

Chapter 28

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INFECTIONS

There are a variety of both exotic and mundane infections to which divers are exposed. Some are terrestrial and are the same as experienced by non-divers. Others are caused by specific marine organisms and require special methods of identification.

ABRASIONS AND INFECTED CUTS

Divers are frequently subjected to minor injuries including cuts and abrasions. These injuries are more prone to infection than those encountered in terrestrial pursuits because of the unusual bacteria encountered in the aquatic environment and because cuts and abrasions on divers frequently remain moist for long periods of time.

Cuts and abrasions which are not due to coral or other marine life do not require aggressive cleaning unless they are obviously contaminated. Bleach, antiseptic or antibiotic cream or powder should be applied as soon as possible. When out of the water they should be kept dry and loosely covered to prevent further contamination.

Coral Cuts

Coral often causes minor cuts and abrasions in unprotected divers in tropical waters. These cuts are particularly prone to infection, probably because of the large numbers of marine bacteria on coral and the retention of coral particles and slime in the wound.

They frequently become infected within hours. Even minor cuts or abrasions can become red, swollen, tender and painful. Later there may be a discharge of pus from the area.

A severe infection may spread to the lymphatics and blood stream, with fever, chills and tender swollen lymph glands in the groin or armpit, depending on the site of the injury.

❑ Treatment.

All coral cuts should be washed with bleach or soapy water as soon as possible and the surface of the cut or abrasion should be thoroughly cleaned. This removes foreign material that may be the source of inflammation. All cuts should then have local antibiotic powder, cream or ointment applied every 6 hours until healed. The senior (elderly) author, who has a tendency towards cowardice, relies more on the antibiotics than vigorous cleansing. Suitable topical antibiotics include neomycin or bacitracin.

Early attention to every coral cut in this way will usually prevent serious infections. If treatment is delayed, or if systemic effects occur, oral broad-spectrum antibiotics may be needed. The development of a chronic inflammation may cause severe itching over the next few weeks, but this usually responds to local steroid (cortisone) ointments.

❑ Prevention.

It is wise when diving on coral reefs to always wear protective clothing or a wet suit, gloves and booties. Modern lightweight "lycra suits" afford some protection and may be worn in very warm tropical waters. These provide no flotation or thermal insulation properties, and diving must be adjusted for this.

EAR INFECTIONS

Otitis Externa (Swimmer's or Tropical Ear")

This outer ear infection is one of the most common and troublesome problems in divers. It is especially likely to occur in **hot humid conditions** (e.g. tropical climates, standard diving dress, compression chambers) or when **water is retained** within the ear after immersion, especially if with **contaminated water**. Small bony outgrowths (**exostoses**) are commonly found in the ears of swimmers and divers, and these may be large enough to cause retention of water, wax, debris and organisms. **Local injury** induced by scratching the ear canals (with a match or hair pin), or by clumsy attempts to remove **wax** (often using cotton buds) frequently precipitates the infection. Sometimes an underlying **skin disorder** is present such as eczema or dandruff. Many bacterial organisms have been incriminated, as well as fungi.

❑ Clinical features.

Mild infection causes **itching** of the ear which encourages the diver to scratch the ear canal, further breaking down the protective barrier and aggravating the infection. This has prompted the good advice that "nothing smaller than your elbow" should be inserted into the ear canal.

Serious infection may appear as a local boil in the ear canal, or as a diffuse inflammation with narrowing of the canal and an offensive smelling discharge. **Pain** with movement of the jaws or pulling on the ear is common. Occasionally a **mild hearing loss** or **dull feeling** in the ear may be noticed, and **dizziness** during diving is a possibility if one canal is completely blocked.

❑ Treatment.

The condition may be difficult to cure and treatment should be supervised by a doctor. Mild cases may only require careful cleansing of the ear canal followed by local (topical) **antibiotic + steroid** ear drops three times per day. More severe cases will need pain killing tablets such as paracetamol — two tablets four hourly as required, along with packing of the canal with special antibiotic + steroid ointments e.g. "Kenacomb otic". Oral antibiotics may be required in severe cases. Diving, along with further exposure to any water, should cease until the infection resolves.

❑ Prevention.

This can be achieved by the use of olive oil drops in the ears prior to diving, or the application of a few drops of a solution of 5% acetic acid in 85% isopropyl alcohol in each ear after a dive to ensure adequate drying. Commercial solutions include "AquaEar" and "Otic Domeboro". Scratching the ear canal with matches, hair pins, cotton buds and the like, although tempting, should be avoided.

Otitis Media (Middle ear infection)

Middle ear infection is not very common in adult divers, but may occur after **middle ear barotrauma** or following upper respiratory tract infections (**URTIs**) or allergies. It may also follow an uneventful dive. Most infective organisms enter the middle ear cavity via the Eustachian tubes, which lead from the throat to the middle ear cavity, during middle ear equalisation. Occasionally a **perforation** in the ear drum will allow direct entry of contaminated water.

❑ Clinical features.

Clinically there may be a constant and/or stabbing **pain in the ear, fever, ringing** noises (tinnitus) and often a slight **hearing loss**. In this case the ear will not usually be tender to touch.

❑ Treatment.

Treatment is urgent and will include oral broad spectrum antibiotics, pain relieving tablets such as paracetamol and decongestants (such as pseudoephedrine). Ear drops are not advised. No diving or flying in aircraft should occur until resolution — usually 5-7 days.

GENERAL INFECTIONS

There are many diseases that can be caught while diving and swimming. Some are generalised and serious, and the organisms are especially adapted to water environments. Others, such as infectious hepatitis, poliomyelitis, typhoid, cholera, gastro-enteritis, etc., are common diseases and are found especially in contaminated water. Diving in contaminated water needs special clothing and protection as well as post-dive cleansing techniques.

□ **Vibrio and other Aquatic Organisms**

Generalised manifestations such as fever, chills, septicaemia, shock etc. may be accompanied by respiratory symptoms, muscular pains, headaches, coma and death.

□ **Key West Scuba Divers Disease**

This condition is not restricted to the city where it was described, in Key West. It is due to contamination of regulators (especially older ones with twin hoses) by bacteria and tends to occur in multiple divers– such as in diving courses where regulators are shared. It can also develop from breathing bags. It is similar to influenza with respiratory symptoms, but usually clears after 3 days.

□ **Naegleria (Amoebic Meningitis).**

This lethal condition is encountered by divers or swimmers bathing in fresh water lakes, streams, hot springs, spas or hot tubs. It is caused by a microscopic amoeba which usually enters water by **faecal** contamination. It may survive in **warm fresh water** (not in sea water). The amoeba enters the body through the nose from where it burrows through the olfactory nerve to enter the brain. After an incubation period of about a week it causes meningitis and encephalitis, which is difficult to treat and is usually fatal.

The condition is usually manifest by a progressively worsening headache, fever, vomiting, discomfort on looking at bright light, neck stiffness, confusion and finally, coma. Death usually follows after 5-7 days.

There is very little that can be done to treat this dangerous condition apart from intensive nursing care in a major hospital and aggressive intravenous therapy with several antibiotics – none of which are very effective.

Because the organism enters through the nose, infection can be prevented by not immersing the head in fresh water, which is at risk of contamination. Such waters should be avoided if possible, however if diving is essential in these areas (police underwater searches, mining or drainage assessments etc.) then only diving equipment incorporating helmets which totally enclose the head and face should be used, and these rinsed off thoroughly prior to undressing after the dive. Heavy chlorination will kill the organism as will cold temperatures and seawater, eventually.

SINUSITIS

Because air passes into the sinuses during descent (see Chapters 2 and 10), if the diver has an **upper respiratory tract infection** and goes diving with this, then organisms will be transferred to the sinuses as he equalises pressures. Because of the overwhelming infection that is then produced, it is common to develop symptoms within hours or days of the dive exposure.

As a general rule, the more descents carried out, the greater the amount of infective material which passes into the sinuses. Also, if there is any sign of **sinus barotrauma** (especially on descent) then there is blood and fluid in the sinus at body temperature, which makes an ideal medium for the growth of organisms.

❑ Clinical features.

With sinusitis there is not only a feeling of **fullness over the area of the sinus** (usually maxillary, frontal, ethmoid, sphenoid or mastoid), but there is **pain** which is likely to increase in severity. If there is any significant obstruction of the sinus ostium, then pressure develops within the sinus as infection flares. There may be severe systemic signs – similar to that of an abscess, thus the diver may be **feverish**, feel ill and may look sick.

❑ Treatment.

This usually involves oral broad spectrum antibiotics, pain relief (paracetamol) and decongestants (pseudoephedrine). Sometimes a fluid level can be seen on scans or X-Ray or MRI and rarely, surgical drainage is necessary.

Because infections tend to produce scarring, sinusitis must be avoided as much as possible by divers – otherwise the openings of the sinuses can become scarred and narrowed. This means that the diver is much more likely to develop sinus barotrauma in the future – thereby limiting his diving career.

❑ Prevention.

Avoid sinus barotrauma (see Chapter 10). The rapid and effective treatment of infections that do develop in the sinuses will be of some preventative value. Of more importance is the avoidance of diving during times in which there is any inflammatory disease of the upper respiratory tract (nose, throat), such as hay fever, rhinitis or upper respiratory tract infection.

SWIMMER'S ITCH

Swimmer's itch is a localised skin infection caused by a bird parasite (*Schistosoma cercaria*) which can be encountered by persons swimming or wading in lakes or lagoons frequented by water birds. The parasite, which is present in the water, burrows through the skin and then dies, causing an inflammatory reaction under the skin. It causes multiple small, raised, red itchy lumps, which may last for a week or so.



The lesions usually resolve without treatment. Occasionally, more severe reactions may follow in individuals who are allergic to the parasites and may require medical attention by way of oral antihistamines and even topical or oral steroids (cortisone).

Fig 28.1

SWIMMING POOL GRANULOMA

Also called **Swimmer's Elbow**, this infection is due to an organism (marine *vibrios*) entering the skin via an underwater abrasion from a swimming pool, ship's hull etc. **Red swellings** covered with fine scales may develop 3–4 weeks after injury over bony prominences such as the elbows or knees. Thick pus may be found if the swelling is incised and spontaneous resolution may take up to a year or more. **Diagnosis** may only be confirmed by microscopic examination of a piece of the ulcer or lesion, and culture of the organism involved.

TINEA PEDIS – "TINEA" (or "ATHLETE'S FOOT")

This is a common fungal infection which affects the feet of divers and swimmers exposed to repeated wet and warm conditions, such as shower rooms. It causes itchy, scaly or raw areas between the toes and on the feet.

Many divers suffer from this infection, and are the source of cross-infection to others. The fungus can be found in many areas and makes the condition difficult to prevent because of repeated exposures.

Fortunately it responds readily to modern topical anti-fungal agents such as imidazole derivatives, (tolnaftate or undecylenic acid). The solution or cream should be applied twice daily and continued for two weeks after the condition appears to be cured. Attempts should be made to keep the feet as dry as possible, and drying with tissues between the toes after bathing or swimming is helpful. A light application of an anti-tinea powder (e.g. econazole dusting powder) daily may also be beneficial in preventing recurrence. In severe or resistant cases, oral anti-fungal medication such as ketoconazole or griseofulvin may even be necessary. Towels and footwear should not be shared.

PITYRIASIS VERSICOLOR (or "TINEA VERSICOLOR")

This mild fungus infection of the skin may either cause itching or no symptoms at all. With exposure to the sun however, a diver will notice coin-sized spotty areas which do not tan on the chest, back and arms. A fine scales on the skin will be seen on close inspection. It is best treated with topical anti-fungal lotions or creams such as clotrimazole or econazole applied twice daily. An alternative is 20% sodium thiosulphate (or photographer's 'Hypo' solution – but this stains clothing).

HIV/AIDS

More than 25 million people have died of AIDS, and there are 35 million people living with HIV/AIDS. Half are under the age of 25 years. The potential duration of the disease may be 1-2 decades, or longer. During this time, inevitably some will experiment with scuba diving. The risks to the diver or his companions are not known with certainty. The following is a general discussion based on the current information.

The virus must gain entry to the bloodstream to produce infection and is generally unable to enter through intact body surfaces such as skin or mouth lining. It can gain entry through small breaks in tissues such as cuts, abrasions or ulcers. Tissue fluid oozing from breaks in the skin or mouth lining can contain viruses in infected individuals. The virus is sometimes present in blood (viraemia) and saliva, making transmission a possibility (albeit probably only slight) in some situations encountered during diving. The viraemia is also the danger period to the patient, as this is the time when the virus can attack the central nervous system, especially the brain

□ Sexual.

This is the most common mode of transmission. It can be eliminated by celibacy and reduced by using condoms ("safe sex" practices), avoidance of both promiscuity and anal intercourse. A wet suit should prove an effective barrier if worn at all times.

□ Blood.

Blood from infected people can transmit the virus to others. This usually follows the sharing of needles or transfusions of infected blood, but there have been a few reports of transmission by infected blood splashing onto the skin — usually skin which has been broken. In diving, infection in this way could theoretically follow the first-aid treatment of an injured diver after trauma, cuts or marine animal injury. The sharing of mouthpieces and regulators, such as during buddy breathing, and which have not been adequately cleaned after each individual use, could pose a potential risk of infection through oral abrasions.

□ Resuscitation.

Expired air resuscitation often requires mouth-to-mouth or mouth-to-nose contact. There is a theoretical risk of transmission of the virus during resuscitation, especially if either the victim or rescuer has ulcers or bleeding in the mouth. The risk from saliva is probably small but it would be wise, if a known AIDS carrier was involved, to use a mouth-to-mask or resuscitation tube technique. If the rescuer is trained in its use, an O₂ or air resuscitator bag would be even better. See Chapter 40.

□ Sharing equipment.

It is common for equipment to be shared in diving schools. Since the virus is known to be present in the saliva of infected people, there is a theoretical risk of transmission of the disease from the sharing of demand valves (including buddy breathing practice) and snorkels. The risk is probably slight and there have not been any cases of such transmission yet reported.

Until the risk is excluded it would seem wise to disinfect shared equipment between uses by soaking in a solution known to be lethal to the virus. Check with the manufacturer beforehand to ensure that the chosen solution will not damage the equipment.

❑ **The HIV positive or AIDS infected diver.**

These individuals could pose a risk to their fellow divers in the situations outlined above. It would be considerate for them to take care to avoid situations which might bring their blood or other body fluids into contact with others. Breathing equipment should not be shared.

HIV positive cases (those with the virus infection but no obvious symptoms) have recently been shown to have neuropsychological abnormalities not obvious to themselves, but which could be detrimental to the normal intellectual functioning and judgment needed for scuba diving.

Infected divers may be exposing themselves to added risks by diving. Depression of the immune system makes them more susceptible to infection from coral cuts and abrasions, from exotic marine bacteria, and possibly to infections acquired from shared breathing equipment. It is shown by some researchers that hyperbaric environments and hyperbaric oxygen (as occurs with diving and diving treatment respectively) may reduce the integrity of the blood brain barrier and allow the extension of the virus into the brain, causing the dreaded neurological AIDS. The influence of some of the other physiological effects of increased pressure on AIDS infected divers is unknown.

❑ **Prevention.**

Both divers and non-divers should avoid contamination of the skin by other people's blood where possible, and use disposable plastic or latex gloves whenever possible. If it is unavoidable, wash the blood off as soon as practicable with soap or antiseptic solutions.

If medical attention is sought in **underdeveloped countries**, try to ensure that only single-dose vials, new or disposable syringes (i.e. totally unused) and needles are used, and that re-used instruments have been properly sterilised. Transfusions of blood and blood plasma in some of these countries carries a significant risk of HIV/AIDS or hepatitis infection. Artificial blood expanding solutions such as polygeline ("Haemaccel") should be used whenever available in such countries.

HEPATITIS

This is a highly contagious viral condition which infects and damages the liver. There are three or more variants of the virus but hepatitis-B probably poses the greatest potential threat to divers.

Hepatitis-B virus can cause a fatal infection in up to 10% of cases and fatal liver cancer or cirrhosis may develop after many years in apparent survivors. It is usually transmitted by infected blood.

There is potentially a small risk of infection in divers by sharing breathing equipment (as mentioned previously for HIV/AIDS), but the greatest risk comes from contamination of the skin by the blood of an infected person. In this regard it is similar to, but far more infectious than, HIV/AIDS. The virus is also far more "hardy" and can remain infectious for some time. Old dried blood in syringe needles found lying about can still infect anyone 'pricked' several weeks after being used by a carrier or actively infected person.

Prevention is along similar lines to HIV/AIDS.

INFECTIONS IN HYPERBARIC ENVIRONMENTS

Underwater habitats and compression chambers are humid areas which have a high concentration of oxygen.

This favours the growth of certain types of organisms, both in the chamber and on the skin of inhabitants. Outer ear infections (otitis externa), described earlier, are particularly common in underwater habitats and pressure chambers because of these environmental conditions, and divers occupying these environments are frequently given prophylactic ear drops to prevent these infections.

Should severe infections occur, treatment may prove difficult within such environments. These infections include sinusitis, bronchitis, pneumonias and skin infections. An acute attack of appendicitis occurring in a diver whilst decompressing from a saturation dive may even require surgery within the pressure chamber. The administration of general anaesthesia, along with the sterility necessary for such surgery, render this normally simple procedure much more difficult.