Chapter 37

DRUGS AND DIVING

It is common for divers to enter the water under the influence of drugs. These may vary from paracetamol taken for a minor headache, to alcohol or marijuana from a beach party the night before, or a therapeutic drug for an illness such as high blood pressure.

Since some drugs are innocuous while others can have potentially lethal effects with diving, it is important to know something about them.

Problems can arise from effects of the drugs themselves, but commonly the condition for which the medication is taken poses a greater threat to the diver. For instance, most antibiotics have no harmful influences on divers, but a diver being treated for bronchitis with an antibiotic, has a significant risk of developing pulmonary barotrauma until the condition resolves.

We will consider commonly used drugs under four categories:

- Drugs taken for treatment of illnesses
- Drugs taken for prevention of illness (prophylaxis)
- Recreational or social drugs
- Drugs used for diving related illnesses.

TREATMENT DRUGS

In many cases the drug which is used to treat an illness can be a greater hazard to the diver than the illness itself. Some drugs may have frequent and predictable effects on diving activities and these are summarised here, but much more information can be sought by an Internet search using reliable sources.

The idiosyncratic effects of other therapeutic drugs on an individual are unpredictable. Thus, if drugs are to be used when diving, they should be introduced to the diver long before the diving

is undertaken. Then a drug reaction is less likely to complicate the interpretation and treatment of potential diving diseases.

Cardiac and Blood Pressure Medications

❑ Beta-blockers.

A variety of these drugs (e.g. atenolol, metoprolol) are used to treat high blood pressure or pain from coronary artery disease (angina). Their main action is to block the effect of the cardiac stimulant, adrenalin, on the heart. Adrenalin acts on specific drug receptors in the heart known as "beta receptors", thus giving rise to the term beta-blocker.

By inhibiting the action of adrenalin, beta-blockers reduce the force of contraction of the heart muscle. This diminishes the work it performs and so reduces angina symptoms, while the reduced output of blood lowers the blood pressure.

A diver taking beta-blockers has a significant limitation of the reserve pumping capacity of the heart. If a large blood supply is required by the muscles to extract the diver from an emergency e.g. heavy wave action or and adverse current, it may not be available.

Beta-blockers have been incriminated in the production of both arrhythmias and pulmonary oedema in divers.

Beta-blockers also act on the muscle lining of the bronchi and may unmask asthma in some individuals, exposing them to the dangers of both asthma and burst lung. Even those beta-blockers which are described as "cardio-selective" can still have these effects.

These drugs are often used in eye drops for the treatment of glaucoma. Significant amounts can sometimes be absorbed into the body causing generalised effects. Divers using these drops should seek medical advice to ensure that they are not affected in this way. They can avoid this complication by using a eye-drop technique called lacrimal compression.

The conditions for which the drugs are taken can cause difficulties as well. For example, a diver under treatment for high blood pressure is also at high risk of coronary artery disease, and may already have a sub-clinical form of this disease. The drugs may summate with, or potentiate, other causes of heart rate reduction associated with diving, and provoke arrhythmias and the sudden death syndrome (see Chapter 35).

❑ Other blood pressure drugs.

Apart from beta-blockers, blood pressure lowering drugs fall into two broad categories — blood vessel dilators and diuretics (stimulators of urine production).

- **Blood vessel dilators (vasodilators)** reduce blood pressure by widening peripheral blood vessels, where most of the resistance to blood flow occurs. These include prazosin and felodipine.

Some can inhibit the bodies ability to compensate for changes in posture, causing fainting on standing. This is an undesirable side effect in a diver attempting to ascend a ladder to leave the water, especially in adverse sea conditions or if he is preceding his buddy.

A newer drug, the ACE inhibitors, can produce a dry cough which can be troublesome in the diving environment. Others, (such as calcium channel blockers like verapamil) may affect the nerve conduction of the heart, making it more susceptible to the sudden death syndrome (see Chapter 35).

• **Diuretics** stimulate the production of urine and tend to dry the body out. This reduces blood volume and so tends to lower the blood pressure, but there are probably other mechanisms acting as well. The effects on diving are not clear but there are potential problems.

Reduction of the blood volume may affect blood viscosity and the dynamics of blood flow and so increase the dangers with bubble formation. In addition, changes to regional blood flow may alter the pattern of gas uptake and elimination (decompression).

Some diuretics tend to lower the blood potassium level, making the heart more prone to disturbances of rhythm. These arrhythmias may be unmasked by the effects of cold, the dive reflex, heavy exertion and the other causes of the sudden death syndrome (see Chapter 35).

One group of diuretics, carbonic anhydrase inhibitors, is also used as treatment for glaucoma. These cause increased paraesthesia especially in the cold-exposed hands of divers, and may lead to a mistaken diagnosis of decompression sickness.

Psychotropic Drugs

❑ Tranquillisers and sedatives.

This group of drugs includes **benzodiazepines**, of which diazepam ("Valium") is a common example, and sleep making drugs like barbiturates. A significant proportion of the population takes drugs to relieve anxiety. Excessive anxiety alone is a significant risk factor in diving, and the drugs taken to relieve it further complicate the problem.

Another class of tranquillisers, like **phenothiazines**, (e.g. chlorpromazine – "Largactil") and its modern equivalents, are used to treat serious psychiatric disorders such as schizophrenia. Apart from the side effects of these drugs, people suffering from this disorder often have a tenuous grip on reality and this can seriously impair their ability to make safe judgments related to diving.

Tranquillisers and sedatives cause; drowsiness, impaired judgment, slowing of thought processes and reduction in problem solving ability. These effects are intensified by nitrogen narcosis, but they are potentially dangerous at all depths.

❑ Antidepressants.

Depression is not an ideal state of mind for an active diver. Even when successfully treated with antidepressants, the diver is left with potentially harmful side effects from the drugs. Some of the antidepressants cause sedation, but the principal problem is the tendency of others to cause potentially lethal disturbances of heart rhythm and epilepsy. Some can react with certain foods and other drugs to affect blood pressure and consciousness.

❑ Anticonvulsants (anti-epileptic drugs).

These have similar sedative side effects to the tranquillisers as well as some other specific complications. Any form of epilepsy can have disastrous effects on cerebral activity, with loss of consciousness being common. The influence of nitrogen narcosis on these drugs is unknown. Some diving conditions (stress, glare and flickering light, high or low oxygen and carbon dioxide levels) can precipitate convulsions, despite these medications. Epilepsy and medications used for its control (e.g. phenytoin or carbamazepam), preclude safe diving.

Antihistamines

These are usually taken to treat allergic conditions. Pharmacologically, many are closely related to the psychiatric drugs and share a common side effect, sedation. They cause the same potential hazards to diving as other sedatives. In addition, if antihistamines are taken to treat hay fever, there is a strong possibility of the diver developing ear or sinus barotraumas. These drugs seldom completely cure the nose and throat congestion. Other recently developed drugs are less sedative, but may provoke cardiac arrhythmias or bronchospasm (asthma).

Antibiotics

These have a large number of side effects, but few of specific relevance to diving. Tetracyclines can occasionally cause photosensitivity, a condition resembling sunburn caused by enhancing sensitivity to sunlight. Many antibiotics increase susceptibility to **vomiting**.

The condition for which the antibiotic is taken is usually of more concern. This especially applies to respiratory tract infections which make the diver prone to barotraumas.

Analgesics

A diver suffering from pain which warrants the use of pain killers should generally not be diving. Apart from the adverse interactions some diseases can have on diving, the commonly used analgesics can have undesirable side effects. There is also the **diagnostic confusion** that may result between the painful condition aggravated by diving, and decompression sickness.

❑ Aspirin.

This commonly used analgesic causes an inhibition of the clotting ability of blood, with just one dose and lasts for many days.

This is usually not a problem in everyday use – in fact the blood effect is used to prevent heart attacks and strokes. However, it can have implications if the diver develops **inner ear barotrauma** or serious **decompression sickness**. The increased bleeding tendency can result in haemorrhage into injured tissues, such as the spinal cord, with greater consequences. Ulcer-like erosions can also occur in the stomach, with vomiting and occasionally bleeding from the gut

It may also cause bronchospasm, like **asthma**, in some divers.

❑ Paracetamol (acetaminophen).

If a diver needs to take analgesics for minor pain (hopefully after excluding diving related illnesses as a cause), it is better to use paracetamol which has fewer side effects than aspirin. Paracetamol does not effect blood coagulation and avoids the stomach upsets, common with aspirin.

❑ Strong analgesics.

Preparations containing codeine or dextropropoxyphene (both narcotic derivatives) and other strong analgesics are sometimes prescribed for severe pain.

These drugs have comparable sedative effects to the tranquillisers and can have similar adverse interactions with diving. People with pain of this intensity should not be diving.

Insulin and Anti–diabetic Agents

People taking these drugs are prone to sudden depression of the blood sugar level which produces **anxiety**, **confusion** and then **unconsciousness**. This is particularly likely during exercise. This complication in the water often has a fatal outcome. Because of this possibility and other potential physiological complications (e.g. acidosis and hyperventilation), diabetics are generally advised against diving.

Bronchodilators and other Asthma Medications

Asthma is an inflammatory condition of the air passages of the lungs. It causes swelling of the lining of the airways, spasm of the muscles in the airways (bronchospasm) and obstruction of airflow through them. The bronchospasm can be reduced by aerosol sprays containing drugs such as salbutamol ("Ventolin") or oral bronchodilators. These can disturb cardiac rhythm and precipitate the sudden death syndrome during diving, because of the multiple trigger factors (see Chapter 35).

While the use of these and other asthma medications will improve some of the airway flow and thus relieve symptoms, it does not cure the condition. Asthmatics have airways which are excessively sensitive to irritants, reacting with bronchospasm to stimuli such as cold dry air and sea water inhalation. There is usually a degree of obstruction in some of the airways most of the time. This makes them susceptible to pulmonary barotrauma or death from the diving sequelae of asthma - panic and drowning.

Some oral bronchodilators (theophylines) can cause pulmonary vasodilatation – which could potentially allow asymptomatic venous bubbles from normally safe dives to enter the arterial circulation as gas emboli, even without pulmonary barotrauma. **Asthma and these medications are incompatible with safe diving.**

Implanted Drug Delivery Systems

Implanted **reservoirs** are now being used to deliver drugs which cannot be taken orally and which need to be used over prolonged periods. Many of the conditions for which these reservoirs are used are incompatible with scuba diving.

Implants form a potential site of bubble formation during decompression. If bubbles form inside or around the reservoir, expansion in response to the gas laws may lead to excessive delivery of the drug. As experience with these devices in diving is limited, divers fitted with them are advised to seek expert medical advice concerning the possible complications.

PROPHYLACTIC (PREVENTION) DRUGS

Statins

These are frequently used to reduce the harmful effects of cholesterol, but may have other beneficial effects. Patients who need these drugs are likely to have an increased risk of cardiac disease, and so should be assessed more completely by their diving physician.

Some recipients will respond to statins with serious muscular and other disorders and so diving should be delayed for some weeks or months to ensure these problems are not experienced.

Oral Contraceptives — the "Pill"

These preparations can have serious side effects, even without the complication of diving. In older high dosage drugs, excessive blood clotting resulted in occasional deaths from pulmonary embolus or strokes.

Occasionally the pill produces serious psychological sequelae, migraine, nausea and vomiting, which may make diving more hazardous.

The newer low dose oral contraceptives have a lower incidence of these disorders. The concern with diving is the possibility of more congealable blood interacting with gas bubbles during decompression. There is no overwhelming evidence to either confirm or refute this theoretical risk, despite a number of surveys on female divers.

Anti-Sea Sickness Drugs

See Chapter 32.

Antimalarial Drugs

Tropical countries offer some spectacular diving locations but also frequently have endemic diseases, including malaria.

The chances of contracting this potentially lethal disease are reduced by the use of anti-malarial drugs such as chloroquine and pyrimethamine ("Maloprim"). Unfortunately many countries now have strains of malaria which are resistant to conventional anti-malarial drugs, making their use as a preventative measure not fully reliable. As well as being fallible, these drugs can have serious side effects including suppression of white blood cell production, anaemia, and eye damage.

One of the anti-malarials, mefloquine ("Lariam"), can cause coordination disturbances and vertigo which may have alarming implications and cause diagnostic problems for divers.

A diver intending to visit a malaria endemic area should seek expert medical advice regarding prophylaxis for malaria in that area, as well as other more exotic tropical diseases. A diving physician should also be asked about possible interactions of the prescribed drugs with diving.

RECREATIONAL (SOCIAL) DRUGS

Alcohol

Diving culture has traditionally included substantial use of alcohol. Like other drugs, it can have adverse interactions with diving.

There is no safe blood alcohol level for diving and few people in their right mind would consider diving while under its influence. Some may not be aware that the liver has a limited capacity to metabolise this drug, so it is possible to have an appreciable blood alcohol level on the morning after a night of heavy consumption. Traffic police are well aware of this. They frequently apprehend drivers going to work with an illegal blood alcohol level on the morning after.

The danger of alcohol consumption associated with aquatic recreations is well documented — 80% of **drownings** in adult males are associated with alcohol use, in Western countries. The hazards are predictable. Alcohol intoxication, as well as **impairing judgment** and **coordination**, causes **cardiac rhythm disturbances**, **impairs the pumping ability of the heart, reduces the blood volume** due to excessive urine production, and increases **heat loss** through the skin (**hypothermia**).

The disturbed physiology – otherwise known as a "hangover" – after excessive alcohol consumption is well known to the younger authors of this text. Used to excess, this drug is a toxin, damaging the liver, heart and brain. In divers, the vascular and metabolic dysfunction after heavy consumption is a probable risk factor for the development of **decompression sickness**. Increased susceptibility to both **sea sickness** and **vomiting** is frequently observed. Soporific effects may summate with those of **nitrogen narcosis**.

Tobacco

The gentle art of inhaling burnt tobacco leaf has some unfortunate side effects. The associated risks of lung cancer, heart and vascular disease are well known. There are more subtle effects.

A smoker inhales carbon monoxide, which binds to the haemoglobin and reduces the blood's ability to transport oxygen by up to 10%. This reduces the capacity for exertion and impairs the physical ability to respond to an emergency (e.g. fatigue from a surface swim). The nicotine in the tobacco also stimulates the heart, making it prone to **rhythm disturbances** (arrhythmias).

Airway narrowing caused by chronic smoke irritation impairs exercising ability and increases the risk of **pulmonary barotrauma**. A similar chronic irritation of the upper respiratory tract predisposes to **ear** and **sinus** b**arotrauma**.

Marijuana — Cannabis or "pot"

Chronic use of this drug causes many of the diving related respiratory problems attributable to cigarette smoke, and **chronic bronchitis** is especially common in heavy users. This predisposes to **pulmonary barotrauma**.

Marijuana causes altered perception, **impaired judgment**, and mood alterations, which are incompatible with diving safety. As with other drugs, these effects are compounded by the effects of nitrogen narcosis. It also is said to increase the likelihood of **hypothermia** by blocking blood vessel response to cold. The allegedly "beneficial effects" of marijuana are negated by pressure!

Cocaine ("coke") and Other Stimulants

These drugs have similar physiological effects to adrenalin, stimulating and irritating the heart, causing potentially lethal **cardiac rhythm disturbances**, and elevating the blood pressure. Sudden death in young people from the cardiac effects is common, especially in athletes who exercise after taking cocaine.

The mental stimulation and mood elevation **impair judgment** and encourage **risk taking**. Its use while diving, apart from being illegal, is very risky.

Caffeine

This drug is found in coffee, tea, cola, and many natural foods. Even chocolate drinks, periodically given to children at bedtime, contain it. It is one of the more innocuous drugs which is used almost universally.

When used to excess it can irritate the heart causing **rhythm disturbances** which are a potential problem in diving or other strenuous exercise. It also stimulates urine production which discourages some divers from lending their wet suit to known caffeine abusers.

Narcotics

The **sedative** and **judgment impairing** qualities of these drugs makes their use during diving even more dangerous and destructive than their use as a recreational drug.

Intravenous drug users have a significant risk of being infected with the **hepatitis** and **HIV (AIDS)** virus, which should be born in mind by their diving companions (see Chapter 28).

DRUGS FOR DIVING DISEASES

Anti Sea Sickness Drugs

See Chapter 32

Sinus and Ear Problems

Many inexperienced divers have difficulty equalising the ears and sinuses to pressure changes. Often this difficulty is associated with congestion of the lining of the nose, generally due to allergy (hay fever) or infection (URTI). Poor technique is a contributing factor.

Nasal congestion can be relieved to some extent by the use of tablets such as pseudoephedrine ("Sudafed"), or nasal decongestant sprays such as phenylephrine or ephedrine. They all have a **disruptive effect** on the **heart's conduction system** and may thus increase the likelihood of the sudden death syndrome.

These agents used in proper doses on land have few harmful generalised effects. However their activity on the nasal tissues can be unpredictable. Prolonged use causes localised tolerance to the drug, eventually aggravating the congestion which they are supposed to relieve. This applies particularly to nasal sprays. Their effect can wear off during the dive, allowing a trouble free descent, followed by sinus or ear barotrauma during ascent (see Chapters 9 and 10).

These drugs are sometimes used by divers to overcome the temporary nasal congestion of an upper respiratory tract infection (a cold or URTI). A safer approach is to avoid diving during the course of these infections.

If the decongestant is somewhat effective, it may result in the diver avoiding barotrauma of descent (as the beneficial effect is on the nasal lining) but have little or no effect on the "internal" opening of each of the air passages (Eustachian tube, sinus ostia, etc.). Thus the diver is now vulnerable to an internal blockage which manifests during ascent and produces **barotrauma of ascent**. This disorder is far more dangerous than the disease for which he is taking it, as it prevents ascent to safety. Barotrauma of descent merely stops him diving.

Self medication with these drugs is unwise and divers with “congestion” problems should seek the advice of a diving physician.

Medication for use in Decompression Sickness

In view of the relative unreliability of the decompression tables, researchers have experimented with drugs to inhibit the development of bubbles and speed gas elimination from the body. While some experimental drugs now allow laboratory animals to dive with a much greater margin of safety, no agents useful to human divers have yet been convincingly demonstrated.