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Examination and Interpretation of the Fundus

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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.

EXAMINATION

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 refelection?

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 20 diopter 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.

Lens	Magnification- dog	Magnification- horse
30 D	2.0 X	0.3 X
20 D	4.0 X	0.8 X
14 D	8.0 X	2.0 X

Optic nerve	Retinal blood vessels	Reflectivity
Size	Size	Hyper vs Hypo
Shape	Color	
Color	Vessel margin	
Elevation/Depression	Hemorrhage	

Ultrasonography

Ultrasonography, using a 7.5 or preferably a 10 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 by 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 (micopapilla, 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 an degenerative, non-inherited change in other dogs. Retinal degeneration can be secondary to conditions resulting in chrorioretinitis, 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/

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

The normal blood pressure in the dog is:

Systolic - 148 +/- 16 mmHg

Diastolic - 87 +/- 8 mmHg

Mean - 102 +/- 9 mmHg

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.

Hyperthyroidism

Pheochromocytoma

Idiopathic

Immune-mediated

The most common example of this would be Uveo-Dermatologic Syndrome or VKH. This is seen more commonly in the Akita, Samoyed and Siberian Husky, but other breeds can be affected. In the acute phase anterior and posterior uveitis, retinal detachment, uveal depigmentation and periocular and dermal poliosis and vitiligo are seen. Idiopathic retinal detachment, with or without anterior segment involvement has been seen in other breeds and an immune-mediated etiology is suspected.

Infectious

Systemic mycoses, septicemia, bacteremia, rickettsial disease, 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:

Mycotic

Protothecosis

Rocky Mountain Spotted Fever

Brucellosis

Lymes disease

- FeLV/FIV
- Bacterial
- F.I.P
- Erlichia
- Toxoplasmosis
- Other

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	Beagle
Laborador Retriever	English Springer Spaniel
Australian Shepherd	Rottweiller
Bedlington & Sealyham Terriers	

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, polydypsia 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.

Additional copies can be obtained from Waltham USA, Inc. The proceedings may also be found online at the WALTHAM® web site at http://www.walthamusa.com or the VIN web site at http://www.vin.com/OSUWaltham/2001/.

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