UPDATES ON CANINE GLAUCOMA

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REVIEW

The definition of glaucoma is an elevated intraocular pressure. Normal intraocular pressures in dogs are 12-24mmHg. The pressure is best measured by tonometry and the most common tonometers are the Tonopen, TonoVet, and Schiotz tonometers. The Tonopen and TonoVet are more easily utilized but the Schiotz can also be accurate when the user is adequately trained in its use.

Glaucoma can be either be primary or secondary in cause. Primary glaucoma is due to an abnormality in the drainage angle that prevents the release of aqueous humor. Secondary glaucoma is due to a different condition causing secondary blockage of a normal drainage angle. The most common cause of secondary glaucoma is uveitis with obstruction of the drainage angle from inflammatory cells or red blood cells or a pre-iridal fibrovvascular membrane. Other causes include neoplasia, pupillary blockade from lens luxation, melanocytic deposition, or posterior synechia leading to pupillary blockade and iris bombe.

Primary glaucoma is most common in purebred dogs. The most common breeds of dogs affected are Cocker Spaniel, Basset Hound, Chow, Shar-Pei, Boston Terrier, Husky, Poodle, Akita, Malamute, Chihuahua, Beagle, and Great Dane. The age of presentation is generally between 4 and 10 years.

Acute clinical symptoms include episcleral injection, corneal edema, mydriasis, varying degrees of pain, and they are usually visual. Because IOPs can vary throughout the day, initial IOPs may be normal or high normal. Chronic symptoms include all of the acute symptoms but also buphthalmos, lens zonule tearing leading to lens subluxation or luxation, dark and cupped optic nerve head, and loss of vision.

MEDICAL THERAPY

Parasympathomimetics cause miosis and increase outflow of aqueous. Examples include Pilocarpine and Demecarium Bromide. Pilocarpine is very inexpensive but is also very acidic and therefore is not tolerated in some canine patients. Pilocarpine should be given 2-3 times daily. Demecarium bromide is very good at reducing IOP with minimal side effects but has to be compounded, as it is not available commercially. It should be compounded in either the 0.125% or 0.250% solution and given 1-2 times daily. Since they induce miosis, these medications should not be used if there is an anterior lens luxation. They are often used with posterior lens luxation to keep the lens in the posterior segment.

Adrenergics include beta-blockers and alpha agonists and decrease production of aqueous. They lower IOP but should be used with other medications, as they are not strong enough alone. Beta-blockers include Timolol, Betaxolol, and Levobunolol. They should be used 2-3 times daily. Be careful as they can decrease heart rate. Alpha agonists
include dipivefrin, apraclonidine, and brimonide. These medications are used 2-4 times daily but can also cause local conjunctival irritation and increased heart rate.

Topical carbonic anhydrase inhibitors (CAI’s) decrease production of aqueous. These include dorzolamide (Trusopt) and brinzolamide (Azopt). Topicals avoid systemic side effects. It needs to be administered every 8 hours. Trusopt has a lower pH than Azopt so therefore can cause more irritation. Trusopt is combined with Timolol to form Cosopt so that it can be easier to administer but is also more expensive than the 2 separately.

Systemic CAI’s available commercially include acetazolamide and methazolamide. They decrease IOP but reducing production of aqueous. These medications cause systemic acidosis, which can cause excessive panting and vomiting, and diarrhea. Acetazolamide is much worse than methazolamide and is therefore NOT recommended. They can also cause mild hypokalemia. They are usually given 2-3 times daily.

Prostaglandin analogs decreased IOP by increasing outflow. These include Xalatan, Travatan, and Lumigan. These are very strong medications that result in the most significant drop in IOP. They are very good in emergency situations to rapidly get the pressure down. Since they also induce miosis, be careful using if there is an anterior lens luxation. They can be used to keep a lens in the posterior segment. These medications are usually given 1-2 times daily.

Finally, hyperosmotic agents work to decrease IOP by drawing fluid out of the eye and are only for short-term use. The agents that are most commonly used are Mannitol (1-2gm/kg) and oral glycerol (1-2 gm/kg). Ocular hypotension occurs within 30 minutes and last for 5-6 hours. They are primarily used to quickly reduce IOP in acute congestive glaucoma. Mannitol is safe to use in diabetics whereas glycerol is not. Do not use if the patient has significant heart disease as these can cause an increase in the vascular volume.

**SURGICAL THERAPY**

Surgery for visual eyes is aimed at either constructing alternate pathways of drainage from the eye or decreasing the formation of aqueous by destroying part of the ciliary body. Surgery to increase outflow include gonioimplants, iridenclesis, and cyclodialysis. Of these, gonioimplants are used most often.

Gonioimplants shunt aqueous from the anterior chamber to a different location. The most common is the Ahmed shunt, which is a valved unidirectional shunt that removes the aqueous and shunts into the subconjunctival space. The benefit of this procedure is that it causes very little inflammation but the downfall is that the exit becomes scarred in 50% of dogs by 6 months. The large Ahmed shunt is the most successful due to its larger surface area but still can become scarred.

A newer gonioimplant shunt includes the Cullen frontal sinus shunt. This is a valved unidirectional shunt that shunts the fluid from the eye into the frontal sinus. This reduces the likelihood that the shunt will become scarred. However there have been a few reports of occult sinus infections traveling from the sinus to the eye and causing a bacterial endophthalmitis, resulting in enucleation.
Newer experimental glaucoma implants are in trials at this time. These use micropore technology to reduce the fibrotic response. There are 2 types at this time, a gold implant and the TR-ClarifEYE. The success rates are unknown but these may be the most promising if the problem of fibrosis can be overcome.

Several ciliary body destruction techniques have also been described with varying success. The most advanced procedure at this time is a Diode Endolaser technique in which the lens is removed and a scope is used intraocularly to visualize the ciliary body processes and they are then lasered to kill them. Success rates reported have been up to 90% chance for vision, however, anecdotal success rates have been less. There is a considerable amount of post-operative inflammation leading to fibrin formation. Therefore tissue plasminogen activator (TPA) injections may be necessary. This technique is often used with a gonioimplant as well.

More traditional types of ciliary body destruction includes “blind” transscleral laser with Diode or Nd:YAG lasers or transscleral cryotherapy. These procedures are less precise and less effective and often have to be repeated. In addition, cataract formation after surgery is more common. However these procedures are significantly less expensive than endolaser. The biggest post-operative complication is elevated intraocular pressure from the inflammation. Therefore surgery is most successful if performed early in the course of the glaucoma.

If the glaucomatous eye is blind, there are several surgeries to permanently reduce the IOP to provide comfort. These include intravitreal injection of Gentamicin, enucleation, or evisceration with intrascleral prosthesis. The intravitreal injection is least invasive and can be performed under sedation, but is the least successful with reported success rates of 70-75%. I personally have a higher success rate but cosmesis can not be guaranteed as the eye will develop a cataract, but also can develop intraocular hemorrhage or phtisis bulbi. Enucleation is nearly 100% successful and also can be submitted for histopathology to determine cause of glaucoma, but to some owners is not cosmetically appealing. Evisceration with intrascleral prosthesis leads to more consistent post-operative cosmetic results, but the prosthetic can be rejected and the eye can still develop extraocular disease (KCS, ulcers).

**SUMMARY**

Most of the primary glaucomas present with one eye nearly or completely blind because they rely on the other eye for vision and most owners do not notice the early subtle changes. If the vision is irreversible, we talk to the owners about medical surgery knowing that it will eventually fail (but length of time is unknown) or surgery to permanently reduce the IOP (injection, enucleation, intrascleral prosthesis). We always also start the other “normal” eye of prophylactic therapy. Timolol and Demecarium bromide 2 times daily have been shown to delay glaucoma development in the good eye from 12 months if no medications are given to an average of 33 months.

Now we talk about watching the good eye and performing periodic IOP evaluation. With the last good eye, you want the IOPs to be in the teens. If the pressure starts to get into the low twenties, you need to either add in more medications or consider either a laser surgery or gonioimplant. If these are performed early, they can save vision.
If a dog develops acute glaucoma, the goal is to reduce the IOP as soon as possible to prevent permanent optic nerve damage and loss of vision. If the IOP > 50, give Mannitol and start a prostaglandin and CAI. If it is <50, I start Travatan and Cosopt and give them every 5 minutes for 1 hour and reassess IOP. If it is better, then I may send the pet home on maintenance medications and recheck the IOP in a few days. If it is not, then consider giving Mannitol. Remember to give Mannitol slowly over 20-30 minutes and do not give any water or IV fluids for 5-6 hours to maximize effect. If it is not better, then there is a poor prognosis for return to vision and the only possibility (albeit low) to control IOP is to have immediate surgery (implant or laser). The owners need to know that treating glaucoma is expensive and tries to delay loss of vision. With more sophisticated techniques, our success rate continues to improve but they should be prepared for vision loss as a possible sequelae.