

# Chapter 30

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## HEARING LOSS

This chapter may be easier to understand if the structure and function of the ear, as outlined previously in Chapter 9, is reviewed. All cases of hearing loss should be assessed by a diving physician.

Divers frequently complain of a sensation of hearing loss which cannot be verified when hearing tests (pure tone audiometry) are performed. It is likely that currently available hearing tests, such as speech discrimination, are not sophisticated enough to detect such subtle alterations in the sensation of hearing.

The **causes** of demonstrable hearing loss fall into two categories:

- **Conductive hearing loss** – where there is some impediment to the conduction of sound vibrations (usually in the external and middle ear) *en route* to the hearing organ.
- **Sensorineural (nerve) hearing loss** – where sound vibrations reach the hearing organ (cochlea) in the inner ear, but the sound is not perceived due to damage of the cochlea or its nerve.

### CONDUCTIVE HEARING LOSS

The likely causes of conductive hearing loss are in the external or internal ear.

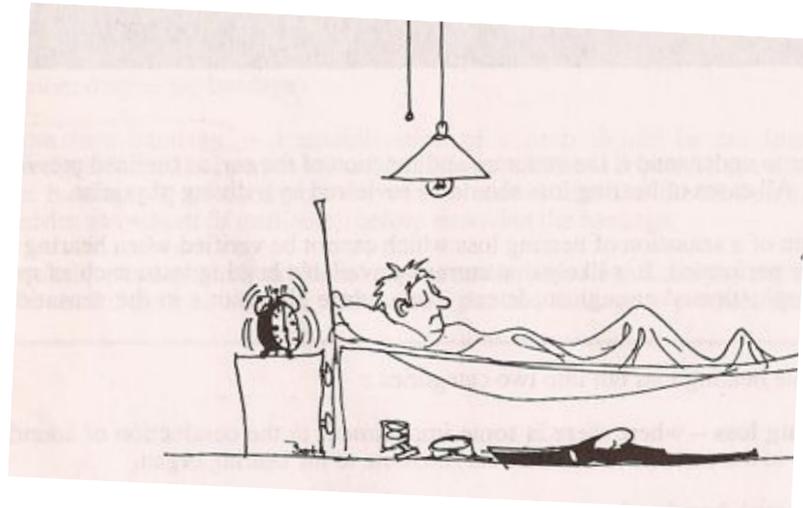
#### External Ear Obstruction

Any obstruction to the outer ear such as wax accumulation, plugs or hoods, outer ear infections (see Chapter 28) or exostoses (see Chapter 32) can cause this.

## Tympanic Membrane Damage

This membrane can be torn by:

- **Excessive stretching** during descent (middle ear barotrauma). See Chapter 9.
- A **shock wave** passing down the ear canal, such as an **underwater explosion** or a **pressure wave from a fin** passing close to the divers ear.
- An excessively forceful **Valsalva** manoeuvre has also been known to rupture the tympanic membrane from within.



**Fig. 30.1**

**Case History 30.1.** A diver swimming closely behind his buddy suddenly felt pain in his left ear as his buddy's fin swept past his ear. Dizziness followed but soon settled. He surfaced and noticed a small amount of blood coming from his ear.

**Diagnosis:** Rupture of the ear drum caused by a pressure wave from a fin. The dizziness was due to cold water entering the middle ear through the ruptured ear drum. The blood was extruded by gas expanding in the middle ear, during ascent.

**Case History 30.2.** An old professional hard hat diver who smoked cigarettes and had suffered repeated tympanic membrane ruptures from barotrauma was in great demand at parties because of his ability to blow smoke from his ears. He claimed that during the latter part of his career he no longer needed to equalise.

**Diagnosis A:** Chronic perforation of the ear drums. His unusual talent was made possible by smoke passing from his throat to his ears through the Eustachian tubes, after he takes a drag from the cigarette and performs a Valsalva manoeuvre. His ears became self equalising later in his career because of permanent holes in his ear drums. Although in demand at parties, unfortunately he often misheard the directions and turned up at the wrong address.

**Diagnosis B:** Poor hearing due to recurrent barotrauma and chronic perforation of tympanic membranes.

## Middle Ear Disorders

Disturbances of the middle ear impair conduction of sound vibrations from the ear drum, through the bony chain to the cochlea. Causes include:

- **Middle ear barotrauma** which produces bruising and swelling of the middle ear tissues and bleeding into the middle ear space. Both factors dampen sound transmission (see Chapter 9).
- **Middle ear infection (otitis media)** which causes swelling and inflammation. This fills the middle ear space with pus, which impairs sound conduction (see Chapter 28).

## SENSORINEURAL HEARING LOSS

This is often accompanied by tinnitus (ringing in the ears) and sometimes by disorientation. Tinnitus can sometimes be more incapacitating than hearing loss. In recent hearing loss, early treatment increases the likelihood of improvement in hearing.

## Noise Induced Deafness

Repeated exposure to loud noise may produce a progressive hearing loss which usually affects high frequency hearing first. This loss may be noticed by hi-fi enthusiasts who will complain that music has lost its sparkle. It is often insidious and may not be noticed for many years. Occasionally, a single exposure to loud noise can cause noticeable hearing loss immediately. Rock concerts and discos are also incriminated.

Noise induced hearing loss may be transient in the early stages but repeated exposure leads to permanent deafness, which worsens with more exposure. Industrial noise usually affects the ears symmetrically, but other noise such as gunfire, commonly affects only one ear (the one exposed to the noise or blast).

The diving environment is often a noisy one. Recompression chambers, compressors, boat engines, helmets and compressed air leaks are often loud enough to present a threat to the hearing of those in their vicinity. Divers should take care to protect their ears when necessary by the use of industrial protective ear muffs or ear plugs (but not when diving).

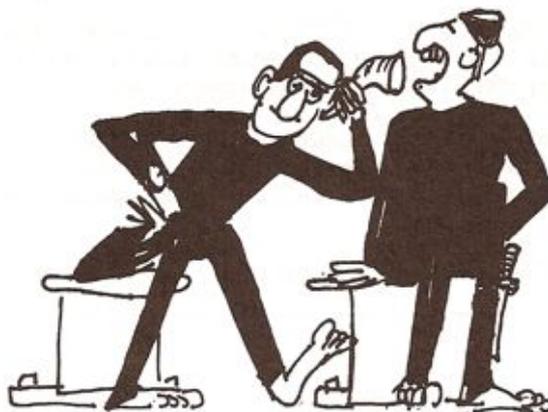


Fig. 30.2

High frequency hearing loss also renders consonants such as "S" or "CH" difficult to hear – hence the story of the yacht owner who was delighted when the curvaceous blonde diver with sensorineural deafness accepted his invitation to "crew" on his yacht.

## **Barotrauma**

Inner ear barotrauma or associated round window fistula may lead to temporary or permanent hearing loss (see Chapter 9).

## **Decompression Sickness**

Inner ear damage is an uncommon complication of decompression sickness (see Chapter 15) in shallow air breathing divers. It is more common in deep, helium or mixed gas divers.

# **OVERVIEW OF HEARING LOSS**

- **All prospective divers must have their ears examined to exclude ear problems** likely to predispose to barotrauma.
- **All divers should have a baseline audiometry** performed, to enable the physician to detect early hearing loss, to make assessment of future hearing problems much easier and to allow early and more knowledgeable treatment to be administered in the (not uncommon) event of a diver presenting with hearing loss.
- **Any case of hearing loss in a diver should be assessed as soon as possible by a diving physician.** The doctor will take a history of the condition, examine the ears, test the hearing by pure tone audiometry at least, and possibly perform other specialised investigations such as bone conduction, speech discrimination, impedance audiometry, diving tympanogram, electro-nystagmograms and brain stem evoked auditory responses.

The cause is usually fairly obvious and **management** of the specific conditions is covered in other chapters.

- **Divers with pre-existing hearing loss** should realise that any deafness arising from barotrauma will be added to the loss they already have. It is also believed that people with hearing impairment are more susceptible to further damage than others. Divers who are aware of hearing loss should discuss the implications with a diving physician.
- **Occupational implications are raised.** Those who need excellent hearing for their livelihood, such as musicians, cardiologists, sonar operators and airline pilots, should consider whether the small but real risk of hearing damage associated with diving is worth taking.
- **Hearing loss is sometimes associated with abnormalities of the body's balance mechanism,** which might have safety implications with diving (see Chapter 31).