droppers are not generally available for personal use; consequently, loss of instilled medication using standard eye droppers is a common occurrence. The average dropper delivers about 25 to 50 µL/drop.

Because of the dynamics of the lacrimal system, the retention time of an ophthalmic solution on the eye surface is short, and the amount of drug absorbed is usually only a small fraction of the quantity administered. For example, following administration of pilocarpine ophthalmic solution, the solution is flushed from the precorneal area within 1 to 2 minutes, resulting in the ocular absorption of <1% of the administered dose (5,6). This necessitates repeated administration of the solution. Decreased frequency of dosing, increased ocular retention time, and greater bioavailability are achieved by formulations that extend corneal contact time, such as gel systems, liposomes, polymeric drug carriers, and ophthalmic suspensions and ointments (7,8). Systemic absorption of the active ingredient(s) that may result from drainage of the drug through the nasolacrimal duct and then swallowed can be minimized by applying gentle pressure to the lacrimal sac for 3 to 5 minutes after administration.

PHARMACOLOGIC CATEGORIES OF OPHTHALMIC DRUGS

The major categories of drugs applied topically to the eye are as follows:

- *Anesthetics*: Topical anesthetics, such as tetracaine, cocaine, and proparacaine, are employed to provide pain relief preoperatively, postoperatively, for ophthalmic trauma, and during ophthalmic examination.
- *Antibiotic and antimicrobial agents*: Used systemically and locally to combat ophthalmic infection. Among the agents used topically are azithromycin, gentamicin sulfate, sodium sulfacetamide, ciprofloxacin hydrochloride, ofloxacin, polymyxin B–bacitracin, and tobramycin.
- *Antifungal agents*: Among the agents used topically against fungal endophthalmitis and fungal keratitis are amphotericin B, natamycin, and flucytosine.
- *Anti-inflammatory agents*: Used to treat inflammation of the eye, as allergic conjunctivitis. Among the topical anti-inflammatory steroidal agents are fluorometholone, prednisolone, and dexamethasone salts. Nonsteroidal anti-inflammatory agents include diclofenac, flurbiprofen, ketorolac, and suprofen.
- *Antiviral agents*: Used against viral infections, as that caused by herpes simplex virus. Among the antiviral agents used topically are trifluridine, ganciclovir, and vidarabine.
- *Astringents*: Used in the treatment of conjunctivitis. Zinc sulfate is a commonly used astringent in ophthalmic solutions.
- *Beta-adrenergic blocking agents*: Agents such as betaxolol hydrochloride, levobunolol hydrochloride, metipranolol hydrochloride, and timolol maleate are used topically in the treatment of intraocular pressure and chronic open-angle glaucoma.
- *Miotics and other glaucoma agents*: Miotics are used in the treatment of glaucoma, accommodative esotropia, and convergent strabismus and for local treatment of myasthenia gravis. Among the miotics are pilocarpine, echothiophate iodide, and demecarium bromide. Several other types of agents are used in the treatment of glaucoma, including carbonic anhydrase inhibitors, such as acetazolamide (oral); beta-blockers, such as timolol; *alpha*-adrenergic agents, such as apraclonidine hydrochloride; sympathomimetics, such as dipivefrin hydrochloride; and an ester prodrug analog of prostaglandin F2a (e.g., bimatoprost, latanoprost, travoprost).
- *Mydriatics and cycloplegics*: Mydriatics allow examination of the fundus by dilating the pupil. Mydriatics having a long duration of action are termed *cycloplegics*. Among the mydriatics and cycloplegics are atropine, scopolamine, homatropine, cyclopentolate, phenylephrine, hydroxyamphetamine, and tropicamide.
- *Protectants and artificial tears*: Solutions employed as artificial tears or as contact lens fluids to lubricate the eye contain agents such as carboxymethyl cellulose,