formulation adjuncts, such as surface-active agents, have been shown to enhance nasal absorption of large molecules (18,21).

Pharmaceuticals on the market or in various stages of clinical investigation for nasal delivery include oxytocin (Syntocinon, Sandoz), desmopressin (DDAVP, Sanofi-Aventis), vitamin B_{12} (Ener-B Gel, Nature's Bounty), progesterone, insulin, calcitonin (Miacalcin, Novartis), propranolol, and butorphanol (Stadol, Bristol-Myers Squibb) (17,18).

OTIC PREPARATIONS

Otic preparations are sometimes referred to as ear or aural preparations. Solutions are most frequently used in the ear, with suspensions and ointments also finding some application. Ear preparations are usually placed in the ear canal by drops in small amounts for removal of excessive cerumen (earwax) or for treatment of ear infections, inflammation, or pain. Because the outer ear is a skin-covered structure and susceptible to the same dermatologic conditions as other parts of the body's surface, skin conditions are treated using the variety of topical dermatologic preparations discussed in Chapter 10.

Cerumen-Removing Solutions

Cerumen is a combination of the secretions of the sweat and sebaceous glands of the external auditory canal. The secretions, if allowed to dry, form a sticky semisolid that holds shed epithelial cells, fallen hair, dust, and other foreign bodies that make their way into the ear canal. Excessive accumulation of cerumen in the ear may cause itching, pain, and impaired hearing, and it impedes otologic examination. If not removed periodically, the cerumen may become impacted and its removal made more difficult and painful.

Through the years, light mineral oil, vegetable oils, and hydrogen peroxide have been commonly used agents to soften impacted cerumen for its removal. Recently, solutions of synthetic surfactants have been developed for their ability to remove earwax. One commercial product uses carbamide peroxide in glycerin and propylene glycol (Debrox drops, GSK). On contact with the cerumen, the carbamide peroxide releases oxygen, which disrupts the integrity of the impacted wax, allowing its easy removal.

Cerumen removal usually involves placing the otic solution in the ear canal with the patient's head tilted at a 45-degree angle, inserting a cotton plug to retain the medication in the ear for 15 to 30 minutes, and followed by gentle flushing of the ear canal with lukewarm water using a soft rubber ear syringe.

Anti-Infective, Anti-Inflammatory, and Analgesic Ear Preparations

Drugs used topically in the ear for their anti-infective activity include such agents as ciprofloxacin, colistin sulfate, neomycin, ofloxacin, polymyxin B sulfate, and nystatin, the latter agent used to combat fungal infections. These agents are formulated into eardrops (solutions or suspensions) in a vehicle of anhydrous glycerin or propylene glycol. These viscous vehicles permit maximum contact time between the medication and the tissues of the ear. In addition, their hygroscopicity causes them to draw moisture from the tissues, reducing inflammation and diminishing the moisture available for the life process of the microorganisms. To assist in relieving the pain that frequently accompanies ear infections, a number of anti-infective otic preparations also contain analgesic agents, such as antipyrine, and local anesthetics, such as pramoxine hydrochloride and benzocaine.

Topical treatment of ear infections is frequently considered adjunctive, with concomitant systemic treatment with orally administered antibiotics.

Liquid ear preparations of the anti-inflammatory agents hydrocortisone and dexamethasone sodium phosphate are prescribed for their effects against the swelling and inflammation that frequently accompany allergic and irritative manifestations of the ear and for the inflammation and pruritus