Table 12-2 Glaucoma Medications

Class/Compound	Concentration	Dosing	Mechanism of Action	IOP Reduction	Adverse Effects: Ocular	Adverse Effects: Systemic	Comments, Including Time to Peak Effect and Washout
Prostaglandin analogues							
Latanoprost	0.005%	Once daily	Increases uveoscleral outflow primarily; also increases conventional outflow	25%–32%	Increased pigmentation of iris and lashes, hypertrichosis, trichiasis, distichiasis, blurred vision, keratitis, anterior uveitis, conjunctival hyperemia, exacerbation of herpes keratitis, CME, prostaglandin-associated periorbitopathy	Flulike symptoms, joint/muscle pain, headache	±IOP-lowering effect with miotic Peak: 10–14 hours Washout: 4–6 weeks Maximum IOP-lowering effect may take up to 6 weeks to occur
Travoprost	0.004%	Once daily	Same as above	25%–32%	Same as above	Same as above	Same as above
Bimatoprost	0.03%, 0.01%	Once daily	Same as above	27%–33%	Same as above	Same as above	Same as above
Bimatoprost sustained-release	10 µg sustained-release implant	FDA-approved for one-time use	Same as above	~30%	Conjunctival hyperemia, pain, irritation, corneal endothelial cell loss, photophobia, iritis	None	Intracameral implant composed of bimatoprost in a poly(D,L-lactide-co-glycolide) polymer matrix
Tafluprost	0.0015%	Once daily	Increases uveoscleral outflow	27%–31%	Same as above	Same as above	Same as above
Latanoprostene bunod	0.024%	Once daily	Increases uveoscleral outflow; nitric oxide may also increase conventional outflow	~32%	Same as above	Same as above	Same as above
β-Adrenergic antagonists (β-blockers) *Nonselective*							
Timolol maleate	0.25%, 0.50% solution or gel 0.1% gel	Solutions: 1–2 times daily Gels: once daily	Decreases aqueous humor production	20%–30%	Blurred vision, irritation, corneal anesthesia, punctate keratitis, allergy; aggravation of myasthenia gravis	Bradycardia, heart block, bronchospasm, lowered blood pressure, decreased libido, CNS depression, mood swings, reduced exercise tolerance, masked symptoms of hypoglycemia, exacerbation of myasthenia gravis	May be less effective if patient is taking systemic β-blockers; short-term escape, long-term drift; diabetic patients may experience reduced glucose tolerance and masking of hypoglycemic signs/symptoms Peak: 2–3 hours Washout: 1 month
Timolol hemihydrate	0.5%	Same as above	Same as above	20%–30%	Same as above	Same as above	—
Levobunolol	0.25%, 0.5%	Same as above	Same as above	20%–30%	Same as above	Same as above	Peak: 2–6 hours
Metipranolol	0.3%	2 times daily	Same as above	20%–30%	Same as above	Same as above	Report of iritis Peak: 2 hours

Class/Compound	Concentration	Dosing	Mechanism of Action	IOP Reduction	Adverse Effects		Comments, Including Time to Peak Effect and Washout
					Ocular	Systemic	
Carteolol hydrochloride	1.0%	1–2 times daily	—	—	—	Intrinsic sympathomimetic	May have less effect on nocturnal pulse, blood pressure Peak: 4 hours Washout: 1 month
Selective							
Betaxolol	0.25%	2 times daily	Same as above	15%–20%	Same as above	Lower risk of pulmonary complications	Peak: 2–3 hours Washout: 1 month
α_2-Adrenergic agonists							
Selective							
Apraclonidine hydrochloride	0.5%, 1.0%	2–3 times daily	Decreases aqueous humor production	20%–30%	Irritation, ischemia, allergy, eyelid retraction, conjunctival blanching, follicular conjunctivitis, pruritus, dermatitis, ocular ache, photopsia, mydriasis	Hypotension, vasovagal attack, dry mouth and nose, fatigue	Useful in pre- or postlaser or cataract surgery Tachyphylaxis may limit long-term use Peak: <1–2 hours Washout: 7–14 days
Brimonidine tartrate preserved with benzalkonium chloride	0.15%, 0.2%	2–3 times daily	Decreases aqueous humor production, may increase uveoscleral outflow	20%–30%	Blurred vision, foreign-body sensation, eyelid edema, dryness, less ocular sensitivity/allergy than with apraclonidine, miosis	Headache, fatigue, hypotension, insomnia, depression, syncope, dizziness, anxiety, dry mouth	Highly selective for α_2-receptor Brimonidine should not be used in infants and young children Peak: 2 hours Washout: 7–14 days
Brimonidine tartrate preserved with Purite	0.1%, 0.15%	2–3 times daily	Same as above	Same as above	Same as above, except less allergy than with brimonidine 0.2%	Same as above, except less fatigue and depression than with brimonidine 0.2%	Same as above
Carbonic anhydrase inhibitors							
Oral							
Acetazolamide	125 mg	Seldom used for IOP-lowering therapy in adults	Decreases aqueous humor production	15%–20%	None	Poor tolerance of carbonated beverages, acidosis, depression, malaise, hirsutism, flatulence, paresthesias, numbness, lethargy, blood dyscrasias, diarrhea, weight loss, renal stones, loss of libido, impotence, bone marrow depression, hypokalemia, cramps, anorexia, taste disturbance, increased serum urate, enuresis	Use with caution in patients susceptible to ketoacidosis Contraindicated in patients with hepatic cirrhosis Adjust dose for chronic renal insufficiency Caution for using an oral CAI with other drugs that cause potassium loss Peak: 3–6 hours (sustained release) 2–4 hours (oral) Indicated for long-term therapy only in rare cases
	250 mg	2–4 times daily					
	500 mg (sustained release)	2 times daily					

(Continued)

Class/Compound	Concentration	Dosing	Mechanism of Action	IOP Reduction	Adverse Effects		Comments, Including Time to Peak Effect and Washout
					Ocular	Systemic	
Acetazolamide (parenteral)	500 mg 5–10 mg/kg	Usually every 6–8 hours	Same as above	Same as above	Same as above	Same as above	Same as above
Methazolamide	25 mg, 50 mg	2–3 times daily	Same as above	Same as above	Same as above	Same as above	Same as above
Topical							
Dorzolamide	2%	2–3 times daily	Same as above	15%–20%	Induced myopia, blurred vision, stinging, keratitis, punctate keratopathy, conjunctivitis, dermatitis	Less likely to induce systemic effects of CAI, but may occur; taste disturbance	Peak: 2–3 hours Washout: 48 hours
Brinzolamide	1%	2–3 times daily	Same as above	Same as above	Same as above, except less stinging when compared with dorzolamide	Same as above	Same as above
Parasympathomimetic agents (miotics)							
Cholinergic agonist (direct acting)							
Pilocarpine HCl	0.5%, 1.0%, 2.0%, 3.0%, 4.0%, 6.0%	2–4 times daily	Increases trabecular outflow	15%–25%	Posterior synechiae, keratitis, miosis, brow ache, cataract growth, angle-closure potential, myopia, retinal tear/detachment, dermatitis, change in retinal sensitivity, color vision changes, epiphora	Increased salivation, increased secretion (gastric), abdominal cramps	Exacerbation of cataract effect; more effective in lighter irides Peak: 1½–2 hours Washout: 48 hours
Anticholinesterase agent (indirect acting)							
Echothiophate iodide	0.125%	1–2 times daily	Same as above	15%–25%	Intense miosis, iris pigment cyst, myopia, cataract, retinal detachment, angle closure, punctal stenosis, pseudopemphigoid, epiphora	Same as pilocarpine; more gastrointestinal difficulties	Increased inflammation with ocular surgery; may be helpful in aphakia, anesthesia risks (prolonged recovery); useful in eyelid-lash lice, cataract surgery postoperatively
Rho kinase inhibitor							
Netarsudil	0.02%	Once daily	Increases conventional (trabecular) outflow, also decreases episcleral venous pressure	~20%–25%	Conjunctival hyperemia, subconjunctival hemorrhage, cornea verticillata, pain, blurred vision, increased lacrimation	None	—
Fixed combinations							
Timolol/ brinzolamide	0.5%/1%	2 times daily	Decreases aqueous humor production	25%–30%	Same as those of nonselective β-adrenergic antagonist, topical CAI	Same as those of nonselective β-adrenergic antagonist, topical CAI	—

Class/Compound	Concentration	Dosing	Mechanism of Action	IOP Reduction	Adverse Effects		Comments, Including Time to Peak Effect and Washout
					Ocular	Systemic	
Timolol/dorzolamide	0.5%/2%	2 times daily	Decreases aqueous humor production	25%–30%	Same as those of nonselective β-blocker, topical CAI	Same as those of nonselective β-blocker, topical CAI	Peak: 2–3 hours Washout: 1 month
Timolol/latanoprost	0.5%/0.005%	Once daily (nighttime)	Same as nonselective β-blocker and latanoprost	Greater than monotherapy with each individually	Same as those of nonselective β-blocker and latanoprost	Same as those of nonselective β-blocker and latanoprost	Not currently available in the United States
Timolol/travoprost	0.5%/0.004%	Once daily (nighttime)	Same as nonselective β-blocker and travoprost	25%–30%	Same as those of nonselective β-blocker and travoprost	Same as those of nonselective β-blocker and travoprost	Same as above
Timolol/bimatoprost	0.5%/0.03%	Once daily (nighttime)	Same as nonselective β-blocker and bimatoprost	Same as above	Same as those of nonselective β-blocker and bimatoprost	Same as those of nonselective β-blocker and bimatoprost	Same as above
Timolol/brimonidine tartrate	0.5%/0.2%	2 times daily	Same as nonselective β-blocker and α-agonist	Same as above	Same as those of nonselective β-blocker and α-agonist	Same as those of nonselective β-blocker and α-agonist	—
Brimonidine/ brinzolamide	0.2%/1%	3 times daily	Decreases aqueous humor production; may increase uveoscleral outflow	26%–36%	Same as those of the individual components	Same as those of the individual components	—
Latanoprost/ netarsudil	0.005%/0.02%	Once daily (nighttime)	Same as those of the individual components	31%–37%	Same as those of the individual components	Same as those of the individual components	—
Hyperosmotic agents							
Mannitol (parenteral)	20%	0.5–2.0 g/kg body weight	Creates osmotic gradient; dehydrates vitreous	—	IOP rebound, increased aqueous flare	Urinary retention, headache, congestive heart failure, diabetic complications, nausea, vomiting, diarrhea, electrolyte disturbance, confusion, backache, myocardial infarction	Contraindicated in patients in renal failure or on dialysis; caution in heart failure; useful in acute increased IOP
Glycerol (oral)	50%	1–1.5 g/kg body weight	Same as above	—	Similar to above	Similar to above; can cause problems in diabetic patients	Similar to above; may precipitate diabetic ketoacidosis

CAI = carbonic anhydrase inhibitor; CME = cystoid macular edema; CNS = central nervous system; IOP = intraocular pressure.