring than my drawings on an exam form or my written descriptions would provide. Enucleation is strongly recommended if certain signs develop during the course of monitoring.

These signs include progressive growth and the expansion or coalescence of multifocal areas of pigmentation moving towards the base of the iris, where tumor cells would be closer to a means of breaking free from the eye, if the lesion develops a raised velvety surface texture, if there's evidence of exfoliation of pigmented cells into the anterior chamber, if the pupil becomes misshapen, dyscoric, or if the pupillary light reflex is diminished, or absolutely if a secondary glaucoma develops. Because the risk of metastasis is known to be increased if glaucoma is present, ideally intraocular pressure is monitored over time in these cats. And enucleation is performed far before this complication develops.

As you can see in the clinical photos at the bottom of the slide in the corner, the lesions can progress from flat to more lightly pigmented to raised velvety and darkly pigmented over time. This is the type of change that would prompt me to recommend enucleation.

## Glaucoma: Secondary (Neoplasia → FDIM)



### ● Prognosis

- Good if closely monitored and enucleated when concerning signs develop
- Growth is slow and metastasis occurs late in disease

### ● Referral?

- Iris biopsy
- Diode laser therapy for focal lesions

### ● Client education

- FDIM has the potential to metastasize
- Micrometastasis can occur, causing morbidity and death even after enucleation
- Every cat should be screened for metastasis prior to enucleation

Considering that diffuse iris melanoma is a tumor with metastatic potential, the prognosis we're most concerned with is for survival of the cat rather than for the eye. The prognosis for metastasis-free survival is considered good if the cat is closely monitored and the eye is enucleated if or when concerning signs develop. Growth of diffuse iris melanoma is usually slow over months to years. And metastasis is expected to occur rather late in the course of disease. Referral may be indicated if you evaluate a cat with diffuse iris melanoma features that have you on the fence about whether to be concerned. Recently, iris biopsy as a diagnostic tool for distinguishing diffuse iris melanoma from benign iris pigment changes has also been described. This procedure would require special equipment and training in microsurgery, so it would need to be performed by an ophthalmologist. And specialists can also occasionally offer diode laser therapy for early focal lesions. And this is in an effort to ablate any neoplastic cells and slow growth, so that this is only an appropriate option in few select cases.

From a client education standpoint, the discussion surrounding diffuse iris melanoma can be difficult, because you're often faced with recommending enucleation of a visual and comfortable eye in order to save the cat's life. It can be challenging for clients to accept the idea that an otherwise normal eye must be sacrificed in order to try to avoid metastasis and life-threatening complications. This communication challenge is really compounded by the fact that micrometastasis may occur causing morbidity and death, even after enucleation is pursued.

I always screen cats with thoracic radiographs and abdominal ultrasound prior to enucleation of a visual comfortable eye to evaluate for evidence of metastasis prior to taking that fairly radical step in treatment. If there's already evidence of metastatic disease, in my opinion, there would be really no point in putting the cat through an enucleation, considering that preventing metastasis would be the major goal of surgery.

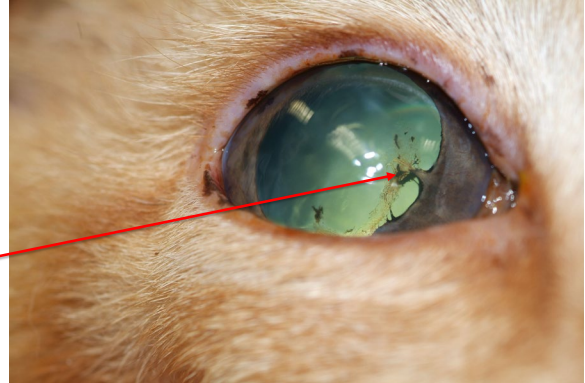
Of course, this aspect of management in the conversation that's had the client is made easier if a cat already presents affected with glaucoma as enucleation would be necessary from a quality of life standpoint under those specific circumstances.

## Glaucoma: Secondary

- **Neoplasia**

- Post traumatic ocular sarcoma (FPTOS)
- Malignant, locally invasive tumor
- Develops after penetrating ocular trauma
  - Lens damage

Penetrating corneal trauma  
with lens damage and focal  
posterior synechiae



Another form of intraocular neoplasia to consider is unique to the cat and referred to as post-traumatic ocular sarcoma. This is a malignant locally invasive tumor that has three described variants. The most common spindle cell variant is thought to develop after a penetrating injury and lens damage. Exam findings demonstrating a penetrating corneal trauma with lens damage and a focal posterior synechiae are shown in the clinical photo on the slide. Lens damage may be the key to the development of post-traumatic ocular sarcoma with the theory that lens epithelial cells undergo neoplastic transformation after the trauma. There is a reportedly very long latency period described after the trauma, with an average of up to 10 years elapsing before a problem is reported.

## Glaucoma: Secondary (Neoplasia → FPTOS)

- **Treatment**

- Early/prophylactic enucleation (especially blind eyes)

- **Prognosis**

- Good if early intervention
- Risk of optic nerve infiltration

- **Referral?**

- Possibly for minor trauma? Cataract surgery may help prevent tumor development?

- **Client education**

- Enucleation can save the life of a cat that experiences penetrating ocular trauma

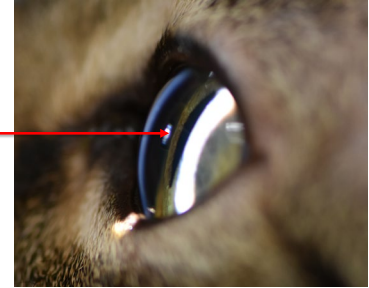
Post-traumatic sarcomas are locally aggressive and tend to infiltrate the optic nerve, invading the rostral brain and causing severe neurologic signs before death. For this reason, early prophylactic enucleation may be indicated to avoid the risk of tumor development, especially if the eye is already blind. The prognosis for survival if early intervention is pursued is good as metastasis is rare. Enucleation prevents infiltration of the optic nerve and associated signs. In some cases, if the eye is visual and trauma is minimal, referral might be a reasonable consideration as cataract surgery could be performed in an effort to save the eye and prevent tumor development. That said, with the long latent period and relative rarity of this tumor, there really isn't a widely accepted treatment option to mitigate the risk of tumor development in cats after a penetrating ocular trauma. It's important to explain to the owner of a cat that has sustained a penetrating globe injury that enucleation may become necessary to save the cat's life. At minimum, when I manage a suspected or confirmed case of penetrating globe trauma in a cat, I always mention the risk of tumor development months to even years later and encourage clients to reach out immediately if there are any changes in the appearance of the eye. If an eye is already blind, in my opinion, it's best to intervene with early enucleation to avoid the risk of tumor development altogether.

## Glaucoma: Primary Ocular

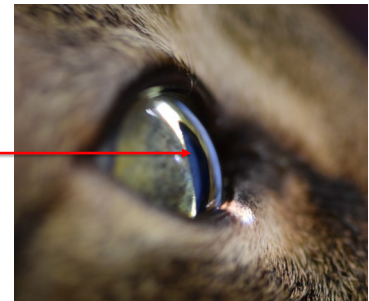
- **Aqueous humor misdirection (FAHMS)**

- 'Malignant glaucoma'
- Aqueous diverted into vitreous humor
  - Anterior displacement of lens-iris diaphragm
- Subtle anisocoria (mydriasis)
- Shallow anterior chamber
- Elevated IOP

*Normal anterior chamber depth*



*Narrowed anterior chamber depth*



The final type of secondary feline glaucoma to cover is another uncommon condition unique to cats called aqueous humor misdirection syndrome, also referred to as malignant glaucoma. With this disease, aqueous humor is diverted into the vitreous humor gel at the back of the eye, leading to swelling of the gel and pressure on the lens. As the lens is pushed anteriorly within the eye, this causes narrowing of the anterior chamber depth as seen when performing a slit beam exam. This is the same exam skill that you use to look for aqueous flare. The top image depicts a normal anterior chamber depth. And the bottom image shows the typical narrowing with aqueous humor misdirection. A subtle anisocoria with the affected pupil exhibiting mydriasis is sometimes the first noticeable sign, as interpreting the depth of the anterior chamber is admittedly a somewhat advanced exam skill. The change that's clinically significant in aqueous humor misdirection is the impact of the lens and iris shift on the intraocular pressure. The lens blocks the pupil to diminish fluid flow. And the forward displacement of the iris leads to narrowing of the drainage angle opening in the anterior chamber, all causing an elevation in the intraocular pressure, and eventually secondary glaucoma. Early on, the magnitude of intraocular pressure elevation is often milder with values in the high 30s and low 40s.

## Glaucoma: Primary Ocular → FAHMS



- **Treatment**

- Ocular hypotensive drugs

- **Prognosis**

- Guarded; variable response to medical therapy

- **Referral?**

- Surgical treatment: cataract surgery +/- glaucoma surgery

- **Client education**

- Slow, insidious onset causes progressive vision loss
- Look for signs of anisocoria/pupil dilation
- Lifelong therapy with periodic reevaluation and IOP monitoring

Ocular hypotensive drugs that we discussed previously for management of uveitis-induced glaucoma are the most effective at controlling aqueous humor misdirection. But the response to therapy is quite variable from cat to cat, making the prognosis for the eye somewhat guarded with this condition. Recently, surgical treatment involving cataract surgery and a surgical treatment of glaucoma has been reported with reasonable success for this condition. And this option would require referral. If you ever manage a case of suspected aqueous humor misdirection, medical therapy can be attempted until referral is made if the client is willing to pursue it. Clients should understand that aqueous humor misdirection has typically a slow insidious onset with progressive vision loss. And that signs of anisocoria with pupil dilation are often the first indicators of a problem, in addition to redness and other signs that accompany an elevation in intraocular pressure. Lifelong medical therapy with periodic re-evaluation and intraocular pressure monitoring is necessary. And in some cases of aqueous humor misdirection, referral for surgery may be an option.



## Glaucoma Treatment Summary: My Approach



### ● Medical therapy

- Uveitis-associated glaucoma
- FAHMS
  
- Dorzolamide 2%
  - Carbonic anhydrase inhibitor
- Timolol 0.5%
  - $\beta$ -blocker

### ● Surgical therapy

- End-stage glaucoma (buphthalmic, blind)
- Progressive intraocular neoplasia
  
- Enucleation with histopathology

After talking extensively about the different types of secondary feline glaucoma, to summarize my approach, in visual eyes, I recommend medical therapy with topical carbonic anhydrase inhibitors and beta blockers for glaucoma caused by uveitis or aqueous humor misdirection. And I recommend surgical therapy for eyes with end-stage glaucoma and progressive intraocular neoplasia. Almost any time I perform an enucleation, I recommend histopathology. I live by the saying that if it's worth taking out, it's worth submitting for histopathology. And I find this especially true in cases of glaucoma caused by uveitis of unknown etiology and in eyes with intraocular tumors.

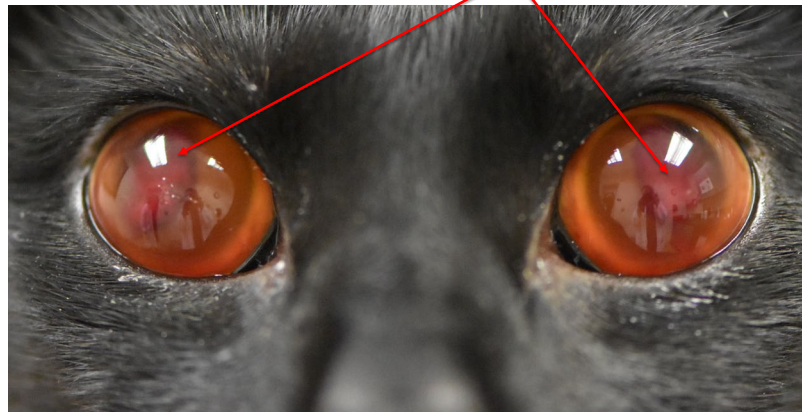
## Hyphema

- Red blood cells in the anterior chamber

- Most common causes:

- Systemic
  - Hypertension
- Primary ocular
  - Chronic uveitis
  - Trauma
  - Neoplasia

Blood clots suspended in pupils  
Background of dispersed RBCs throughout anterior chamber



Hyphema or blood in the anterior chamber is the last intraocular cause of red eye that will round out this presentation. The most common causes of hyphema are divided into systemic and primary ocular. Hypertension is by far the most common cause of hyphema in an older cat. Primary causes of hyphema include chronic or severe uveitis, trauma, and intraocular neoplasia. In general, I place traumatic hyphema low on the list of differentials if the exam is otherwise unremarkable. The globe is fairly protected within the orbit. So for trauma to cause hyphema, I would anticipate seeing significant signs of periorbital trauma in addition to the hyphema. Severe uveitis, presumed infectious, was the cause of bilateral hyphema in the young kitten in this clinical photograph. You can appreciate blood clots suspended within the pupils amidst a background of dispersed red blood cells throughout the anterior chamber.

## Hyphema: Systemic Disease

- **Systemic hypertension: feline hypertensive oculopathy**

- Chronic kidney disease, hyperthyroidism = older cats
- Iris aneurysms
- Retinal hemorrhage and detachment



'Eightball' hyphema



Hyphema with blood and fibrin clot forming

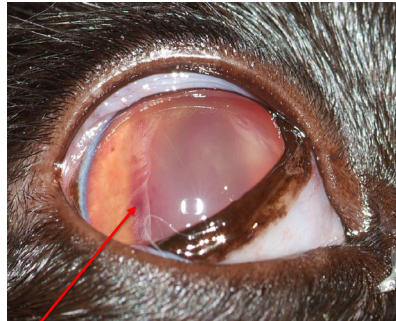


Multifocal retinal hemorrhages and serohemorrhagic detachment

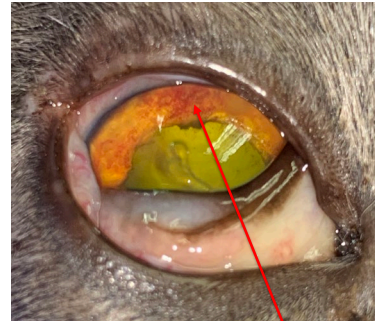
Hyphema caused by systemic hypertension is termed hypertensive oculopathy. Since hypertension most commonly occurs as a result of chronic kidney disease or hyperthyroidism in cats, hyphema due to systemic hypertension is typically an older cat problem. In addition to hyphema, aneurysms or bulging iridial blood vessels and iridial stromal hemorrhages can be seen anteriorly. And retinal hemorrhages and detachment can be seen posteriorly within the eye. The image on the left provides an example of an eye with chronic hyphema or old blood. We often refer to this appearance of old dark blood in the eye as eight-ball hyphema. And this is because that black coloration is reminiscent of a magic eight ball. The image in the middle shows a fresher form of hyphema, with more recent bleeding causing bright red blood and fibrin forming a clot in the anterior chamber. And then on the right image, you can appreciate multiple hemorrhages dotted throughout the retina, in addition to a bullous or complete retinal detachment. Retinal hemorrhages and bullous detachments are really the classic findings of hypertensive retinopathy or the consequences of hypertension in the back of the eye.

## Hyphema: Primary Ocular

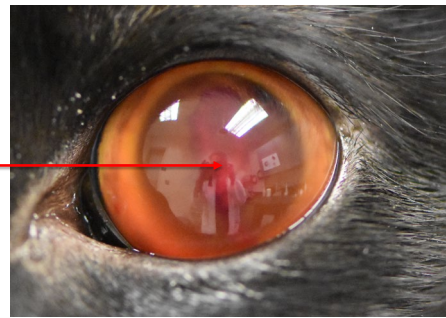
- Chronic uveitis
- Trauma\*
- Neoplasia
  - FPTOS



Hyphema



Iridial stromal hemorrhage



Blood clot in anterior chamber

Primary ocular causes of hyphema include severe or chronic uveitis, trauma, and intraocular tumors. You can see in the collage of clinical photos various manifestations of blood inside the eye. Chronic uveitis can cause hyphema when rubeosis iridis is present as those new blood vessels associated with the change are fragile and prone to rupture. More acute uveitis can also cause hyphema if severe enough as with the example of the young kitten a few slides ago. As previously mentioned, trauma would be pretty low on my differential list for feline hyphema unless there was a history or evidence of fairly significant head trauma, with an example being a cat hit by a car. Otherwise, sharp trauma may also cause hyphema if there's evidence of penetrating globe injury. And in that case, I would be concerned about the potential for lens trauma and the development of a post-traumatic ocular sarcoma as we discussed previously.

## Hyphema: Diagnostic Workup

- Physical examination
- Blood pressure (Doppler)
- Minimum database (including urinalysis!)
  - IRIS Staging of CKD:  $\geq 1.6$  is considered abnormal for creatinine
- T4
- Infectious disease screening tests
  - If uveitis is suspected
- Ocular ultrasound?
  - If hyphema is complete

The diagnostic workup for feline hyphema includes a physical exam to screen for areas of bleeding elsewhere in the body, petechiae or ecchymosis, a blood pressure measurement using Doppler, a minimum database including a urinalysis, as well as a T4 to screen for hyperthyroidism. And those aspects are especially important in an older cat if you confirm systemic hypertension. You can also perform some infectious disease screening tests on a selective basis if uveitis is the suspected cause of hyphema. Unlike in dogs, I don't routinely investigate for a coagulopathy in cats with hyphema, unless there's a history of rodenticide exposure or some other concerning aspect to the history. Otherwise, I use the CBC to evaluate platelet count and clotting ability as a baseline. And finally, ocular ultrasound may be useful if hyphema is complete and precludes the ability to see inside the eye to determine the possible cause of the bleeding.

## Hyphema



### ● Treatment

- Address underlying cause!
- Symptomatic therapy as for uveitis

### ● Prognosis

- For eye vs. for cat

### ● Referral?

- Medically refractory underlying condition
- Unable to identify etiology of hyphema

### ● Client education

- Systemic causes of hyphema (hypertension) may require *a lot*
- Emphasize importance of controlling systemic cause for cat's overall health

Treatment of hyphema is targeted at addressing the underlying cause if it's found. For instance, if a cat has systemic hypertension, anti-hypertensive therapy using amlodipine at an initial dose of 0.625 milligrams per cat once per day is initiated. And whatever underlying comorbidity has caused hypertension is addressed. Symptomatic therapy, as would be prescribed for uveitis, is also used. And this is because hyphema can be irritating to the intraocular tissues. The prognosis for the eye and for the cat depend on the severity and the cause of the hyphema. Systemic hypertension can be controlled and the hyphema may resolve. However, if the retina is also detached, time is really a critical factor. And this is particularly true when we're discussing the vision prognosis. If hyphema is severe, this often indicates that the eye may be permanently blind, though it's still worthwhile to give it time and symptomatic therapy before coming to that conclusion. Referral should be considered if the underlying reason for hyphema is medically refractory. If uveitis is the cause, that may be really the purview of an ophthalmologist. But if you're dealing with medically refractory systemic hypertension, I would then defer to my internal medicine colleagues for additional assistance. Being unable to ascertain the reason for the hyphema is another very good reason to consider referral to an ophthalmologist initially. When it comes to educating the client on hyphema, this can be quite involved depending on the underlying etiology. Problems confined to the eye are generally more straightforward than hyphema that's a manifestation of systemic disease. Uveitic hyphema overlaps with the client education tips for uveitis as does the discussion for hyphema induced by intraocular tumor. Traumatic hyphema, if complete, does not often impact the general health of the cat. But the prognosis for the eye is typically poor. This is because severe traumatic hyphema often signals extensive damage to the uveal tract, which over time leads to phthisis bulbi or shrinkage of the eye and permanent blindness due to lack of aqueous humor

production. The discussion about systemic hypertension, for instance, goes beyond the prognosis for the eye to involve explaining the implications of high blood pressure on the body, in addition to addressing the underlying comorbidity that's caused the hypertension. Details regarding the type of client communication associated with the systemic hypertension discussion are beyond the scope of this presentation, but in general, really focus on emphasizing the importance of controlling systemic disease for the health of the cat. The causes of feline red eye localized to the inside of the eye are widely variable as I think I've demonstrated in this potpourri of topics covered during the presentation.

## Summary: My Approach



- Interpret clinical signs alongside basic objective ocular diagnostics
  - IOP should be *low* in eyes with uveitis
- Glaucoma signs can be subtle and insidious in cats
  - Look for clues of chronicity (buphthalmos, permanent blindness)
  - Blind, painful eyes should be enucleated *with histopathology*
- Hyphema is most commonly due to:
  - Systemic hypertension (older cats) or chronic uveitis (cats of any age)
  - Remember that creatinine  $\geq 1.6$  is abnormal and evaluate urine specific gravity

To provide a general summary of my approach to red eye localized inside the eye, I always remind myself to interpret clinical signs alongside the results of basic ocular diagnostic testing. In this case, tonometry is the most important. And IOP should be low in eyes with uveitis, high in eyes with glaucoma. Beyond IOP, glaucoma signs can be subtle and insidious. So I look for the single big clue of buphthalmos to indicate chronicity and permanent blindness. This is because I know the best recommendation for an irreversibly blind and painful eye is enucleation with histopathology. Hyphema, really the ultimate cause of feline red eye due to an intraocular cause, is mostly attributable to systemic hypertension in older cats or chronic or severe uveitis in cats of any age. Though I'm an ophthalmologist, I manage a good number of cats with systemic hypertension due to chronic kidney disease, at least during the initial diagnosis when they present to me for sudden blindness due to retinal detachment. So I want to wrap up by emphasizing that a creatinine value greater than or equal to 1.6 is considered abnormal in a cat based on the standards of iris staging, no matter what your in-house chemistry analyzer or outside reference laboratory reports for a reference range. I always try to evaluate urine specific gravity in cats presenting with hyphema and systemic hypertension, especially if serum creatinine is greater than or equal to 1.6. That is all I have for you on the topic of feline red eye delving deeper. Thanks so much for joining me for this presentation. I look forward to discussing surface ocular causes of feline red eye in a separate presentation.



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