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The management of glaucoma in cats and dogs to include medical and surgical intervention

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ABSTRACT: Glaucoma is a progressive disease and is very challenging to manage. The disease results in an elevated intra-ocular pressure and unfortunately in cases that are uncontrolled there will be a loss of vision. Eventually, in order to maintain the patient's comfort levels, we may need to enucleate the glaucomatous eye/s. There are various aspects to consider when managing these cases to include owner expectation and support, pain management, medical and surgical intervention and blindness. This article will discuss the causes of glaucoma and what we can do to maintain vision for as long as possible.

Keywords: Ophthalmology nursing; glaucoma management; glaucoma

Introduction

Glaucoma in domestic animals presents as a group of well recognised pathological changes involving the globe. These may result from one or more ocular disorders whose common endpoint is elevation of the intraocular pressure (IOP) above normal limits, leading to impairment or loss of vision (Gould & McLellan, 2014).

The aqueous humour is an optically clear fluid which assists in maintaining ocular structure and is important for the avascular structures within the eye such as the lens, cornea and vitreous (Barnett et al., 2003). Within the eye the aqueous humour fills the anterior chamber and the posterior chamber and is considered an ultrafiltrate of plasma, containing ions, proteins, carbohydrates, and oxygen, which supports the nourishment of the ocular tissue. It is also able to transport lactate, urea, and other waste products from tissues lining the anterior and posterior chambers back into the blood stream for disposal (Biros, 2021).

The maintenance of IOP depends on a balance between production and drainage of aqueous humour. The ciliary body produces aqueous, and it flows through the pupil into the anterior chamber and

drains out of the eye through the iridocorneal angle (drainage or filtration angle) (Figure 1). All cases of glaucoma result from impaired drainage rather than overproduction of aqueous humour (Turner, 2005).

Causes

Primary glaucoma

- Goniodysgenesis (closed-angle glaucoma)
- Primary open-angle glaucoma

In cases of primary glaucoma, there is no other recognised ocular disease process and, almost invariably, there is the potential for elevation of the IOP to become bi-lateral (Gould & McLellan, 2014).

Primary closed-angle glaucoma has been shown to be significantly associated with pectinate ligament dysplasia (PLD), an abnormality affecting the iridocorneal angle that has been shown to be highly heritable. The pectinate ligaments are slender, widely separated fibres of connective tissue that span the iridocorneal angle. In dogs with PLD, broad sheets of tissue are observed in place of the thin, widely separated pectinate ligaments that are present in normal dogs (Mellersh, n.d.) (Figure 2). The sheet of

tissue may only allow for intermittent flow holes. It is understood that goniodysgenesis can progress with time. Not all patients with PLD go on to develop glaucoma.

The breeds commonly affected are:

- Basset Hound
 - Border Collie
 - Dandie Dinmont
 - Hungarian Vizsla
 - Japanese Shiba Inu
 - Leonberger
 - Retriever (Flat Coated)
 - Retriever (Golden)
 - Siberian Husky
 - Spaniel (American Cocker)
 - Spaniel (Cocker)
 - Spaniel (English Springer)
 - Spaniel (Welsh Springer)
 - Spanish Water Dog
- (Eye scheme- primary glaucoma, 2020)

Primary open-angle glaucoma is less common but can be encountered in the Norwegian elkhound and the beagle. Vision can be maintained until quite late in the course of the disease. The increase in pressure is gradual and the eye can tolerate these changes with less pain and globe damage than with goniodysgenesis (Turner, 2005).

Primary glaucoma in cats is a relatively rare, inherited, and often breed-related condition. Burmese and Siamese cats are among the predisposed breeds (Feline Glaucoma, n.d.).

Secondary glaucoma

Secondary glaucoma is the most commonly encountered type of glaucoma in both dogs

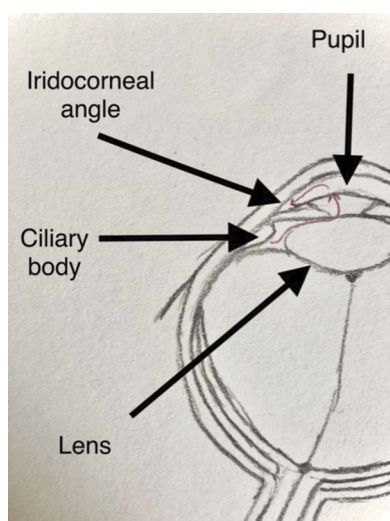
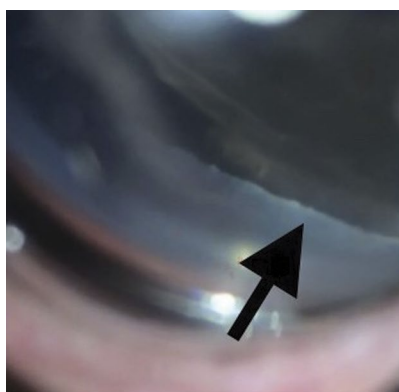
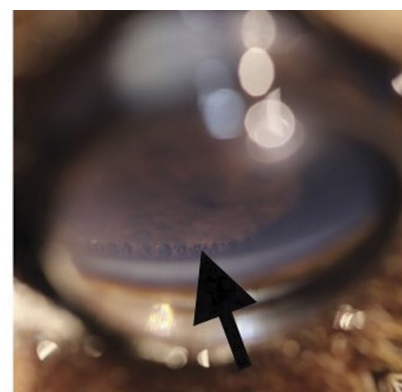


Figure 1. A diagram showing the drainage pathway of aqueous humour from the ciliary body, through the pupil and into the drainage angle.



Closed drainage angle, no pectinate ligament visible



Open drainage angle, pectinate ligament strands visible

Figure 2. Open and closed drainage angle.

and cats. It develops when antecedent ocular pathology reduces the circulation and drainage of aqueous, leading to an increase in IOP (Gould & McLellan, 2014). The obstruction preventing drainage may occur at the pupillary opening or at the level of the iridocorneal angle and in some globes flow of aqueous humour is impaired in both places (Barnett et al., 2003). Glaucoma in cats are predominantly secondary to uveitis and neoplasms (Gelatt & Gelatt, 2001).

Some causes of secondary glaucoma:

- Lens luxation (Figure 3)
- Uveitis
- Cataracts
- Iris cysts
- Ocular melanosis
- Neoplasia
- Ocular haemorrhage
- Vitreous prolapse

Clinical signs and diagnostic tests

Clinical signs of chronic glaucoma include dilated pupils, mild bulbar conjunctival venous congestion, and early enlargement of the eye (buphthalmia). With prolonged increases of IOP, secondary enlargement of the globe, lens displacement, and breaks in Descemet membrane (haab striae) result (Gelatt, 2014).

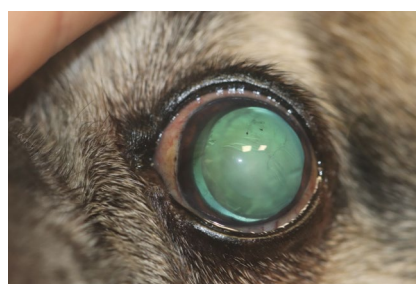


Figure 3. Lens luxation in a canine patient.

As mentioned earlier the increase in pressure can be gradual and signs can be subtle so that by the time the patient visits the veterinary practice it may be that the disease is quite advanced.

The clinical signs of acute and often markedly increased levels of IOP are a dilated, fixed pupil; bulbar conjunctival venous congestion; corneal oedema; and a firm globe (Gelatt, 2014). Other clinical signs of an acute episode of glaucoma are pain, loss of vision and corneal vascularisation (Figures 4 and 5).

Feline glaucoma is very commonly insidious in onset. Signs of pain, corneal oedema and episcleral congestion are frequently much less marked than in dogs. The first presenting signs may include suspected vision loss, or a change in appearance of the eye due to mydriasis, buphthalmos, uveitis or neoplasia (Gould & McLellan, 2014).

Tonometry combined with clinical signs is essential in diagnosing glaucoma.

A tonometer is a piece of equipment that makes contact with the patient's cornea (through indentation, flattening or appplanation) in order to give an intra-ocular pressure reading (Figure 6). Intra-ocular pressure above 25 mm Hg and clinical signs as described above is consistent with

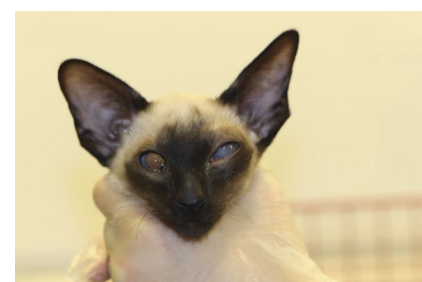


Figure 4. A feline patient presenting with glaucoma of the left eye.



Figure 5. A glaucomatous eye.

a diagnosis of glaucoma. (Strom, 2017). When measuring the IOP, it is important not to restrain around the patients neck and not to put too much pressure on the eyelids when opening the eye as this will cause a false increase in intra-ocular pressure. It is also worth checking the patients collar is not too tight.

Another diagnostic test that can be performed is Gonioscopy. Gonioscopy is an examination of the drainage angle within the eye, using a specially designed contact lens (BVA, 2020). The lenses are placed on the cornea (after numbing with proxymetacaine) and allow the light to be bent such that the drainage angle can be evaluated (Turner, 2005) (Figure 7). This test will help to observe any abnormalities and diagnose primary glaucoma cases.

Owner discussion

Once a patient has been diagnosed with glaucoma it is extremely important to have a thorough discussion with the owner in order to manage their expectations and support them with what can be quite overwhelming information. They will need to be prepared for their pet to lose their vision in uncontrolled cases and in primary glaucoma this can be bi-lateral in their pets life time.

Glaucoma is painful and where the IOP is >40–50 mm Hg, the degree of discomfort may be so severe as to cause vocalisation, head shy-ness and marked depression and/or inappetence (Gould & McLellan, 2014). Ocular pain may also present as blepharospasm, third eyelid protrusion and increased lacrimation.



Figure 6. The Icare rebound tonometer.

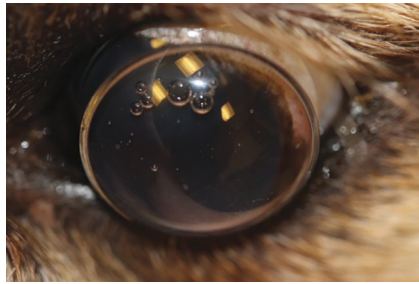


Figure 7. A lens is placed on the patients' cornea in order to perform Gonioscopy and have a look at the drainage angle.

Due to glaucoma being a painful disease, it is important to prepare owners for the potential need to enucleate the eye/s in uncontrolled cases. It is possible that by the time the patient has presented there is already irreversible damage to the ganglion cell axons in the region of the optic nerve head resulting in blindness. This information can be difficult to accept as an owner, however they should be supported and reassured that their pet can adapt very well to blindness as they rely on their other senses much more than we do as humans and they can still enjoy their usual activities (Figure 8). Recommendations for blind pets can include noisy toys, toys that are scented and food orientated games. There are helpful books available for owners such as Living with Blind dogs by Caroline D. Levin and Caring for a blind cat by Natasha Mitchell.

A recent study showed that following bilateral enucleation, owners were satisfied with the procedure and perceived their dogs to have a good quality of life (Hamzianpour et al., 2019).

In order to maintain vision for as long as possible and provide pain relief by controlling IOP, both medical and surgical options can be considered. At this stage, many factors are involved such as the cause of glaucoma, general health and temperament of the patient, owner compliance and costs of treatment.

If the patient has developed secondary glaucoma, of course it is important to treat the underlying cause and this will either be a medical or surgical approach. For example, if the patient has presented with a lens luxation and secondary glaucoma they may require surgery to remove the lens and in turn this should resolve the glaucoma.

Medical intervention

There are various topical medications that we can apply to the glaucomatous eye/s in an attempt to control the IOP.

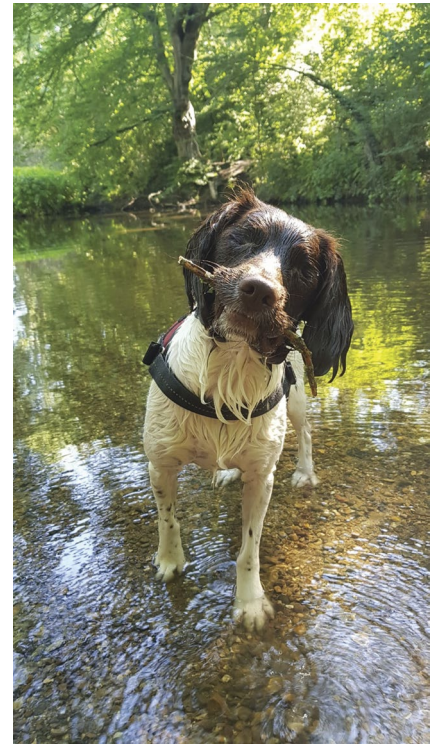


Figure 8. Maggie underwent bi-lateral enucleation due to glaucoma as a puppy and has adapted to life as a blind dog extremely well.

Carbonic anhydrase inhibitors decrease the production of aqueous humour. Initially their effect can be so dramatic as to reduce the IOP by up to 50% (Gould & McLellan, 2014). Examples of carbonic anhydrase inhibitors are Dorzolamide and Brinzolamide.

Topical prostaglandin analogues decrease IOP by increasing outflow. These are very potent IOP reducing medications and are often very effective in rapidly reducing IOP. (Strom, 2017). Examples of prostaglandin analogues are Travoprost and Latanoprost (Figure 9).

Topical beta-blockers reduce IOP by decreasing aqueous humour production, but the exact mechanism of this effect is not completely understood. Bradycardia and mild (bilateral) miosis associated with their use have been documented. (Armour, 2015) Examples of these medications include Timolol, Metipranolol, Levobunolol, and Betaxolol.

The acute rise in IOP in most canine glaucoma cases results in substantial pain which can be difficult to manage without a reduction in the pressure, but it can be the case, as in people with progressive open angle glaucoma, that animals (dogs or cats) with chronic glaucoma do not appear to be in pain (Williams, 2018). Pain relief through opiates, non-steroidal's and tramadol should be considered.



Figure 9. Eye medications used in the treatment of glaucoma.

Occasionally in glaucoma cases that are uncontrolled an aqueocentesis can be performed for emergency immediate relief. This is also sometimes required after cataract removal and post-operative ocular hypertension. Proxymetacaine is applied to the eye and a 27 G needle is inserted into the anterior chamber in order to remove a small amount of aqueous humour. Sedation may be required for this to be carried out safely.

Surgical intervention

When glaucoma is associated with angle closure, medical therapy alone is rarely successful. Even with the event of new agents for topical treatment such as those mentioned above, surgical intervention in the form of laser transcleral cyclophotocoagulation and drainage implant procedures should be considered (Barnett et al., 2003).

The surgical therapies described can be applied to cats. However, they are rarely performed as a result of usually late presentation and secondary nature of a large proportion of feline cases (Gould & McLellan, 2014).

Surgical procedures either aim to increase outflow of aqueous humour or aim to decrease the production of aqueous humour. Two new treatment modalities, laser transcleral cyclophotocoagulation and anterior chamber shunts have shown promise for the management of canine primary glaucomas (Gelatt, 2014). Endoscopic laser cyclophotocoagulation is also an option although it is more invasive than trans-scleral there are pros and cons to both methods.

IOP must be reduced to low normal range in patients prior to glaucoma surgery if at all possible (Gelatt, 2014).

Transscleral laser cyclophotocoagulation is a surgical procedure that can be used to reduce aqueous humour. Energy is developed by different types of lasers to destroy the ciliary body where the aqueous humour is formed. The lasers can be used in different animal species and can offer considerable

promise in the treatment of canine glaucoma (Gelatt, 2014). Since lasers are generally effective only on pigmented tissue, laser surgery is not suitable in pale/blue-eyed dogs (e.g., Siberian huskies) (Turner, 2005). It is usual to apply the laser probe between 30 and 40 sites around the circumference of the globe, avoiding the 3 and 9 o'clock positions (Turner, 2005).

These positions are avoided due to the blood vessels running through the sclera.

Haemorrhage, IOP spikes, and uveitis are postoperative complications associated with this procedure.

The laser energy can either be directed through the sclera or from within the globe. Endoscopic laser involves introducing an endoscopic camera with a light source and laser delivery system via two limbal incisions, through the pupil and under the iris. The ciliary processes can then be visualised and the tissues photocoagulated (Gould & McLellan, 2014).

The use of drainage implants has become popular in recent years and the use of various types of implant has been reported and amongst the most common in use in the UK is the Joseph implant.

A large silicone strap retained under the rectus muscles and covered by conjunctiva is joined to a silicone tube, which enters the anterior chamber at the limbus (Figure 10) (Gould & McLellan, 2014). Some implants have inbuilt valves to reduce the IOP dropping too low. Post-operative complications involve haemorrhage, uveitis, blockage of the tube with fibrin, scarring of the filtering bleb.

There are other surgical options such as cyclocryotherapy or pharmacologic destruction of the ciliary body with intravitreal injection of gentimycin. Decisions on which procedure to carry out will involve factors such as how advanced the glaucoma is, open or closed angle, if the eye is visual or not, overall health of the patient and of course costs.

Conclusion

There are various aspects to consider when managing a patient with glaucoma and the patient's quality of life and pain management should be priority. Glaucoma can be very painful in uncontrolled cases and appropriate pain relief should be provided. Despite attempts at therapy, cases of glaucoma may ultimately become end-stage and enucleation may be indicated (Gould & McLellan, 2014). Owner expectations should be managed at the very point of



Figure 10. A canine patient with a drainage implant in place.

diagnosis so that they are aware of the complications and challenges of glaucoma. A well-informed client will assist in the management of these cases and may have a better chance at observing painful episodes related to increased IOP at home.

Disclosure statement

No potential conflict of interest was reported by the author.

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