DIAGNOSTIC OPHTHALMIC EXAMINATION
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Objectives of the Presentation

To make the general small animal veterinarian more comfortable with performing and interpreting a complete ophthalmic examination. This will better serve the patient and the veterinarian, as targeting of specific tests will improve medical results, will result in early diagnosis and improve not only the ophthalmic diagnosis, but will also enable the clinician to use the eye as an aid in the diagnosis of systemic disease.

General Key Points

The ophthalmic diagnosis is only as good as the information obtained to make the diagnosis. The equipment required to perform a complete ophthalmic examination, the order in which tests should be performed and the interpretation of the results as they pertain to general practice must be understood. Also understanding when collaboration with an ophthalmologist is indicted is essential.

Key Clinical Diagnostic Points

Initially, the veterinarian should begin with an external examination of symmetry – the eyes, eyelids, orbit, globe size and position and pupil size. The menace and PLR responses (direct and consensual) are evaluated. The first diagnostic tests to consider are always a culture, Schirmer tear test, Fluorescein and Rose Bengal staining. These are generally performed without the use of topical anesthetics. Following these tests (if indicated) the clinician may use topical anesthesia to facilitate additional testing such as intraocular pressure, nasolacrimal irrigation, cytology collection, examination for a foreign body, etc. Magnification and use of a bright, focal light source are essential. Finally, the pupil may be dilated to permit a complete examination of the intraocular structures.

Additional Detail

Culture

Indications
1. Chronic, non responsive corneal ulcer
2. Acute, severe melting corneal ulcer
3. Purulent ocular discharge
4. Infectious blepharitis

The principles and techniques for obtaining a culture from the eye are the same as for elsewhere. A sterile swab, pre-moistened in transport media, is used. The sample is taken in an aseptic manner specifically from the area of concern. In other words if the lesion is a corneal ulcer the swab is touched to the ulcer, and not placed into the conjunctival fornix. No topical anesthetic is used for this procedure as it may interfere with the growth of organisms.

Schirmer Tear test

Indications
1. Assessment of normal tear production
2. Chronic mucoid epiphora
3. Chronic pigmentary keratitis
4. Epiphora

The prepackaged, sterile strips are removed and the notched end is placed in the lower conjunctival fornix. Do not touch this end. The eye is held closed and the strip allowed to remain in place for exactly 1 minute. If convenient both eyes may be tested at the same time. The strip is then removed and using the standard measurement on the package the tear production is measured and recorded. Normal dogs should secrete 15 mm or more in one minute. This is an UNDERUTILIZED test and there are MANY subclinical dry eye dogs waiting to be discovered!

Fluorescein sodium

The normal precorneal tear film appears yellow-orange with fluorescein. The intact corneal epithelium resists penetration of water-soluble fluorescein and is not colored by it. Any break in the epithelium allows rapid penetration and appears bright green. Fluorescein in solution is susceptible to bacterial contamination and multidose formulations are dispensed with a preservative. Fluorescein will stain soft contact or bandage lenses due to their high water content.
Indications

- Detection of epithelial defects
- Evaluation of nasolacrimal system
- Determination of tear breakup time - Topical fluorescein associated with a reduction in tear film stability, therefore tear film stability is likely greater than reported by the fluorescein method.
- Seidel’s test
- Fluorescein angiography
- Fluorophotometry - allows calculation of the permeability coefficient of the blood-aqueous barrier.

Fluorescein is a hydrophilic drug that binds to the corneal stroma, but not to the epithelium or to Descemet’s membrane. It comes as a prepackaged, sterile strip. Fold the strip lengthwise to create a trough. Remove it from the package holding it by the green end. Place 2-3 drops of sterile eye wash on the strip and tilt the strip to allow stain to drip onto the eye. Do not touch the eye with the strip as this may result in an iatrogenic area of stain retention. Using the eye wash gently irrigate the excess stain from the eye onto a cotton ball and then examine the eye for stain uptake using a penlight. Visualization of the fluorescein uptake is improved by using a blue or Wood’s light which excites the fluorescein molecules, making them glow green.

To evaluate the patency of the nasolacrimal duct all of the previous steps are performed, but the fluorescein is not rinsed from the eye. The stain should appear at the nares within 5 minutes. A positive test is definitive for a patent nasolacrimal duct, but does not prove that both puncta are patent. A negative test is only suggestive of a problem and indicates that the clinician should attempt to flush the duct.

Rose bengal

Rose bengal stains dead or degenerated epithelial cells of the cornea and conjunctiva (including nuclei and cell walls) a red color. The mucus of the precorneal tear film is also stained. Cells will stain when they are not covered by mucin as is seen in deficiency of the precorneal tear film. The presence of mucin will block the staining of live or damaged cells. Can be associated with irritation. Rose bengal is not a vital dye, but is associated with a loss of cell vitality resulting in loss of cellular motility, cell detachment, and cell death. This effect is augmented by light exposure.

Topical Anesthetics

Rapid onset of action, 15-20 seconds with 15-20 minute duration. If greater anesthesia is desired for more painful procedures repeated instillation of several drops over several minutes will increase the effect. Local tissue pH effects anesthetic efficacy. In inflammation, the pH is lowered making the anesthetic more deionized and less available to penetrate tissue. The most common topical anesthetic is proparacaine 0.5%. It has less side effects and is better tolerated. Prolonged use will diminish duration of anesthesia, retard wound healing (interfere with actin and myosin cytoskeleton) and result in keratitis and corneal epithelial erosions. In addition, a rare severe immediate hyperallergic corneal reaction can occur with epithelial keratitis and sloughing. Proparacaine is the third most common topical ocular agent causing contact dermatitis after neomycin and atropine. Preinstillation of anesthetic will increase the effect of subsequently applied mydriatic/cycloplegics. Also will enhance the non uniform penetration of fluorescein into the epithelium.

Nasolacrimal Irrigation

Indications

- Keratoconjunctivitis sicca
- Herpes
- Examination for corneal abrasions

This procedure can be performed on a minimally restrained dog with only topical anesthesia and causes minimal discomfort. It usually requires sedation or general anesthesia in cats.

Topical anesthetic is applied. A 23 or 25 gauge nasolacrimal cannula is connected to a 3 cc syringe filled with eyewash. An assistant restrains the head and the clinician elevates and rolls the upper eyelid in the medial canthus to expose the superior punctum. Place your thumb or index finger on the plunger of the syringe so that you are ready to inject. Hold the syringe loosely such that no injury will result if the patient jerks its head. Gently insert the cannula in the punctum and without forcing it allow it to seat itself in the duct. Apply gentle pressure to the plunger and observe fluid emerging from the inferior punctum. Occlude the

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There are several ways to determine intraocular pressure: indentation tonometry, rebound tonometry and applanation tonometry.

The indentation tonometer measures the amount of corneal indentation that occurs when a given weight is placed on the cornea. The result is inversely proportional to the intraocular pressure and the actual pressure must be obtained from a table of values. The Schiotz tonometer is an indentation tonometer. The Schiotz tonometer requires assembly, disassembly and cleaning in order to ensure its accuracy. The foot plate is large and the patient must be cooperative in order to place the foot plate on the cornea in a vertical position. If the animal is fractious or the eye painful then it is unlikely that accurate placement will be obtained and erroneous values will result. My clinical experience is that practices with a Schiotz tonometer either do not use it or do not believe the results obtained. In many instances, pressures obtained by this method are not confirmed on referral to a specialist. The result is that glaucoma is not diagnosed or monitored accurately and IOP determination is not performed at the frequency indicated by the breed or clinical signs.

Applanation and indentation tonometers are electronic or battery powered tonometers. They have been shown to be highly accurate across species and a wide range of IOP's. In recent years, the Tonopen® and Tonovet® have proved accurate and reliable in veterinary ophthalmology. They are light weight, portable, accurate, self calibrating and averages several readings and gives a % error to ensure accuracy. In addition, the small foot plate allows these tonometers to be used on painful eyes in less cooperative patients as only a small area of cornea is required to obtain a reading and the position of the patients head is not related to obtaining the reading. Equine glaucoma in recent years has received attention and has increased in prevalence solely due to the availability of the Tonopen®/Tonovet® and the increase in the number of equine eyes that are evaluated.

The ease of use, accuracy and comfort level these tonometers gives your practice will ensure its frequent use, increase your hospitals awareness of glaucoma,
allow early and prompt referral of glaucoma patients to a specialist if indicated and subsequent referral of your glaucoma patients back to your hospital for monitoring following laser or other glaucoma surgery by a specialist. In addition, the Tonopen®/Tonovet® will allow you to incorporate IOP determination as a routine part of the physical examination in those breeds predisposed to primary glaucoma.

**Biomicroscopy**

*Indications*

1. Examination of the anterior segment of the eye: Adnexa, Conjunctiva, Cornea, Aqueous, Iris, Lens, Anterior Vitreous

There are several excellent hand-held biomicroscopes or slit lamps available:

- Kowa SL-2 - 5 to 20 X zoom magnification; slit widths 0 to 10 mm
- Kowa SL-5 - 10 and 20 X magnification; slit widths of 0.1, 0.2, and 0.8 mm
- Kowa SL-14 - rechargeable battery; 10 and 16 X magnification
- Zeiss HSO-10 - 10 X magnification
- Heine - 1-800-367-4872; www.heine.com
- Eidolon

The features of a slit lamp are:

- Magnification - generally 5-20X with hand-held types
- Slit beam of light - variable, obtain an optical section of the eye
- Variable image brightness
- Depth of field
- Stereopsis

**Indirect Ophthalmoscopy**

*Indications*

1. Examination of the ocular fundus, especially in small animals.

**Advantages** - compared with direct ophthalmoscopy

1. Both hands are free to manipulate the patient’s head
2. Greater ability to visualize through translucent ocular media
3. Low magnification and larger field of view give a better survey of the entire fundus
4. Stereopsis gives a better appreciation of raised/depressed lesions
5. Easier to examine the peripheral retina
6. Examiner is farther from the patient and less prone to harm

This technique can be performed using a hand-held lens and a bright focal light source, or for those with a stronger interest in ophthalmology an indirect head-set is essential to provide stereopsis.

While this technique initially requires more practice to become proficient, once mastered it is a much more useful procedure to screen the fundus of the small animal patient. It is also less expensive to obtain the needed equipment which consists of a penlight and a 2.2 Panretinal lens. Indirect ophthalmoscopy provides the examiner with an inverted, reversed image that is magnified 2-5 X. This image, while of a lower magnification than with direct ophthalmoscopy, has a much larger field of view and is better for routine screening of the eye.

The patient’s pupils should be dilated with 1- drops of tropicamide (Mydriacyl®). This will take 10-15 minutes for complete dilation and will last 8-12 hours in the dog. The examiner begins at arms length from the patient. An assistant is required to restrain the patient and to hold the eyelids open. Darken the exam room. With a focal light source such as a penlight or your direct ophthalmoscope held at arms length from the patient, the tapetal reflection is obtained. Holding the lens in your opposite hand place the lens 1-2 inches in front of your patient’s eye, in the path of your light. The fundus should appear as a virtual image in front of the lens. To view other areas of the fundus you must move yourself, the light source, and the lens while keeping all of these in alignment. Remember that the image is inverted so you must move in the opposite direction to the image. If the image is lost, move the lens out of the light beam and start again. Practice, practice, practice.

**Direct ophthalmoscopy**

*Indications*

1. Examination of the ocular fundus, especially in large animals.
2. Detailed examination of specific areas such as the optic nerve and blood vessels with higher magnification.
3. In addition, the direct ophthalmoscope handle has additional attachments such as the Finoff
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Evaluation of intraocular mass lesions.
4. Assess intraocular damage following trauma
5. Evaluation of orbital disease.

Ultrasonography is a non-invasive, safe procedure that allows evaluation of the intraocular and retrobulbar tissue without sedation or general anesthesia. Ocular ultrasound is an addition to, not a replacement for, routine ophthalmic examination.

Ocular ultrasonography is indicated whenever opacity of the transmitting media of the eye (cornea, aqueous humor, lens, vitreous humor) prevents a complete ophthalmic examination. Ultrasound aids in evaluation of intraocular mass lesions, differentiation between solid and cystic structures, evaluating the extent of damage following ocular trauma, examination for a foreign body, axial length determination and examination of retrobulbar orbital structures.

The most common clinical indications for ocular ultrasound are to evaluate for the presence of a retinal detachment in eyes with a cataract, to assess posterior segment damage and examine for the presence of a foreign body following trauma, or to evaluate intraocular structures in eyes with severe corneal opacity. In addition, orbital evaluation can be performed in instances of exophthalmos or orbital trauma.

New ultrasound technologies, including three-dimensional imaging, tissue characterization, and very high frequency (50 MHz) ultrasound biomicroscopy, have become available recently.

In general, ultrasonographic images are described as hyperechoic, hypoechoic, and anechoic. There are 4 major ocular acoustic echoes within a normal eye: anterior cornea, anterior lens capsule, posterior lens capsule, and the retina/choroid/sclera. When ultrasound energy travels across these interfaces energy will be reflected back to the transducer in the form of an echo and will be seen as an echodensity. The iris, corpora nigra, ciliary body, optic nerve, orbital fat, muscles, and other orbital structures may generate additional echodensities. The optic nerve head/lamina cribrosa appears as a hyperechoic structure with the optic nerve itself seen as a hypoechoic structure extending posteriorly from the optic nerve head. The orbital muscle cone appears as an echodensity extending posteriorly from the equatorial region of the globe and converging towards the orbital apex. The anterior

Panoptic Ophthamloscope
This is an indirect ophthalmoscope that works in a fashion that feels more like a direct ophthalmoscope. It is a monocular instrument. The image is upright and has a field of view and magnification that is between those of indirect and direct images.

Ocular Ultrasound

Indications
1. Opacity of the transmitting media
2. Prior to cataract surgery
and posterior chambers, lens cortex and nucleus, and vitreous chamber are normally anechoic.

**Electroretinogram**

**Indications**
1. Quantitative and Qualitative assessment of photopic (cone) and scotopic (rod) retinal function.
2. Prior to cataract surgery
3. Sudden onset blindness such as a SARD’s suspect
4. Evaluation for Progressive Retinal Atrophy

This is a referral-only procedure. It is used to assess the function of the retina in much the same way that an electrocardiogram is used to assess the function of the heart. Using this technique the rod and cone function can be separated. An electroretinogram is the only definitive method to obtain a diagnosis of SARDS in the acute stage of the disease. An electroretinogram is mandatory in patients with mature cataracts that are surgical candidates.

**Ophthalmic photography**

**Indications**
1. Documentation for publication.
2. Monitor lesion for progression.
3. Consultation with colleagues.

There are several hand-held fundus cameras available, some such as the ClearView® are designed to allow electronic consultation and are marketed to the general veterinarian. Most of the new digital cameras have a “macro” setting that will allow excellent extracocular documentation for records and for electronic consultation.

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**THE LENS-ABNORMALITIES AND TREATMENT**

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**Embryology/Anatomy/Physiology**

**Embryology**
- The lens originates from surface ectoderm.
- It invaginates from the surface ectoderm and the epithelial cells subsequently produce a basement membrane that surrounds the lens and is called the lens capsule in the mature lens.
- This is significant because the lens capsule surrounds the lens prior to the immune system being competent. The lens is therefore not perceived as part of self. Exposure to the lens proteins will result in an inflammatory response.

**Anatomy**
- The lens is divided anatomically into anterior & posterior; axial & equatorial; cortex (adult, fetal, and embryonal) & nucleus; epithelium, and capsule. These terms are used to describe the location of abnormalities.
- Anteriorly the lens is bathed by aqueous humor and posteriorly is in contact with the vitreous.
- The lens is completely surrounded by a capsule. The capsule is a semi-permeable membrane.
- Anteriorly, below the capsule, is the lens epithelium. There are no epithelial cells posteriorly. These cells continue to produce the new lens fibers throughout the life of the animal.
- The lens fibers wrap around the lens and meet other fibers at the lens sutures. In the dog and cat these sutures are “Y” shaped and are upright anteriorly and inverted posteriorly.
- The lens is suspended by lenticular zonules with connect the lens with the ciliary body. Contraction of the ciliary muscles results in a change in the shape of the lens, termed accommodation. Most domestic animals do not have great accommodative capacity.

**Physiology**
- 35% protein; 65% water

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Abnormalities

Lenticular sclerosis
- Bilateral, Symmetrical, Transparent
- All dogs and cats >6 years old have lenticular sclerosis. It will become more pronounced with increasing age. You do not even need to examine the patient to diagnose lenticular sclerosis, it can be diagnosed based on the signalment.
- It does not prevent examination of the fundus.
- This is a normal aging change and no treatment is required. It will happen in you too!

Cataract
- Any loss of transparency regardless of size, location, or extent is a cataract.
- Cataracts are then classified according to etiology, location, age of onset, and progression. This is done for 3 main reasons:
  1. To follow the progression of the cataract at subsequent examinations.
  2. To attempt to give the owner a prognosis regarding progression.
  3. To establish whether these are typical for the breed, eg. Hereditary.
- Regardless of the severity of a cataract it will never interfere with the afferent arm of the pupillary light reflex. If you do not have a PLR in a patient with a cataract there is more than one ocular abnormality!

Etiology

Hereditary
- Specific cataracts occur in specific breeds. You must look these up, it is not something you can commit to memory for all breeds.
- They occur at various ages and locations according to the breed. Some are progressive, others are not.
- Inherited cataracts are not always present at birth!
- Can be seen in association with other acquired ocular abnormalities that are inherited such as retinal atrophy or with congenital defects such as persistent pupillary membranes, microphthalmia etc.
- Most significant in dogs, but inherited cataracts are also reported in cats, horses, cattle, birds, and others

Diagnostic tests

Penlight examination with magnification (Private practice)
- Dilate the pupil with tropicamide (Mydriacyl®). This is a short-acting mydriatic which will have an effect for 4-6 hours.
- If there is any concern about the possibility of glaucoma the IOP should be measured prior to dilation.
- Remember the center of rotation concept. Abnormalities anterior to the center of rotation move in the same direction as the eye, those posterior move in the opposite direction.

Biomicroscopy (Referral centers)
- examination of the eye using a slit beam of light and magnification to obtain an optical section

Fundic examination
- All patients with abnormalities of the lens must have their fundus examined provided the cataract is not mature. This is to ascertain if abnormalities of the retina, that might prevent cataract surgery in the future, are present. Remember that retinal degeneration/atrophy is associated with secondary cataract formation.

Biochemical profile
- Those patients with rapid onset, bilateral cataracts must be examined for the possibility of Diabetes mellitus.
3. Lens - Equatorial cataracts
4. Retina - rare, hemorrhage, vasculitis

Electric
- Dogs that have had an electric shock (i.e. chewing electric cords) and have survived are reported to develop cataracts 1-2 years following the episode.

Location
- These are descriptive terms based on the area of the lens affected.

Capsular
- These are more likely to progress than nuclear cataracts because they are in an actively growing area of the lens and were formed more recently.
- They can be anterior &/or posterior in location

Nuclear
- Cataracts found in the fetal or embryonal nucleus are always congenital. This is sometimes important in an animal that was purchased and is now found to have an abnormality.
- They may or may not be bilateral
- Congenital does not mean hereditary

Equatorial
- Many toxic, radiation, and metabolic cataracts will appear first at the equator.
- This is the most metabolically active area of the lens and as such is more susceptible to these types of injuries.
- They are also very likely to progress.

Axial
- A line from the anterior central pole to the posterior pole that passes through the central lens is the axis of the lens. Cataracts affecting this portion of the lens are described to be axial.

Age of onset

Congenital
- Involves the nucleus +/− the cortex
- This is the most common congenital ocular anomaly in the horse.

Metabolic
- The most common metabolic disorder is Diabetes mellitus.

Diabetic cataract:
1. Over abundance of glucose in the aqueous
2. Glucose metabolism shifted to the sorbitol pathway where glucose is reduced by aldose reductase to sorbitol.
3. Sorbitol cannot exit the lens. It accumulates and results in an osmotic shift.
4. Water drawn into lens resulting in swelling and disruption of fibers.
5. Bilateral, not necessarily symmetrical, rapid in onset.

Toxic
- These are not of major clinical significance in veterinary medicine at this time.
- Toxic cataracts are important in the laboratory animal industry
- The widespread use of antimitabolites, enzyme inhibitors, and other chemotherapy agents may result in an increased incidence of toxic cataracts.

Nutritional
- Esbilac® is the most commonly implicated nutritional cataract. This is a dietary supplement for orphan puppies and has been reported to result in an increased frequency of cataracts in puppies fed this diet exclusively for the first 1-3 weeks of life.
- Many amino acid deficiencies or imbalances have been implicated in cataracts in domestic, laboratory, and zoo animals.

Radiation
- Radiation, especially gamma, is used with increasing frequency for malignant neoplasms of the head. The eye is affected secondarily.
- The areas most frequently affected are:
  1. Eyelids and conjunctiva - inflammation, necrosis, alopecia, depigmentation
  2. Cornea - Ulceration

Electric
- Dogs that have had an electric shock (i.e. chewing electric cords) and have survived are reported to develop cataracts 1-2 years following the episode.
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- Perhaps in the future we will have medical treatments available for some cataracts, but not currently.
- Cataract surgery is definitely a referral procedure. Do Not Attempt It!
- If your clients are interested in cataract surgery and the cataracts are bilateral and progressive then refer them for an evaluation prior to the time that the dog goes blind. We would like to see the fundus if possible and educate the client about the procedure.
- Adjunctive diagnostic procedures should include ocular ultrasound and electroretinography prior to surgery to ensure and normal, functioning posterior segment.
- The most successful method of cataract surgery in veterinary ophthalmology is phacoemulsification
- To restore as near to normal (emmetropic) vision an artificial lens should be implanted in all cataract surgery eyes.
- Cataract surgery can also be performed on other species such as cats, birds, and horses.

Luxation
- A lens can luxate totally or partially. If the luxation is complete the lens will either fall forward into the anterior chamber or posteriorly into the vitreous.
- The lens is responsible for the support of the iris. When the lens is loose the iris will move or shake in an abnormal fashion. This is termed iridodenesis.
- If the lens shifts in position it may leave an area of the pupil without any lens to look through. This is termed an aphakic crescent.
- Anterior lens luxations are the most serious and require emergency surgery to remove the lens.

Effects of lens luxations:
1. Lens luxations are serious especially anterior luxations. The lens can result in an obstruction in the flow of aqueous humor either through the pupil or out the drainage angle. This will result in secondary glaucoma.
2. Also anterior lens luxations will mechanically damage the corneal endothelium resulting in corneal edema, more severe ventrally. This may be irreversible.
3. Pain from either anterior uveitis or glaucoma.

Treatment
- There is only one treatment for cataracts and that is surgery +/- artificial lens implantation (SEE CLIENT CATARACT INFORMATION SHEET)
- Do not fall prey to the numerous “medical” therapies for cataracts such as vitamins etc. They do not work!
Etiology

Primary
- Primary lens luxations are seen in predisposed breeds. These include virtually all terrier breeds. There is now a DNA test available for the terrier breeds.
- I have also seen lens luxations in several cats that appear to be primary and in one horse.
- The etiology is likely an abnormality in the supporting zonules.
- If you are presented with this in one eye you must dilate the opposite eye as it will often also be affected.
- There is no treatment other than surgical removal of the anteriorly luxated lens or miotics to keep the lens posteriorly.

Secondary
(1) Trauma
- Evaluate the entire eye for abnormalities. If this is seen in the predisposed breeds (terriers) then the trauma may have been minor. In non-predisposed breeds a significant amount of force is required to luxate a lens and other damage will likely be present.
(2) Glaucoma
- Chronic glaucoma results in enlargement of the globe, termed buphthalmia. This stretches the ciliary zonules, ruptures them, and luxates the lens. The lens luxation does not usually require treatment, rather, therapy is directed towards the glaucoma.

Clinical signs
- are variable depending on the etiology and the location of the lens
- Acute anterior lens luxations are often very painful with epiphora, blepharospasm, and redness.
- Posterior luxations, or luxations secondary to chronic glaucoma may have no overt clinical signs.
- with a penlight examination look for aphakia and iridodendesis. If the lens is in the anterior chamber the chamber will appear to be shallow and the iris will be visible behind the lens.
- corneal edema often results and may be more severe ventrally.

Treatment
-All patients with lens luxations must have their IOP measured.

Anterior
- These are surgical emergencies with one exception. The eye that has an anterior luxation secondary to chronic glaucoma or is blind for other reasons does not require emergency lens extraction.
- The best therapy for a patient with an acute anterior lens luxation is referral. I do not advise any medical therapy in the meantime unless an ophthalmologist is not available in which case the IOP must be reduced to prevent retinal damage.
- In addition to removal of the luxated lens, it is now possible to implant an artificial lens using the technique of ciliary sulcus fixation, suturing the lens in position posterior to the iris.

Posterior
- Treatment for these will vary from surgical removal to miotic agents to no therapy at all.
- Miotic agents such as pilocarpine are designed to trap the lens in the posterior compartment and prevent its shifting anteriorly.

Cataract - Client Information Sheet
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Veterinary Comparative Ophthalmology
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Definition:
Cataracts, are by definition, any opacity within the lens of the eye or its capsule. The lens of the eye functions much the same as the lens of a camera, helping to focus objects on the retina so that they may be seen clearly. Cataracts, if affecting a significant portion of the lens, interfere with light reaching the retina and result in loss of vision and blindness. In small animal patients, especially dogs, cataracts are often inherited with the cataract genetically programmed to occur from birth. In addition, diabetes, ocular trauma, and ocular inflammation may also result in cataract formation.

Treatment:
Although many drops and pills have been marketed over the years to treat cataracts, there remains only one accepted, successful treatment, surgery. The surgery is designed to remove the cataract, thereby allowing light to reach the retina and the animal to see. There are several methods of cataract surgery, but the one used at The Ohio State University Veterinary Hospital is termed phacofragmentation. This is the most...
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advanced and successful method to remove cataracts in animals and humans. It allows removal of the cataract through a very small incision, first fragmenting the cataract, then aspirating the pieces through the incision. This is a very effective and fast method of cataract surgery, resulting in a successful outcome in ≥ 95% of eyes.

Prior to performing cataract surgery we must ensure both your animal and their eyes are in otherwise good health. We perform routine blood screening tests to evaluate overall health and 2 tests on the eye, ocular ultrasound and electroretinogram (ERG), to ensure the eye is otherwise normal. The ultrasound examines for abnormalities of the posterior portion of the eye, such as a retinal detachment. The ERG tests the function of the retina. These are all performed prior to surgery with the ERG performed under general anesthesia immediately prior to surgery.

Once the cataract is successfully removed the animal can see again. In addition to removal of the lens, an artificial intraocular lens (IOL) is routinely implanted at the time of surgery. Implantation of an IOL will provide your animal with vision that is very similar to normal and will permit them to function better in day to day activities. If it is not possible to implant an IOL in your dog they are still able to see following cataract surgery, but are considered to be farsighted.

Decisions:
You must decide whether to have cataract surgery on your pet and if you wish to place IOL’s in your dog to have a return of vision that more closely approximates normal.

Estimated Cost:
Cataract Surgery, including anesthesia, pre-surgical evaluation, ocular ultrasound, ERG, medications, hospitalization, and first re-evaluation visit. With Artificial lens implants - Both Eyes $ __________________

Prognosis and Complications:
The success of cataract surgery is approximately 95%. The most common potential complications, all of which are infrequent, include anesthetic risk, post-surgical glaucoma and intraocular scar formation. Complications, while rare, can result in a failure to see following surgery.

I acknowledge reading and understanding the above information regarding cataract surgery for my animal.

Signature: ____________________________
Date: ______________

RETINA - WHAT THE HECK AM I SEEING?
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Objectives of the Presentation
Fundic examination is a tremendously important, but under utilized portion of the physical and ophthalmic examinations. Methods of fundic examination, normal variation within and between species and interpretation of abnormalities while often confusing for the general small animal veterinarian can be made less confusing.

General Key Points
Evaluation of the posterior segment is important not only in the patient with a visual disturbance, but also in all animals for which the differential diagnoses include systemic infectious diseases, vascular disorders, hypertension, or central nervous system disease. Clinicians should realize this is the only location in the body where blood vessels and the central nervous system can be seen directly. In addition, the high blood flow of the choroid makes it very susceptible to blood-borne infectious and neoplastic diseases.

Unfortunately on of the things that makes veterinary medicine interesting is also what makes fundic examinations difficult, namely variation. Once the clinician has mastered the techniques of fundic examination they must then familiarize themselves with the wide variation between species, within species, from breed to breed, based on coat color and numerous other factors that influence the variety of normal appearances seen on fundic examination.
Overview of the Issue

Penlight examination
Evaluate the pupillary light response. Normal direct & consensual? Pupils symmetrical? Can you obtain a tapetal reflection? Are there any opacities in front of the tapetal reflection?

Menace response
Evaluates cranial nerves II (afferent) and VII (efferent). Avoid touching the facial hairs or creating air currents. If the animal does not respond tap the eyelids to evaluate CN VII and to let the animal know that your menace is not just an idle threat. Now repeat the menace test.

Maze Test
Place the animal on the floor with various obstacles in their way. Assess their ability to navigate in both normal room light as well as in dim light.

Fundic examination
Dilate the pupil with Mydriacyl® provided you are certain the animal does not have glaucoma. Perform the examination in a darkened room.

Direct ophthalmoscopy
This is the technique of choice for examination of the ocular fundus in large animal patients and is used to achieve greater magnification of the fundus in small animals. It provides an upright image of the fundus and associated structures and magnifies the image 15 X. Magnification is less with hyperopia and aphakia and greater with myopia. Although a useful procedure in small animals, the field of view is small, there is no stereopsis and therefore this is a difficult technique to use for general screening of the eye. Also, with opacities of the transmitting media it is difficult to visualize the fundus as compared with indirect ophthalmoscopy.

The ophthalmoscope is turned on and the rheostat is used to adjust the light intensity to suit the examiner. The diopter wheel is turned to select the 0 diopter setting. This is the setting to view the fundus for most people and animals. Use your right eye to examine the patients right eye and visa versa. Darken the exam room. Place the ophthalmoscope to your eye and from a distance of 25 cm obtain the tapetal reflection. Move toward the eye and as you do so observe for any interference with the tapetal reflection indicating an opacity of the transmitting media, the cornea, aqueous, lens, and vitreous. When you are 2-3 cm from the patient’s cornea you should see the retina, optic nerve, retinal vessels, and tapetum in clear focus. Find a blood vessel and follow it to the optic nerve. In the horse find the tapetum, move ventrally to the tapetal non-tapetal junction, then move horizontally to find the optic nerve. Evaluate the optic nerve and blood vessels then scan the fundus for abnormalities of color, clarity, size, and shape. Use the diopter wheel to focus in and out to evaluate raised and depressed lesions. The red numbers are negative or deeper and the black are positive or more superficial.

Indirect ophthalmoscopy
This technique can be performed using a hand-held lens and a bright focal light source, or for those with a stronger interest in ophthalmology an indirect headset is essential to provide stereopsis.

While this technique initially requires more practice to become proficient, once mastered it is a much more useful procedure to screen the fundus of the small animal patient. It is also less expensive to obtain the needed equipment which consists of a penlight and a 2.2 PanRetinal lens. Indirect ophthalmoscopy provides the examiner with an inverted, reversed image that is magnified 2-5 X. This image, while of a lower magnification than with direct ophthalmoscopy, has a much larger field of view and is better for routine screening of the eye.

The patient’s pupils should be dilated with 1- drops of tropicamide (Mydriacyl®). This will take 10-15 minutes for complete dilation and will last 8-12 hours in the dog. The examiner begins at arms length from the patient. An assistant is required to restrain the patient and to hold the eyelids open. Darken the exam room. With a focal light source such as a penlight or your direct ophthalmoscope held at arms length from the patient, the tapetal reflection is obtained. Holding the lens in your opposite hand place the lens 1-2 inches in front of the patient’s eye, in the path of your light. The fundus should appear as a virtual image in front of the lens. It is important to look at the image which is in front of the lens and not at the lens or the eye. To view other areas of the fundus you must move yourself, the light source, and the lens while keeping all of these in alignment. Remember that the image is inverted so you must move in the opposite direction to the image. If the image is lost, move the lens out of the light beam and start again. Practice, practice, practice.
Various lenses are used in indirect ophthalmology and they provide varying magnification and field of view. The less the magnification, the greater the field of view.

The Panoptic Ophthalmoscope is a monocular, indirect ophthalmoscope with a prism inserted to “re-invert” the image. It feels similar to a direct ophthalmoscope. It is in between direct and binocular indirect ophthalmoscopy with respect to magnification and field of view.

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**Ultrasonography**

Ultrasonography, using a 7.5 or preferably a 10-15 MHz probe, is a non-invasive, safe procedure that allows evaluation of the intraocular and retrobulbar tissue without sedation or general anesthesia. Ocular ultrasonography is indicated whenever opacity of the transmitting media of the eye (cornea, aqueous humor, lens, vitreous humor) prevents a complete ophthalmic examination. Ultrasound aids in evaluation of intraocular mass lesions, differentiation between solid and cystic structures, evaluating the extent of damage following ocular trauma, examination for a foreign body, axial length determination and examination of retrobulbar orbital structures.

The most common clinical indications for ocular ultrasound are to evaluate for the presence of a retinal detachment in eyes with a cataract, to assess posterior segment damage and examine for the presence of a foreign body following trauma, or to evaluate intraocular structures in eyes with severe corneal opacification. In addition, orbital evaluation can be performed in instances of exophthalmos or orbital trauma.

**Electroretinogram**

This is a referral-only procedure. It is used to assess the function of the retina in much the same way that an electrocardiogram is used to assess the function of the heart. Using this technique the rod and cone function can be separated. This is the only definitive method to obtain a diagnosis of SARDS in the acute stage of the disease.

An electroretinogram is mandatory in patients with mature cataracts that are surgical candidates.

**Interpretation**

Fundic examination, like physical examination, cardiac auscultation, etc is an art form that requires practice both with the technique, but also with the interpretation of what is seen. In small animals, indirect ophthalmoscopy is the preferred method to examine the posterior segment. When performing a fundic examination the species, age, breed and coat color all influence what is within normal limits. For example dogs do not look like cats, but chocolate dogs do not look like black or yellow dogs, large breed dogs do not look like small breed dogs and color dilute dogs look different from animals with normal pigmentation. The size and color of the tapetum is variable and a complete absence of the tapetum may be seen in some small breed dogs and with certain coat colors. We do not expect our patients to look the same on the outside, why should they on the inside? If as a clinician, we fail to look at a wide variety of normal animals how can we expect to diagnose and interpret abnormalities?

When interpreting a fundic examination special attention is paid to reflectivity, pigmentation, size, color and whether a change is raised or depressed. Remember, the posterior segment appears as it does because of the three distinct tunics (fibrous, vascular and nervous) and how they appear superimposed on each other. The innermost retina has the consistency of wax paper, the choroid has blood, pigment and the tapetum while the outermost sclera is white in appearance. Changes in thickness, pigmentation, etc will alter the appearance of the posterior segment and it is the responsibility of the clinician to determine normal variation vs. disease.

**Hyperreflective**

In general, a hyperreflective change indicates thinning of the retina. Evaluate the margin of the hyperreflective zone.

- Well demarcated, localized - inactive disease, likely healed area of inflammation
- Poorly demarcated - active disease
Generalized - Progressive retinal atrophy, glaucoma, nutritional deficiency, SARDS, severe inflammation

**Hyporeflective**
Indicates an increase in tissue thickness by:
- Cells – inflammatory, infectious, neoplastic
- Fluid – transudate, exudate, edema, hemorrhage
- Folding of the retina – dysplasia, detachment

**Pigment change**
Inflammatory and degenerative disease can result in depigmentation and pigment clumping in the non-tapetal fundus and hyperpigmentation in the tapetal fundus.

**Size and Color**
Evaluate the retinal vessels (arteries and veins) and the optic nerve for increases or decreases in size. Dilated and engorged vessels may suggest systemic diseases such as hypertension or hyperviscosity. Along with these changes may be increased tortuosity, hemorrhage and retinal detachment. A decrease in vessel size may be associated with retinal degeneration. Vessel color will change with systemic abnormalities such as hyperlipemia. A small optic nerve size can be congenital (micropapilla, hypoplasia) or acquired (atrophy) while an enlarged optic nerve suggests papilledema or papillitis.

**Depth Perception**
The clinician must endeavor to remember they are examining a 3-dimensional structure. Elevations and depressions of posterior segment structures occur as both congenital and acquired abnormalities. In addition, the retina can be detached and move vitread. Determination of such changes requires the clinician use clues such as changes in retinal vascular direction and plane of focus along with color and reflectivity changes to correctly interpret pathologic changes.

**Abnormalities – Retina**

**Retinal Degeneration/Progressive Retinal Atrophy**
Generalized retinal atrophy, with the exception of SARDS, is a slow progressive disease. Retinal atrophy occurs as a inherited disease, Progressive retinal atrophy (PRA) in certain breeds and as a degenerative, non-inherited change in other dogs. Retinal degeneration can be secondary to conditions resulting in chorioretinitis, retinal detachment or other primary diseases of the posterior segment. PRA, by definition, must occur in a specific breed, at a prescribed age, be inherited, and progress in a known fashion. The breeds in which PRA has been described are numerous, but some of the more common breeds include:

- American & English Cocker Spaniel
- Collie
- Miniature Poodle
- Akita
- Tibetan Terrier
- Labrador Retriever
- Irish Setter
- Miniature Schnauzer
- Norwegian Elkhound
- Briard
- Siberian Husky
- Portugese Water Dog

Other - numerous other breeds have been reported to have PRA, but the hereditary pattern is not well understood. Initially, many of these animals will begin with night blindness (nyctalopia) and progress to total blindness with time. The pupils may be dilated and the PLR slow and incomplete. The diagnosis is made based on fundic examination:
- Tapetal hyperreflection
- Pale optic disc
- Vascular attenuation

For further information on PRA, genetic testing and other inherited eye diseases the following Web sites may be of help:
http://www.acvo.com/
http://vet.purdue.edu/~yshen/cerf.html
http://www.optigen.com/
http://www.aht.org.uk/

**Retinal Detachment**
Since partial retinal detachments are not observed by owners, these patients will usually present for acute blindness with a complete detachment. Their pupils will be fixed and dilated. No response to menace testing or PLR will be present. Penlight examination will often reveal a veil of tissue situated immediately posterior to the lens. The color of the retina and subretinal material is important in determining etiology. The anterior segment should be evaluated for inflammation and the contralateral eye also evaluated. A complete systemic examination is mandatory.

**Etiologies of retinal detachment:**
- Hypertension
  - Hypertension exists when systolic pressure exceeds 180 mmHg or the diastolic exceeds 95 mmHg.
- Etiologies of hypertension:
  - Renal -This is the most frequent reason for systemic hypertension seen in veterinary medicine.

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Infectious
Systemic mycoses, septicemia, bacteremia, rickettsial disease, Bartonella, Lymes infection and others may result in anterior uveitis, chorioretinitis, and retinal detachment. See Chorioretinitis.

Hyperviscosity
Multiple myeloma, polycythemia or other causes of intravascular hyperviscosity may result in blood vessel leakage, accumulation of intraretinal and subretinal fluid, hemorrhage and retinal detachment.

Neoplastic
While primary neoplasms of the posterior segment are rare (melanoma, meningioma) metastasis to the eye (lymphoma, carcinoma) is not unusual due to the high uveal and retinal blood flow.

Congenital
Breed-related retinal detachment can occur as the sole abnormality, but is more often associated with multiple ocular abnormalities such as microophthalmia, coloboma, cataract, retinal dysplasia or Collie-Eye syndrome.

Chorioretinitis
Inflammation of the posterior uvea can be seen alone, but is more often seen in association with anterior uveitis. The clinical signs of posterior uveitis include retinal detachment, hemorrhage, exudate and retinal edema while those of anterior uveitis are miosis, flare, hypotony, photophobia and keratitic precipitates.

Immune-mediated:
Uveo-Dermatologic syndrome (VKH)

Other

Infectious:
- Myotic: Rocky Mountain Spotted Fever
- Lymes disease
- Bacterial
- Erlichia
- Bartonella
- Other

Protothecosis
Brucellosis
FeLV/FIV
F.I.P
Toxoplasmosis
Leishmania

Neoplastic

Primary
melanoma
adenocarcinoma

Secondary
lymphosarcoma
adenocarcinoma

Retinal Dysplasia
Retinal dysplasia is an abnormality of retinal differentiation and proliferation during development. It is seen most often in the dog, but has been reported in numerous other species. Inherited retinal dysplasia is most common, but dietary, toxic, and infectious causes are possible. Although usually a primary ocular problem, some forms of retinal dysplasia are associated with systemic abnormalities as seen in field-trial Labradors with oculo-skeletal dysplasia.

Mild forms of retinal dysplasia are evident only on ophthalmoscopic examination appearing as single or multifocal retinal folds. Retinal folds appear as gray or white vermiform streaks in the tapetal and non tapetal fundus, respectively. Larger affected areas are termed geographic dysplasia. The most severe form of retinal dysplasia occurs as a non-attachment of the retina resulting in blindness in the affected eye. In addition, a form of inherited retinal dysplasia with associated skeletal dysplasia has been described in the Labrador Retriever. There is no treatment for retinal dysplasia and affected dogs, siblings and sire and dam should not be used for breeding.

Commonly affected breeds include:
- Am. Cocker Spaniel
- Laborador Retriever
- Australian Shepherd
- Bedlington & Sealyham Terriers
- Beagle
- English Springer Spaniel
- Rottweiller
Sudden Acquired Retinal Degeneration Syndrome (SARDS)

Sudden acquired retinal degeneration syndrome (SARDS) is characterized by acute onset blindness. The PLR is variable from fixed and dilated or sluggish to normal. On fundic examination there are no visible abnormalities on initial presentation, but in 2-3 months the typical appearance of generalized retinal degeneration will be present. Prior to presentation or concurrently there may be a history of polyuria, polyphagia, polydipsia and weight gain. On serum biochemical profile increased alkaline phosphatase (steroid isoenzyme), cholesterol or liver values may suggest mild Cushings or hepatic disease.

The etiology is unknown and there is no treatment. These animals are permanently blind. SARDS results from the acute degeneration of all photoreceptors. The diagnosis is difficult because the lesion is retinal and yet the fundic examination is initially normal.

Depending on the PLR the differential diagnoses are Retrobulbar optic neuritis (Dilated and non-responsive pupil) or Cortical blindness (normal PLR).

The definitive diagnosis of SARDS requires an electroretinogram to differentiate it from these diseases. If the diagnosis is SARDS the ERG will have no response. A normal ERG response indicates normal retinal function and the need for further electrodiagnostic testing in the form of a Visual Evoked Potential followed by a cerebrospinal fluid tap, MRI or CT scan.

Abnormalities – Optic Nerve

Micropapilla/Optic Nerve Hypoplasia

As the name indicates, this a congenital abnormality of the optic nerve. Micropapilla is a smaller than normal optic nerve in a visual eye, while optic nerve hypoplasia is associated with blindness, absent menace response, and absent PLR. These occur most often as a primary abnormality, but can be seen in association with multiple ocular abnormalities. Optic nerve hypoplasia is an inherited condition in Miniature and Toy Poodles, German Shepherd and numerous other breeds.

On ophthalmoscopic examination, the retina appears normal as do the retinal blood vessels. The optic nerve appears to be small and gray in color. An electroretinogram in these animals is normal, even with optic nerve hypoplasia and blindness. Histologically, the retinal nerve fiber and ganglion cell layers are decreased to absent, with the remaining retinal layers normal. There is no treatment and affected animals should not be bred.

Coloboma

Appears as a pit or defect in the optic nerve and often adjacent fundus. Most often seen in association with Collie Eye Anomaly or other multiple congenital ocular diseases. A clue to the presence of a coloboma is to follow the retinal blood vessels to the edge of the coloboma where they are seen to disappear over the edge and into the pit. Most colobomas do not cause clinically significant changes in vision, but severe colobomas may result in visual disturbance and predispose to retinal detachment. Colobomas must be differentiated from optic nerve cupping secondary to chronic glaucoma. Affected animals should not be used for breeding.

Papilledema/Papillitis/Optic Neuritis

Papilledema is a non-inflammatory swelling of the optic nerve and is usually not associated with significant visual disturbance. Papilledema is associated with diseases resulting in elevation of cerebrospinal fluid pressure or with mass lesions compressing the optic nerve.

Papillitis is inflammation of the optic nerve. If the inflammation extends to the intraocular portion of the optic nerve, papillitis will be noted. Remember that optic neuritis can affect only the retrobulbar portion of the optic nerve with the intraocular portion of the nerve appearing normal. Papillitis/optic neuritis is associated with a decrease in vision, usually sudden in onset, and a decreased to absent PLR. Papillitis appears as a swollen, hyperemic, edematous, raised optic disc. In addition, peripapillary hemorrhage and retinal detachment may be noted. To distinguish retrobulbar optic neuritis from SARDS an ERG is required.

The optic nerve is part of the central nervous system and diseases affecting the optic nerve may be primary CNS diseases. Neoplasia, inflammation (infectious and non-infectious), trauma, and a variety of other CNS abnormalities can present for or have associated ocular changes. It is therefore essential to perform a complete physical and neurologic examination on these animals. Electrodiagnostic testing, CSF analysis and MRI or CT scan may also be indicated. Primary optic neuritis, not
associated with other CNS or infectious disease may respond to systemic corticosteroids administered at immunosuppressive doses for several weeks.

Optic Nerve Atrophy/Degeneration
Atrophy of the optic nerve occurs secondary to inflammatory disease of the optic nerve or adjacent choroid and retina, as the result of trauma, and associated with chronic glaucoma. Optic nerve atrophy appears as a gray, flat optic nerve with vascular attenuation. In addition, cupping or depression of the optic nerve head and peripapillary hyper-reflectivity are seen in association with chronic glaucoma.

**Clinical Signs**

**Miosis**
- Constriction of the sphincter muscle resulting in a decrease in the size of the pupil
- This is the result of prostaglandins and other inflammatory mediators in the aqueous humor

**Flare**
- Protein +/- cells in the anterior chamber as a result of a breakdown in the blood-aqueous barrier
- Appears as a continuous beam of light from the cornea to the lens

**Redness**
- The deeper episcleral/scleral blood vessels will vasodilate making the eye appear red to the owner.
- If the inflammation persists these blood vessels can invade the cornea as a 360 degree wall of deep corneal vessels

**Photophobia**
- The muscles of the iris (sphincter) and the ciliary body are in spasm as a result of the inflammation. When you shine light into the eye these muscles attempt to constrict resulting in pain.

**Pain**
- Manifest as epiphora, blepharospasm, squinting, photophobia, and rubbing the eye. Systemically these animals may also be depressed, lethargic, and anorexic.

**Keratic precipitates**
- Accumulations of protein and mononuclear cells on the corneal endothelium. They are most commonly seen ventrally.
- Usually indicate a granulomatous anterior uveitis
- Hypotony
- The IOP is typically lowered by anterior uveitis due to a decreased aqueous production. Normal IOP with active uveitis suggests concurrent outflow abnormalities.

**Etiologies**
The etiologies of anterior uveitis can be either *ocular* or *systemic*.

**Ocular:**
1. Corneal ulceration - can result in a neurogenic reflex anterior uveitis.
2. Lens-induced - a hypermature cataract can result in anterior uveitis as a result of the leakage of lens protein into the anterior chamber.
3. Ocular trauma - penetrating or blunt trauma.

**Systemic:**
1. In general any systemic bacteremia, viremia, or septicemia can result in anterior uveitis. A complete physical examination is therefore essential.
2. Specific species etiologies:

   **Dog:**  
   - *Infectious*: Erlichiosis, Rocky mountain spotted fever, Mycoses (Blasto, Crypto, Histo, Toxo), Lymes disease, Protheosis, Brucellosis, Distemper, Infectious hepatitis, Bartonella
   - *Autoimmune*: SLE, Uveo-dermatologic syndrome (VKH)

   **Cat:**
   - FeLV, FIP, FIV, Toxo, Mycotic, Bartonella
4. Drug reactions
5. Other
Environment? Does this animal have exposure to other animals? to mycotic organisms etc?

**Physical examination**
- a complete physical examination must be performed on all animals with anterior uveitis. Carefully evaluate the lymph nodes, liver, spleen, auscultate the chest, take the temperature, etc.

**Complete blood count**
- WBC count? Differential?
- Platlet count? If low consider rickettsial agents.

**Biochemical profile**
- Serology
  - Blasto, Histo, Crypto
  - RMSF, Erlichia canis/platys, Lymes, ICH, Distemper
  - FeLV, FIV, Bartonella
  - Toxo - request IgG, IgM, and Toxo antigen tests

**Radiology**
- thoracic radiographs looking for neoplasia, mycotic involvement.

**Ultrasound**
- of the eye to examine the posterior portions if they are not visible by ophthalmoscopy

**Cytology/Histopathology**

**Treatment of Anterior Uveitis**
- As you can see from the extensive list of etiologies it is impossible to give you one treatment that will apply to every case. We therefore divide treatment into specific and non-specific therapy.

**A) Specific:**
- directed towards the inciting cause
- requires you to correctly diagnose the etiology and, if possible, eliminate it

**B) Non-Specific:**

**Feline Uveitis**

Mean Age - 8.6 yrs
- 2.6 : 1 male to female
- Most breeds w/ DSH or DLH predominate
- Idiopathic / Immune-mediated (58% MGD; 33%RLP)
- Neoplasia (13% MGD; 23% RLP)
- Systemic infectious disease (26% MGD; 24.5% RLP; 83.1% MRL)
- Feline Infectious Disease
  - FELV (12%)
  - FIP (5-19%)
  - Toxo (5-75%)
  - FIV (13-21%)
  - Crypto (2%)
  - Bartonella

**Diagnostic Tests**

**History**
- Duration, progression of disease.
- Other physical changes such as weight loss, anorexia, vomiting, diarrhea are very important.

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1. **Atropine 1%** - generally give to effect and then as required to maintain pupil dilation. I usually do not exceed 4x/day. In the horse topical atropine can result in an ileus type of colic. In some small animals topical atropine will decrease tear production. Atropine is contraindicated in patients with anterior uveitis and secondary glaucoma. It is for this reason that the IOP must be measured in all eyes with anterior uveitis.

2. **Corticosteroids** - The topical corticosteroid of choice is 1% prednisolone acetate. This has the best ocular penetration. Frequency of therapy varies according to the severity of the disease (1-6x/day). *Avoid the combination products* that contain both an antibiotic and a corticosteroid unless you require both these drugs and at the same frequency.

   **Effects:**
   - inhibition of inflammation via the arachidonic acid pathway
   **Side effects:**
   - potentiate infection
   - potentiate collagenase
   - delay healing
   - absorbed systemically - alters ACTH/Dex response

   *Do Not Use Topical Corticosteroids In Patients With A Corneal Ulcer!!!!!!*

3. **Non-steroidals** - topical non-steroidal agents are only recently available. They should be treated with the same respect that you give topical corticosteroids. Their main advantages are that they can be administered to diabetic patients without fear of the systemic effects associated with topical corticosteroids and they are synergistic when used with topical corticosteroids. Their disadvantage is their cost. Frequency of application - 4x/day
   - Ocufen® - 0.03% flurbiprofen
   - Voltaren® - diclofenac

II) **Systemic Antiinflammatories** - In general systemic anti-inflammatory agents are not used for anterior uveitis unless there is also involvement of the posterior uvea (retina & choroid), there is a corneal ulcer that precludes the use of topical corticosteroids, or the anterior uveitis fails to respond adequately to topical therapy.

**Corticosteroids**
- Prednisolone is usually the corticosteroid of choice. You must decide if you require an anti-inflammatory or an immunosuppressive dose.
  - Anti-inflammatory 0.5 mg/kg BID
  - Immunosuppressive 1.0 mg/kg BID

   The side effects of systemic corticosteroids include:
   - PU/PD
   - Polyphagia
   - Weight gain
   - Hepatomegaly
   - Elevated Alkaline Phosphatase
   - Predisposition to infection
   - Etc

**Non-steroidal**
- The indications for NSAID’s are the same as for corticosteroids, but have the advantage that they do not have the side effects of corticosteroids. They can be administered to diabetic patients and are the systemic anti-inflammatory of choice in patients with infectious disease.

   **Side effects:**
   - Gastrointestinal ulceration and hemorrhage
   - Acute renal failure

**Sequelae of Anterior Uveitis**
- Anterior &/or posterior synechia
- Cataract
- Glaucoma
- Blindness
- Phthisis bulbi

**Posterior Uveitis**
- The posterior uvea is the choroid and it is intimately associated with the retina, supplying nutrition and removing waste products. Abnormalities of the choroid are therefore usually associated with abnormalities of the retina. Inflammation is therefore termed:

**Chorioretinitis or retinochoroiditis**
- The choroid has an extremely high blood flow and is predisposed to blood borne diseases. This includes bacteremia, septicemia, mycotic infections, and disseminated neoplasia.
- In addition, the choroid is one of the few locations in the body where you are able to directly view blood vessels and capillaries. This makes the eye an ideal site for neoplastic invasion.
excellent location to look for vasculitis and bleeding disorders. Examples of this include:

- Rickettsial infections - vasculitis
- Thrombocytopenia - microhemorrhages
- Hypertension - bleeding, transudate, retinal detachment
- Hyperlipemia - “tomato” soup colored blood
- Hypergammaglobulinemia - flow disorder seen as vascular engorgement, hemorrhages, retinal detachment
- The posterior uvea is also predisposed to autoimmune disease:
  - Systemic lupus erythematosus
  - Uveo-dermatologic syndrome (VKH)
  - Breed-associated – Golden retriever

**Clinical signs**
- All changes of chorioretinitis will result in a color change on fundic examination. This is the result of either:
  - Loss of normal structures
    - Thinning of the retina - tapetal hyper-reflection
    - Depigmentation - of the non-tapetal fundus
    - Thinning &/or loss of vasculature
- Addition of abnormal material
  - Edema
  - Transudate
  - Exudate
    - Granulomatous
    - Non-granulomatous
  - Hemorrhage
  - Neoplasia
- In addition, the retina may be partially or totally detached
- In general, changes of the posterior uvea are discovered for one of 3 reasons:
  - Owner complains of visual disturbance in their pet
  - Anterior uveitis results in your performing a fundic exam
  - Animal is systemically ill and you perform a fundic exam as part of your routine workup

**Diagnostic tests**
- Are the same as for anterior uveitis.
- Also if the eye is blind consider either a vitreocentesis or a diagnostic enucleation followed by cytology/culture or histopathology respectively.

**Treatment**
- Posterior uveitis requires **systemic medication** to treat.
- In patients where infectious disease is the etiology systemic non-steroidal anti-inflammatories are the drug of choice. In the dog this is carprofen, in the horse Banamine® is the drug of choice.
- Corticosteroids are the drug of choice if the etiology is known and it does not preclude the use of corticosteroids.
- Occasionally more potent immunosuppressive agents such as azathioprine (Imuran®), cyclophosphamide (Cytoxan®), or cyclosporin are required. These cases should be referred.