

# GLAUCOMA

## BASICS

### OVERVIEW

- “Glaucoma” is a disease of the eye, in which the pressure within the eye is increased (pressure within the eye is known as “intraocular pressure”)
- High intraocular pressure that causes characteristic degenerative changes in the optic nerve and retina with subsequent loss of vision; the “optic nerve” is the nerve that runs from the back of the eye to the brain; the “retina” is the innermost lining layer (located on the back surface) of the eyeball; it contains the light-sensitive rods and cones and other cells that convert images into signals and send messages to the brain, to allow for vision
- Diagnosis—*intraocular pressure* greater than 25 to 30 mmHg in dogs or greater than 31 mmHg in cats, as determined by specialized pressure measurements (such as *applanation*, *rebound*, or *Schiötz tonometry*) with evidence of changes in vision or appearance of the optic nerve or retina
- Glaucoma may be “primary” or “secondary;” “primary” refers to a condition in which the pressure within the eye (*intraocular pressure*) increases without a preceding eye problem; “secondary” refers to a condition in which *intraocular pressure* increases as a complication or secondary to an eye disease or injury

### GENETICS

- Dogs—abnormality of the structure of the eye that makes development of glaucoma more likely in some dogs is thought to be inherited; mode of inheritance uncertain

### SIGNALMENT/DESCRIPTION of ANIMAL

#### Species

- Dogs—primary and secondary glaucoma
- Cats—primary glaucoma is rare; secondary glaucoma seen in patients with signs of long-standing inflammation of the iris and other areas in the front part of the eye (known as “*uveitis*”) or with movement of the lens out of its normal location (known as “*lens luxation*”); the “*lens*” is the normally clear structure directly behind the iris that focuses light as it moves toward the back part of the eye (*retina*)

#### Breed Predispositions

- Developmental abnormality of the angle between the iris and the cornea of the eye (known as “*goniodysgenesis*”)—Arctic circle breeds (such as Norwegian elkhounds, Siberian huskies, Alaskan malamutes, Akitas, Samoyeds); Bouvier des Flanders; basset hounds; chow chows; Chinese shar peis; spaniels (such as American and English cocker spaniels, English and Welsh springer spaniels)
- Narrow filtration angles—spaniels; chow chows; Chinese shar peis; toy breeds (such as poodles, Maltese, and shih tzus)
- Secondary to movement of the lens out of its normal location (*lens luxations*)—terriers (such as Boston terriers, Cairn terriers, Manchester terriers, Dandie Dinmont terriers, Norfolk terriers, Norwich terriers, Scottish terriers, Sealyham terriers, West Highland white terriers, Parsons Jack Russell terriers, and fox terriers), Chinese shar peis

#### Mean Age and Range

- Primary glaucoma in dogs—any age; predominantly affects middle-aged dogs (4 to 9 years of age)
- Secondary to movement of the lens out of its normal location (*lens luxations*) in dogs—usually affects young dogs (2 to 6 years of age)
- Secondary to long-term (chronic) inflammation of the iris and other areas in the front part of the eye (*uveitis*) in cats—usually affects older cats (greater than 6 years of age)

### SIGNS/OBSERVED CHANGES in the ANIMAL

- Sudden closure of the angle between the iris and cornea of the eye (known as “*acute angle closure*”), leading to blockage of the flow of fluid and subsequent increased pressure within the eye—apparent pain (squinting or spasmodic blinking [known as “*blepharospasm*”], tenderness about the head, discharge from the eye(s), may be clear or may contain mucus); may note a cloudy or red eye; vision loss usually not noticed unless both eyes are involved
- Secondary glaucoma—depends on primary disease
- Inflammation of the iris and other areas in the front part of the eye (*uveitis*)—may note pain (for many days); red or bloodshot eyes, caused by dilated blood vessels (known as “*scleral injection*”); and cloudiness due to fluid build-up in the clear part of the eye (known as “*corneal edema*”)
- Movement of the lens out of its normal location and into the front part of the eye (known as “*anterior lens luxation*”)—may note sudden (acute) pain; red or bloodshot eyes (*scleral injection*); and cloudiness due to fluid build-up in the clear part of the eye (*corneal edema*); may see lens in the anterior chamber (the front part of the eye, between the cornea and the iris), if *corneal edema* is not severe
- Long-term (chronic) inflammation of the iris and other areas in the front part of the eye (*uveitis*) in cats—may not have signs of pain; enlarged, seemingly painless eye or a dilated pupil is common
- Eyeball or globe enlargement (known as “*buphthalmos*”)—may be noticed first by owners

### ***Sudden (Acute) Primary Glaucoma***

- High intraocular pressure (measured by your pet's veterinarian)
- Squinting or spasmodic blinking (blepharospasm)
- Eyeball may recede into back of socket (known as "enophthalmos")
- Red or bloodshot eyes (scleral injection)
- Cloudiness due to fluid build-up in the clear part of the eye (corneal edema)
- Dilated pupil; the "pupil" is the circular or elliptical opening in the center of the iris of the eye—light passes through the pupil to reach the back part of the eye (known as the "retina"); the "iris" is the colored or pigmented part of the eye—it can be brown, blue, green, or a mixture of colors
- Vision loss
- Optic nerve may be depressed or cupped when the back of the eye is evaluated with specialized eye instruments by your pet's veterinarian; the "optic nerve" is the nerve that runs from the back of the eye to the brain

### ***Long-Term (Chronic) or End-Stage Glaucoma***

- Eyeball or globe enlargement (buphthalmos)
- Lines that develop on the inner lining of the cornea, the normally clear part of the front of the eye (known as "Descemet streaks" or "Haab's striae")
- Partial movement of the lens out of its normal location (known as a "lens subluxation") with a resultant "crescent" appearing in the area of the iris (known as an "aphakic crescent")
- Wasting away or decrease in size of the cells in the optic nerve head (known as "optic nerve head atrophy"); the "optic nerve" is the nerve that runs from the back of the eye to the brain
- Death of tissue in the retina (known as "retinal necrosis")—detected increased reflectivity in the back of the eye when the veterinarian performs an examination

### ***Glaucoma Induced by Inflammation of the Iris and Other Areas in the Front Part of the Eye (Uveitis)***

- Elevated intraocular pressure
- Red or bloodshot eyes (scleral injection)
- Cloudiness due to fluid build-up in the clear part of the eye (corneal edema)
- Inflammatory debris in the front part of the eye, between the cornea and the iris (anterior chamber)
- Constricted or miotic pupil may or may not be seen; the "pupil" is the circular or elliptical opening in the center of the iris of the eye; light passes through the pupil to reach the back part of the eye (known as the "retina"); the "iris" is the colored or pigmented part of the eye—it can be brown, blue, green, or a mixture of colors
- Scar tissue between the iris and the lens of the eye (known as "posterior synechia") may or may not be present; the "lens" is the normally clear structure directly behind the iris that focuses light as it moves toward the back part of the eye (retina)
- Bulging of the iris toward the front of the eye (known as "iris bombé") may or may not be present

### **CAUSES**

- Primary glaucoma—structural abnormalities of the eye involving the filtration angle (the "filtration angle" is the area where the cornea, sclera, and iris meet; it contains a structure that allows fluid to flow out of the eye, thus maintaining normal pressure within the eye; in primary glaucoma, the structure is abnormal so fluid does not flow adequately and the pressure within the eye increases)
- Secondary glaucoma—blockage of the flow of aqueous humor out of the eye; the "aqueous humor" is the transparent liquid that fills the front part of the eyeball

### **RISK FACTORS**

- Inflammation of the front part of the eye, including the iris (known as "anterior uveitis")
- Movement of the lens out of its normal location (lens luxation)
- Blood in the anterior chamber of the eye (the front part of the eye, between the cornea and the iris; accumulation of blood known as "hyphema")
- Tumor or cancer within the eyeball
- Medications applied to the eye directly to dilate the pupil (known as "mydriatics")—may lead to sudden (acute) glaucoma in susceptible animals
- Primary glaucoma in dogs—consider all cases to involve both eyes, even if one eye has normal intraocular pressure at the time of evaluation; a veterinary eye doctor (ophthalmologist) should examine the apparently normal eye for filtration angle abnormalities to determine the risk for future glaucoma

## **TREATMENT**

### **HEALTH CARE**

- Sudden (acute) glaucoma in dogs—inpatient care
- After discharge from the veterinary hospital—re-evaluate every 1 to 2 days for 1 week to monitor for return of increased intraocular pressure

### **SURGERY**

- Cases with primary glaucoma or glaucoma due to movement of the lens out of its normal location (lens luxation) induced are best treated surgically
- Primary glaucoma in dogs—less than 10% of patients undergoing medical treatment alone will have vision remaining at the end of the first year following diagnosis
- Various surgical procedures may be performed to increase the flow of aqueous humor out of the eye; to decrease production of aqueous humor in the eye; procedures performed attempt to maintain normal intraocular pressure and vision; the “aqueous humor” is the transparent liquid that fills the front part of the eyeball
- Surgical removal of lens that has moved forward in the eye (anterior lens luxation) may result in a visual eye, as well as help lower intraocular pressure
- Blind, painful eyes—surgically remove the eye (known as “enucleation”); may remove the inner parts of the eye surgically, leaving the eyeball and place a prosthesis in the eye (known as “evisceration and intraocular prosthesis implantation”) in some cases

## MEDICATIONS

Medications presented in this section are intended to provide general information about possible treatment. The treatment for a particular condition may evolve as medical advances are made; therefore, the medications should not be considered as all inclusive.

- Use multiple agents to lower intraocular pressure into the normal range as quickly as possible in an attempt to salvage vision

### ***Sudden (Acute) Primary Glaucoma in Dogs***

- Emergency medical treatment may include one or more of the following:
  - Medications applied to the eye directly to cause the pupil to constrict (known as “topical miotics”)—latanoprost 0.005% (Xalatan®), travoprost 0.004% (Travatan®), or bimatoprost 0.03% (Lumigan®); 2% pilocarpine solution; 0.25% demecarium bromide; treatment aimed at improving aqueous outflow
  - Topical beta-adrenergic antagonists—timolol maleate 0.5%, levobunolol 0.5%, betaxolol 0.5%; reduce aqueous humor production; the “aqueous humor” is the transparent liquid that fills the front part of the eyeball
  - Carbonic anhydrase inhibitor (administered by mouth)—methazolamide; reduce production of aqueous humor
  - Carbonic anhydrase inhibitors (applied to the eye directly)—dorzolamide 2% (TruSopt®), brinzolamide 1% (Azopt®); reduce aqueous humor production
  - Medications to remove fluids from the body (known as “hyperosmotic agents”)—mannitol or glycerin; dehydrate the vitreous humor; the “vitreous” is the clear, gel-like material that fills the back part of the eyeball (between the lens and the retina)

### ***Glaucoma Secondary to Movement of the Lens Out of its Normal Location Toward the Front of the Eye (Anterior Lens Luxation) or Inflammation of the Iris and Other Areas in the Front Part of the Eye (Uveitis) in Dogs***

- Treated like primary glaucoma
- Medications to cause the pupil to constrict (miotic agents) should not be used
- Steroids applied to the eye directly (known as “topical steroids”)—used to reduce inflammation if no changes of the cornea (the clear outer layer of the front of the eye) characterized by the presence of ulcers, with or without inflammation (condition known as “ulcerative keratitis”)

### ***Long-Term (Chronic) Smoldering Inflammation of the Iris and Other Areas in the Front Part of the Eye (Uveitis) in Cats***

- Steroids applied to the eye directly (topical steroids)
- Topical beta-blockers; reduce aqueous humor production; the “aqueous humor” is the transparent liquid that fills the front part of the eyeball
- Carbonic anhydrase inhibitor diuretics and topical carbonic anhydrase inhibitors to reduce production of aqueous humor

## FOLLOW-UP CARE

### **PATIENT MONITORING**

- Intraocular pressure—monitored often and regularly after starting initial therapy; if low intraocular pressure (known as “hypotensive ocular pressure”) is maintained for many weeks, *slowly* taper drug therapy (as directed by your pet’s veterinarian)
- Monitor for drug reactions

### **PREVENTIONS AND AVOIDANCE**

- Primary glaucoma—consider all cases to involve both eyes, even if one eye has normal intraocular pressure at the time of evaluation; a veterinary eye doctor (ophthalmologist) should examine the apparently normal eye for filtration angle abnormalities to determine the risk for future glaucoma
- Prophylactic therapy for the apparently unaffected eye—0.25% demecarium bromide or 0.005% latanoprost or 0.5% timolol maleate or 2% dorzolamide; delays onset of glaucoma in second susceptible eye

### **POSSIBLE COMPLICATIONS**

- Blindness
- Long-term (chronic) eye pain

### **EXPECTED COURSE AND PROGNOSIS**

- Long-term (chronic) disease that requires constant medical treatment (even with surgical intervention)
- With medical treatment only—most patients ultimately go blind
- Surgical treatment—better chance of retaining vision longer; most patients do not remain visual for more than 2 years after initial diagnosis
- Secondary glaucoma due to movement of the lens out of its normal location (lens luxation)—may carry a fair prognosis with successful surgical removal of the luxated lens
- Secondary glaucoma due to anterior uveitis—may carry a fair prognosis with control of inflammation of the iris and other areas in the front part of the eye

### **KEY POINTS**

- Primary glaucoma is a disease that involves both eyes; over 50% of animals develop glaucoma in the other eye within 8 months without prophylactic therapy
- 40% or more of dogs will be blind in the affected eye within the first year, no matter what is done medically or surgically

