Common Ear Injuries While Diving

What's the most frequent diving injury: Decompression illness? Jellyfish stings? Backaches from lifting tanks?

It's ear injuries, as you may have already guessed. The most common injury divers experience is some form of barotrauma to the ear or sinuses. Barotrauma literally means injury from pressure: baro (pressure) + trauma (injury), and in this article we'll concentrate on ear injuries.

NOTE: No article can give you the same degree of information as an experienced medical practitioner. DAN recommends that individuals with any ear discomfort be examined by a trained medical practitioner as soon as possible after the complaint develops.

This type of injury can happen for a variety of reasons, but generally it develops when the pressure in the middle ear is not equal to the pressure of the outside environment as the diver descends in the water column.

*Because of the rapid relative gas volume change as the diver descends at the beginning of the dive, the first 4.2 meters of the descent is where the ear is at most risk of injury.

ANATOMY of the EAR

No discussion of any part of the human body is complete without a working knowledge of the anatomy of that part. The ear is made up of three compartments: the external ear, the middle ear and the inner ear.

The Auricle and the External

Ear Canal
The auricle (pinna) is the first and most obvious view of the ear: it's what we generally refer to as the ear, although it is just the outside section of it. Funnelshaped and mostly cartilage covered by a thin layer of skin, it channels sound (and water) into the ear. Directly behind the tragus, the cartilaginous prominence in front of the external opening of the ear, the ear canal curves inwards approximately 24 millimeters in the average adult. The outer portion of the ear canal contains the glands that produce earwax (cerumen). The inner portion of the ear is covered by thin, hairless skin. Pressure on this area can cause pain.

The Middle Ear
The tympanic membrane (eardrum) is located at the inner end of the ear canal and separates the external ear from the middle ear. The middle ear is an air-filled space that contains the ossicles – three tiny bones that conduct sound. (Many of us learned them as the hammer, anvil and stirrup: In medical terminology they are the malleus, incus, and stapes. See the sidebar "How the Ear 'Hears.") The Eustachian tubes, one in each ear, connect the middle ear and the back of the throat (nasopharynx). They keep the middle ear "equalized" by keeping the air pressure on both sides of the eardrum the same. Because they are surrounded by cartilaginous tissue, they don't allow for expansion. Because of this, a diver must equalize his or her ears by gently "opening" the tubes – that is, by introducing air through them and into the middle ear.

The Inner Ear
Separating the middle ear from the inner ear are two of the thinnest membranes in the human body, the round and oval windows. These membranes embody one of the reasons divers are taught to gently blow to equalize their middle ears: damage to the round or oval windows may cause a leakage of fluid (perilymph)

from the inner to the middle ear. This can cause a ringing or roaring in the ears, and even hearing loss. Window rupture can also cause severe vertigo and vomiting, a dangerous, even deadly, combination when underwater.

Getting An Earful, or Summing It Up

Ear injuries are the most common injuries to divers. Permanent hearing loss may result from barotrauma to the ears. The likelihood of injuries is reduced by preventive measures such as:

- properly equalizing;
- never diving with a cold or other congestion; and
- aborting your dive if you cannot clear your ears.

Several types of ear injuries can occur when you're diving. All of these injuries should be examined by a qualified medical practitioner. If in doubt regarding the practitioner's knowledge of diving medicine, bring this article with you or encourage your doctor to call DAN for a consult. To determine just what type of injury you may have incurred and to understand its severity, it's helpful to have an otoscopic examination of your ear by a qualified medical practitioner knowledgeable in diving and emergency medicine. In remote areas of the world or on board liveaboard dive vessels you may have to wait a while until you can get medical help. DAN's advice is to encourage you to get to a medical facility as soon as possible. Good diving to you, and keep your ears dry.

*Barotrauma of ascent can also occur. It happens when gases in the middle ear expand with ascent and become blocked, causing tissue damage similar to barotrauma of descent. This malady is less common, because, in all probability, any blockage will usually be felt first upon descent by blocking the Eustachian tubes. How the Ear "Hears" Sound travels as vibrations through the air of the external ear canal. These vibrations are transmitted through the tympanic membrane to the ossicles. The movement of the ossicles transmits the vibrations through another thin membrane into the fluid in the cochlea in the inner ear, where they are converted to fluidic pressure changes. Special structures and cells in the cochlea convert the fluidic pressure changes into nerve impulses. The nerve impulses are then transmitted to the brain through a portion of the eighth cranial nerve, where they become sounds.

COMMON EAR INJURIES Associated With SCUBA DIVING

Otitis externa (swimmer's ear)

This is an inflammation of the external ear caused by infection. Some people are prone to developing this kind of infection, while others have never had a brush with it. With the unfortunate few, when the ear remains moist from immersion in the water, this moisture, coupled with the warmth of the body, creates an inviting growth for many microorganisms, especially opportunistic bacteria.

Otitis Media (middle ear infection)

This is not a diving malady, but it may look the same as middle ear barotrauma to a medical practitioner not trained in dive medicine. Because the treatments can vary, it is important to determine whether an ear problem immediately following a dive outing is signaling a pressure-related injury rather than an infection.

Tympanic Membrane (TM) Rupture

Barotraumatic injuries to the ear may result in perforation or rupture of the tympanic membrane. This may occur in as little as 2.1 meters of water.

Signs & Symptoms: Generally there is pain and bleeding from the ear. This may not always be the case, as a number of divers experiencing traumatic TM ruptures have reported no pain at all. Hearing loss and

tinnitus may be present, but not always. A discharge from the ear of commingled perilymph fluid and blood may be a sign of TM rupture.

Treatment: Go to the nearest medical practitioner immediately for an examination. Do not re-enter the water if you suspect TM rupture: Water entering the middle ear cavity may cause severe and violent vertigo. Do not put any drops of any kind in your ear, and do not attempt to equalize your middle ears.

Barotitis Media (middle ear barotrauma, MEB)
This is by far the most frequently reported injury among divers. People with barotitis media generally develop symptoms immediately following the dive, but delays of up to one day or longer have been reported. When the diver descends, the pressure can cause injury to the middle ear. This overpressure of the middle ear can cause serious fluid and blood to leak into the middle ear, partially or completely filling it.

Signs & Symptoms: A feeling of fullness in the ear may develop, like the feeling of fluid inside the ear. Muffled hearing and hearing loss are other indications of middle ear barotrauma. On examination with an otoscope (a special device medical personnel use when examining the ear) fluid may appear behind the tympanic membrane, causing it to bulge and appear red. In other cases, the eardrum may be retracted, or sunk in. Either condition warrants immediate medical attention.

Treatment: First and foremost, diving must stop. Also, if you have signs of MEB, you must consider altitude changes -as with flying – a concern. See a medical practitioner.

External Ear Canal Superficial Vessel Rupture
This occurs more often in divers who wear hoods. Occasionally, the overpressure may rupture a blood vessel inside the external ear canal, causing minor bleeding.

Signs & Symptoms: A minute trace of blood trickling from the ear canal can signal this injury. Later, injured divers may find drops of blood on their pillows or bedclothes.

Treatment: In order to distinguish between this injury and other, more severe, injuries, you need to stop diving and seek evaluation by a medical practitioner. On a general note, a physician should examine any ear problem that drains purulent material (pus) or has a foul or disagreeable odor. The combination of drugs and time usually allows this injury to heal in a few days, but cases have lasted up to several months. If you have been on decongestant therapy for seven days and have experienced little or no relief, it’s time to see your otolaryngologist, an ear, nose and throat (ENT) specialist.

The DAN Otoscope includes a Pelican Super MityLite®.

The light is sealed, waterproof and impervious to most chemicals. This makes it ideal for a first aid kit that is subjected to marine environments. You can purchase this item on the DAN Shop. Important! The placement of foreignobjects, including medical instruments, in the ear canal by an untrainedperson can result in significant and permanent injury. The final diagnosis and treatment of injuries or illnesses of the ear shouldalways be performed by and prescribed by a qualified physician.

About the Author

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