Cataract assessment – when to operate?

Cataract is a major cause of blindness in dogs and cats. Any opacity of the lens or its capsule – regardless of its size or location within the lens – is termed a cataract. Cataracts are presumed to be hereditary unless associated with known trauma, ocular inflammation, specific metabolic diseases or nutritional deficiencies (Belknap et al, 2015). Phacoemulsification for cataract removal is an elective procedure with several potential blinding and painful complications, so patient and owner compliance with postoperative treatment is vital.



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OPHTHALMOLOGY

The lens consists of the capsule (transparent and elastic), anterior epithelium (lens epithelial cells) and the lens fibres (the lens substance) and is divided into a nucleus (central) and cortex (outer area) (Maggs and Miller, 2008). The lens is held in position by the lens zonules that attach the lens to the ciliary processes of the ciliary body.

Towards its equator, the lens epithelial cells of the anterior epithelium proliferate, elongate and form new fibres which are laid down on the old fibres. The region where the lens fibres meet with each other is termed the Y-suture. The lens fibres become denser with age and nuclear sclerosis develops (**Figure 1**). The lens is avascular, therefore its metabolic needs are dependent on the composition of the aqueous humour and diffusion of solutes through the lens capsule (Maggs and Miller, 2008).



Figure 1. *The lens fibres become denser with age and nuclear sclerosis develops. (Photo: RVC)*

Cataract in dogs and cats

A cataract can be classified according to the degree of lens involvement and its stage of progression by incipient, immature, mature, hypermature and morgagnian cataract (Maggs and Miller, 2008; Gelatt et al, 2013) (**Figures 2-6**). The cortical, subcapsular, or Y-suture regions are most commonly involved and may or may not progress, depending on the cause of the cataract.

Examination of the lens, using a direct ophthalmoscope and classifying the cataract into one of the above categories, is important for further medical and treatment planning.

Inherited cataracts

These have a typical age of appearance, location within the lens and rate of progression. Therefore, describing the shape and the location of the cataract helps in identifying its type. For example, a posterior subcapsular triangular cataract in a Labrador/golden retriever is most likely inherited, generally very slowly progressive and does not interfere with vision (**Figure 7**).

There is a long list of dog breeds with suspected inherited cataracts, including: English cocker spaniel, German shepherd dog, miniature schnauzer, Staffordshire bull terrier, standard poodle, West Highland white terrier and many others. The full list can be found in the *Blue Book* of ocular disorders presumed to be inherited in purebred dogs, published in 2015 by the American College of Veterinary Ophthalmologists (Belknap et al, 2015).

Congenital cataracts

These are present at birth and are often diagnosed with other ocular developmental anomalies, such as microphthalmia (small eye globe), persistent hyaloid artery (the main vascular supply of the lens during embryo development) or persistent hyperplastic primary vitreous.

"Cataract surgery is an elective procedure; so careful patient selection is important to minimise risks and complications"



Figure 2. *An incipient cataract. (Photo: RVC)*



Figure 3. *An immature cataract. (Photo: RVC)*



Figure 4. *A mature cataract. (Photo: RVC)*



Figure 5. *A hypermature cataract. (Photo: RVC)*



Figure 6. *A morgagnian cataract.*

Age-related (senile) cataracts

These can have a variable clinical appearance and rate of progression, generally developing with advanced nuclear sclerosis. They most commonly start at the equator and appear as 'spokes of a bicycle wheel' (**Figure 8**). They are most commonly seen after the patient's eye has been dilated pharmacologically.

A study of over 2,000 dogs in the UK has shown the prevalence of these cataracts to be higher at 9.4±3.3 years of age (Williams et al, 2004). The same study reported that all dogs over 13.5 years of age had some degree of cataract. The rate of progression of senile cataract is generally slow – requiring months to years to cause significant loss of vision.

Rapidly developing, bilateral cataract

This is commonly associated with diabetes mellitus in dogs (not in cats). The lens levels of glucose increase with the blood glucose levels; which leads to a shift in the metabolism of the lens where the sorbitol concentration increases and the lens becomes hyperosmotic. This attracts water from the aqueous humour toward the lens, which then causes fibre swelling, vacuole formation and cataract (**Figure 9**).

Studies on diabetic cataracts failed to find an association between cataract development and the level of hyperglycaemia (Salgado et al, 2000). The majority of diabetic dogs will develop cataracts within six months of diagnosis, and approximately 80 per cent by 16 months of diagnosis as reported in a retrospective study in the US (Beam et al, 1999). In some cases, the cataracts develop within 24 hours, depending on the level of hyperglycaemia. Therefore, a dog presented with rapidly progressing cataracts should be suspected of diabetes mellitus.

Other causes

There are other possible causes of cataract formation, including:



Figure 7. *A propeller-shaped posterior subcapsular triangular cataract in a Labrador/golden retriever.*

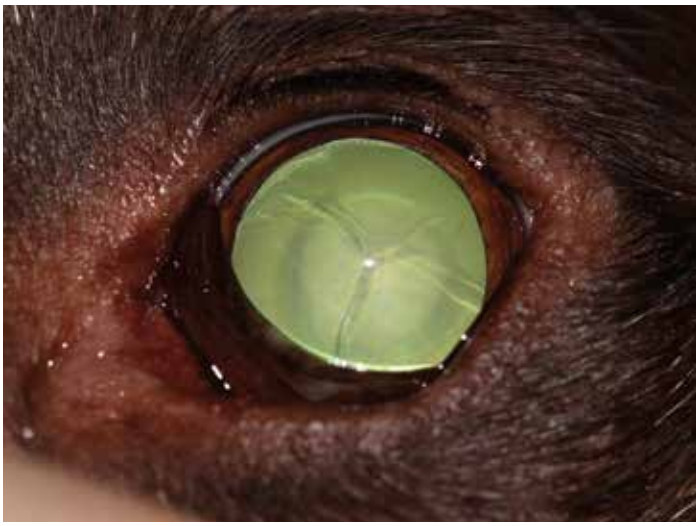


Figure 8. *Senile cataracts most commonly start at the equator and appear as 'spokes of a bicycle wheel'. (Photo: RVC)*

- traumatic cataract following blunt or penetrating trauma – most commonly cat scratch lens laceration
- toxic – imidazole-associated cataract owing to chronic ketoconazole administration, especially at higher doses in dogs
- other metabolic conditions – hypocalcaemia or hypercupraemia, for example
- secondary to intraocular disease – progressive retinal atrophy in dogs and uveitis in cats, for example.

Lens-induced uveitis (LIU)

Essentially, the lens is made up of 65 per cent water and 35 per cent proteins (Maggs and Miller, 2008). The lens proteins are divided into soluble (crystallins) and insoluble proteins. The proportion of insoluble proteins rises with age and during cataract development. The capsule is impermeable to large molecules but allows diffusion of water and electrolytes (Gelatt et al, 2013).

During cataract formation, the lens proteins break down and diffuse through the lens capsule into the anterior chamber. These molecules (lens antigens) are not recognised by the eye's immune system and they trigger an inflammatory reaction (LIU or phacolytic uveitis).

Lens-induced uveitis is an immune reaction of the uvea to the released lens proteins. This develops with the progression of the cataract toward a mature stage and can become severe in cases of hypermature/morgagnian cataracts.

Clinical signs vary and include mild to moderate conjunctival hyperaemia, darker or hyper-pigmented iris, miosis, reduced intraocular pressure (below 10mmHg); and, in severe cases, blepharospasm, corneal oedema, perilimbal deep corneal vascularisation. LIU occurring with lens capsule rupture (diabetic intumescent lenses or penetrating lens injuries) is known as phacoclastic uveitis (**Figure 10**).

If LIU is present, then this must be managed medically before the surgery (one to four weeks prior to surgery) with topical anti-inflammatory drops. The prevalence of complications is greater if there is lens-induced uveitis at the time of the surgery.

Clinical examination

In referral settings, cataract assessment and patient surgical selection starts with obtaining a full history, including breeding line, vaccination status, travel history, past/recent illnesses, recent traumatic events – cat scratch/lacerations, for example – vision history, and presence of ocular discomfort, discharge and increased opacity. It is important to determine if vision loss started prior to cataract development or any reported reduction in vision at night (nyctalopia) as this could indicate retinal disease.

A general physical examination is then performed to assess cardiovascular status, to look for signs of active infection (e.g. abscesses, gingivitis), concurrent diseases (e.g. diabetes, Cushing's syndrome, and hypothyroidism).

A full ophthalmic examination starts by performing a maze test – with obstacles in ambient and dim light conditions – followed by assessment of cranial nerves, visual reflexes, Schirmer tear test-1, intraocular pressures, fluorescein test, slit-lamp biomicroscopy, gonioscopy and indirect and direct ophthalmoscopy.

Testing visual reflexes should be performed prior to instillation of mydriatics. These include menace response, dazzle, direct and indirect pupillary light reflexes. A Schirmer tear test-1 (STT-1) should be measured prior to instillation of any eye drops for diagnosis of keratoconjunctivitis sicca and for obtaining a baseline preoperative result.

Most of the sedatives and anaesthesic agents were shown to reduce tear production from 24 hours up to two weeks post administration. Keratoconjunctivitis sicca should be addressed prior to surgery, owing to the presence of corneal vascularisation. Cases with STT-1 lower than 15mmHg Schirmer-tear test readings are treated initially for four to six weeks to improve ocular health prior to surgery. Also, corneal pigmentation may interfere with visualisation during surgery.

Intraocular pressures are measured by either applanation (Tonopen) or rebound tonometry (TonoVet) with a reported normal range of 15-25mmHg. In the presence of mature or hypermature cataracts, the intraocular pressures tend to be lower than 10mmHg as a consequence of LIU.

Progressive retinal atrophy (PRA) is an inherited, slowly progressive, retinal disease, in which the photoreceptors die off and secondary cataracts can develop. Dogs

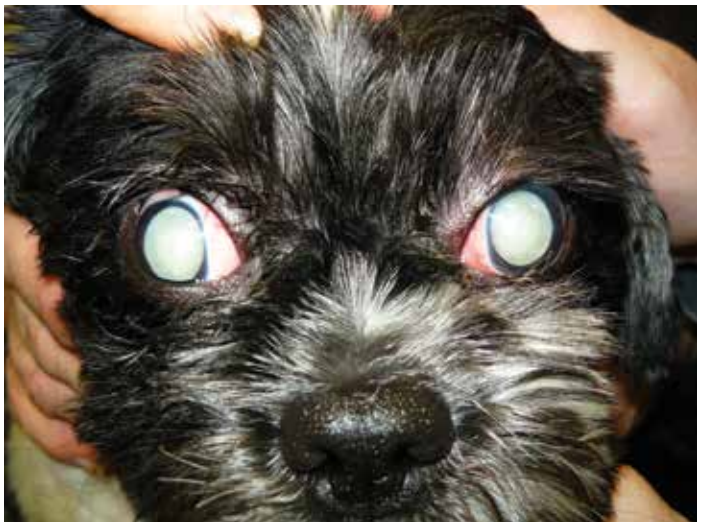


Figure 9. *Rapidly developing bilateral cataracts are commonly associated with diabetes mellitus in dogs. (Photo: RVC)*



Figure 10. *Lens-induced uveitis occurring with lens capsule rupture is known as phacoclastic uveitis.*

with PRA – English cocker spaniels and Labrador retrievers, for example – may be presented for cataract assessment. Cataracts in these cases usually develop late in the disease and are often posterior cortical, or equatorial and immature.

Performing phacoemulsification in these cases may only regain vision for a short period of time or no vision at all, depending on how advanced the disease process is. Therefore, prior to surgery, an electroretinography (ERG) is performed. If the electroretinogram's amplitude is low or flat, then the patient likely has retinal disease and his sight may not improve after cataract removal because of the already affected retina. In breeds such as the English cocker spaniel, with slowly progressive retinal atrophy, vision may be restored and maintained for a few months or years until there is complete loss of photoreceptors.

Gonioscopy allows visualisation of the irido-corneal angle using a special contact lens. This allows identification of goniodysgenesis or pectinate ligament dysplasia, which is a risk factor for primary glaucoma in dogs. This is performed before surgery to help guide advice on likelihood of postoperative complications, such as glaucoma.

Identifying the stage and location of the cataracts can be performed only after pupillary dilation with short-acting mydriatic drops, such as tropicamide (minims). Dilating the pupils should always be performed after assessment of pupillary light reflexes. In cases of mature or hypermature cataracts, the pupils will dilate very slowly owing to the presence of LIU. The tapetal reflection can be assessed by distant direct ophthalmoscopy – a cataract will appear black/dark on a tapetal background.

Surgery

The only treatment for cataract is surgical removal by phacoemulsification and implantation of artificial lenses.

Cataract surgery is an elective procedure; so careful patient selection is important to minimise risks and complications (Gelatt and Gelatt, 2011). Some cases require emergency surgery – intumescent lenses (diabetic lenses), lens capsule rupture (diabetic cataracts, cat laceration), severe LIU and cataractous anterior lens luxation, for example (**Figure 11**).

Generally, the prognosis is better if the cataract is removed early on, before LIU develops (Sigle and Nasisse, 2006). However, owing to the number of potential complications that can occur, some owners elect not to proceed with the surgery, or wait until their pet has a significant visual deficit.

Postoperative complications

There is a range of undesirable sequelae that can occur following cataract surgery:

- uveitis – present with all progressive cataracts, especially in the mature and hypermature stages; it requires long-term topical and/or systemic anti-inflammatory medication regardless of whether the patient undergoes cataract surgery or not
- retinal detachment – can be induced during surgery owing to traction on the vitreous, or postoperatively as a consequence of long-standing uveitis
- postoperative hypertension – transient increase in the intraocular pressure (>25mmHg) in the first 72 hours occurs in up to 50 per cent of cases (Klein et al, 2011); Labrador retrievers have an increased chance (33%) of developing postoperative hypertension compared to non-Labrador breeds (18%) (Moeller et al, 2011)
- wound dehiscence – invariably caused by self-trauma or uncooperative patients
- corneal ulceration – especially in diabetic or keratoconjunctivitis sicca patients
- hyphaema, fibrin, endophthalmitis
- glaucoma – according to a histopathological study on eyes enucleated after phacoemulsification surgery, the Cocker spaniel, Boston terrier, Labrador retriever, Bichon Frise, Shih Tzu and Jack Russell terrier may be at increased risk of the development of glaucoma following elective cataract surgery (Scott et al, 2013); Labrador retrievers are at an increased risk of glaucoma and blindness following phacoemulsification and postoperative hypertension and elderly patients are also risk factors
- posterior capsule opacification is the most



Figure 11. *A cataractous anterior lens luxation.*

common long-term complication – 62 per cent in one study (Sigle and Nasisse, 2006). It occurs as a result of metaplasia of the remaining lens epithelial cells which, when significant, can obstruct vision.

Summary

Phacoemulsification for cataract removal in dogs and cats is an elective procedure with several potential blinding and painful complications.

Patient and owner compliance with postoperative treatment and long-term commitment for close monitoring are important to minimise these complications.

The presence of lens-induced uveitis and diabetic intumescent lenses increase the risk of complications and require cataract removal as soon as the patient can withstand a general anaesthetic. Long-standing, untreated cataracts predispose the eyes to secondary glaucoma through chronic uveitis.

Specialist advice can be sought if unsure when to refer cataract patients. ■

The author wishes to thank Dr Charlotte Dawson for her support and advice in the writing of this article.

PPD Questions

1. The lens is made up of:
   A. 35 per cent water and 65 per cent proteins
   B. 65 per cent water and 35 per cent proteins
   C. 50 per cent water and 50 per cent proteins
   D. 80 per cent water and 20 per cent proteins.

2. A dog is presented with unilateral, sudden-onset blindness and upon examination you notice fully dilated pupils and an immature cortical cataract in both eyes. The rest of the clinical examination is unremarkable. There is no menace response, no dazzle reflex and no pupillary light reflexes in either eye. Funduscopy is impeded by the cataract changes; however, there is enhanced tapetal reflectivity and the retinal vessels appear thin. The most likely diagnosis is:
   A. bilateral retinal detachment
   B. progressive retinal atrophy
   C. optic neuritis
   D. diabetic cataracts.

3. A dog was presented with bilateral, sudden-onset blindness and mature cataracts have been diagnosed. Upon examination there is miosis, marked conjunctival hyperaemia and the intraocular pressures are 5mmHg in both eyes. Diabetes mellitus was diagnosed upon biochemistry and urinalysis results. When do you consider ophthalmology referral?
   A. start medical treatment for diabetes mellitus and refer when the levels of serum fructosamine are consistent with excellent control
   B. there is evidence of lens-induced uveitis; start topical anti-inflammatory drops and medical management for diabetes. Contact an ophthalmologist for advice if you suspect imminent lens capsule rupture. General anaesthesia and cataract surgery can be performed in unstable diabetic dogs as long as there is no ketoacidosis. Otherwise, refer when you see improvement in his clinical signs (polyuria/polydipsia)
   C. wait until the dog is showing obvious ocular discomfort
   D. cataract surgery is not recommended in diabetic dogs owing to the high risk of glaucoma postoperatively.

4. One of the following sentences is false:
   A. Labrador retrievers have a higher risk of postoperative hypertension (33%) compared to non-Labradors (18%)
   B. the English cocker spaniel is a breed that can be affected by progressive retinal degeneration; diagnosis is based on typical visual history (nyctalopia) and a flat ERG
   C. uveitis is only present in hypermature cataracts
   D. senile cataracts commonly start at the equator and appear as 'spokes of a bicycle wheel'.

Answers
1.B 2.B 3.B 4.C

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