Cataract in dogs - present and future

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Cataract is one of the major causes of vision impairment, especially in purebred and aged dogs. Surgical treatment for cataract is getting more and more popular in veterinary practice also. With growing concern of pet owners about the well being of their wards and also with increased awareness among public, the demand for such procedures are on a rise. With the implantation of artificial intraoccular lenses the visual acuity has been re established to near normalcy, which is another reason for enhanced public demand.

The normal crystalline lens is 65% water and 35% protein (in the form of alpha, beta, and gamma crystallins). About 85% of the total lens protein is made of soluble proteins, which, with age, tend to become more insoluble. The lens is transparent due to its highly ordered arrangement of lens fiber protein and its critical spatial variation in the refractive index relative to a wavelength of incident light. In young dogs, there is little difference between the density of inner lenticular nucleus and outer cortex. But as age advances, as the density or rigidity of the nucleus also increases and by about eight years of age, the nuclear sclerosis reaches such a level that the lens focusing ability is lost to a considerable extend. This type of age related loss of lens focusing ability is called presbyopia and is more significant in the case of humans, which necessitate the use of bifocals.

Strictly defined, a cataract is any opacity of the lens or its capsule, which may be congenital or inherited or caused by disease, toxicity, trauma or age. Biochemically fundamental mechanisms in the formation of any cataract include some form of osmotic stress (eg. Diabetes induced cataract), protein aggregation (individual crystalline proteins when clumped together can scatter light) and oxidative stress (adverse effects of oxidation and reduction reactions). The most common type of cataract in dogs occurs as a result of some inherited alteration in the lens protein metabolism. Many purebred dogs and their crosses are predisposed to developing this type of cataract. This may develop during the juvenile or early adult life of the dog. Cataract associated with advancing age is called as senile cataract, which can affect any dog. Cortical cataracts are associated with alterations in electrolyte and water balance where as nuclear cataract tend to be associated with protein modification. It is important not to confuse senile cataract with lenticular or nuclear sclerosis, which also occurs in aged populations. Nuclear or lenticular sclerosis is confirmed by ophthalmoscopy in which retinal details are not obscured, where as in cataract the opaque lens prevent visualizations of the retinal details. Another common cause of cataract in dogs is diabetes mellitus. When the level of glucose in lens exceeds the capacity of the glycolytic pathway, the glucose is converted to sorbitol, which cannot readily diffuse from the lens. As sorbitol accumulates, it creates an osmotic gradient that favors the movement of water in to the lens cells, ultimately rupturing them.

Cataracts are classified based on anatomic features or etiology or severity of the condition. Anatomically, they are classified either cortical or nuclear. Etiologically it could be inherited, diabetic or traumatic. Based on severity, cataract could be immature or incomplete,

mature or complete and hyper mature or resorbing cataract. Generally, the degree of completeness of a cataract is related to the amount or percentage of tapital reflection that it blocks. In a hyper matured cataract the lens material become liquefied and leaks out of the capsular bag.

The normal canine eye is typically within one diopter of emmetropia, ie, the light rays are focused sharply on the retina. The canine population as a whole shows a slight tendency towards hyperopia, ie, the light rays are focused behind the retina. Dogs are seldom affected by significant degrees of astigmatism (refractive power is not uniform in all meridians) or anisometropia (unequal refractive error in two eyes). Older dogs with marked lenticular sclerosis show signs of myopia, where light rays are focused in front of the retina. The accommodative capacity of the normal lens does not exceed 2 to 3 diopters and the visual acuity (the smallest identifiable object that can be seen at a specified distance) is estimated to be approximately 20/80 (a man with 20/80 vision sees an object at 20 feet what another with 20/20 vision sees at 80 feet). A typical canine eye without a lens or aphakia is approximately 40 diopters hypermetropic with an estimated visual acuity of less than 20/800. to correct this hyperopia, a lens implant with a diopter strength of approximately +41D (positive sign denote a lens with converging light rays) is needed to achieve emmetropia in most cases. A-scan biometry using ultra sound and keratometry help in assessing the proper refractive power of an intra ocular lens (IOL) needed to achieve postoperative emmetropia. In general, biometry results appear to be similar for all dogs with a possible exception of giant breeds, suggest that a lens with resolving power of approximately +41D is needed to approach emmetropia in majority of dogs. Considering the canine visual acuity, any small difference in refractive error is likely to be insignificant and hence a wide assortment of lens powers is not required.

Intraocular lenses have been designed for placement in the anterior chamber, the papillary space, the posterior chamber and the ciliary sulcus. By far, in-the-bag fixation (the posterior chamber) is considered safest site for primary implantation. Implanting the IOL in the capsular bag sequesters it from adjacent vascular tissue. Currently, the material of choice for both human and canine IOL is polymethyl methacrylate (PMMA) which is light weight, durable, bio compatible, non-antigenic, sterilizable and highly polished.

By convention the term extra capsular cataract extraction (ECCE) refers to an operation in which the lens nucleus and cortex, excluding the capsule are delivered through a limbal incision of about 20 to 25 mm length. The latest advancement in canine cataract surgery is small-incision cataract surgery, made possible by phacoemulsification, where a probe is inserted into the eye through a 2.7 to 3.5 mm limbal incision and the lens is fragmented before aspirating it. The incision is then widened to a size of 6 to 7 mm length in order to insert a PMMA lens. This technique has an advantage of less oprating time, minimal immediate post operative astigmatism, lower incidence of wound related complications and more efficient surgery. The phaco hand piece is inserted into the eye in order to fragment the lens material along with simultaneous irrigation and aspiration. Recently, surgeons in the west started using foldable IOL instead of rigid PMMA lenses so that, the folded lenses can be inserted through a keyhole incision, which is then unfolded, once properly positioned. These lenses are made of silicon or hydrogels or soft acrylics.

Complications of cataract surgery include endophthalmitis, glaucoma and retinal detachment. Complications that have been associated with PMMA-IOL in canine eyes, which may develop several years after cataract surgery, include haptic dislocation, papillary capture, pseudophakic corneal edema etc. with wide spread application of phacoemulsification technique and foldable lenses which has been recently introduced in veterinary practice, these complications can be still minimized and the acceptability of the procedure may increase further, so that better visual rehabilitation can be provided to more veterinary patients than before.