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OTITIS MEDIA

Minsk BSMU 2023

МИНИСТЕРСТВО ЗДРАВООХРАНЕНИЯ РЕСПУБЛИКИ БЕЛАРУСЬ
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СРЕДНИЙ ОТИТ

OTITIS MEDIA

Учебно-методическое пособие



Минск БГМУ 2023

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Отражены основы современных представлений об этиологии, патогенезе, клинко-лабораторных особенностях заболеваний среднего уха. Рассматриваются современные методы лечения различных форм среднего отита и их осложнений.

Предназначено для студентов 4-го курса медицинского факультета иностранных учащихся, обучающихся на английском языке.

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Ответственный за выпуск П. А. Затолока

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LIST OF ABBREVIATIONS

- AdOM — adhesive otitis media
AOM — acute otitis media
CSOM — chronic suppurative otitis media
CT — computerized tomography
ESR — erythrocyte sedimentation rate
ETD — eustachian tube dysfunction
OM — otitis media
OME — otitis media with effusion
PE tube — Pressure equalizing tube

MOTIVATIONAL CHARACTERISTIC OF THE TOPIC

Quantity of study hours: 6.

Otitis media (OM) is one of the most common types of infection and also the most frequent reason for outpatient antibiotic therapy. Young children are particularly susceptible to OM which globally affects over 80 % of children below the age of 3 years. OM may be associated with development of hearing loss and different, even life-threatening, complications. Thus, the high prevalence of OM among the population makes it important for every practitioner to know the methods of diagnosis, differentiation and treatment of various forms of OM. Besides, the diagnosis and treatment of OM present particular challenges in the pediatric age group. OM may have a negative impact on the quality of life, professional activity. Treatment of OM is accompanied by significant financial costs.

The purpose of the practical lesson is to gain knowledge about etiopathogenesis, clinical course, methods of laboratory diagnostics, principles of conservative and surgical treatment, possible complications of different forms of OM in pediatric and adult patients.

Lesson objectives are to:

- study the actual predisposing factors and etiology of different forms of OM;
- study the main clinical manifestations of different forms of OM;
- study the modern diagnostic options for different forms of OM;
- study the principal features of different forms of OM in pediatric patients;
- study most common extracranial complications of different forms of OM;
- study otogenic intracranial complications and methods of early diagnostic of this pathology;
- study up-to-date methods of treatment of different forms of OM;

Baseline knowledge requirements. Repeat:

– from the course of **Human Anatomy**: Structure of the middle ear; Innervation and blood perfusion of the ear;

– from the course of **Normal Physiology**: Function and physiology of the middle ear; Concept on the physiological condition of the cell, activation, inhibition, parabiosis, selective irritation response of the cell;

– from the course of **Histology, Cytology, Embryology**: Microstructure of the mucous membranes that lines respiratory tract and middle ear cavities;

– from the course of **Pathological Anatomy**: Morphological changes of the mucous membranes of the middle ear in case of inflammation;

– from the course of **Pathological Physiology**: Manifestation and consequences of impairment of Eustachian tube function;

– from the course of **Radiodiagnostics and Beam Therapy**: Assessment of the results of roentgenography, tomography, magnetic resonance imaging and computer tomography; Basic methods of roentgenologic diagnostics of the diseases of the ear and their interpretation; Roentgenologic symptoms of mastoiditis;

– from the course of **Microbiology, Virology, Immunology**: Nasal cavity and nasopharynx microbiology; Technics of sampling of microbiological material; Microbiological diagnostics of infectious diseases;

– from the course of **Pharmacology**: Characteristics and action mechanism of antimicrobial drugs; The mechanism of action of antiseptics and analgesics.

Control Questions from Related Disciplines:

1. Describe anatomy of each wall of the tympanic cavity.
2. Enumerate the parts of the middle ear.
3. What is the function of the mucous membrane that lines the middle ear spaces.
4. What are the 5 cardinal signs of inflammation?
5. What are the different types of inflammation?
6. What are the radiological signs of purulent effusion, edema, bone destruction?
7. Explain the function of the Eustachian tube.
8. Enumerate the main groups of antibacterial drugs. Explain the mechanism of their action, activity, side effects.

Control Questions on the Topic:

1. Classification of OM.
2. Etiology of Eustachian tube dysfunction.
3. Treatment of Eustachian tube dysfunction depending on the duration of the disease.
4. Causative microorganisms of an acute otitis media.
5. Symptoms of an acute otitis media.
6. Treatment tactics for an acute otitis media.

7. Indications for tympanotomy.
8. Clinical features and diagnosis of mastoiditis.
9. Clinical features and diagnosis of different forms of otitis media with effusion.
10. Management of otitis media with effusion.
11. Explain difference between chronic mesotympanic and epitympanic otitis media.
12. Management of chronic suppurative otitis media.
13. Explain the difference between cortical and radical mastoidectomy.
14. Possible complications of OM.

Tasks for independent work of students:

1. Determine the required minimum of examination for patients with different forms of OM.
2. Analyze the results of X-ray and CT for curated patients.
3. Analyze the results of cultural methods for the patients with acute and chronic suppurative otitis media.
4. Draw up an examination and treatment plan for a patient with mastoiditis.
5. Plan the treatment for the patients with different forms of OM.

DEFINITION AND CLASSIFICATION OF OTITIS MEDIA

Otitis media is any inflammation of the middle ear spaces. It is very common in children.

The following types of pathology of middle ear could be distinguished:

- Eustachian tube dysfunction and inflammation;
- Acute otitis media;
- Mastoiditis;
- Otitis media with effusion;
- Adhesive otitis media;
- Chronic suppurative otitis media.

EUSTACHIAN TUBE DYSFUNCTION

Definition. The Eustachian tube is a narrow tube which links the nasopharynx to the middle ear. It is normally closed but it opens during swallowing, yawning or chewing. The Eustachian tube has three main functions: to protect the middle ear from pathogens, to ventilate the middle ear and to drain secretions from the middle ear spaces. Eustachian tube dysfunction (ETD) is the inability of the Eustachian tube to adequately perform these functions.

Etiology. The Eustachian tube dysfunction follow the onset of an infectious or inflammatory condition such as an upper respiratory tract

infection, allergic rhinitis or rhinosinusitis, leading to difficulties in pressure equalization, discomfort and other symptoms. Dysfunction of the Eustachian tube may also be related to nasal septal deviation. One of the most common reasons for ETD in preschool age children are adenoids and adenoiditis. Enlarged or inflamed adenoids mechanically obstruct pharyngeal orifice of the Eustachian tube. Tumors or trauma may also result in extrinsic compression of the Eustachian tube and lead to its dysfunction.

The incidence of ETD is high in patients with cleft palate due to failure of the muscles associated with Eustachian tube opening.

Other potential risk factors include tobacco smoke and reflux.

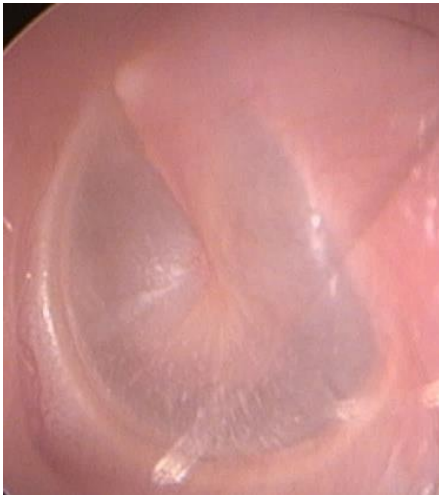


Figure 1. Left ear. Normal appearance of the eardrum in patient with ETD

Clinical features and diagnosis.

Symptoms of ETD include: aural fullness, muffled or reduced hearing, difficulty popping ears (more common), tinnitus, disequilibrium, intermittent sharp ear pain (less common). Otoscopy is characterized by lack of findings: eardrum appears indrawn, light reflex is deformed, however in some cases eardrum remains intact (Figure 1). Pharyngeal end of the eustachian tube can be examined by posterior rhinoscopy, rigid nasal endoscopy or flexible nasopharyngoscopy. This examination reveals the extrinsic causes of auditory tube obstruction.

Tympanometry is one of the most useful of all tests in association with ETD. It is used to measure middle ear pressure. The device has a soft probe that seals the ear canal tightly, a sound generator, a microphone to detect the returning energy and a vacuum pump that alters the pressure. Tympanometry measures acoustic admittance, that is the ease of sound energy go through the middle ear to the liquids of the cochlea. The tympanic membrane and middle ear act as a transformer. Sound energy has a maximal admittance from the ear canal into the middle ear when the air pressure on both sides of the eardrum is equal. The resulting curve of this measurement is a tympanogram, a graphic presentation of the acoustic admittance of the middle ear as a function of altered air pressure. The highest peak is called the tympanometric peak. Its position on the x-axis indicates tympanometric peak pressure. It is an indirect estimate of pressure in the middle ear. Normally, the peak pressure is at 0 daPa. The basic types of tympanogram are as follows: type A curve indicating normal middle ear pressure, type B curve (flat peak/no peak) indicating decreased or low admittance suggesting effusion in the middle ear and type C curve (peak is in the negative zone) suggesting ETD (Figure 2).

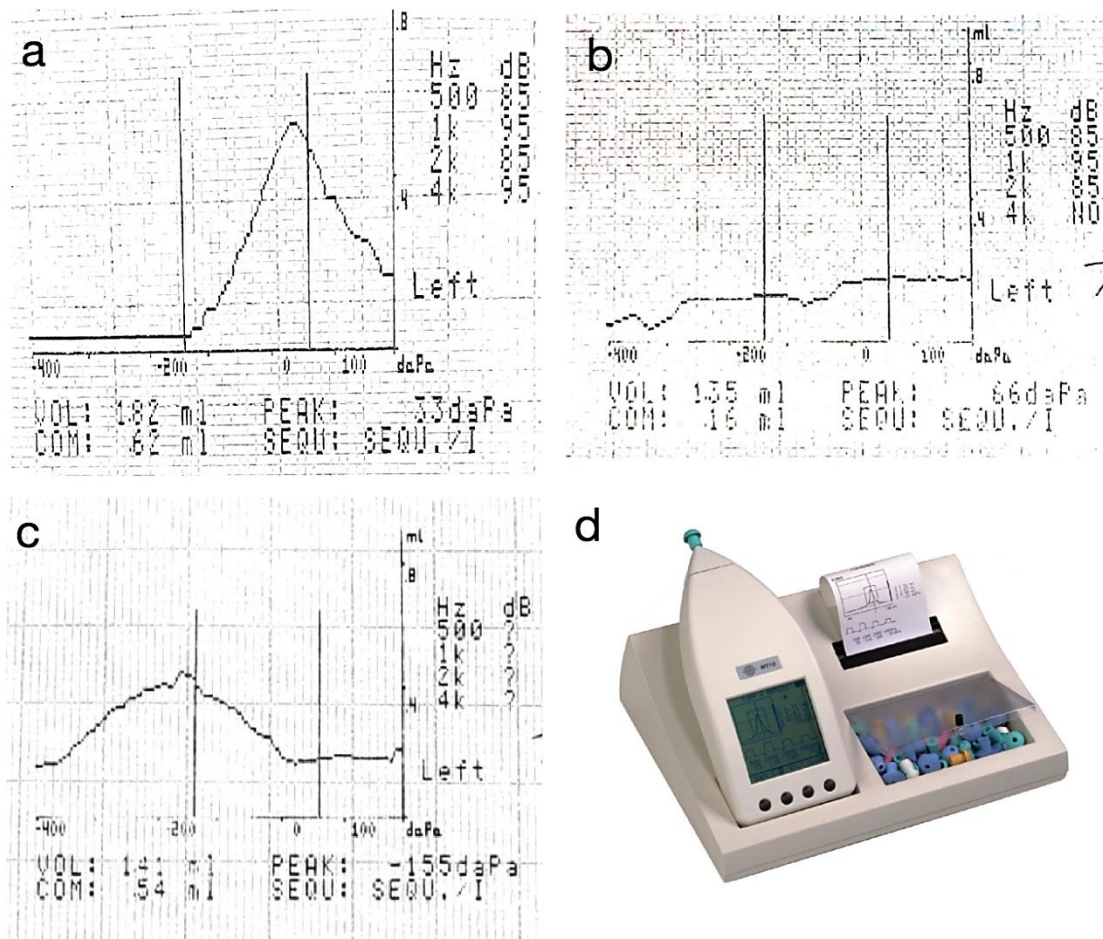


Figure 2. The basic types of tympanogram:

a — type A curve; b — type B curve; c — type C curve; d — MT10 Impedance Tympanometer

Treatment. Symptoms of ETD are often mild and generally resolve after treatment of underlying disease (adenoidectomy etc.). However, symptoms sometimes persist, in which case non-surgical or even surgical treatment may be indicated. Treatment choice is based on etiology, severity and persistence of symptoms.

Non-surgical treatment include:

- Simple actions, which includes swallowing, yawning, or chewing to help equalize the pressure in the middle ear.

- Pressure equalization method, which is a technique whereby the Eustachian tube is reopened by raising the pressure in the nose. This can be achieved in several ways, including forced exhalation against a closed mouth and nose (Valsalva maneuver) and blowing up a balloon through each nostril.

- Nasal douching, in which the nasal cavity is washed with a saline solution to flush out excess mucus and debris from the nose and sinuses.

- Decongestants, antihistamines, nasal or oral corticosteroids which are aimed at reducing nasal congestion and/or inflammation of the lining of the Eustachian tube.

Surgical treatment. Chronic ETD may require the surgical treatment, which includes a pressure equalizing tube (syn. tympanostomy tube, ventilation tube, grommet) placement into the eardrum through a small incision. Pressure equalizing tubes (PE tubes) typically extrude after 6–12 months.

In recent years, new methods of surgical treatment have been proposed: balloon dilatation of the Eustachian tube, Eustachian tuboplasty. Balloon dilatation of the Eustachian tube is a procedure which aims to dilate the Eustachian tube and improve its function. It consists of introducing a balloon catheter into the Eustachian tube through the nose, under transnasal endoscopic vision. The balloon is filled with saline. Pressure is maintained for approximately 2 minutes, following which the balloon is emptied and removed. In Eustachian tuboplasty a laser or rotary cutting tool is used to strip away enlarged mucous membranes and cartilage to clear obstruction to the Eustachian tube.

Complications. A long-lasting dysfunction of the eustachian tube may cause the development of chronic otitis media with tympanic membrane perforation, otitis media with effusion or atelectasis of the middle ear.

ACUTE OTITIS MEDIA

Acute otitis media (AOM) is inflammation of the middle ear: tympanic cavity, Eustachian tube and mastoid process. Recurrent AOM means three or more episodes of AOM within the preceding 6 months or 4 or more episodes in a year.

Epidemiology. AOM more often affects infants and preschool age children. More than 80 % of children have had at least 1 episode of AOM by the age of 3 years. Besides, near 20 % of them may suffer from a recurrent episodes of disease.

Etiopathogenesis. Typically, the disease follows viral infection of upper respiratory tract when pyogenic organisms invade the middle ear through Eustachian tube. This is the most common route of the infection. Microorganisms can also penetrate the middle ear through the external ear in case of traumatic perforation of the eardrum. Other uncommon routes are meningogenic and hematogenous spreading of infection.

There are number of anatomical features that predispose infants and young children to AOM: Eustachian tube in such children is shorter, wider and more horizontal and thus may cause higher incidence of infections in this age group. Young children are also often have adenoids which can be nidus for middle ear infection, even if they are not markedly enlarged.

Other predisposing factors vary depending on patient's age and may include:

- Recurrent upper respiratory tract infections;
- Craniofacial abnormalities;
- Genetic predisposition;
- Male gender;

- Family history;
- Altered immunity;
- Crowded living conditions;
- Low socioeconomic status;
- Attendance of kindergartens;
- Nasal allergy;
- Passive smoking and other pollutant exposure;
- Tumours of nasopharynx;
- Cold season;
- Use of pacifiers;
- Short duration of breastfeeding;
- Nasal packing for epistaxis;
- Chronic rhinosinusitis.

The main causative microorganisms are *Streptococcus pneumoniae*, *Haemophilus influenzae*, *Moraxella catarrhalis* and *Staphylococcus aureus*.

Pneumococcal infection is the most common cause of otitis media. At the same time, pneumococcal infection tends to cause a more severe course of AOM, recurrences and complications of the disease. Therefore, the introduction of vaccination against pneumococcus opens new opportunities in the prevention of the AOM and its complications.

Clinical features. 5 stages of AOM could be distinguished:

- Stage of Eustachian tube dysfunction/inflammation;
- Stage of acute catarrhal inflammation;
- Stage of nonperforated suppurative inflammation;
- Stage of suppuration;
- Reparation (healing) stage.

Clinical picture of the 1st stage include such symptoms as aural fullness, some degree of hearing loss and at times intermittent sharp ear pain (Figure 3-*b*). It was fully discussed previously (for more details, see the section Eustachian tube dysfunction).

At the second stage of catarrhal inflammation pain becomes more marked, hearing deteriorates more significant, low-grade fever appears. Otoscopy reveals hyperemia of the eardrum, short process of the malleus is still visible, full-blooded vessels being observed along the handle of malleus (Figure 3-*c*). Active treatment at this stage can stop the further progress of the inflammation and deterioration of the patient's condition.

At the 3rd stage earache becomes very sharp, patient becomes restless, high fever is typical. Pus under pressure fulfils the middle ear and eardrum starts bulging, it is hyperemic, thick, infiltrated. Landmarks of the eardrum disappear: short process, handle of the malleus, cone of light are not visible anymore (Figure 3-*d*, 3-*c*). Leukocytosis, neutrophilia, left shift and increased erythrocyte sedimentation rate (ESR) are determined in the general blood test on this stage.

At the 4th stage rupture of the tympanic membrane appears and suppuration starts. Patient's general condition improves, pain disappears, fever decreases. The main symptoms are some degree of hearing loss and purulent discharge from the ear. During otoscopy, pus in the outer auditory canal is visible, after the removal of which the perforation of the still hyperaemic and infiltrated eardrum could be determined (Figure 3-f). Culture and sensitivity of a specimen from a fresh perforation should be obtained.

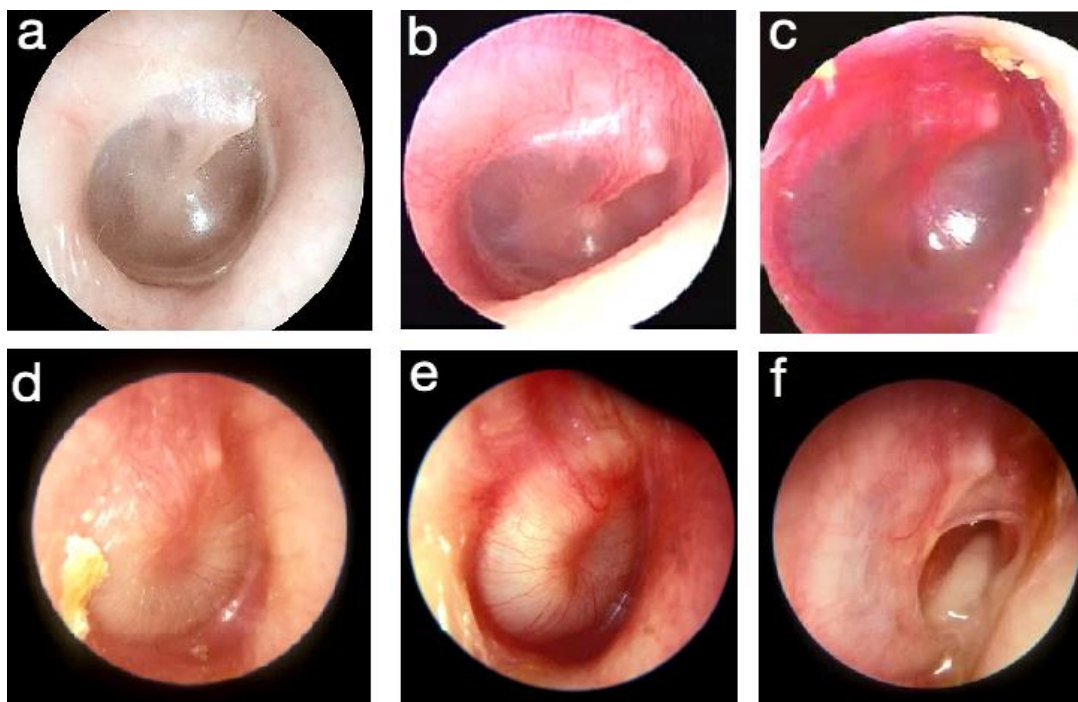


Figure 3. Right ear. Variants of otoscopic findings:

a — normal ear; *b* — eardrum is transparent, there is no middle ear effusion, the handle of the malleus is well seen and is more horizontal (stage of Eustachian tube inflammation); *c* — marked hyperaemia of the eardrum, short process of the malleus is still visible, there is no bulging of the eardrum (stage of acute catarrhal inflammation), *d* — mild bulging of the eardrum, *e* — severe bulging (stage of nonperforated suppurative inflammation); *f* — perforated tympanic membrane with otorrhoea (stage of suppuration)

The 5th stage of AOM is characterized by the disappearance of symptoms of the disease and the complete healing of the patient.

AOM in infants is characterized by lack of local signs and severe general symptoms with high fever, meningeal and cerebral irritation, vomiting, loss of appetite, disturbance of sleep. Protracted course with numerous recurrences or exacerbations is typical. Quite often AOM is combined with bronchitis, pneumonia, anemia, digestive and feeding upsets.

Treatment

Non-surgical treatment. Antibacterial therapy is indicated in all cases with fever and severe earache. Also it is indicated for all cases of AOM in children below 2 years of age. As the most common causative organisms are Streptococcus

pneumoniae, Haemophilus influenzae, Moraxella catarrhalis and Staphylococcus aureus, the first line drug which is effective in AOM is amoxicillin with or without clavulanic acid. In case of allergy to penicillin or if the patient has recently received drugs from this group, cephalosporins of 2nd or 3rd generation, macrolides or respiratory fluoroquinolones (only for adults) may be prescribed. Antibacterial therapy must be continued for a 7–10 days. Early discontinuance of therapy or therapy given in inadequate doses may lead to recurrence of the disease, development of otitis media with effusion or even severe complications.

Decongestant nose drops (oxymetazoline or xylometazoline) should be used to relieve eustachian tube edema and improve ventilation and drainage of the middle ear.

Analgesics and antipyretics could be used in the form of eardrops or orally. Eardrops containing lidocaine helps to relieve earache. Also Ibuprofen or Paracetamol could be administered if the pain is significant or body temperature is elevated.

If there is spontaneous discharge in the ear or after myringotomy analgesic eardrops are not usually indicated. Ear toilet with 3 % H₂O₂ and eardrops containing non-ototoxic antibiotics or antiseptics could be used in such case.

Surgical treatment. Stage of nonperforated suppurative inflammation usually requires incision of the tympanic membrane to evacuate pus — myringotomy. Myringotomy provides short-term ventilation of the middle ear space and decreases the pain that the pressure in the middle ear causes.

Indications for myringotomy include:

- Marked bulging of the eardrum and severe acute pain (Figure 3-e);
- Worsening of the general condition despite appropriate antibiotic therapy;
- Prolonged symptoms despite appropriate antibiotic therapy;
- Suppurative complications of AOM;
- Infants with OAM and severe intoxication symptoms.

Recurrent AOM may require tympanostomy with PE tube placement. PE tubes allow drainage of the purulent effusion during attacks of AOM and reduces pain. In addition, PE tubes may reduce the damage caused by the inflammatory effusion to the middle ear mucosa and the mucociliary lining of the Eustachian tube. In a middle ear with no effusion, PE tubes may prevent the generation of negative middle ear pressure when the function of the Eustachian tube is impaired during common cold. This may inhibit aspiration of nasopharyngeal microbes into the middle ear cavity, and thus theoretically preventing episodes of AOM.

MASTOIDITIS

Definition. Mastoiditis is a serious bacterial infection of the temporal bone and is the most common extracranial complication of the AOM.

Mastoiditis develops when the infection spreads beyond the mucosa of the middle ear cleft, and osteitis within the mastoid air-cell system develops, either directly by bone erosion through the cortex or indirectly via the emissary vein of the mastoid.

Etiology. Etiological factors include high virulence of organisms or lowered resistance of the patient due to prior infections, poor nutrition or associated systemic disease such as diabetes. Acute mastoiditis is often seen in mastoids with well developed air cell system. Children are affected more. *Streptococcus pneumoniae* and Group A beta-hemolytic streptococci are the most common causative organisms though other pathogens responsible for acute otitis media may also be seen. Anaerobic organisms are also often associated with mastoiditis and need antibacterial therapy against them.



Figure 4. Left ear. Inflammation behind the pinna in Mastoiditis (source: teachmepaediatrics.com)

Clinical features. Tenderness and inflammation over the mastoid process are the most persistent signs of mastoiditis. Periosteal thickening requires comparison to the other side. Subperiosteal abscess displaces the auricle laterally and obliterates the postauricular skin crease (Figure 4). If the crease remains, the process is lateral to the periosteum.

Other symptoms of mastoiditis are similar to those of acute suppurative otitis media. In the case of AOM, it is the worsening of these symptoms that indicates the development of acute mastoiditis.

Persistence or recurrence of fever in AOM, despite adequate antibiotic treatment, indicates the development of mastoiditis. Ear discharge becomes profuse. In some cases, discharge may cease due to obstruction to its drainage but other symptoms would worsen. Any persistence of discharge beyond 3 weeks, in a case of AOM, points to mastoiditis. Sometimes, tympanic membrane is intact but dull and opaque especially in those who have received inadequate antibiotics.

Signs of acute mastoiditis include the following:

- Tympanic membrane perforation and otorrhea;
- Erythema, tenderness, and edema over the mastoid area;
- Postauricular fluctuance;
- Protrusion of the auricle;
- Sagging of the posterosuperior canal wall (71 % of patients);
- Hearing loss. Conductive type of hearing loss is always present;
- General findings. Patient appears ill and toxic with high fever.

Diagnosis. Although the diagnosis of mastoiditis can often be made on a clinical basis alone, computed tomography (CT) scanning may be performed for confirmation of the diagnosis, evaluation of potential complications, and surgical planning.

In blood tests, the ESR is usually significantly increased.

Opacification of air cells being observed on X-ray of the mastoid process (Figure 5). Bony partitions between air cells become indistinct. In later stages, a cavity may be seen in the mastoid.

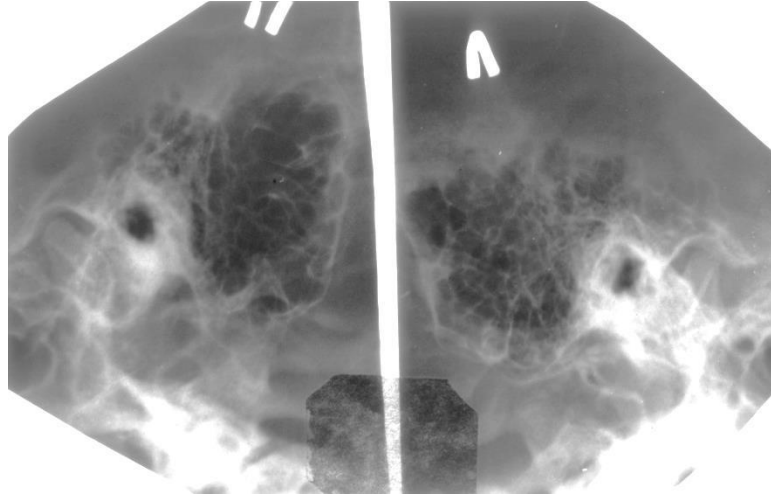


Figure 5. X-ray of the mastoid process

Localization and enlargement of the pathological process within the middle ear spaces can be determined based on CT scan findings. Immediate CT scanning is compulsory whenever intracranial extension or complications are suspected. Evidence of mastoiditis is illustrated by appearance of haziness or destruction of the mastoid outline and cortex and a decrease or loss of the sharpness of the mastoid air cells bony septa. At the same time opacification of the middle ear and mastoid cells is a nonspecific finding that may be present early in the illness, and it is often observed in patients with AOM without mastoiditis. Other findings include periosteal thickening, disruption of the periosteum, and subperiosteal abscess.

If the tympanic membrane is already perforated, the external canal can be cleaned, and ear swab for culture and sensitivity should be taken. Culture and susceptibility testing of the isolates can assist in modifying the initial empiric antibiotic therapy.

Treatment. Patient with mastoiditis should always be hospitalized.

Treatment of mastoiditis requires administration of parenteral antimicrobial therapy. The choice of antimicrobial should be based on findings from clinical specimens obtained from the middle ear by tympanocentesis or aspiration. In the absence of culture and sensitivity, initial therapy include amoxicillin/clavilanic acid, ceftriaxone or cefepime.

If mastoiditis develops on the basis of the nonperforated AOM, myringotomy with or without the placement of a PE tube should be performed.

Early cases of mastoiditis may respond to conservative treatment with antibiotics alone or combined with myringotomy. However, surgical treatment is indicated in great majority of cases of mastoiditis. It includes cortical mastoidectomy.

Indications for surgery are:

- Subperiosteal abscess;
- Sagging of posterosuperior meatal wall;
- Positive reservoir sign, i.e. meatus immediately fills with pus after it has been mopped out;
- No change in condition of patient or it worsens in spite of adequate medical treatment for 48 h;
- Mastoiditis, leading to complications, e.g. facial paralysis, labyrinthitis, intracranial complications, etc.

The aim of cortical mastoidectomy is to exenterate all the mastoid air cells and remove any pockets of pus. Adequate antibiotic treatment must be continued after mastoidectomy.

OTITIS MEDIA WITH EFFUSION

Definition. Otitis media with effusion (OME) is a condition in which there is fluid in the middle ear, but no signs of acute infection. This effusion prevents the tympanic membrane from vibrating properly, decreases sound conduction, and therefore results in a decrease in patient hearing.

OME could be acute, subacute and chronic depending on the duration of the pathological process. Acute OME lasts up to 3 weeks, subacute — from 3 weeks to 3 months. Chronic OME is defined as disease that persists for 3 or more months.

Epidemiology. OME is one of the most frequent infectious diseases in children and is the most common cause of acquired hearing loss in childhood. The disease commonly affects children between the ages of 1 and 6. There is a higher prevalence at the age of 2, which goes down after the age of 5. OME is more prevalent during the winter months, corresponding to higher patient rates of upper respiratory infections.

Pathogenesis. The main mechanism of OME development is permanent Eustachian tube dysfunction. The typical causes for ETD were described before. Chronic dysfunction of the Eustachian tube fails to aerate and drain the middle ear. As time goes by this may also increase secretory activity of middle ear mucosa, due to activation of goblet cells of the mucous membranes that lining middle ear. Nasal allergy was referred as possible etiological factor in OME development. However allergy not only causes obstruction of the eustachian

tube by edema, but may also lead to increased secretory activity, as middle ear mucosa acts as a shock organ. Often OME develops as an outcome of the unresolved acute otitis media, if antibiotic therapy was inadequate.

Clinical features (or symptoms). The main symptom of OME is hearing loss. Other symptoms of inflammation are usually absent in patients with OME. Taking in account that OME more often affects preschool age children, they may not tell about hearing loss, and disease could be revealed with delay. Pain is unusual. So not rarely children with OME, without any obvious symptoms, are diagnosed after routine hearing assessment screens. Delay in speech and language development may be observed in young children in bilateral cases.

Diagnosis. Pneumatic otoscopy with adequate illumination is the basic examination method of OME (Figure 6). The position, colour, degree of translucency and mobility of the tympanic membrane should be evaluated.

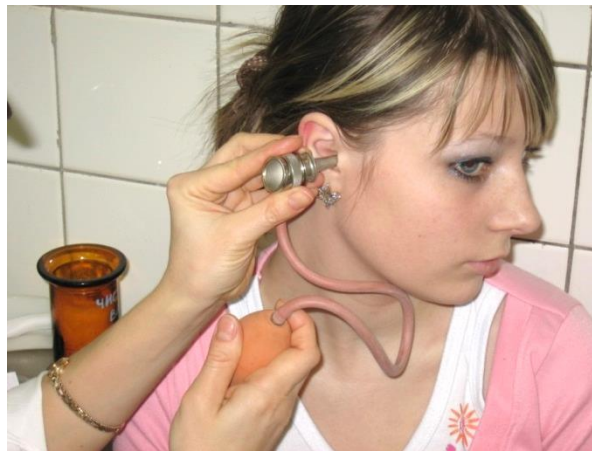


Figure 6. Photo demonstrating the use of the Siegle speculum for pneumatic otoscopy

Tympanic membrane is often dull and opaque with loss of light reflex, horizontal fluid level and air bubbles could be observed. Mild retraction of the tympanic membrane indicates negative middle ear pressure or effusion, or both. Middle ear effusion may be yellow, grey, blue in color, sometimes it may be translucent. Correspondingly during otoscopy eardrum may have yellowish, greyish or bluish discoloration (Figure 7). Tympanic membrane may appear normal if effusion is translucent. That's why pneumatic otoscopy is so important. This method reveals poor mobility, which is highly suggestive of OME.



Figure 7. Right ear. Mild retraction of the tympanic membrane and yellowish effusion behind the eardrum

Tympanometry is very useful for revealing middle ear effusion. Flat peak tympanogram (type B curve, Figure 2-*b*) indicates middle ear effusion.

Hearing tests usually reveal conductive hearing loss of 20–40 dB.

Treatment. Treatment tactics depend on duration of the disease and underlying causes for EDT. Non-surgical treatment is indicated for acute and subacute forms of OME and include decongestant nose drops, intranasal corticosteroids and middle ear aeration. Patient should repeatedly perform Valsalva manoeuvre. Sometimes, politzerization or eustachian tube catheterization has to be done. This helps to ventilate middle ear and promote drainage of fluid. Patients can be recommended chewing gum and inflate balloons with the nose (otovent nasal balloon, Figure 8), as it also improves middle ear ventilation.



Figure 8. Conservative treatment of OME: child is blowing a nasal balloon

The value of antibiotic therapy is controversial. Antimicrobials are not indicated for the initial treatment of OME, but they may be useful if signs of acute inflammation appears or in case of unresolved acute suppurative otitis media.

If the disease persist for more than 3 months, there is a little chance that effusion will resolve spontaneously. In such cases tympanotomy with or without PE tube placement is recommended (Figure 9).



Figure 9. Surgical treatment of OME: tympanotomy with pressure equalisation tube placement (source: <https://journals.sagepub.com>)

ADHESIVE OTITIS MEDIA

Definition. Adhesive otitis media (AdOM) is a form of chronic otitis media where there is an adhesion of medial ear structures as a result of chronic inflammation. There are often complete or partial adhesions between the thin retracted and atrophic pars tensa and the medial wall of the middle ear.

Etiopathogenesis. This is rare late sequelae of untreated OME when fibrous organization of chronic sterile effusion develops. In the process of resolving the inflammatory reaction, the liquid is partly absorbed back, partly leaves the tympanic cavity through the auditory tube, and partly is evacuated during the provision of medical care. In the presence of a large amount of exudate, the first two mechanisms do not work effectively enough, therefore, the lack of timely treatment leads to the deposition of insoluble fibrin on the walls of the tympanic cavity and other structures of the middle ear. The process of converting fibrin into fibrous-scar tissue does not occur simultaneously and takes up to several years.

Symptoms. AdOM does not have a pronounced clinical picture of inflammation. The main manifestation of AdOM is progressive conductive hearing loss and the appearance of tinnitus. These symptoms bother patients constantly, and the tinnitus becomes so intolerable that it makes them seek medical help.

Diagnosis. Otoscopic findings are quite typical: tympanic membrane is opacified, retracted, scarred, deformed, short process of the malleus markedly protruding; sometimes eardrum may be thinned, there are white spots on it — areas of tympanosclerosis (Figure 10). Pneumatic otoscopy and tympanometry reveal decreased mobility of the eardrum.

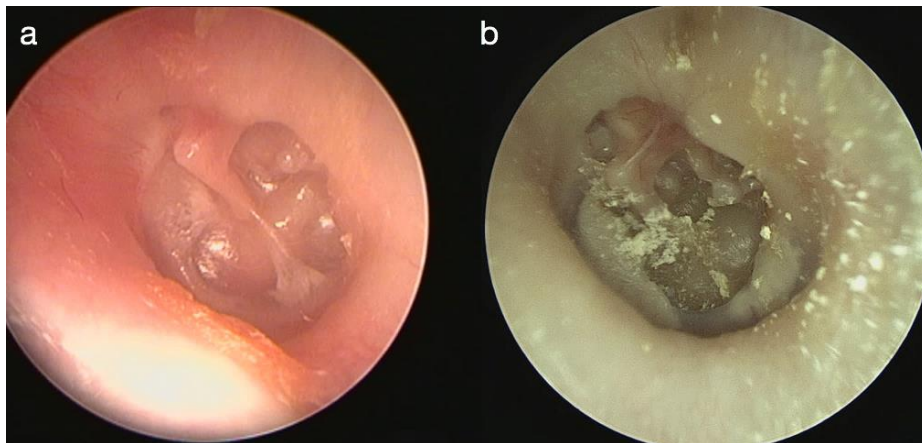


Figure 10. Patients with Adhesive otitis media. Left ear:
a — opacified, retracted eardrum; *b* — severe retraction, areas of tympanosclerosis
(source: <https://robertnash.co.uk>)

Diagnosis of the AdOM is based on the long history of otitis media, otoscopic findings, testing the function of the auditory tube and hearing.

To reveal the degree of adhesions and the severity of the disease computerized tomography (CT) or magnetic resonance imaging being used. These studies allow visualizing the most inaccessible structures of the middle ear for a simple examination.

Treatment. Treatment of the AdOM is a very difficult, painstaking and lengthy process.

First of all, it is necessary to eliminate the underlying disease causing dysfunction of the auditory tube (e.g. adenoids).

At the early stage of the disease, therapy consists of conventional evacuation of secretion from the middle ear, and care is taken to obtain proper ventilation and tubal function. Tympanotomy with pressure equalisation tube placement could be used for this.

Non-surgical treatment options include:

- Regular blowing of the auditory tube in order to restore its patency;
- Pneumatic massage of the tympanic membrane;
- Introduction of proteolytic enzyme preparations into the tympanic cavity;
- Intravenous use of biostimulants, vitamin therapy, physiotherapy;
- With persistent tinnitus, sedatives and psychotherapy are prescribed to protect the nervous system from exhaustion;
- Patients with severe hearing loss may require hearing aids.

CHRONIC SUPPURATIVE OTITIS MEDIA

Chronic suppurative otitis media (CSOM) is characterized by 3 features:

- persistent eardrum perforation;
- persistent or intermittent drainage from the middle ear;
- some degree of hearing loss.

Etiology. The diagnosis of CSOM requires a perforated tympanic membrane. These perforations may arise traumatically, iatrogenically with tube placement, or after an episode of acute otitis media, which decompresses through a tympanic perforation.

The risk of developing CSOM increases with the following circumstances:

- A history of multiple episodes of an acute otitis media;
- Craniofacial anomalies;
- Living in crowded conditions;
- Day care facility attendance;
- Being a member of a large family.

Bacteriology. Pus culture may show multiple organisms. Common aerobic organisms are *Pseudomonas aeruginosa*, *Proteus*, *Escherichia coli* and *Staphylococcus aureus*, while anaerobes include *Bacteroides fragilis* and anaerobic *Streptococci*.

Classification. Clinically, CSOM is divided into two types:

1. Chronic mesotympanic otitis (benign type) involves mesotympanum and is associated with a central perforation (Figure 11-*a*). There is no risk of serious complications.

2. Chronic epitympanic otitis (unsafe type) involves attic, antrum and mastoid (Figure 11-*b*). It is associated with an attic or a marginal perforation of the tympanic membrane. The disease is often associated with a boneeroding process such as cholesteatoma, granulations or osteitis. Risk of complications is high.

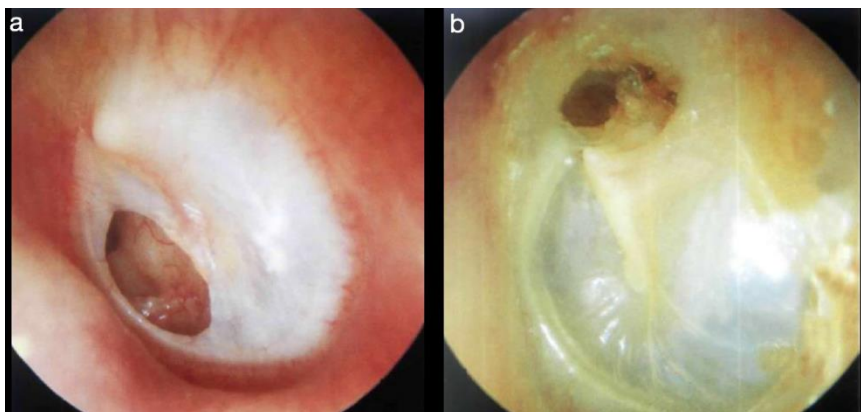


Figure 11. Left ear:

a — central perforation of pars tensa; *b* — attic perforation and cholesteatoma

Clinical features of chronic mesotympanic otitis:

- Central perforation of pars tensa;
- Mucoïd or purulent odorless discharge from the ear;
- Ossicular chain is usually intact and mobile;
- General condition remains fine;
- Pain is unusual;
- Polyps (if they arise) are pale;
- Granulations are uncommon;
- Conductive hearing loss;
- Cholesteatoma is absent.

Clinical features of chronic epitympanic otitis:

- Attic or marginal perforation;
- Fetid purulent otorrhea;
- Bone destruction and ossicular chain necrosis;
- Otagia and fever in acute exacerbations;
- Dull headaches or feeling of pressure in the head;
- Polyps are red;
- Granulations are common;
- Progressive conductive or mixed hearing loss;
- Cholesteatoma.

Cholesteatoma is a skin growth that occurs in the middle ear. It consists of keratinizing squamous epithelium, products of its degradation and pus. While growing it causes destruction of surrounding bony structures of the middle ear.

Diagnosis. Diagnostic workup include history-taking, otoscopy, otomicroscopy, audiological examination, cultural and sensitivity examination of ear discharge, Mastoid X-rays and CT of the temporal bone. CT scan of temporal bone gives more information and is preferred to mastoid X-ray.

History-taking should be carried out to reveal the symptoms of ear pain, ear discharge, ear tugging or crying when the ear is touched, all of which suggest an ear problem. A history of previous ear discharge should raise the suspicion of CSOM. A history of active ear cleaning, itching or swimming that could traumatize the external ear canal suggests acute otitis externa, and not usually CSOM. A history of ear pain suggests AOM, not usually CSOM. Thus, if the main symptom is painless otorrhea, the duration of otorrhea will help distinguish AOM from CSOM.

Not all draining ears are CSOM. Acute otitis externa and AOM can produce both ear pain and ear discharge. However, tragal pain is found in otitis externa, mastoid pain in otitis media. The discharge in otitis externa is less profuse and foul-smelling. Fever is also higher in otitis media than in otitis externa. CSOM produces painless mucoid otorrhoea without fever, unless accompanied by otitis externa or complicated by an extracranial or intracranial infection.

The exact duration of otorrhea that distinguishes CSOM from AOM is controversial, but it can be assumed that any ear that continues to discharge for more than 2–3 months is already CSOM.

The size of the perforation, character of discharge, and the appearance of the middle ear mucosa on otoscopy can confirm the presence of CSOM more than patient anamnesis.

CT in case of chronic mesotympanic otitis reveals sclerotic mastoid process without evidence of bone destruction. In chronic epitympanic otitis CT indicates extent of bone destruction and degree of mastoid pneumatization.

Treatment. The two principal aims of management are the eradication of infection and the closure of the tympanic membrane perforation. Both are important. While the abiding presence of pathologic bacteria within the middle ear and mastoid cavities accounts for the mortality and severe morbidity associated with CSOM, the persistent tympanic membrane perforation represents unrelieved hearing loss and the constant risk of microbial invasion of the middle ear.

Treatment of CSOM should be complex and include treatment of underlying diseases (adenoids, nasal allergy, chronic rhinosinusitis and other pathology which hampers Eustachian tube function), conservative therapy and surgical treatment.

Initial treatment of CSOM usually include topical antibiotic and antiseptic eardrops. The antibiotic should have an appropriate spectrum of activity that

includes gram-negative organisms (especially pseudomonads) and gram-positive organisms (especially *S. aureus*). Aminoglycosides and the fluoroquinolones are antibiotics that meet this initial criterion. But all aminoglycosides have significant potential toxicity. Some are more vestibular-toxic than cochlear-toxic and, therefore, are more likely to produce vestibular dysfunction than hearing loss. For other aminoglycosides, the opposite is true. Also it was proved that topical ciprofloxacin had been more effective than other topical antibiotics in terms of clinical response. That's why fluoroquinolones (ciprofloxacin) are treatment of choice for CSOM. But topical therapy may fail if antibiotics cannot reach infected tissues. That's why aural toilet is a critical process in the treatment of CSOM. The external auditory canal and tissues lateral to the infected middle ear are often covered with mucoid exudate or desquamated epithelium. Topically applied preparations cannot penetrate affected tissues until these materials are removed. Irrigating solutions must be warmed to near body temperature to avoid vertigo. They can be instilled into the middle ear by means of medicine droppers or bulb syringes. For best results, aural toilet should be done two to three times daily just before the administration of topical antimicrobial agents. It should be continued until discharge disappears. The type of irrigating solution might include the hydrogen peroxide or saline solution.

The entry of water or soap into the ear, particularly during bathing, is avoided by plugging the ear with rubber or cotton wool covered with Vaseline. This also prevents soiling and irritating the skin surrounding the ear canal with infected discharge.

Systemic antibiotic therapy should be reserved for severe exacerbations and cases of CSOM that fail to respond to topical therapy. Severe exacerbations require systemic antibiotic therapy with amoxicillin/clavulanic acid orally for 10 days or a 3rd- and 4th-generation cephalosporins, subsequently modified by culture results and response to therapy. Bacteriology must be always taken into account when choosing appropriate antibiotic. Ototopical therapy is generally continued once systemic therapy has begun.

Granulation tissue (Figure 12) should be removed if it arise. Cautery is often used to reduce the amount of granulation tissue and to control its formation. Microbipolar cautery or chemical cautery can be used for this. Care must be taken, as the depth of the chemical burn induced by the application of chemical agents is uncontrolled. Surgical excision of granulation tissue can be



Figure 12. Left ear. Anteroinferior central perforation. At the posteroinferior location of the perforation, polypoid granulation tissue is present (source: muhadharaty.com)

also accomplished with the use of a microscope and microinstruments. Ciprofloxacin and dexamethasone is then instilled into the ear canal for 7 to 10 days after removing of granulations.

Surgical treatment is mainstay of treatment in both types of CSOM. Eradication of disease, prevention of complication, maintenance and restoration of hearing, and giving the patient a non-discharging ear are the main aim of surgery.

Type of surgery depends on type of inflammation and presence of cholesteatoma.

Tympanoplasty is indicated for patients with marginal or attic perforations and chronic central tympanic membrane perforations. A disrupted ossicular chain may be repaired during tympanoplasty as well.

Chronic epitympanic otitis requires mastoidectomy. There are several different types of mastoidectomy, that can be performed.

Canal wall up mastoidectomy includes removal of all of the mastoid air cells, but the posterior bony wall of the external auditory canal is preserved.

In canal wall down mastoidectomy bony posterior canal wall that separates the middle ear and mastoid cavities also being removed, stopping only to preserve the facial nerve that lies within its base. The tympanic membrane is reconstructed to separate the mucosal lined middle ear space from the mastoid cavity and ear canal.

A radical mastoidectomy is a canal wall down mastoidectomy in which the tympanic membrane and ossicles are not reconstructed, thus exteriorizing the middle ear and the mastoid. The eustachian tube is often obliterated with soft tissue to reduce the risk of a chronic otorrhea. A skin graft can be placed in the middle ear to reduce the risk of mucosalization and otorrhea.

A modified radical mastoidectomy is identical to a canal wall down mastoidectomy except the middle ear space and native tympanic membrane are not manipulated. This procedure is useful when there is no extension of cholesteatoma in the middle ear space. This procedure is often indicated in patients with a cholesteatoma in their only or better hearing ear.

The canal wall down mastoidectomy may be easier to perform, and affords better access to the middle ear particularly with extensive cholesteatomas. Surgical restoration of hearing may also be difficult due to the lack of graft support provided by the posterior wall of the ear canal. the canal wall up mastoidectomy is technically more difficult and often results in recurrence or residual disease due to limited surgical access to the middle ear. Thus, good post-operative monitoring is required and patients should be prepared to undergo a second surgery, either just to “look-and-see” or to remove recurrent or residual cholesteatoma.

It is important to determine the appropriate indications for performing each procedure among patients with CSOM.

COMPLICATIONS OF OTITIS MEDIA

Development of serious complications is usually associated with acute suppurative otitis media (more common) and chronic epitympanic otitis (less common).

Spread of the infection occurs through 3 main routes:

1. Direct extension;
2. Thrombophlebitis;
3. Hematogenous dissemination.

Complications of otitis media can be divided into extra- and intracranial.

The following are the extracranial complications:

- Mastoiditis with or without subperiosteal abscess;
- Petrositis (Gradenigo syndrome);
- Facial nerve paresis;
- Labyrinthitis.

Intracranial complications include:

- Meningitis;
- Intracranial abscesses;
- Sigmoid sinus thrombosis.

Severe otogenic complications are life-threatening condition and may be associated with high mortality rate.

SELF-MONITORING TESTS

Select 1 or more answers.

1. Functions of the Eustachian tube:

- a) middle ear ventilation;
- b) sound conduction;
- c) middle ear drainage;
- d) amplification of the sound;
- e) middle ear protection.

2. Symptoms of the Eustachian tube dysfunction include:

- a) severe earache is common;
- b) aural fullness;
- c) reduced hearing;
- d) sensorineural hearing loss;
- e) febrile fever;
- f) low grade fever.

3. Otosopic findings in the Eustachian tube dysfunction:

- a) bulging eardrum;
- b) indrawn eardrum;
- c) hyperemia of the eardrum;
- d) infiltration of the eardrum;
- e) absence of the short process of the malleus;
- f) light reflex is deformed;
- g) eardrum perforation.

- 4. Most typical tympanometry results in patients with the Eustachian tube dysfunction:**
- a) type A curve;
 - b) type B curve;
 - c) type C curve;
 - d) type D curve;
 - e) type E curve.
- 5. Typical non-surgical treatment of the Eustachian tube dysfunction include:**
- a) board spectrum antibiotics;
 - b) eardrops;
 - c) decongestant nose drops;
 - d) non-steroidal anti-inflammatory drugs;
 - e) pressure equalization methods.
- 6. Surgical treatment of the Eustachian tube dysfunction include:**
- a) ventilation tube placement;
 - b) radical surgery;
 - c) antrotomy;
 - d) balloon dilatation of the Eustachian tube.
- 7. Middle ear consist of:**
- a) vestibulim;
 - b) Eustachian tube;
 - c) internal auditory canal;
 - d) middle ear cavity;
 - e) mastoid process air cells.
- 8. Causative agents of acute otitis media:**
- a) Streptococcus pneumoniae;
 - b) Pseudomonas aeruginosa;
 - c) Proteus;
 - d) Escherichia coli;
 - e) Staphylococcus aureus;
 - f) Haemophilus influenzae;
 - g) anaerobic Streptococci
 - h) Moraxella catarrhalis;
 - i) Bacteroides fragilis.
- 9. Acute otitis media predisposing factors in children:**
- a) female gender;
 - b) pacifier use;
 - c) long duration of breastfeeding;
 - d) craniofacial abnormalities;
 - e) passive smoking;
 - f) professional hazards.
- 10. Typical symptoms of acute nonperforated suppurative otitis media:**
- a) severe earache is common;
 - b) aural fullness;
 - c) reduced hearing;
 - d) sensorineural hearing loss;
 - e) febrile fever;
 - f) low grade fever.
- 11. Typical otoscopic findings in acute nonperforated suppurative otitis media:**
- a) bulging eardrum;
 - b) indrawn eardrum;
 - c) hyperemia of the eardrum;
 - d) infiltration of the eardrum;
 - e) absence of the short process of the malleus;
 - f) light reflex is visible;
 - g) eardrum perforation.

12. Acute otitis media in infants is characterized by:

- a) high fever;
- b) loss of appetite;
- c) disturbance of sleep;
- d) local signs are expressed;
- e) general condition is fine.

13. Surgical treatment of acute otitis media include:

- a) myringotomy;
- b) radical surgery;
- c) antrotomy;
- d) balloon dilatation of the Eustachian tube.

14. The first line antibacterial therapy of acute otitis media include:

- a) ampicillin;
- b) amoxicillin;
- c) amoxicillin/clavulanic acid;
- d) azithromycin;
- e) meropenem;
- f) ciprofloxacin.

15. Indications for myringotomy include:

- a) eardrum is indrawn;
- b) marked bulging of the eardrum;
- c) worthening of the general condition despite appropriate antibiotic therapy;
- d) acute myringitis;
- e) infants with acute otitis media and severe intoxication symptoms;
- f) epitympanic otitis.

16. Symptoms of the otitis media with effusion include:

- a) severe earache is common;
- b) chills;
- c) reduced hearing;
- d) delay in speech and language development in young children;
- e) febrile fever;
- f) low grade fever.

17. Otosopic findings in patients with otitis media with effusion:

- a) hyperemia of the eardrum;
- b) yellowish discoloration of the eardrum;
- c) poor mobility of the eardrum;
- d) tympanic membrane may appear normal;
- e) absence of the short process of the malleus;
- f) light reflex is absent;
- g) eardrum perforation.

18. Most typical tympanometry result in case of otitis media with effusion:

- a) type A curve;
- b) type B curve;
- c) type C curve;
- d) type D curve;
- e) type E curve.

19. Surgical treatment of otitis media with effusion:

- a) ventilation tube placement;
- b) radical surgery;
- c) antrotomy;
- d) septoplasty;
- e) tympanotomy.

20. Symptoms of the adhesive otitis media:

- a) earache;
- b) chills;
- c) conductive hearing loss;
- d) tinnitus;
- e) febrile fever;
- f) low grade fever.

21. Otosopic findings in patients with adhesive otitis media:

- a) hyperemia of the eardrum;
- b) yellowish discoloration of the eardrum;
- c) poor mobility of the eardrum;
- d) eardrum is opacified;
- e) absence of the short process of the malleus;
- f) retraction of the eardrum;
- g) eardrum perforation.

22. Non-surgical treatment of adhesive otitis media:

- a) antibiotics;
- b) decongestant nose drops;
- c) eardrops with lidocaine;
- d) pneumatic massage of the eardrum;
- e) tympanotomy;
- f) corticosteroids;
- g) physiotherapy;
- e) proteolytic enzyme preparations;
- f) hearing aids.

23. Chronic suppurative otitis media is characterized by:

- a) eardrum perforation persists;
- b) more than 4 episodes of suppuration from the ear per year;
- c) hearing loss
- d) eardrum perforation only during exacerbations;

24. Clinical features of chronic mesotympanic otitis:

- a) central perforation of pars tensa;
- b) attic or marginal perforation;
- c) mucoid or purulent odorless discharge from the ear;
- d) fetid purulent otorrhea;
- e) ossicular chain is intact and mobile;
- f) bone destruction and ossicular chain necrosis;
- g) polyps are pale;
- e) polyps are red;
- f) granulations are common;
- g) mixed hearing loss;
- h) cholesteatoma is absent.

25. Clinical features of chronic epitympanic otitis:

- a) central perforation of pars tensa;
- b) attic or marginal perforation;
- c) mucoid or purulent odorless discharge from the ear;
- d) fetid purulent otorrhea;
- e) ossicular chain is intact and mobile;
- f) bone destruction and ossicular chain necrosis;
- g) polyps are pale;
- e) polyps are red;
- f) granulations are common;
- g) mixed hearing loss;
- h) cholesteatoma is absent.

26. Choose extracranial complications of acute otitis media:

- a) mastoiditis;
- b) Gradenigo syndrome;
- c) facial nerve palsy;
- d) meningitis;
- e) cerebellum abscess;
- f) sigmoid sinus thrombosis;
- g) labyrinthitis.

27. Choose intracranial complications of acute otitis media:

- a) mastoiditis;
- b) Gradenigo syndrome;
- c) facial nerve palsy;
- d) meningitis;
- e) cerebellum abscess;
- f) sigmoid sinus thrombosis;
- g) labyrinthitis.

Answers: 1 – a, c, e; 2 – b, c; 3 – b, f; 4 – c; 5 – c, e; 6 – a, d; 7 – b, d, e; 8 – a, e, f, h; 9 – b, d, e; 10 – a, c, e; 11 – a, c, d, e; 12 – a, b, c; 13 – a; 14 – b, c; 15 – b, c, e; 16 – c, d; 17 – b, c, d, f; 18 – b; 19 – a, e; 20 – c, d; 21 – c, d, f; 22 – d, g, e, f; 23 – a, c; 24 – a, c, e, g, h; 25 – b, d, f, e, f, g; 26 – a, b, c, g; 27 – d, e, f.

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