

Ministry of Defence

Synopsis of Causation

Conductive Hearing Loss

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Disclaimer

This synopsis has been completed by medical practitioners. It is based on a literature search at the standard of a textbook of medicine and generalist review articles. It is not intended to be a meta-analysis of the literature on the condition specified.

Every effort has been taken to ensure that the information contained in the synopsis is accurate and consistent with current knowledge and practice and to do this the synopsis has been subject to an external validation process by consultants in a relevant specialty nominated by the Royal Society of Medicine.

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1. Definition

- 1.1. Conductive hearing loss occurs when sound conduction is impaired as a result of pathology in the outer or middle ear. The outer ear includes the pinna, which is a receptacle of sound, and the external auditory canal through which sound passes onto the eardrum. The middle ear is a space that has the eardrum laterally and the cochlea medially connected by an ossicular chain of 3 middle ear bones that helps transmit sound optimally. These bones are the stapes, the incus and the malleus.

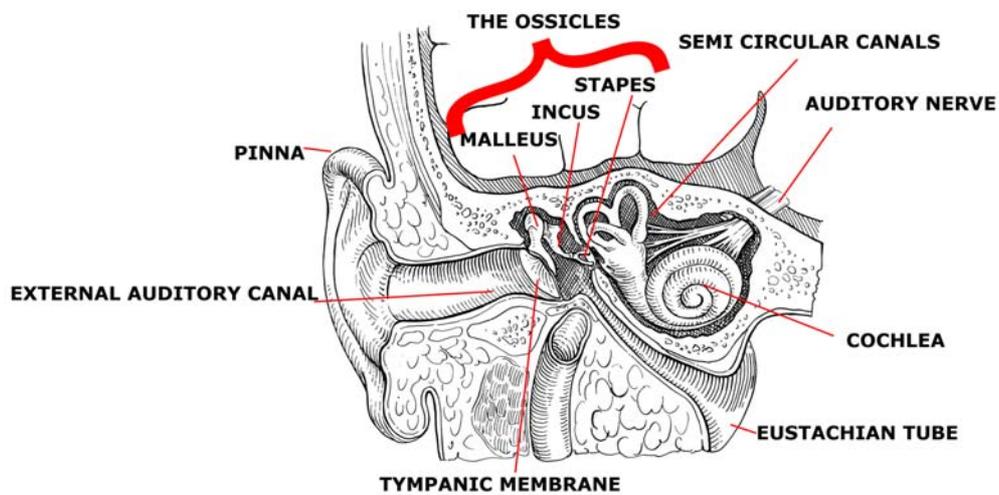


Figure 1: Anatomy of the ear

2. Clinical Features

- 2.1. The clinical features will depend on the cause of conductive hearing loss and are covered under Section 3; aetiology.
- 2.2. The audiometric configuration of conductive hearing loss is typically an air-bone gap. Sound is conducted better through bone conduction than by air.

3. Aetiology

3.1. Trauma

- 3.1.1. **Perforated eardrum.** Rupture of the eardrum will lead to deafness. The degree of deafness is dependent on the size and site of the perforation. A subtotal perforation may lead to a hearing loss of 40 to 60 decibels (dB). The loss is generally conductive. A sensorineural element may be present which in minor trauma may be reversible.¹ Traumatic rupture may be the result of a sudden change in air pressure as in hand slap or blast injuries. Instrumentation or a foreign body such as a pencil injury can perforate the eardrum as can fracture of the base of the skull.
- 3.1.2. **Ossicular discontinuity.** Traumatic disruption of the ossicular chain may be associated with a ruptured eardrum. In cases of ossicular discontinuity with an intact eardrum, there may be a consequent greater hearing loss. This may be associated with head injuries and the commonest form of ossicular discontinuity is a separation of the incudo-stapedial joint.²
- 3.1.3. **Haemotympanum.** The collection of blood within the middle ear (haemotympanum) following trauma leads to conductive deafness. This may be associated with fracture of the temporal bone and, depending on the type of fracture, may be associated with further conductive deafness (longitudinal fracture) or sensorineural deafness (transverse fracture).

3.2. Infections

- 3.2.1. **Otitis externa (OE).** This is inflammation of the skin of the ear canal and the pinna. OE will only cause deafness if sound conduction is impeded by blockage of the ear canal, either by debris or from swelling of the canal wall. The hearing should return following successful treatment. This condition is common in adults and less common in children.
- 3.2.2. **Acute Otitis Media (AOM).** This is inflammation of the middle ear cleft. The deafness in AOM is conductive and is due to the collection of pus within the middle ear and/or a perforation which, when untreated, releases pus to the ear canal.
- 3.2.3. **Chronic otitis media.** This is persistent inflammation of the middle ear cleft, which typically presents with deafness and discharge. The deafness is mostly conductive and is the result of perforation of the eardrum with or without destruction of ossicular bone(s). A sensorineural element may be present.
- 3.2.4. **Cholesteatoma.** The presence of skin in the middle ear is clinically cholesteatoma. The normal middle ear is lined by columnar epithelium whereas skin or squamous epithelium covers the ear canal. Squamous epithelium in the middle ear forms a keratinous cyst and may be destructive. The cyst may cause pressure necrosis and, in the presence

of infection, may release enzymes that destroy bone. Cholesteatoma is seen in some cases as a form of chronic otitis media.

- 3.3. **Tumour.** These are uncommon. Osteoma or any other tumour of the external ear canal can cause conductive deafness if sufficiently large to block the passage of sound to the eardrum. Middle ear tumours cause deafness in the same way. The commonest middle ear tumour is a paraganglioma (glomus tympanicum).
- 3.4. **Congenital.** These are caused by defects in the development of the ear. Microtia is partial absence of the pinna (auricle) with atresia of the ear canal that may mean that there is no connection to the middle ear. The middle ear itself may be defective and rarely there may not be an inner ear. All of these conditions, apart from the last, lead to conductive deafness.
- 3.5. **Miscellaneous conditions**
 - 3.5.1. **Cerumen.** Cerumen, or wax, is present in most external ear canals and does not usually cause deafness. Impacted wax may, however, lead to a small (30dB) conductive hearing loss.
 - 3.5.2. **Exostosis.** Commonly this condition is seen in swimmers and, in particular, surfers.³ There is new bone formation in the bony wall of the external ear canal and this may project into the meatus. Exostoses usually arise at more than one site within the bony ear canal, unlike an osteoma, which presents as a single mass.
 - 3.5.3. **Otitis media with effusion (OME).** This is the most common cause of conductive hearing loss in children; however it is uncommon in adults. OME is the presence of fluid behind an intact eardrum in the absence of overt infection. In adults the presence of OME in only one ear requires an exclusion of an underlying tumour in the nasopharynx (post-nasal space).
 - 3.5.4. **Otosclerosis.** This is an uncommon cause of conductive hearing loss in adults and affects both sexes, though there may be a female predominance. It is more common in the white population with a clinical prevalence of 0.3–0.4%. The disease may be bilateral or confined to one ear. The hearing loss is conductive in stapedial otosclerosis, though an apparent sensorineural element may be noted at 2000 Hertz (Hz) on pure tone audiometry. However, there may be a true sensorineural loss due to cochlear involvement by the otosclerotic process.
 - 3.5.5. **Tympanosclerosis.** This is the presence of whitish patches of hyalinisation or calcareous deposition on the eardrum or in the middle ear. This may be a sequel of infection or a form of scarring. On the eardrum, small patches usually cause no hearing impairment but large ones may. Involvement of the middle ear and the ossicles may lead to marked conductive deafness that is not amenable to surgical treatment. The hearing loss is usually minor if tympanosclerosis simply involves the eardrum; if the middle ear is involved and the ossicular chain becomes fixed, up to 60dB loss may be seen.

- 3.5.6. **Chronic adhesive otitis media.** If the eardrum becomes adherent to the medial wall of the middle ear with the ossicles or remnant ossicles warped within, sound conduction will be impaired. This may be the end result of chronic otitis media.
- 3.5.7. **Barotrauma.** Normally the air pressure in the middle ear is the same as pressure outside. This is maintained by action of the Eustachian tube which connects the middle ear with the post-nasal space. During rapid descent in a non-pressurised aircraft, or if a diver descends rapidly, the Eustachian tube is unable to maintain middle ear pressure and becomes “locked”. The negative middle ear pressure causes the eardrum to retract and the fluid collects within the middle ear leading to conductive deafness. Occasionally, the change is such that the eardrum ruptures.

4. Prognosis

- 4.1. The prognosis may be good with the exception of cases of tympanosclerosis (of the middle ear), chronic adhesive otitis media, and some cases of chronic infection such as cholesteatoma.
- 4.2. Traumatic rupture of the eardrum usually heals although secondary infection may delay healing. Occasionally a surgical repair may be required. Ossiculoplasty will restore hearing in most cases of ossicular discontinuity. The treatment of acute otitis media is medical and a surgical drainage procedure is rarely required. Chronic middle ear disease and cholesteatoma are usually treated surgically. Exostoses are excised and cerumen is removed manually under the microscope or by syringing. Otosclerosis is treated with a hearing aid or by surgery.
- 4.3. In tympanosclerosis of the middle ear and in adhesive otitis media, the prognosis is so poor in terms of surgical repair and reconstruction of the middle ear apparatus that few surgeons will operate. Hearing aids are useful as the hearing loss is mostly conductive.

5. Summary

- 5.1. Conductive hearing loss is a common form of deafness and is mostly acquired. It is often amenable to surgical treatment.

6. Related Synopses

Sensorineural Hearing Loss

Blast Injury of the Ear

Otosclerosis

Otitis externa

7. Glossary

cholesteatoma	The accumulation of dead cells (squamous epithelium) in the middle ear, which typically causes damage to the ear bones in association with repeated middle ear infections.
decibel (dB)	A measure of sound density.
Hertz (Hz)	A measure of frequency of sound.
incudo-stapedial joint	The joint between the incus and the stapes bones.
meatus	The ear canal, leading from the concha to the tympanic membrane (eardrum). Approximately 1 inch long, the outer one-third of the meatus is cartilaginous; the remaining two-thirds is bony. Ceruminous (wax) and sebaceous (oil) glands are plentiful in the cartilaginous segment, and are also found on the posterior and superior walls of the bony canal. The wax and oil lubricate the canal and help keep it free of debris and foreign objects.
middle ear cleft	A term used to describe the middle ear behind the eardrum, as well as the areas above and below the middle ear, the mastoid air cell system, and the Eustachian tube connecting the front of the middle ear to the post-nasal space.
ossicles	The 3 middle ear bones. These are the malleus, incus and stapes. Hence: <i>ossicular</i> , pertaining to the ossicles.
ossiculoplasty	The reconstruction of the ossicular chain.
osteoma	A tumour of the bone.
pinna	The auricle (external portion) of the ear.
sensorineural	A type of deafness that involves the cochlea and/or the auditory nerve.
tympanosclerosis	A form of membrane thickening produced by hyalinisation. It results from chronic inflammation or trauma, often in association with the insertion of ventilating tubes.

8. References

1. Hussain SSM. Hearing loss in the 4-8 kHz range following tympanic membrane perforation from minor trauma. *Clin Otolaryngol Allied Sci.* 1995 Jun;20:211-2.
2. Wang LF, Ho KY, Tai CF, Kuo WR. Traumatic ossicular chain discontinuity - report of two cases. *Kaohsiung J Med Sci* 1999 Aug;15(8):504-9.
3. Hurst W, Bailey M, Hurst B. Prevalence of external auditory canal exostoses in Australian surfboard riders. *J Laryngol Otol* 2004 May;118(5):348-51.