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Head and Neck Surgery Foundation  
(AAO-HNSF) Presents. . .**



## **Chapter 5: Otitis Media**

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One Prince Street | Alexandria, VA 22314-3357 | 1-703-836-4444 | Fax: 1-703-684-4288

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## Chapter 5: Otitis Media

**Editor: Mark K. Wax, MD. Authors: J. Gregory Staffel, MD; James C. Denneny III, MD; David E. Eibling, MD; Jonas T. Johnson, MD; Margaret A. Kenna, MD; Karen T. Pitman, MD; Clark A. Rosen, MD; Scott W. Thompson, MD; and Members of the Core Otolaryngology Education Faculty of the American Academy of Otolaryngology—Head and Neck Surgery Foundation**

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Dr. Gregory Staffel first authored this short introduction to otolaryngology for medical students at the University of Texas School for the Health Sciences in San Antonio in 1996. Written in conversational style, peppered with hints for learning (such as "read an hour a day"), and short enough to digest in one or two evenings, the book was a "hit" with medical students.

Dr. Staffel graciously donated his book to the American Academy of Otolaryngology—Head and Neck Surgery Foundation to be used as a basis for this primer. It has been revised, edited and is now in the second printing. This edition has undergone an extensive review, revision and updating. We believe that you, the reader, will find this book enjoyable and informative. We anticipate that it will whet your appetite for further learning in the discipline that we love and have found most intriguing. It should start your journey into otolaryngology, the field of Head and Neck Surgery.

Enjoy!

Mark K. Wax, MD

Editor: Primary Care Otolaryngology and Chair: AAO-HNSF Core Otolaryngology Education Faculty



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**Otitis media** may be thought of in terms of **Eustachian tube dysfunction**.

You probably recognize the sensation of acute eustachian tube dysfunction due to a cold (upper respiratory infection [URI]) or allergy. If the tube remains **obstructed, negative pressure devel-**

**ops** in the **middle ear** leading to **transudation of serous fluid**. When this is inoculated with **bacteria** from the **nasopharynx**, an acute otitis media develops. This is usually caused by ***Streptococcus pneumoniae***, ***Haemophilus influenzae***, or ***Moraxella catarrhalis***. **First-line antibiotic therapy** is either amoxicillin or trimethoprim and sulfamethoxazole for 10 days. The high incidence of resistant organisms has made treatment of acute otitis media much more complicated. Failure to respond to first-line therapy is an indication for a second-line drug resistant to **beta-lactamase** and effective against resistant *Streptococcus* organisms. Treatment

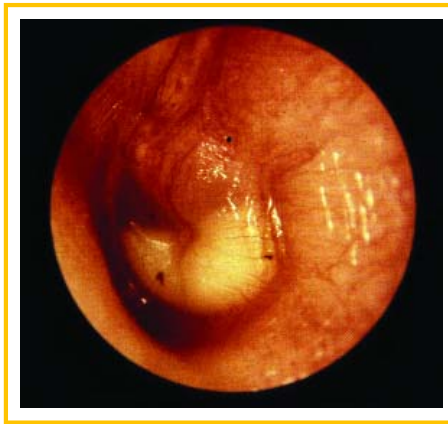


Figure 5.1.

This tympanic membrane demonstrates the bulging seen with an acute infection.



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choices will be dictated by the prevalence of resistant organisms in your community. A **tympanocentesis** (ear tap) may be appropriate to obtain a culture, especially in immunocompromised patients, in regions where resistant *S. pneumoniae* are common, and in cases that fail to respond to standard therapy.

At 2 weeks, 50% of these patients will still have fluid in their ears. By 10 weeks, only about 10% will have residual fluid. In many children, the cycle then starts all over again, and they may have 5 or 6 bouts of acute otitis media in as many months. This is called **recurrent acute otitis media**.

These children benefit from **pressure equalization (PE) tube insertion**.

Small tubes are placed in the **tympanic membrane (TM)** to "vent" the middle ear and prevent the negative

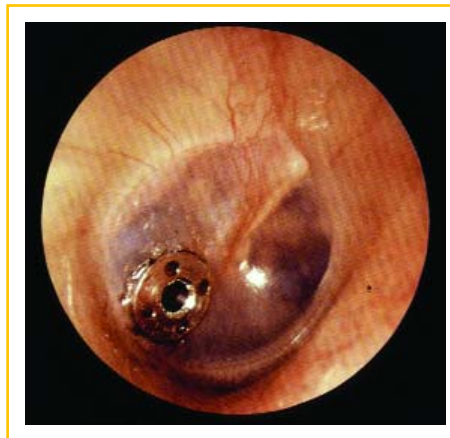


Figure 5.2.

Photograph of a tympanic membrane with a pressure equalizing (PE) tube in place. The tube permits aeration of the middle ear. It isn't intended for the drainage of fluid, as drainage through a PE tube represents infection.



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pressure buildup in the first place. Note that the tube isn't intended to drain the fluid, but is for pressure equalization. If the ears drain after tubes have been inserted, the patient has otitis media. Children often grow out of the eustachian tube dysfunction by the time the tubes extrude on their own (1-2 years). Rarely a 3- to 6-month trial of antibiotic prophylaxis recommended. This has been shown to **decrease the incidence** of recurrent acute otitis media, but **enhances the development of resistant organisms** and is controversial. If patients "break through" and have an episode while on prophylaxis, then tubes are indicated. You can **anticipate changes in practice recommendations over the next several years** due to the effect of prophylaxis on the development of resistant organisms.

A variant of acute otitis media occurs when blisters start to form on the outer surface of the tympanic membrane. This condition is **exquisitely painful** until the blisters burst. The condition is called **bullous myringitis** and these patients have such pain that they require very strong analgesics (hydrocone or oxycodone) as well as topical numbing ear drops containing benzocaine such as Auralgan. The pain usually arises quite quickly, and then subsides very quickly when the blisters burst. Antibiotic treatment is the same as for acute otitis media.



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Children with chronic eustachian tube dysfunction also develop **fluid without active infection**. Their eustachian tubes don't ventilate the middle ear space, and the fluid remains there without infection. This is **otitis media with effusion (OME)**. These patients may have up to a **30 decibel (dB) conductive hearing loss**. The hearing loss **affects speech development and learning**. Patients are often treated with antibiotics (even though the fluid isn't actually infected) because some studies show that such treatment will **clear up to 50% of the cases**. The idea is to **decrease the swelling** in the eustachian tube and **allow ventilation**. If the child is old enough, try to get him or her to "clear" the ears (**politzerization**) several times per day. If all these measures fail and hearing loss persists, then PE tubes should be placed. Treatment guidelines have been formalized that recommend placement of PE tubes if hearing loss persists for more than 3 months. An **adenoidectomy** is performed at the same time if the patient is getting his or her 2nd set of tubes. This usually prevents the re-accumulation of fluid in the ears. Children usually grow out of the need for the tubes as the eustachian tube assumes its longer and more downward slanted course with time.

**OME in an adult**, especially if it is **of recent duration and unilateral**, suggests a **disease process in the nasopharynx**. **Early nasopharyngeal carcinoma** is well



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known for its silent nature—usually the only sign is unilateral OME. Later in the disease process, the tumor **metastasizes** to the cervical lymph nodes and extends into the skull base, causing **cranial neuropathies**.

Nasopharyngeal examination is **mandatory** for any adult patient with unilateral OME. In the past, this was performed with mirrors, but most otolaryngologists now routinely use rigid and flexible endoscopic instrumentation.

### Complications of Acute Otitis Media:

Complications of acute otitis media were common in the pre-antibiotic era. It is largely because of those complications that otolaryngology developed as a specialty more than 100 years ago. Most physicians practicing today have never seen a case of **mastoiditis** or **meningitis** due to otitis media. However, **as the prevalence of resistant organisms increases**, especially Streptococcal pneumoniae, there is a chance that **these complications may become more common**. Therefore, even if you never see a case during your medical school years, you must know about these complications and be able to recognize them should you encounter them in your practice.

If untreated, acute otitis media can lead to **several complications**, one of which is **perforation of the eardrum**.



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**Purulence** must drain someplace, and this is the path of least resistance in the ear. Treatment is with both systemic and topical antibiotics, quinolones are the optimal choice; currently **ofloxacin otic solution (0.3%)** is the only topical agent approved for use in the presence of a tympanic membrane perforation. The perforation will often heal on its own; however, if it doesn't, this can lead to chronic otitis media, which by definition refers to a hole in the TM. Also, a **particularly severe infection can necrose the long process of the incus** by cutting off the blood supply. Although this occurs more commonly with a **cholesteatoma**, it can also occur with an acute infection. Another **residual effect** of acute otitis media can be **tympanosclerosis**, firm submucosal scarring that can appear as a chalky white patch on the TM. It can **infrequently lead to conductive hearing loss if the middle ear and ossicles are involved extensively**. Other complications of acute otitis media are more severe.

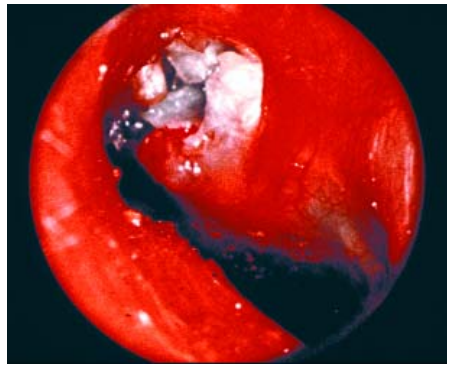


Figure 5.3.  
Otosopic view of left eardrum with cholesteatoma involving the pars flaccida. The white material is keratin filling the canal.



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Meningitis, for example, is felt to occur by **blood-borne spread** of the bacteria into the **meninges**. The most common offending organism for this was Haemophilus influenzae, though epidemiologic patterns may change with the advent of the Haemophilus influenzae vaccine. Of academic interest is that the method of spread to the meninges in **frontal sinusitis** is felt to be direct extension of **thrombophlebitis**, but in otologic complications, it is felt to be blood borne.

**Infection of the air cells in the mastoid** just behind the ear occurs when acute otitis media is present. However, if **the infection becomes more severe and invades the bony structures**, it becomes acute mastoiditis. The condition presents as **ear pain** associated with a **draining perforated eardrum**. Remember that once the TM has **ruptured**, in acute oti-

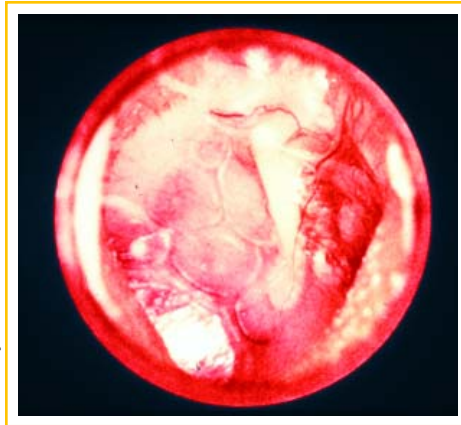


Figure 5.4.

Photograph of a tympanic membrane with chronic otitis media with effusion (COME). Note the bubbles in the fluid behind the drum. This is a common condition that affects children. Most will respond spontaneously and will not require surgical intervention.



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tis media there is **no pain**. If pain develops, usually 1 or 2 weeks later, you must consider mastoiditis. A CT scan is a useful diagnostic tool. The condition may resolve with intravenous antibiotics; however, it **may also require surgical drainage of the mastoid**. The complications of mastoiditis are legendary. Sometimes, a collection of pus can occur just outside the **dura**, termed an **epidural abscess**, and surgical drainage is required. The **sigmoid sinus can become infected, thrombose**, and serve as a **nidus of infection**. This classically leads to **showers of infected emboli**, causing "**picket fence fevers**." **Brain abscesses** can also occur as a result of acute otitis media, as can facial nerve paralysis. The **facial nerve paralysis** is felt to be due to **inflammation** around the nerve, and this generally responds to appropriate intravenous antibiotic therapy as well as drainage of the pus, through either a **myringotomy** or, if necessary, a **mastoidectomy**. It is possible that these complications, now rare, may become more common in the future.

Some people don't outgrow their eustachian tube dysfunction. They may suffer from chronic negative middle ear pressure. This can **retract part of the pars flaccida** of the TM back into the middle ear. The outside of the TM is lined with **squamous epithelium**, which **desquamates**. Over the course of time, the **keratinous debris** can get caught in the pars flaccida pocket. This can continue to accumu-



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late, expanding the pocket, and is then called a cholesteatoma, which often gets infected. The patients may be put on **antibiotic/steroid drops** and their drainage may get better, only to come back when the treatment is stopped. If the cholesteatoma is left untreated, it will **continue to grow and erode bony structures**. Possible sequelae include **hearing loss secondary to necrosis of the long process of the incus** due to pressure on a bone with a tenuous blood supply, **erosion into the lateral semicircular canal** causing dizziness, **subperiosteal abscess, facial nerve palsy**, meningitis, and brain abscess.

The treatment of cholesteatoma is surgical removal. They aren't cancers and don't metastasize. Remember that excision gets rid of the cholesteatoma, but not the eustachian tube dysfunction and sometimes these recur. A PE tube will prevent chronic negative middle ear pressure. Once patients have undergone surgery for removal of a cholesteatoma, they will need continuous monitoring of their ear for the rest of their life.

A cholesteatoma also can occur when squamous epithelium migrates into the middle ear space through a hole in the TM. The hole can come from a previous severe necrotizing infection, a previous PE tube hole that didn't heal, or trauma. **Marginal perforations are more likely to allow migration than central ones**. Remember that the TM has



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**3 layers: cuboidal epithelium in the middle ear, a fibrous layer, and squamous epithelium on the outside.** When there is a perforation, all 3 layers start to **proliferate**, but if the **squamous layer and the cuboidal layer meet**, the **fibrous layer will stop**. This can lead to a chronic perforation.

By definition, "chronic otitis media" means "TM perforation." The logic behind this older nomenclature is that the middle ear is constantly being exposed to the outside and has a low-grade inflammation chronically associated with it. Curiously, a **perforation usually doesn't cause much of a hearing loss**. In fact, even if the entire TM is gone, the hearing loss is only about 40 dB.

**Clinical Example:**

A 14-year-old comes to your office complaining of painless right ear drainage. He is otherwise healthy, although he did have PE tubes in his ears as a child. On examination, you find he has slightly turbid drainage coming from a hole in his right TM. You diagnose chronic otitis media and learn that he doesn't know he has a perforation. He hasn't been trying to keep water out of his ear. You assume he has a ***Pseudomonas aeruginosa*** infection and prescribe **ofloxacin otic solution (0.3%)** b.i.d. for 10 days. He returns in 2 weeks with a dry ear and a small residual TM perforation. What test do you order next? An



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**audiogram**, which shows a 15 dB **conductive hearing loss with normal discrimination** (ability to understand words). You tell the patient to keep water out of his ear. He comes back in 4-6 weeks and hasn't had any more drainage, so you refer him for a **tympanoplasty (repair of the hole in the TM)**.

**Tympanoplasty:**

**Tympanoplasty**, an operation to patch a hole in the eardrum, is done in a way you might not expect. It is generally performed **through the ear canal or from behind the ear**. The surgeon freshens up the edges of the hole (where the squamous layer has crossed over the fibrous layer and met the cuboidal layer). Then, because the fibrous tissue won't grow with squamous epithelium meeting cuboidal epithelium, a piece of **fascia temporalis** or **tragal perichondrium** is harvested as a **graft**. Small, semicircular cuts in the skin of the **external auditory canal (EAC)** are made about 5 mm out from the **annulus**. The surgeon scrapes the skin off the bone and sneaks under the annulus to the **medial aspect** of the TM. The middle ear is then filled with a sponge-like material made of hydrolyzed collagen, which acts as a scaffold holding the graft up against the medial aspect of the eardrum. Then the TM and skin are replaced and the EAC is packed. The collagen substance is eventually reabsorbed; meanwhile, the fibrous layer proliferates along the scaffold-



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ing of the graft to close the hole. We usually leave the ear alone for 3 weeks, then gently suction out any remaining collagen substance from the EAC.

Let's say a 49-year-old, male, nondiabetic comes to your clinic with a draining right ear. He says it has drained off and on for years. Once again, the ENT exam is normal except for copious purulence coming out of a TM perforation. You give him ciprofloxacin, 500 mg, orally BID and **ofloxacin otic solution (0.3%)** ear drops BID. You tell him to keep water out of his ear, which he does, and he comes back in 2 weeks, cleared up. You order an audiogram, which shows a 20 dB conductive hearing loss and good discrimination. He is then scheduled for a tympanoplasty in 6 weeks, but he comes in draining again in 2 weeks. He hasn't gotten his ear wet. You repeat medical therapy and, once again, he clears but drains a month later. He has a deep nidus of infection in his mastoid cavity that needs to be cleared. You schedule him for a CT scan, which shows no cholesteatoma, and then you perform a **tympanomastoidectomy**. At surgery, you find normal air cells throughout the mastoid cavity, with the exception of a few infected cells at the very tip of the mastoid. He does well postop.

Now, let's say you have the same history and you couldn't see a cholesteatoma by physical exam (you almost never can), but the CT scan shows it. The audio is the same. You



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perform the same operation (a tympanomastoidectomy) and remove the cholesteatoma. The patient does well postop. Did you notice that when patients present with a recurrent draining ear, appropriate therapy includes systemic antibiotics as well as antibiotic-containing topical eardrops? This includes patients who have a previously placed PE tube. Currently, there is a trend to use quinilone drops such as **ofloxacin otic solution (0.3%)** rather than neomycin-containing preparations due to the theoretical risk of neomycin-induced inner ear damage.

Drops alone are needed for uncomplicated **otitis externa (swimmer's ear)**. *P. aeruginosa* is the bug here, and it doesn't do well in an acidic environment. That is why many swimmers use half-strength vinegar for prevention. Remember: The sine qua non of otitis externa is **pain on traction of the pinna**. Tragal compression may also elicit discomfort. If you pull on the ear and it doesn't



Figure 5.5.

Fungal otitis externa. The white areas that resemble cotton are fungal filaments.



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increase the pain, the patient doesn't have otitis externa. If the EAC swells shut, you insert a small sponge, which wicks the drops down into the ear canal. Remember also that in diabetic patients, the infection can progress to necrotizing otitis externa.

### Questions, Section #5

1. The most common organisms causing otitis media are \_\_\_\_  
, \_\_\_\_\_  
and \_\_\_\_\_
2. The length of time acute otitis media should be treated for is \_\_\_\_\_
3. \_\_\_\_% of children with acute otitis media that have been adequately treated will still have fluid in their ears at 2 weeks.
4. \_\_\_\_% of children with successfully treated acute otitis media will have residual fluid in their ears at 10 weeks.
5. The presence of bilateral fluid in the ears may cause up to a \_\_\_\_\_ dB conductive hearing loss.
6. It is important to examine the \_\_\_\_\_  
\_\_\_\_\_ in any adult with unilateral otitis media with effusion.
7. PE tubes are not placed to drain fluid from the middle ear. They serve to \_\_\_\_\_ the ear.
8. The first thing you look at on an x-ray is \_\_\_\_\_



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9. The secret to becoming a good physician is to \_\_\_\_\_  
\_\_\_\_\_ for 1 hour every day.
10. The collection of trabeculated bony cavities lined with mucosa and connected with the middle ear are called the mastoid \_\_\_\_\_
11. The pars flaccida of the TM can become \_\_\_\_\_  
\_\_\_\_\_ when there is chronic negative pressure in the middle ear.
12. The outside of the TM, including the pars flaccida, is lined with \_\_\_\_\_ epithelium.
13. In the natural course of things, squamous epithelium tends to lose the stratum \_\_\_\_\_
14. As the stratum corneum desquamates off of a retracted pars flaccida, sometimes it can't easily reach the external auditory canal. If this occurs, the desquamated debris consisting mainly of keratin collects in the retracted pars flaccida. Over time, this can grow and become a \_\_\_\_\_
15. When surgically removing a cholesteatoma, it is important to remove all \_\_\_\_\_  
\_\_\_\_\_ epithelium that may have been retracted into the middle ear.
16. Desquamated epithelium can be a nidus of \_\_\_\_\_  
\_\_\_\_\_ in the middle ear.
17. If a patient presents with a draining ear, appropriate therapy includes drops and \_\_\_\_\_



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**Answers**

1. S. Pneumoniae, H. Influenzae, M. Catarrhalis
2. 10 Days
3. 50
4. 10
5. 30
6. Nasopharynx
7. Vent
8. the name
9. Read
10. Air Cells
11. Retracted
12. Squamous
13. Corneum
14. Cholesteatoma
15. Squamous
16. Infection
17. Antibiotics



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