II./3. : Diseases of the Middle Ear

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II./3.1.: Otitis Media

A numerous forms of otitis media are known: it can be serous, purulent, it can also be acute and chronic. These pathologies often do not appear independently, but they develop from each other (3). We will discuss the most important ones in detail, and mention the other types as well.

II./3.1.1.: Acute Serous Otitis Media

Etiology

Upper air-way inflammation (cold chills, viral or bacterial infection, maybe allergic process) develops because of wrong Eustachian tube function. It prevails for shorter than six weeks. At first the tympanic membrane looks ensconced, negative pressure is present in the tympanic cavity, then serous fluid is excretes (4).

Symptoms

pressure and blockage feeling in the ear, hearing loss.

Diagnosis

otoscopy (the tympanic membrane can be grained with yellowish liquid behind it).

tympanometry (flat tympanogram)

audiometric examination: mild (cca. 30 dB) hearing loss

examination of the nose is important and if it is necessary, endoscopic examination.

Therapy

Nasal sprays that brings down the nasal mucosa.

Taking air into the middle ear with Valsalva manoeuvre, or with Politzer ball

II./3.1.2.: Chronic Serous Otitis Media
for hearing decrease among children?

**Etiology**

The constant disorder of the Eustachian tube, if it persists more than six weeks, or if it frequently reoccurs.

The most frequent causes are hypertrophic adenoids, allergic mucosal disorders of the nose, sometimes with polyyp formation, chronic sinonasal inflammations (sinus maxillary and ethmoidal cells). The hypertrophy of the lower concha nasalis, septum deviation, inflammatory or tumoural lesions of the nasopharynx.

**Symptoms and diagnostics**

The symptoms the patient notices and the diagnosis is very similar to the acute form. The tympanic cavity can be totally or partly filled with fluid. In the second case we can see fluid level or sometimes bubbles behind the tympanic membrane.

The underlying reason has to be examined and possibly ceased.

**Complications**

tympanic membrane atrophy, sticking to the medial wall, ossicular chain damage, fixation

the tympanic cavity fluid condensation, fibroblast can grow inside, it can be a starting point for a recurrent acute purulent otitis media, and chronic otitis media, especially the so called cholesteatoma. The chronic, persisting Eustachian tube disorder can result in tympanosclerosis when the tympanic membrane atrophies its promontorium adheres and the ossicular chain mobility is greatly decreases, part of the ossicular chain bones can be damaged and may dissolve.

![Picture: Tympanosclerosis](image)

**Therapy**

restoration of the Eustachian tube function with removing the main cause

paracentesis in order to ensure the tympanic cavity pneumatization (the incision of the tympanic membrane), the suction of the excretion, implanting ventilation tube (Grommet) if needed.
II./3.1.3.: Acute Purulent Otitis Media

It occurs most frequently in small children, therefore pediatric viewpoints are also to be considered.

**Etiology**

Bacteria can get into the tympanic cavity through the Eustachian tube or through the blood stream.

often preceded with viral infection

Risk factors: Lack of lactation, over-crowdedness, poor hygienic conditions, malnutrition, passive smoking, the potential pathogenic bacteria immense nasopharyngeal colonisation, anatomical and immunological variations (Down syndrome).

**Symptoms**

Ear pain, fever, hearing loss, otorrhoea in case of perforation are general symptoms for children (irritability, lack of appetite, nausea, vomiting)

**Diagnosis**

Based on the otoscopical picture: in mild cases the tympanic membrane is grained and thickened.

In advanced cases the tympanic membrane cambers forward yellowish pus appears behind the membrane.

In case of perforation mucopurulent fluid excretes

Audiometric and tympanometric examination (showing conductive hearing loss and fluid in the tympanic cavity)
Plain x-ray or CT are only needed for complicated cases.

**Pathogens**

- Streptococcus Pneumoniae
- Haemophylus Influenzae
- Moraxella Catarrhalis
- Streptococcus pyogenes (7)
- Staphylococcus Aureus
- Group A β hemolizing Streptococcus
- Escherichia Coli
- Enterococcus Faecalis (8)

**Complications**

- ear pain, otorrhoea and hearing loss draws the attention to it
- vertigo nystagmus (serous or purulent labyrinthitis)
- skin rash behind the ear, swelling and sensitivity to pressure appears, “projecting ears” (mastoiditis)
- facial nerve palsy starts to develop
- thrombosis of the sigmoid sinus
- meningitis and brain abscess

**Therapy**
Antibiotics for seven-ten days (possibility of antibiotics resistance)

First line treatment: amoxicillin/clavulanic acid, cephalosporins (cefuroxime, cefprozil, ceftriaxone, cefixime), macrolides (erythromycin, roxithromycin, clarythromycin, azithromycin)

fluoroquinolons for adults (ciprofloxacin, levofloxacin, moxifloxacin) can be considered pain killers, anti-inflammatory drugs

adjuvant therapy nasal drops for children: the suction of the excretion in the nasal cavity, heating the ear region

**Paracentesis** in case of severe pain, fever, and cambered tympanic membrane, and beside antibiotic treatment if thickened grained tympanic membrane persists for a long time. The incision of the tympanic membrane is recommended to make local or general anaesthesia in its frontal inferior or dorsal inferior quadrants, to avoid middle ear damage. The excretion needs to be removed by suction from the middle ear, and culture is needed.

![Picture 7.: Unclosed opening of Paracenthesis](image)

**Treat the complications**: surgery and parenteral antibiotics (the today modern antibiotic treatment is suppressing the symptoms of the complications, that is why it is hard to recognise it.)

After the patient clinically feels better, fluid may still persist in the middle ear for several weeks, then we have to observe it closely. As profilaxis vaccines against flu and pneumococcus, and in the autumn-winter months amoxicillin in smaller dose can be given for several months.

**II./3.1.4.: Chronic Purulent Otitis Media**

The chronic otitis media is based on intermittent otorrhoea (it may cease for a shorter or even longer period), tympanic membrane perforation and conductive hearing loss. These symptoms could persist for months, in rare cases even for years. Two forms are known: mesotympanal and cholesteatomal form. In the former case the tympanic ring is intact, oval, and central real perforation persists, in the later case a perforation that destroys the tympanic ring and the bones is on the edge of the tympanic membrane. It starts typically from the , in rare cases from the , and it develops into the tympanic cavity.
Connection to the vestibular system chapter

Picture 8.: Chronic Purulent Otitis Media

Picture 9.: Chronic Purulent Otitis Media Cholesteatomal form

Picture 10.: On the left side: Pneumatised Tympanic Cavity, on the right side, the epitympanal part of the tympanic cavity is filled by cholesteatoma, which surrounds the ossicular chain bones (marked with rectangle)

Etiology
The main risk factors are mostly the same as discussed at the acute purulent otitis media.
Wrong Eustachian tube function can be originated from the acute purulent otitis media.

Symptoms
Intermittent otorrhoea
hearing loss,
fever, pain only if the inflammation acutely exacerbates
the complications and their symptoms are similar to what we discussed at the acute purulent otitis media. Ossicular chain damage is more frequent causing conductive hearing loss. If chronic inflammation persists for a long time, sensoryneural hearing loss occurs, which cannot be treated with surgery. (11)

Pathogens
Because of the tympanic membrane perforation, bacteria can easily get into the tympanic cavity.
Pseudomonas Aeruginosa
Staphylococcus Aureus

Diagnostics
During otoscopy and microscopic tympanic membrane examination we often
see dry central tympanic membrane perforation or mucopurulent excretion through the perforation.

*Figure 9.* Chronic Purulent Otitis Media Cholesteatomal form

In case of Cholesteatoma, edge perforation where whitish skin debris stays

collateral ear canal inflammation

polypos mucosal cambering

audiometric examinations and plain x-ray (sinus, Schüller) and when

necessary (complications) CT scan.

Culture.

**Complications**

Mastoiditis and inflammation can spread from the mastoid process into the

soft tissues. Abscess can appear (subperiosteal, cervical or skull base)

*Figure 11.*

*Figure 11-12.* Perisinus abscess with bloody content on the

right side at the border of the transverse – sigmoid sinus

1x1x3 cm precise epidural lesion is seen, which lifts the sinus

from its bony wall, the lumen of the sinus is very narrow, but

flow is visible. On the lateral surface of the cerebellum small

imprint is seen, the cerebellum is dislocated to the other side.

In the right middle ear cavity fluid can be seen.

Spread to the apex of pyramid (trigeminal) and abducent nerve is involved in Gradenigo syndrome).

Picture 14.: Otitis media with complications on MRI: pus at the pyramidal apex (marked with yellow circle), the left internal carotid artery is compressed >50%.

Picture 15.: CT image of otitis media with complications: cell system of mastoid process (marked with a square) and then the tympanic cavity (marked with an arrow) non-pneumatised on the apex of the pyramid bone the edge of the bone is blurry (marked with a yellow circle). The images were taken from the same patient, the CT and the MRI correspond with each other. Conducting both examinations the more complicated cases can be evaluated precisely.

Facial nerves palsy

When to think about the development of complications in case of middle ear inflammation?

Labyrinthitis, which can be circumscribed or diffuse. In the former case cholesteatoma causes destruction of the bony wall of the labyrinth in a small territory. Thus, in the ear canal the change of pressure causes vertigo, nystagmus (fistula symptom). In the later case excitement, then later drop-out vestibular and cochlear symptoms.

Meningitis, thrombophlebitis of sigmoid sinus, epi- and subdural abscess, brain abscess (fever, headache, nausea, irritability in the beginning, then later somnolence, and neurological symptoms).

Therapy

Surgery: the elimination of purulent process, closure of the tympanic membrane perforation, and the restoration of the ossicular chain (Mastoidectomy and tympanoplasty and the so called radical ear surgery in case of cholesteatoma).

Before the surgery, the otorrhoea, which causes the patient serious problems, can be treated with systemic antibiotics and local drugs, and the ear has to be dried out as well. However, this does not mean definitive solution; surgery is still necessary.
II./3.2.: Non-Inflammatory Changes of the Middle Ear

The ossicular chain fixation belongs to this disease group, when the movement of the ossicular chain and thus the capability of sound transfer is also bone. The most common cause of status fixation is otosclerosis, but there are ossicular chain fixations with different origin as well. In some rare cases bone metabolism pathologies can also cause hearing loss, such as osteogenesis imperfecta, Paget disease (osteitis deformans) and osteopetrosis.

Otosclerosis

It is a bone metabolism disorder of the bony wall of the cochlea. It appears only here, it is not typical for other bones. It involves both ears, and it occurs in women more frequently than in men.

Symptoms

The first symptom is the conductive hearing loss, and tinnitus. As the disease progresses, the level of the hearing loss increases and sensorineural hearing loss is also present beside the conductive one (mixed type of hearing loss). The appearance of the sensorineural component is most likely caused by inflammation and bone metabolism disorder, which causes penetration of toxic substances into the inner ear’s fluid compartments.

The hearing loss is caused by ossification of the stapes into the oval window. A tympanic membrane with reddish and pink colour is a very common symptom during the otoscopic examination (flamingo symptom, or Schwartze sign).

In the beginning, due to the inflammatory active lesions bone resorption occurs, that is why the bone gets spongy and then new bone structure forming makes the sclerosis visible.

Etiology

In its etiology genetic causes (failure of the genes coding the collagen synthesis), and measles virus infection can be suspected.

Diagnostics

With an otoscopic examination we can see an intact or maybe pinkish tympanic membrane.

During an audiological examination the threshold audiometry shows conductive hearing loss especially frequencies lower than 2000 Hz. The lace-shaped perception hearing loss (Carhart lace) is typical on 2000 Hz. During tympanometry tympanic cavity pressure is normal, the stapedial reflex cannot be triggered. Among the tuning fork probes the Gellé probe is typical for otosclerosis.

Therapy

Surgery where the mobility of the ossicular chain is restored. During stapedectomy the stapes is removed completely. During stapedotomy only a part is removed (on the basis of the stapes a hole is drilled) and is substitutes with prosthesis.

Sometimes incus laxation, facial nerve damage, labyrinth damage can occur as complications.

When the general condition of the patient or because of comorbidity the surgery is not recommended or if the patient does not want the surgery, rehabilitation is recommended with a hearing aid. In this case because of the
progress of the process, increasing conductive then sensorineural hearing loss and tinnitus has to be considered.

II./3.3.: The Tumours of the Middle Ear

Benign lesions

In case of cholesterin granuloma from the chronic persisting serous excretion in the middle ear cholesterol crystals precipitate inducing growth of granuloma due to immune reaction, mimicking benign tumour. Haemangioma and the tumour of the jugulare glomus causes pulse synchronised tinnitus, in case of huge tumour angiography and selective embolization is recommended before surgery.

Facial nerve neurinoma and eosinophil granuloma can sometimes also happen.

Malignant lesions

Adenoidcystic carcinoma and squamous cell carcinoma, which cause chronic purulent excretion thus it is hard to differentiate them from inflammations. Pain and facial nerve palsy are typical. Their prognosis is very bad, surgery is complicated.

Picture 16.: Patient, who has a history of radical ear surgery because of cholesteatome in the radical cavity squamous cell carcinoma developed on the left side pneumatised tympanic cavity, on the right side the wide based hiatus of the tegmen tympani is visible, and the cranial part of the pyramid bone, and the bony wall of the sigmoid sinus is also dissolved.