Dosage Forms/Regulatory Status

VETERINARY-LABELED PRODUCTS: None

HUMAN-LABELED PRODUCTS:

Betaxolol HCl 0.5% and 0.25% Solution: 2.5, 5, 10, & 15 mL bottles; *Betoptic*® & *Betoptic - S*® (Alcon); (Rx)

CARTEOLOL

(***kar***-tee-oh-lole)

Indications/Pharmacology

Carteolol HCl is a nonspecific beta adrenergic blocking agent and it reduces aqueous humor production by decreasing cyclic-AMP synthesis in the ciliary body. Carteolol is a suitable substitute for timolol maleate or any of the other beta blocking agents although it is rarely used in veterinary medicine. In humans, similar IOP reducing effects have been shown for all members of this class. Substitutes are necessary when one particular product induces topical irritation upon application. As noted above, beta blocking agents seem to be particularly useful in the management of primary glaucoma in cats.

Suggested Dosages/Precautions/Adverse Effects

One drop twice daily of the 1% solution. While problems have rarely been noted in veterinary medicine, ophthalmic beta blockers should be used with caution in patients with bronchoconstrictive disease or congestive heart failure.

Dosage Forms/Regulatory Status

VETERINARY-LABELED PRODUCTS: None

HUMAN-LABELED PRODUCTS:

Carteolol HCl 1% Solution: 5, 10 & 15 mL bottles; *Ocupress*® (Otsuka America); (Rx)

LEVOBUNOLOL HCL

(lee-voe-***byoo***-noe-lole)

Indications/Pharmacology

Levobunolol HCl is a beta1- and beta2-blocking agent similar to timolol and metipranolol above but without the potential for myocardial depression or airway constriction noted rarely in veterinary medicine and occasionally in human patients. Levobunolol is used in humans with glaucoma responsive to beta adrenergic blocking agents but who suffer cardiac and respiratory side effects associated with timolol. Levobunolol HCl and then carteolol HCl would be suitable Beta blocking agents for feline patients with glaucoma and asthma, although carbonic anhydrase inhibitors should be used in such cases prior to adding a Beta blocking agent.

Suggested Dosages/Precautions/Adverse Effects

One drop twice daily of the 0.5% concentration. Miosis may develop in veterinary patients after application of topical beta blocking antiglaucoma medications.

Dosage Forms/Regulatory Status

VETERINARY-LABELED PRODUCTS: None

HUMAN-LABELED PRODUCTS:

Levobunolol HCl 0.25% or 0.5% solution: 5, 10, & 15 mL. *Betagan*® (Allergan); (Rx)

METIPRANOLOL

(meti-***pran***-oh-lol)

Indications/Pharmacology

Metipranolol HCl can be used as a substitute for timolol maleate (see above). Metipranolol is a nonselective beta blocking agent and reduces intraocular pressure minimally in animals by decreasing cyclic-AMP synthesis in the ciliary body. Pilot studies have suggested that metipranolol is as effective as timolol maleate, but is significantly less expensive then trade name timolol preparations, but not the generically labeled products. Metipranolol has been useful for the management of primary open angle glaucoma in cats.

Suggested Dosages/Precautions/Adverse Effects

One drop twice daily of the 0.3% solution. While problems have rarely been noted in veterinary medicine, ophthalmic beta blockers should be used with caution in patients with bronchoconstrictive disease or congestive heart failure.

Dosage Forms/Regulatory Status

VETERINARY-LABELED PRODUCTS: None

HUMAN-LABELED PRODUCTS:

Metipranolol Solution 0.3%: 2, 5, & 10 mL; *OptiPranolol*® (Bausch & Lomb); (Rx)

TIMOLOL MALEATE

(***tye***-moe-lole)

Indications/Pharmacology

Timolol maleate is used primarily to prevent the development of primary glaucoma in the contralateral eye of a dog which has developed primary glaucoma in one eye. It only reduces intraocular pressure 3–10 mmHg and, therefore is of minimal usefulness in patients requiring treatment of primary acute congestive glaucoma. Timolol's mechanism of action: decreases cyclic-AMP synthesis in non-pigmented ciliary epithelium resulting in decreased aqueous humor production. It may also cause slight miosis in dogs and cats. Timolol maleate is rarely used alone but is combined with dorzolamide solution (*Cosopt*®). Caution is advised with use of Beta blocking agents in cats with concurrent asthma. As timolol maleate is now available in generic form, it is the primary Beta blocker agent now used.

Suggested Dosages/Precautions/Adverse Effects

One drop twice daily of the 0.5% solution. The 0.25% concentration has minimal efficacy in animals and is not worth using. While problems have rarely been noted in veterinary medicine, ophthalmic beta blockers should be used with caution in patients with bronchoconstrictive disease or congestive heart failure.

Dosage Forms/Regulatory Status

VETERINARY-LABELED PRODUCTS: None

HUMAN-LABELED PRODUCTS:

Timolol Maleate 0.25% (see dosage above) or 0.5% Solution: 2.5, 5, 10, & 15 mL *Ocumeter*® bottles; *Timoptic*® (MSD); *Istalol*® (ISTA Pharmaceuticals); generic; (Rx)

Timolol Maleate 0.5% and Dorzolamide 2% Solution: 5 mL & 10 mL *Ocumeter*® bottles, *Cosopt*® (MSD); (Rx)

Carbonic Anhydrase Inhibitors

BRINZOLAMIDE HCL

(brin-***zoh***-la-mide)

Indications/Pharmacology

Brinzolamide is chemically similar to dorzolamide and reduces aqueous humor production by altering H+/Na+ active transport mechanisms associated with aqueous humor production in the ciliary epithelial cells. It can be used as a substitute for dorzolamide and some patients that exhibit excessive topical irritation following application of dorzolamide drops, tolerate brinzolamide better or vice versa. Cats seem to be particularly sensitive to irritation from topical dorzolamide and often brinzolamide can be used in these patients. Comparative data is available suggesting that brinzolamide and dorzolamide are equally effective in animal patients.

Suggested Dosages/Precautions/Adverse Effects

One drop three times daily is the standard treatment frequency, adjusted based on clinical response. May also cause stinging upon application like dorzolamide.

Dosage Forms/Regulatory Status

VETERINARY-LABELED PRODUCTS: None

HUMAN-LABELED PRODUCTS:

Brinzolamide HCl 1% solution: 2.5, 5, 10 & 15 mL containers; *Azopt*® (Alcon); (Rx)

DORZOLAMIDE HCL

(dor-***zole***-a-mide)

Indications/Pharmacology

Dorzolamide is often used in the contralateral eye of a dog with primary glaucoma to prevent development of bilateral disease. It is also an excellent agent to consider for most secondary glaucomas in dogs and cats because it has no effect on pupil size. Like the related oral carbonic anhydrase inhibitors (dichlorphenamide or *Daranide*®, methazolamide or *Neptazane*®), dorzolamide decreases aqueous humor production by the ciliary body epithelium by altering pH and affecting the H^+/Na^+ active transport exchange mechanism. Oral carbonic anhydrase inhibitors cause numerous systemic side effects such as metabolic acidosis and panting, diarrhea, vomiting, anorexia and others, all of which can be avoided with topical carbonic anhydrase inhibitors.

Suggested Dosages/Precautions/Adverse Effects

One drop three times daily is the standard treatment frequency, adjusted based on clinical response. Dorzolamide may cause stinging upon topical application, particularly in cats. Approximately 5–10% of humans will experience irritation with use of topical dorzolamide.

Dosage Forms/Regulatory Status

VETERINARY-LABELED PRODUCTS: None

HUMAN-LABELED PRODUCTS:

Dorzolamide HCl 2% Solution: 5, 10 & 15 mL; *Trusopt*® (Merck); (Rx)

Timolol Maleate 0.5% and Dorzolamide 2% Solution: 5 & 10 mL *Ocumeter*® bottles, *Cosopt*® (Merck); (Rx)

Prostaglandins (Ophthalmic)

LATANAPROST, BIMATOPROST, TRAVOPROST

(la-***ta***-noe-prost), (bi-***ma***-toe-prost), (***tra***-voe-prost)

Indications/Pharmacology

Prostaglandin analog drugs reduce intraocular pressure by increasing outflow of aqueous humor via the uveoscleral pathway. The major outflow mechanism in animals and people is through the iridocorneal angle, termed the "conventional outflow mechanism". A species variable alternative pathway directly across the surface of the iris into the iridal venous supply accounts for some outflow in people and animals. The horse apparently has the highest uveoscleral outflow of the domestic species studied. Latanoprost was the first drug marketed in this class. Prostaglandin analogues are an exiting class of topical medications for patients with glaucoma because they increase the alternative outflow of aqueous which logically would seem superior to reducing production or attempting to increase outflow through a failing conventional outflow system.

Latanoprost is marketed for once daily usage in people and clinical studies show reduced effectiveness when once daily treatment is exceeded. Despite this report in people, many canines are started on once daily treatment but with the progression of their glaucoma, further pressure management can be noted with twice daily administration. The canine uveal tract apparently metabolizes latanoprost at a rate higher than humans because the IOP reduction is profound, but only for 12–15 hours in most dogs. Latanoprost will provide the greatest amount of pressure reduction in canine primary glaucoma cases compared with any other single oral or topical agent. It is even more effective in combination with topical or oral carbonic anhydrase inhibitors. Latanoprost has been used in veterinary ophthalmology to treat primary and select secondary glaucomas in the dog although clinicians should assess the possibility of profound miosis associated with the use of this medication in their secondary glaucoma cases. Latanoprost has not been found to be useful in the management of glaucoma in cats.

0.003% bimatoprost (*Lumigan*®) and 0.004% travoprost (*Travatan*®) are similar to latanoprost both in mechanism of action and clinical indications. Since latanoprost does not seem to be effective for most forms of feline glaucoma, it is not likely bimatoprost or travoprost will prove effective in these cases either.