

**Anatomy of the external ear**

- Auricle (pinna): 3 tissue layers (cartilage, perichondrium, thin vascularized skin)
- External auditory (ear) canal (meatus)
  - Outer 1/3: mobile cartilage (hair, sebaceous and ceruminous glands)
  - Inner 2/3: rigid bone with thin skin
- Isthmus: narrowing of canal
- S-shaped: up & backwards to straighten to adults (down & backwards in children)

**Furuncles/boils of external auditory canal**

- Infection of hair follicles in outer 1/3 canal
- Pain exacerbated with chewing; hearing impaired by severe swelling
- REFER to physician for lancing & drainage

**Cerumen:** acidic (pH 5 – 7.2) to protect against bacteria & fungi

→ lubricates skin and traps foreign material

→ self-cleaning: new epidermal cells migrate from center of eardrum and out of canal

**Impacted cerumen:** accumulation of wax in auditory canal (S/S: fullness, deafness, tinnitus)

**Pathophysiology:**

- Excessive secretions
- Abnormal shaped ear canal
- Admixture of long hairs with earwax
- Use of cotton-tip applicators to remove wax

**Treatment:**

1. Solvents: wax softeners (olive/mineral oil, hydrogen peroxide) BID x 2-3 days before syringing
2. Syringing performed by trained professional

**Acute otitis externa**

**Bacterial OE:** inflammatory infection involving skin of external ear canal

→ 98% OE (*P. aeruginosa*, *S. aureus*)

Sx: otalgia (exacerbated by movement of tragus), pruritis, fullness, otorrhea, swollen ear canal, hearing loss

Signs (otoscopy): erythematous & edematous ear canal, possible cellulitis

**Pre-disposing factors:**

- Trauma
- Prolonged exposure to water (maceration & ↑pH)
- Systemic causes (diabetes, dermatitis)

**Treatment:**

- Cleanse ear canal: irrigate w/ warm water
- If severely swollen, insert cotton wick w/ Burow's soltn (leave in place for 24-48 h)
- Relieve pain: analgesics + local heat
- Control predisposing factors: avoid swimming for 7-10 days
- Abx eardrops (+ acidify ear canal) 2-4 drops tid-qid x 7-14 days (acetic acid aka Vosol or Buro-Sol; Polysporin)

**Fungal OE (otomycosis):** 10% of OE; occur in warm, moist climates; may follow overuse of abx ear drops

→ *Aspergillus niger* (90%); *Candida albicans*

Sx: itching; slight pain  
→ black exudate = *A. niger*  
→ brown gelatinous film = *Candida*

**Treatment:**

Clotrimazole 1% bid x 7 day  
Vosol, salicylic acid 2%  
Locacorten-Vioform

**Viral OE:** Herpes simplex or zoster

Sx: pain, blisters (vesicles, swelling)

Txt: keep canal dry; anesthetic eardrop

**Malignant OE:** *P. aeruginosa* spreads to cartilage & temporal bone → osteomyelitis (50% mortality)

Rare: elderly w/ poorly controlled diabetes or immunocompromised persons

**AVOID:** cotton swabs, hairpins in ear canal; water in canal

**Refer:** fever, malaise, bleeding, discharge, progressing ear pain or severe stabbing pain, hearing loss

**External ear drug delivery**

- Solutions/suspensions: most common (ability to travel down ear canal) but retention times can be short
- Ointment: only used for externally accessible regions

**Surfactants:** wetting agents in suspensions

→ non-ionic: tyloxapol

**Tonicity:** isotonicity is not a requirement for these formulations (unlike ophthalmic)

→ NaCl typically used

**Humectants:**

Glycerin: prevents bacterial growth (hygroscopic)

Propylene glycol: inhibits mold growth; non-greasy; useful for poorly water soluble drug

**Ototoxic drugs:** salicylates, furosemide, aminoglycosides, quinine, alcohol, nicotine

**Typical ear drops**

- Basic vehicle
- Local anesthetic
- Bacteriostatic agent
- Buffer
- Antiseptic properties
- Isotonicity

**Sterility:** must be sterile (comes in contact w/ tympanic membrane)

Multi-dose products contain preservatives (benzalkonium chloride or EDTA)

**Viscosity/thickening agents:** added to increase contact time with ear canal

→ non-ionic: celluloses and polyvinyl alcohol

**pH:** 3.5 – 7.5 in outer ear

→ low pH can kill bacteria

pH adjusting agents: NaOH, HCl or acetic acid

Phosphate buffers: sodium phosphate dibasic anhydrous & sodium phosphate monobasic monohydrate

**Carbamide peroxide:** white crystalline solid (urea/H<sub>2</sub>O<sub>2</sub>) that dissolves in water to release hydrogen peroxide

**Hydrogen peroxide:** oxidizes waxy substances

**Drug delivery to inner ear**

- Systemic route: limited by blood labyrinth barrier; high necessary concentrations lead to SEs
- Intratympanic route: injection of drug into middle ear followed by diffusion through round window into inner ear
- Intracochlear route: direct injection through tympanic membrane and round window