

Middle Ear and its Health Issues

When we look into the external auditory canal (ear canal), the middle ear is the air-filled space located behind the eardrum. It connects the outer and inner ear structures. Since the middle ear is located deep in the head, it seldom attracts attention. However, the middle ear is easily affected by problems in the upper respiratory tract as it is connected with the nasopharynx (the upper part of the throat behind the nose). Middle ear disease may lead to serious complications as it is adjacent to the important parts in the head.



Structure and function of middle ear

The most well-known structures in the middle ear are: tympanic membrane, ossicular chain and Eustachian tube.

1. Eardrum and ossicular chain: sound conduction and regulation

Sound vibration collected by the outer ear is transmitted to the oval window of the cochlea by the eardrum and the ossicular chain (consisting of three ossicles: malleus, incus, stapes) connected to it. This results in vibration of fluid within the cochlea and hearing sensation arises.

This lever system amplifies the sound vibration and makes very soft sound audible. Middle ear muscles are connected with some of the ossicles. When the incoming sound is very loud, the ratio of sound transmitted by the lever system will be reduced by neural reflexes of the muscles in order to protect the inner ear from damage.

2. Eustachian tube: regulating the pressure in the middle ear

Eustachian tube is the pipeline connecting the ear (middle ear) and throat (nasopharynx and rear side of nasal cavity). Its main functions are: to regulate the pressure in the middle ear, thus equalize the pressure difference between outer ear and middle ears; to drain the secretion from the middle ear cavity to the nasopharynx; and to ventilate the middle ear cavity with fresh air from the nasopharynx. However, the Eustachian tube is the major gateway that the middle ear gets infection.

The Eustachian tubes of babies and children are shorter and flatter than those of adults, and their diameters are relatively smaller. The muscles of soft palate that control the opening and closure of Eustachian tube are not mature yet. Hence, children get otitis media more easily than adults. The structure of the Eustachian tube will mature gradually in children aged eight or above and their middle ear function will gradually become similar to that of adults.

Eustachian tube dysfunction

In normal circumstances, the Eustachian tube can be opened and closed intermittently. Either patent or blocked Eustachian tube can be considered as abnormal.

1. Patent Eustachian tube

Middle ear connects with the nasopharynx continuously. People affected will be able to "hear their own breathing." Causes include:

- Sudden loss of weight (e.g. after childbirth)
- Intake of certain medications (e.g. antihistamines, birth control pills, etc.)

This situation rarely occurs. This can be solved by leaning the head down, or lie down sideways after a few minutes.

2. Blocked Eustachian tube

When the Eustachian tube fails to open, middle ear pressure will decrease continuously. People affected may have a sense of ear blockage, or even have earache or tinnitus. Causes include:

- (The most common) Allergic rhinitis (allergy of the nose), upper respiratory tract infections (colds and sinusitis) resulting in swelling and inflammation of the Eustachian tube
- Swelling of tissue adjacent to nasopharynx such as adenoid (gland-like lymph tissue)
- Rapid pressure changes caused by air travelling or diving
- Sudden weight gain (e.g. pregnancy, decreased thyroid function)
- Developmental defect in Eustachian tube, as in Down syndrome
- Cleft palate or malfunction of muscles of soft palate
- Nasopharyngeal cancer
- Reflux of gastric acid

Prolonged Eustachian tube blockage will cause negative middle ear pressure, which retracts the eardrum. Fluid may accumulate in the middle ear, leading to a higher risk of acute otitis media (middle ear infection). Accumulation of pus in the middle ear reduce the mobility of the eardrum and the lever system function of the ossicles, causing temporary conductive hearing loss. If the obstruction continues without treatment, this may even cause suppurative otitis media or cholesteatoma (abnormal cyst), resulting in damage to the ossicles.

Management

- Get rid of the underlying cause such as allergic rhinitis, colds or sinusitis.
- When blowing your nose, pressed against one side of the nose, gently blow out from the other side, and then swap sides. This help to prevent the infectious secretion in nose and nasopharynx from entering the middle ear via the Eustachian tube.
- Keep your home clean in order to reduce irritation of the respiratory tract by dust. Do not smoke in front of children.
- Use medication according to doctor prescription, if applicable.
- While feeling ear blockage, try these to make the Eustachian tube open: chewing gum, blowing balloon and swallowing.
- Parents with children that have hearing problems or symptoms of ear disease should consult health care professional for early treatment to prevent the problems from getting worse.

Common middle ear diseases associated with Eustachian tube blockage

1. Acute otitis media

Young children are more likely to have acute otitis media as their immune systems are less mature. Eustachian tubes of children aged 7 and below are shorter. When children suffer from upper respiratory tract infections, germs in the nasopharynx can easily enter the middle ear via the Eustachian tube and cause infection.

Common symptoms of acute otitis media:

- Severe earache
- Fever
- Middle ear effusion causing feeling of blockage and hearing loss
- Symptoms of rhinitis
- Pus coming out of the ear canal if eardrum ruptured

Doctors may prescribe treatment such as antibiotics, anti-allergy medications and nasal spray, depending on the clinical course of the patient. Patients should use medications according to doctor's recommendations. Antibiotics may relieve earache in a short time, but it takes longer to get rid of the infection. Failure to complete the whole course of antibiotic treatment may lead to the development of antimicrobial resistance.

If the patient suffers from serious earache or complications develop, the doctor may have to pierce the eardrum to drain the pus and relieve discomfort of the patient. Such a small hole will usually heal within a few days, and this will not cause damage or leave obvious scar on the eardrum. Even if the acute otitis media has subsided, fluid may still accumulate in the middle ear, affecting sound conduction and leading to hearing loss. Generally, hearing will return to normal within four to six weeks. If hearing does not improve, the doctor may have to pierce the eardrum or insert a grommet. This helps to accelerate the recovery of middle ear by draining the accumulated fluid. As otitis media may be caused by chronic infection in adenoids and tonsils (lymph tissue mass), the doctor may recommend removal of adenoids and tonsils during grommet insertion for cases with recurrent otitis media.

Children are prone to acute otitis media in autumn and winter. Second hand smoking and air pollution will also increase the risk of otitis media. Children and adolescents with cleft palate and Down syndrome are prone to otitis media due to dysfunction of their Eustachian tube. The most common bacteria causing acute otitis media include *Streptococcus pneumoniae*, *Haemophilus influenzae* and *Moraxella catarrhalis*. Among them, *Streptococcus pneumoniae* accounted for about half of the bacterial cases. Pneumococcal vaccination can reduce the risk of otitis media. Seasonal influenza vaccination can reduce those cases of otitis media due to complication of seasonal influenza.

2. Middle ear effusion

Middle ear effusion is fluid accumulation in middle ear in the absence of acute inflammation or infection. This is common among children aged two to six. Most of the children will recover without treatment within two to four months. Middle ear effusion is difficult to detect when symptoms are mild, with occasional feeling of ear swelling and blockage. In a few cases, the condition may persist, resulting in mild to moderate conductive hearing loss. Permanent structural damage to the eardrum and ossicles may even occur in serious cases.

As long as the Eustachian tube is functioning, the accumulated fluid will subside gradually. Sometimes this can be facilitated by medications such as anti-allergy medications and nasal spray. If middle ear effusion persists, the doctor may consider piercing the eardrum and inserting grommet to drain the effusion in order to prevent hearing loss and other complications.

If children have allergy, hearing loss, nasal congestion, snoring, history of acute tonsillitis and acute otitis media within past one year, they have a higher risk of middle ear effusion.

3. Air travel and otitis media

During taking-off and landing of aircraft, there will be a difference between the air pressure in the cabin and the air pressure in the middle ear of the passenger. Such air pressure difference may easily cause Eustachian tube obstruction, especially among children whose Eustachian tubes are shorter and flatter.

Precautions

- Consult a doctor before air travel if suffer from nasal congestion, colds or flu. Use medication to relieve nasal congestion during the flight, according to doctor's advice.
- Babies are prone to otitis media related to air travel. Give a pacifier or bottle to the baby during taking-off and landing of aircraft.
- May try gum chewing, swallowing saliva or yawning during taking-off and landing of aircraft.
- Do not sneeze hard or pinch the nose firmly to blow hard during taking-off and landing of aircraft.

4. Perforated eardrum

Small perforation on eardrum will not affect hearing significantly. If the perforation is large, the hearing will be impaired. Without proper care, a perforated eardrum will be infected, presenting with ear discharge and pain and even leading to otitis media, which may damage the ossicles and auditory nerve, and worsen the hearing loss.

In case of eardrum perforation, the external auditory canal should be kept clean and dry. Safety measures should be taken to prevent dirty water from entering the middle ear: stop swimming and diving; put cotton ball in the entrance of external auditory canal when washing hair. Consult a doctor if there are symptoms of infection and use the medications according to doctor's advice.

In general, a perforated eardrum will heal naturally in ten days or more under proper care. If it has not healed after a long period of care, surgery for eardrum repair may be considered.

Summary

Healthy middle ear is crucial to good hearing. The middle ear is easily affected by problems in the upper respiratory tract as it is connected with the nasopharynx. Middle ear disease may lead to serious complications as it is adjacent to the important parts in the head.

Children aged seven or below are more prone to otitis media as their Eustachian tubes are immature. If their children suffer from allergic rhinitis, sinusitis or other upper respiratory tract disease, parents should pay attention to their children's hearing. If parents noticed any signs of hearing loss or ear disease in their children, they should consult a doctor as soon as possible. Early treatment can prevent the problem from getting worse.

The Student Health Service of the Department of Health provides hearing screening services to all primary one students (or any students who attend a health check for the first time), secondary two students and those students who have concerns about their hearing. Parents who suspect their children have hearing problem may consult the health professional at the time of health check.

Student Health Service

Department of Health

Student Health Service website: www.studenthealth.gov.hk

2022