

TITLE: Complicated Otitis Externa

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Introduction:

Otitis externa is inflammation and infection of the external auditory canal (EAC) and is a common occurrence both in the emergency room and within the pediatric community. As such, it is important to recognize the common historical information, presenting symptoms, and physical findings associated with this condition in order to treat appropriately.

The auricle, or pinna, is the visible part of the ear located outside of the head. Its purpose is to collect sound. It does so by acting as a funnel, amplifying the sound and directing it to the ear canal. While reflecting from the pinna, sound also goes through a filtering process that adds directional information to the sound. The filtering effect of the human pinna preferentially selects sounds in the frequency range of human speech.

Embryology:

To better understand some of the congenital malformations that may predispose a patient to acquiring otitis externa, or to broaden your differential diagnosis in a pediatric setting, embryology is key. The auricle begins development during the 6th week of gestation. It is derived from mesoderm of the 1st and 2nd branchial arches, forming 6 His hillocks. Adult shape is attained by the 20th week of gestation, but the adult size is not reached until the age of 9 years.

The EAC begins to form during the 8th week of gestation, when the surface ectoderm of the 1st pharyngeal groove thickens and grows toward the middle ear. This core of tissue begins to resorb by 21 weeks gestation to form a channel that is complete by 28 weeks gestation. The canal ossifies completely by age 3 years and reaches adult size by age 9 years.

Knowledge of embryology will help especially in the case of preauricular cyst and fistula, where abnormal development of the first and second branchial arch may manifest as persistent

discharge or recurrent infection around the EAC. A draining sinus may be present anterior to the tragus; when infected, the cyst distends with pus and the overlying skin is erythematous. These lesions are managed by complete surgical excision if they become repeatedly infected. The facial nerve is at risk of injury during the excision of these lesions because of the close relationship of the preauricular cyst or fistula to the superior branches of the facial nerve within the parotid gland. First branchial cleft anomalies have a more complex embryologic origin than preauricular cysts and fistulas. These lesions may not have an obvious sinus tract on the skin and may manifest as an abscess extending deeply into the EAC, parotid, and/or neck.

Incidence and Symptoms:

Fortunately, malformations usually do not accompany the classic presentation of otitis externa and are generally easy to visualize upon examination. It should be noted that most ear canal infections are due to excessive moisture providing suitable conditions for bacterial overgrowth.

Statistically, acute otitis externa occurs in 4 of every 1000 people per year. Otitis externa is defined as chronic when the duration of the infection exceeds 4 weeks or when more than 4 episodes occur in 1 year.

Important clues for otitis externa reside in the patient history:

- 1 to 2 days of progressive ear pain
- Exposure to water
- Itching
- Purulent discharge
- Conductive hearing loss
- Feeling of fullness or pressure

Physical exam:

- sine qua non of otitis externa = pain on gentle traction of the external ear
- Periauricular adenitis
- Speculum examination reveals erythema, edema of the epithelium, and accumulation of moist debris in the canal
- The tympanic membrane may be difficult to visualize, may be mildly inflamed, but it should be normally mobile on insufflation
- Spores and hyphae may be seen in the external canal, if etiology is fungal
- Eczema of the pinna may be present and represent the 1st visible sign of external otitis to the examiner
- (CN) involvement is not associated with simple otitis externa.

Speculum findings:

- The canal may be so swollen that a view into the ear is impossible

- In swimmers, divers and surfers, chronic water exposure can lead to the growth of bony swellings in the canal known as *exostoses*. These can interfere with the drainage of wax and predispose to infection

Differential Diagnosis

Conditions that warrant exclusion prior to the diagnosis of simple otitis externa include:

Otitis media:

Otitis media is usually diagnosed by the combination of symptoms (ear pain and reduced hearing), and direct observation of an inflamed tympanic membrane with fluid behind it. Fever may be present and a recent history of an upper respiratory infection is likely. Hearing in otitis media and otitis externa is generally reduced in a "conductive" pattern, to a modest amount (20-50 dB). Auditory testing is often done to be sure that the condition is improving. The fluid behind the eardrum is associated with immobility and a "flat" tympanometer trace. Differentiation can be difficult, especially in the case of current otitis externa, where occlusion of the EAC prevents visualization of the tympanic membrane. In the absence of systemic symptoms and fever, treat the otitis externa first with topical antibiotics and wait to give oral antibiotics when symptoms persist.

Ramsay Hunt syndrome

This condition, more accurately known as herpes zoster oticus, is caused by varicella-zoster viral infection. Ramsay Hunt syndrome is characterized by facial nerve paralysis and sensorineural hearing loss, with bullous myringitis and a vesicular eruption of the concha of the pinna and the EAC. A painful otitis externa may be present as well. Treatment includes use of an antiviral agent (eg, valacyclovir) and systemic steroids. The role of facial nerve decompression remains controversial.

Furuncle:

Staphylococcal infection of a hair follicle is the usual cause of a furuncle. This infection occurs in the lateral cartilaginous hair-bearing portion of the EAC. On otoscopic examination, a furuncle is a localized infection, which may develop into an abscess, rather than the diffuse inflammatory process characteristic of otitis externa.

Skull base osteomyelitis:

This serious infection, also known as malignant otitis externa, occurs most often in patients who are diabetic or immunocompromised. The pathogenic bacteria are usually *Pseudomonas aeruginosa*. Other predisposing conditions include arteriosclerosis, immunosuppression, chemotherapy, steroid use, and other immunodeficient states. The diagnosis is strongly suggested by a history of diabetes mellitus, severe otalgia, cranial neuropathies, and characteristic EAC findings. The EAC may be filled with friable granulation tissue, which is primarily found inferiorly. Because this presentation may be identical to that of a soft tissue malignancy, prudence dictates a tissue biopsy, even if a history of diabetes mellitus is present. Bare bone of the EAC floor may be exposed; small bony sequestra may be observed

as well. CT scanning demonstrates bone erosion, and gallium scanning can be performed at points throughout treatment to monitor resolution. Treatment consists of administration of an antipseudomonal IV antibiotic such as ceftazidime (in some cases) or oral ciprofloxacin (in less dramatic cases). Extended treatment for at least 6 weeks is most appropriate. Hyperbaric oxygen therapy may also be effective. Surgical debridement is reserved for granulation tissue, necrosis and bony sequestra.

Preauricular cyst and fistula: previously discussed.

Lacerations:

Full-thickness auricular lacerations may be observed after blunt or sharp trauma. These injuries are managed surgically by closing both the perichondrium and the skin. In contrast, external canal lacerations may occur after attempts at cleaning the ear canal using cotton-tipped applicators. Microscopically replacing any skin flaps in their normal position, packing the ear canal, and administering topical antibiotic drops usually manage EAC lacerations.

Atopic dermatitis:

Drug sensitivity to topical antibiotic solutions is well known. Neomycin allergy occurs in up to 5% of patients treated with the medication. Suspect drug sensitivity if worsening of symptoms associated with skin excoriation and weeping occurs in the distribution of the topical medication exposure after application of drops. Metal sensitivity also manifests as excoriation, erythema, and edema around the exposure site (eg, a piercing hole). A common allergen is nickel, an impurity that may be present in precious metals. Atopic dermatitis is managed by removal of the allergen, such as an earring, and beginning topical steroid and antibiotics if the wound is secondarily infected. The diagnosis of metal sensitivity is confirmed by performing a skin patch test.

Cerumen impaction:

Cerumen impaction is the most common abnormality found on otoscopic examination, yet only a small proportion of the general population requires regular disimpaction because the EAC has the innate ability to produce and clear itself of cerumen. Cerumen may vary in color and consistency and may exist with other pathologies. Of note, debris in the EAC from cholesteatoma or tumors may be confused with cerumen, indicating that considerable care is required when attempting debridement of the EAC. Debridement may be accomplished with microinstruments or by aspirating the ear canal contents with a No 5 or No 7 Barton suction, while under direct vision through the otoscope or microscope. Irrigation of the ear canal is another option, but use of a pressurized irrigation system entails the risk of trauma.

Exostosis and osteoma:

The two most common bony lesions of the EAC, exostoses and osteomas, differ histologically and clinically. Exostoses tend to arise from the anterior and/or posterior floor of the medial EAC. Exostoses have a sessile base and are covered with normal-appearing skin. Both anterior and posterior exostoses may be found simultaneously. Osteomas may arise from any region of the bony EAC and often are pedunculated. Osteomas may also be either single or

multiple and are covered by normal skin. Exostosis and osteomas require surgical treatment only if they are so large that they lead to a conductive hearing loss or intractable otitis externa.

Foreign body:

Foreign bodies are not infrequently encountered in the EAC. In children, parts of toys or even food may be found in the EAC, and thus, appearance varies. In adults, fragments of cotton swabs are the most common finding. Erythema and edema surrounding the foreign body are commonly present. Using microinstruments, the foreign body may be removed under a microscope, depending on the patient's ability to cooperate.

Acute (bullous) and chronic (granular) myringitis:

Acute myringitis is usually caused by a mycoplasma or viral infection and is observed in adults and children. It is characterized by hemorrhagic bullae involving the tympanic membrane and a flulike syndrome. It is self-limiting and requires pain and fever management. Chronic myringitis is defined as deepithelization of the tympanic membrane, granulation tissue formation, and discharge. Treatment includes topical application of eardrops, a caustic solution in unresponsive cases, and mechanical removal of polypoidal granulations.

Organisms

The most common organisms causing otitis externa are:

1. *Pseudomonas* species
2. Staphylococci
3. Streptococci/Gram negative rods
4. Fungi (*Aspergillus* & *Candida* species)

On exam, it is important to note the observation of black dots (spores) within the EAC as this is highly suggestive of a fungal infection with *aspergillus niger*. In other fungal species the spores may be white or yellow.

In chronic otitis externa, although the canal wall is not swollen to the same extent as it is in the acute presentation, the skin is excoriated and red. The examiner should note that the drum is essentially normal in appearance without evidence of fluid behind the tympanic membrane.

Labs/workup

Usually after failed empiric therapy with topical antibiotics or antifungals:

- Bacterial and fungal culture
- Gram stain
- KOH prep smear (if available)
- Adults with otitis externa: screening blood glucose and/or a urine dipstick test to rule out occult diabetes.

Imaging

Imaging studies are not required for simple otitis externa. However, in patients with suspected malignant otitis media (diabetic or immunocompromised):

- CT scanning or MRI of the temporal bone
- triple-phase bone scanning
- gallium scanning

Treatment for simple Otitis Externa

First line treatment is topical application of various drying agents, antibiotics, or antifungals. Most preparations require an intact tympanic membrane in order to prevent damaging vital middle ear structures. Acetic acid acts as a drying agent and should not be used if a perforation is present. Neomycin, nystatin, and boric acid also should only be used with an intact tympanic membrane. It should be noted that ciprofloxacin and ofloxacin are safe to use with a perforated eardrum.

- Acetic acid with and without hydrocortisone (EarSol HC, VoSoL HC, Acetasol HC)
5-10 gtts in affected ear TID
- Neomycin, polymyxin B, and hydrocortisone (Cortisporin Otic)
5 gtt in affected ear TID
- Ciprofloxacin (Ciloxan)
5-10 gtt in affected ear BID
- Ofloxacin (Floxin)
-10 gtt in affected ear BID or 10 drops in affected ear QD
- Nystatin powder (Mycostatin, Nilstat) or boric acid powder
1-2 puffs from handheld nebulizer for 1wk

Case Presentation: ER consult

Mr. A.T is a 53 y/o Hispanic male with PMHx sig. for well controlled DM (HbA1C 6.5) and severe fungal otitis externa 7 yrs ago requiring gross debridement and hospitalization. CC: clear, non-purulent, non-odorous d/c from his left ear for the past 10 days following an URI. Pt. denies dizziness, increasing pain, or fever.

Physical exam:

Right Ear: right TM intact, non-erythematous, no fluid present

Left Ear: EAC appears white and wet with friable cheesy material present. Non-bloody.

Large central perforation present.

Next step in management

This patient has risk factors that include a PMHx of diabetes, past surgery on the ear that is symptomatic, past severe fungal infection, and a large perforation that limits the treatment available. It is now important to consider what labs should be ordered, remembering that the patient is not currently in severe pain or having other evidence of a systemic infection. In addition to laboratory studies, imaging studies could be considered if deemed necessary for

proper treatment. Does this patient simply need empiric therapy and follow up? If this is the plan, what medication(s) are indicated?

Treatment plan

Based on history and clinical presentation, the plan for this patient was to:

- Obtain fungal and bacterial cultures
- No imaging necessary
- Tolnaftate 1% topical in L ear BID x 7 days
- Ofloxacin 0.3% otic, 4 gtts in L ear BID x 7 days
- F/U in 2 wks

What if's discussion

Instead of the patient just discussed, what if on arriving in the ER for a simple external otitis consult you find that the patient has:

- Severe, unrelenting, deep-seated otalgia
- Temporal headaches
- Purulent otorrhea
- Dysphagia, hoarseness, and/or facial nerve dysfunction

Suspecting Malignant External Otitis (MEO)

The previous history and physical exam findings point to a more serious clinical picture that warrants immediate intervention. If malignant otitis externa is high on your differential, it is important to look for the following:

Physical exam:

- Inflammatory changes are observed in the external auditory canal and the periauricular soft tissue
- The pain is out of proportion to the physical examination findings
- Marked tenderness is present in the soft tissue between the mandible ramus and mastoid tip
- Granulation tissue is present at the floor of the osseocartilaginous junction. This finding is virtually pathognomonic of malignant external otitis (MEO).
- Fever is uncommon, but if present, it is usually $> 39^{\circ}\text{C}$

Orders

When suspecting MEO, it is imperative that the following labs are obtained:

- Cultures (bacteria & fungi)
- Glucose monitoring

Next step

The following should be performed in all cases:

- Admit patient
- Place on empiric IV antibiotics until organism is isolated through culture
- Pain relief (morphine or other appropriate analgesic)
- Once organism isolated, treat appropriately
- Consult Infectious Disease
- Use decreased severe pain as marker of improvement
- Surgery is necessary only if necrosis is present

Imaging

Appropriate imaging when high suspicion of MEO is present:

- CT scanning or MRI of the temporal bone
- triple-phase bone scanning
- gallium scanning

It should be noted that CT scan is the most readily available and best choice for evaluation of bone. All of these choices are present in the literature and are acceptable choices. Gallium scanning will be discussed in greater detail in regard to therapy continuation and assessing response to treatment.

Treatment

The following are highly recommended general guidelines for the care of MEO:

- meticulous glucose control
- aural toilet
- systemic and ototoxic antimicrobial therapy (fluoroquinolone)
- hyperbaric oxygen therapy
- debridement (generally reserved for exposed bone or necrosis)

Treatment options

The role of systemic antibiotics is essential in the treatment of MEO to prevent further spread of infection to bone or meninges.

- Ciprofloxacin 1500-2250 mg/d PO/IV divided bid/tid
 - Resistance seen in up to 33% of pts with MOE who fail initial outpatient treatment
- Ceftazidime 1-2 g IV q8h
- Ticarcillin/clavulanate (Timentin) 3.1 g IV q6h

Ciprofloxacin remains the current preferred treatment in mild to moderate cases. Severe cases warrant IV ceftazidime and, in conjunction with an Infectious Disease consult, combined drug therapy.

Duration of Treatment

This is a subject of debate and disagreement. Osteomyelitis of the skull base is the most severe form of malignant otitis externa and the following discussion represents a minority of cases encountered in general practice. However, if encountering a virulent case of MEO, current literature strongly suggests treating at least as long as osteomyelitis in any other location (minimum of 6 weeks of IV antibiotics).

Benecke et al developed a method of staging and monitoring this malady using gallium and technetium scanning techniques. Ga-67 accumulates in areas of active inflammation by binding to leukocytes and forming a complex with lactoferrin. Hence, nuclear scanning with gallium-67 will be positive for soft tissue and bone infections. Enhanced uptake will be present in areas of skull base osteomyelitis, but unlike the technetium-99 scan, it returns to normal sooner once the infection has resolved. They devised a staging system where Stage I is localized to soft tissues, Stage II is limited osteomyelitis, and stage III represents extensive skull base osteomyelitis. All stages were treated with appropriate anti-pseudomonal antibiotics. They recommended ending treatment 1 week after the gallium citrate scan findings return to normal and confirming this with a repeat scan 1 month after the treatment is stopped. Using this protocol, average duration of treatment was 8.8 weeks with a range of 4-17 weeks. It should be noted that this study followed 13 pts gathered over 4 yrs in the Los Angeles area, highlighting the extreme nature of these infections and their relative rarity.

Discussion by Dr. Mohammed Akabawy, Kaser Eleiny Medical School, Cairo University:

I would like to thank you and your faculty for this most interesting and high value subject, Complicated External Otitis.

It is important to mention these points:

1. In Ramsey Hunt Syndrome, the pain usually precedes eruption with by a few days.
 2. Infected sebaceous cyst is one of the differential diagnosis also.
 3. We see malignant otitis externa in old diabetics and immunocompromised patients, and it is similar in etiology and pathology to diabetic foot syndrome.
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