Mydriatic agents have both diagnostic and therapeutic applications in veterinary ophthalmology, while cycloplegic agents are particularly useful therapeutically. Adequate visualization of the posterior segment for diagnostic purposes is achieved through administration of mydriatic agents, while agents with combined mydriatic/cycloplegic activity help prevent formation of posterior synechiae and relieve ciliary body muscle spasm associated with inflammation. Additionally, mydriasis facilitates intraocular surgery, particularly cataract extraction and vitrectomy. Mydriasis may be achieved either through blockade of parasympathetic-mediated iris sphincter muscle activity (parasympatholytic, cholinergic antagonists) or through stimulation of sympathetic-mediate iris dilator muscle activity (sympathomimetic, adrenergic agonists). Agents that block the parasympathetic (PS) system also produce cycloplegia to varying degrees, while agents that stimulate the sympathetic (S) system do not result in cycloplegia. The onset of action, duration, and degree of maximal effect vary significantly among agents, species, and disease conditions.

An important concern in patients receiving cycloplegic mydriatic agents is the potential for exacerbation of or induction of an acute increase in IOP. The mechanism believed to induce an increase in IOP is a reduction in aqueous outflow, potentially due to the development of temporary (positional) peripheral anterior synechiae or relaxation of tension on the trabecular meshwork. Caution is warranted when considering use of cycloplegic agents in patients with primary glaucoma, as well as in patients with lens instability (mydriasis may enable anterior lens luxation). Sympathomimetic agents, which do not induce cycloplegia, actually decrease IOP (unless they induce angle closure).

**Adrenergic Agents**

Adrenergic agonists directly stimulate the α-adrenergic receptors of the iris dilator muscle, resulting in mydriasis without cycloplegia. In veterinary ophthalmology, they are generally used in combination with other mydriatic agents to achieve maximal dilation. Potential side effects associated with administration of these agents include systemic arterial hypertension with associated bradycardia, and while these side effects rarely produce clinical complications, it is prudent to use caution in animals with pre-existing cardiovascular disease that might be adversely affected by administration.

**Phenylephrine**

Phenylephrine is supplied as a 2.5 or 10% solution and is a direct-acting α1-agonist. It is most commonly used in veterinary ophthalmology as an adjunctive medication in a pre-operative regimen to achieve adequate mydriasis prior to phacoemulsification, as well as in the diagnosis of Horner’s syndrome (unopposed PS tone). Due to its efficacy in vasoconstriction of conjunctival vessels, it is also frequently administered prior to minor surface ocular procedures to limit bleeding, such as trimming the pedicle of a conjunctival graft. Its stability is adversely affected by exposure to air, light, or heat.

Ocular side effects reported in people include discomfort following instillation, as well as exfoliation of iridal pigment into the anterior chamber, which generally clears within 12-24 hours.

**Epinephrine**

Epinephrine is a direct-acting α- and β-receptor agonist. Due to relatively ineffective mydriasis, particularly following topical administration, its primary use is as an intracameral injection during intraocular procedures, to facilitate mydriasis and provide hemostasis. Used in this manner, it may be instilled as a 1:10,000 dilution or added to irrigating fluids at a 1:1,000,000 dilution. Regardless of the method, it must be preservative-free and bisulfate-free to avoid endothelial toxicity.
**Hydroxyamphetamine**

Hydroxyamphetamine is an indirect-acting adrenergic agonist, stimulating the release of norepinephrine from nerve terminals. It is used as a mydriatic agent in people, with an effect equivalent to that of phenylephrine or tropicamide alone, and may be additive when administered in combination. Its primary use in veterinary ophthalmology is for lesion localization in Horner’s syndrome. Due to its action on nerve terminal release of norepinephrine, rather than direct stimulation of terminal adrenergic receptors, hydroxyamphetamine fails to dilate the pupil in patients with post-ganglionic denervation, as these nerve fibers contain inadequate amounts of norepinephrine for release. Patients with central or preganglionic denervation will have normal norepinephrine concentrations in the post-ganglionic neuron, and will dilate in response to hydroxyamphetamine. (The adrenergic agonist activity of cocaine involves prevention of norepinephrine reuptake by the nerve terminal, allowing it to build up and maintain sympathetic stimulation. Therefore, when used in the diagnosis of Horner’s syndrome, cocaine does not allow lesion localization but confirms the diagnosis of sympathetic denervation.)

**Anticholinergic Agents**

Anticholinergics (antimuscarinics) reversibly block the cholinergic receptors on the iris sphincter muscle, producing mydriasis, and on the ciliary body, producing cycloplegia. Heavy iris pigmentation prolongs the onset and duration of action of most anticholinergics, with pigment serving as a slow-release reservoir of drug. It is important to remember that cycloplegia may induce elevations in IOP, and therefore such agents should not be used in individuals known to have glaucoma, or those at high risk for development of glaucoma.

**Tropicamide**

Tropicamide is available as a 0.5% and 1% solution, and is the most commonly used mydriatic in the exam room setting. It has excellent transcorneal penetration due to the fact that it is only minimally ionized at physiologic pH (unionized forms are better able to penetrate intact corneal epithelium). Tropicamide is less affected by intraocular pigment than are other anticholinergics.

**Atropine**

Atropine is available as 0.25%, 0.5%, 1%, and 2.0% solutions and 0.5% and 1% ointments. It is a potent mydriatic-cycloplegic indicated for therapeutic (versus diagnostic) use, with the degree of cycloplegia correlating to the degree of mydriasis. It is primarily in the ionized form at physiologic pH, causing it to have limited transcorneal penetration. While atropine is used for other disease conditions in humans (i.e., myopia, amblyopia), its primary indication in veterinary ophthalmology is in the treatment of uveitis. When treating uveitis, the response to topical atropine is attenuated by the degree of inflammation, with greater inflammation producing a lesser clinical response, and may be increased in the presence of ulceration (which allows greater intraocular penetration). Side effects include salivation, likely due to the bitter taste when the drug drains from the nasolacrimal duct to the mouth, and contact allergies which may result in periocular dermatitis.

**Homatropine**

Homatropine, similar to atropine but weaker and with a shorter duration of action, is available as 2% and 5% solutions. Even at its greatest extent, the degree of mydriasis achieved with homatropine is less than that achieved with atropine. Potential side effects and contraindications for homatropine are the same as those for atropine.

**Scopolamine**

Scopolamine (hyoscine) results in a similar degree of mydriasis to that seen with atropine, but has a shorter duration of action. It is available in a 0.25% solution, and the potential side effects and contraindications are similar to those of atropine. The incidence of idiosyncratic or toxic CNS (confusional
psychosis) reactions to scopalamine is greater than to atropine, and it is not a first line treatment for anterior uveitis. It can however, be used in patients with atropine hypersensitivity.

**Cyclopentolate**

The mydriatic and cycloplegic effects of cyclopentolate are comparable in degree and duration to those of atropine, however its primary use is to achieve cycloplegia for refractive procedures in humans. It may also be used in the treatment of anterior uveitis in people sensitive to atropine. It has a greater occurrence of CNS side effects than does atropine, consisting of cerebellar dysfunction and hallucinations.

**References**