

exercise thought, commonsense and caution in order to maintain an acceptable degree of diving safety.

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## THE DRUG-AFFECTED DIVER

Ian Unsworth.

The drug-affected diver is not something which has been considered very much. I am going to discuss two aspects. Initially illicit drugs, Table 1, because drugs of that sort are a fact of today, and secondly I will mention drugs we tend to call "medications", just to remind us that many medications prescribed by practitioners and self-prescribed by divers indeed do affect the diver's ability to work or perform or just to be safe underwater.

### Illicit drugs

Illicit drugs are a fact of today and it is going to be very difficult to act in this area as far as divers are concerned. I believe there are three reasons, why divers, both sport and commercial, might take drugs illicit soft drugs and hard drugs in combination with diving or going under pressure.

TABLE ONE

### ILLICIT DRUGS

Cannabis (Marihuana)  
Cocaine  
Heroin  
Amphetamines  
Barbiturates  
Angel Dust

One is a deliberate attempt to enhance psychiatric (yes, it is psychiatric) pleasure of drugs. This would apply to sport divers. Then, commercial divers misguidedly use illegal or illicit drugs as an attempt to enhance their underwater performance, and thirdly perhaps there is a certain ignorance among divers, both commercial and sport, that there is an additive affect of diving on a wide range of medications.

I think we should consider primarily the recreational use of these drugs. The true addict does not occur in either sport or commercial diving. By the true addict I mean someone who is so 'hooked' on agents like heroin that he is not going to spend his money getting a fill for an air tank, he is not going to spend his money on buying diving equipment or taking a charter boat out, he wants all his available cash to supply his habit. I think there are very, very, very, few genuine hard addicts in diving. I do not think it is possible for them to exist.

But the recreational use of drugs is, I think, very important and is very dangerous. Heroin is not commonly considered a recreational drug. They are first of all the

cannabis derivatives. Probably marihuana is the easiest form to obtain it, and the commonest form of its use is smoking. The active ingredient of marihuana is THC which has the lovely name of delta 9 tetrahydrocannabinol. Cocaine is certainly now coming into fashion and it is not, as was commonly believed a year or two ago, the Yuppie drug. It is very, very much the drug of the ordinary person in the street. So we are considering the recreational use of marihuana and cocaine. Using the latest figures from the Federal Government computer on drug abuse in Canberra, in the 14-24 year old age group, 27% of both sexes use marihuana recreationally, whereas it is used by 34% of the males in that age group. In the age group of 25-39 years old, 15% use marihuana recreationally, while 20% of the males use marihuana recreationally. With cocaine in the 14-24 year old age group 0.2% of both sexes use cocaine recreationally but 0.4% of the males use cocaine. In the 25-39 year old age group 1% of both sexes use cocaine recreationally and 2% of males use the drug recreationally. These figures are not specific to divers, but these illustrate that the groups of young people among whom the divers will fall are recreational users and one would anticipate therefore that a smaller, perhaps a much smaller, percentage of usage occurs among divers.

Amphetamines are available on the illicit market and it is well known that they do enhance performance. Long distance truck drivers have been using amphetamines for quite a while and I think perhaps some divers may also be taking amphetamines.

Barbiturates are not all that common. My first close encounter with a diver taking drugs was with deliberate overuse of barbiturates in association with deep diving and therefore nitrogen narcosis. We will not consider heroin because I do not believe much heroin is used in diving if any.

I do not think that Angel dust, or phencyclidine, similar to LSD, is used at all in diving. The bizarre performance would have led us to have had a lot more diving deaths than in fact than there have been.

**TABLE TWO**

**EFFECT OF ILLICIT DRUGS**

**PHYSICAL**

Increased heat loss through vasodilation  
 Increased rate of decompression sickness, because of actions on CVS.

**MENTAL**

Sedation, increases narcosis  
 Reduction of work efficiency  
 Reduced perception of danger leading to ignoring safety rules, etc.

What are the numbers of these maniacs, because this is the only way to describe them, psychiatric maniacs, what evidence have we got that they exist at all? I have had to treat for spinal decompression sickness a fellow who had deliberately dived with three mates under the influence of barbiturates. So there is anecdotal evidence that people have dived, and some are probably continuing to dive, under the influence of illicit drugs. There are also reports of deaths that are available. I know of one that occurred in New Zealand. A diving instructor who deliberately smoked an excessive amount, even to his mates, of marihuana, prior to a dive from which he did not return alive. I suppose it could have been coincidental that he had a fatal diving accident after smoking marihuana, but putting the two together, certainly it would seem to be appropriate. There are other reports of incidents underwater from the use of illicit agents.

I have been doing medical examinations for diving for more years than I care to remember, nearly 20, and I suppose in that time I have come across 15-20 proposed candidates who were heavily into drugs. In fact on a number of occasions during the examination these divers, or prospective divers, were unable to prevent themselves running to the wash basin and vomiting because of a withdrawal effect. But what about the number of people who when asked, "Do you smoke" say "No, not tobacco" and one says, "Do you smoke marihuana?" "Oh, occasionally!". I think perhaps all of us who do diving medicals have come across a few cases in our time. Now if we can winkle these people out, what about the divers who go to general practitioners who do not understand about diving. They certainly would not appreciate the effects of diving under the influence of drugs. I think there is evidence from anecdotal sources, the results of medical examinations and from death reports to suggest that diving and the use of drugs are being combined.

The effects of illicit drugs are detailed in Table 2. That is why we have to say to these people, "No you can not dive". We have got to point out to them some of the effects of illicit drugs that are being used in a recreational manner. We have got to tell our diving friends and our diving instructors that they must teach that the recreational use of soft drugs is very much a no-no. The physical effects will be increased heat loss, the effect on the cardiovascular system which will be to increase pulse and blood pressure, and the resulting increased gas uptake will increase the likelihood of decompression sickness. The second aspect, is the mental effect of illicit drugs. A number of drugs will sedate, which increases the likelihood of nitrogen narcosis which increases the likelihood of underwater accidents and reduces work efficiency. For the sport diver this is not quite so important but to the working diver it is very important. The third aspect which could well lead to accidents going on to a fatality, is the reduced perception of danger. If divers ignore safety rules because of a reduced perception of danger, then they are swimming into trouble. We all know in diving that there are potential hazards. I believe that diving is dangerous and therefore perhaps we should get permission for an autopsy from all prospective divers.

There is the impression among a lot of people is that with cannabis, one or two “smokers” will not do any harm. They might have that in the morning or between dives at midday and then dive again in the afternoon. However with the tetrahydrocannabinol in cannabis there is a big effect on the mood, on memory and on motor coordination and it is quite sedating. This sedating effect is quite contrary to cocaine and the amphetamines. The smoker mellow, memory becomes a little impaired, motor coordination is impaired and balance, interestingly enough, also suffers, even in very low dosage. What do I mean by low dosage? One or two “smokers” of marihuana. That will give impaired perception, attention and information processing which has been very significant in such activities as flying and to which I have now added diving. THC affects the cardiovascular system. There is an increased pulse rate which will mean more uptake of nitrogen. When the diving pot smoker is upright, the blood pressure is lowish or tends to fall, very similar to postural hypotension. There is also an inhibition of sweating, which with activity underwater, may well give an unacceptable rise in body temperature. This has been shown to occur with marihuana at ordinary atmospheric pressures. This again is very undesirable underwater.

The importance of just one cigarette of marihuana is that it lasts much, much longer than the person who has used that marihuana will themselves appreciate. It will last up to eight hours after one smoke of a joint. Obviously these are very undesirable aspects of a “socially acceptable” agent. Very undesirable effects on a sport diver and obviously worse for a commercial diver. So divers must not underestimate the danger of this marihuana smoking associated with diving.

What about the once yuppie drug, cocaine, which one can snort, smoke or inject? I include the designer drug, crack, which is fearfully potent, and add to the list the amphetamines for a little stimulation. Again there are two effects, one on the central nervous system of stimulation. The person using cocaine or amphetamine feels very, very happy or indeed can go past that state and feel extraordinary dysphoric. He might get very restless, not absolutely sure what the restlessness is due to. He may develop tremors and loss of coordination. These drugs give a reduced sense of muscle fatigue. It is only a reduction in the sense of muscle fatigue. It is not actually an improvement in the state of fatigue. It is just that the sense of fatigue is reduced, so they do not feel so tired, and they feel they can go on and on and do much more work and that they can drive much longer distances and so on. Obviously these aspects are very, very important and very dangerous to someone who is using cocaine or amphetamines and diving. With the cardiovascular system, the pulse rate is increased and the blood pressure goes up with increased gas uptake and interestingly enough, vasoconstriction occurs with cocaine. It is one of the most potent of all vasoconstrictors. Vasoconstriction can again give a rise in core temperature as heat is cannot escape easily from the body. These are extremely dangerous conditions to have in a diver and therefore we must discourage, in every possible way, prospective divers who are found to be using

recreational drugs. We must get the word through to the diving community that it is foolhardy even unto death, to use these drugs recreationally and dive.

### Self prescribed medications

Now to turn very briefly to some self-prescribed medications. These are perfectly legitimate, licit medications and include aspirin, antihistamines, alcohol and nicotine. Aspirin is fine when taken for pain relief. When taken after a bend there is certainly some discussion about its use. However I do not want to get embroiled in that. I will move on to the antihistamines for seasickness. This is one of the few medications that diving doctors may prescribe or get their patients to take because a diver who travels by boat, having taken a non-sedating antihistamine and who does not suffer seasickness is probably a safer diver than one who gets there feeling absolutely terrible, having vomited all the way out to the dive site, but having got there feels he must dive because he has paid his money. So I think the legitimate use of anti-seasickness medications is appropriate.

What about alcohol and nicotine? These are often not considered in relation to diving, but they are the commonest “drugs” that we see used, and their effects are shown in Table 3. I must emphasize excess alcohol. Excess alcohol is often taken by foolhardy divers the night before. There is an old adage I was taught many, many years ago when I was a young lad taking up diving, that tomorrow’s dive begins today. People who go to parties before tomorrow’s dive are really acting very irresponsibly. What effect does excess alcohol have on the next day’s dive? Dehydration occurs as a result of the output of antidiuretic hormone (ADH) being reduced and as a result of the antidiuretic hormone being turned off, increased urine is produced. Dehydration has the effect of increasing plasma viscosity and plasma viscosity has a very large effect on the stability of venous gas emboli (VGE) and we know venous gas emboli occur following many perfectly normal dives. They do not usually go on to produce decompression sickness. But if there is increased plasma viscosity, it stabilises these little gas bubbles and therefore it is quite likely that they will initiate early decompression sickness. So by having excess alcohol the night before and becoming dehydrated, one can initiate early decompression sickness from VGE.

What about smoking? Nicotine, among other things, increases the heart rate and raises the blood pressure. Not very good for a diver as they will increase nitrogen uptake. It stimulates tremors and reduces work efficiency, and produces small vessel constriction. Nicotine from smoking may well contribute to a higher incidence of decompression sickness because gas is trapped within muscle masses by the nicotine vasoconstriction. Another problem of smoking and diving is micro-lung rupture, which I have been mentioning for a long time now but which has not really had very much recognition. Let me explain what I mean by micro-lung rupture. Heavy smokers produce a lot of mucus and this mucus can be deep down in the lung, in the respiratory

bronchioles or even just outside the alveoli. If gas within these alveoli is entrapped by this thick tenacious mucus during ascent one can get small areas of lung, very small areas, almost individual alveoli, rupturing due to the expansion of gas which is not able to escape because of mucus. It is not the massive lung rupture that we commonly associate with pulmonary barotrauma, but small discrete areas of lung being damaged. People often say of middle aged heavy smokers "So and so is just not quite himself after this dive. He seems just to have something not quite right with himself". No one can put their finger on exactly what it is. I believe this syndrome is the result of micro-lung rupture. It is not the massive pulmonary barotrauma that we are all taught about. This is discrete micro-lung rupture that will not produce any signs such as coughing up of blood, but will release into the circulation very small amounts of gas which will be entrained and disappear up one of the carotid arteries to the brain. I think these small amounts of gas produce changes such as alteration in personality albeit transiently. Now the final problem with smoking is carbon monoxide production. This decreases oxygen carriage, which is not particularly good in an activity where you might have to work hard underwater with increased requirements for oxygen.

### TABLE THREE

#### COMMONEST "DRUGS" IN DIVING

##### ALCOHOL

Decreased secretion of antidiuretic hormone (ADH) leading to increased urinary secretion and dehydration. Dehydration increases plasma viscosity which stabilises venous gas emboli (VGE). These stable VGEs initiate earlier onset of decompression sickness.

##### NICOTINE

Increases heart rate, raises blood pressure. Increases cardiac output, increases gas uptake. Stimulates CNS tremors and decreases work efficiency. Produces small vessel constriction, reduces removal of gas from the tissues. Traps gas in small airways.

#### Prescribed medications

Then there are prescribed medications. There are the anti-inflammatories, aspirin and non-steroidal anti-inflammatories, anxiolytics and the benzodiazepines. The benzodiazepines include such agents as nitrazepam, diazepam, etc. These can be prescribed for concerned and anxious divers or for people who might then go on to sport diving. There are cardiac drugs, antihypertensives,  $\beta$ -blockers, diuretics and digoxin. There are anti-epileptics. There are bronchodilators for asthma. There is insulin or oral hypogly-

caemic agents for diabetes and drugs for thyroid dysfunction.

There are some specific effects that may cause trouble. The antidepressants will give some degree of cerebral depression and will worsen the problems of nitrogen under pressure. Antihistamines affect people differently and there are some which do not produce drowsiness, but any antihistamine will synergise with nitrogen to produce worse nitrogen narcosis. Among the antihistamines used for seasickness there are some which will produce drowsiness. It is well worthwhile a diver shopping around before he goes on a boat and trying, over a period of two or three weeks, different anti-seasickness preparations to find a compound that does not make him or her drowsy.

Patients with cardiac problems who have been prescribed  $\beta$ -blockers should not dive because the  $\beta$ -blockers will reduce the person's tolerance to exercise. If a situation arises during a dive when maximum effort has to be used to get out of a problem then a  $\beta$ -blocker may well jeopardise that diver's safety. Certainly those taking  $\beta$ -blockers and digoxin should not dive because of reduced tolerance to exercise. Postural hypotension can occur with antihypertensives which may produce a change in the level of consciousness and can, under the stress of diving, produce arrhythmias. People on antihypertensives who want to take up diving really should be discouraged unless they are only on very, very small amounts of medication.

Other medications which can cause problems for divers are the bronchodilators for asthma. I believe that active asthmatics are at very, very profound risk in diving and no one in their right mind, certainly no diving doctor, should allow active asthmatics to dive. One has to explain the reasons why one is refusing an asthmatic. One cannot say to a person, "I am sorry, no diving, you are an asthmatic. Good bye!" They want to know why. Now it is only reasonable that they be given an explanation. An explanation which seems to me to be most appropriate for these people includes discussing Boyle's Law, ruptured lungs, sudden unconsciousness and drowning, instant death and so on. They want to know why they can not take their Ventolin and dive. There is some evidence that salbutamol is not particularly active under pressure. The problem is that if they were to use their bronchodilator at the beginning of a dive the effect is waning at the end of a dive which is precisely the time when it is most required to prevent problems.

It is generally accepted around the world that people on insulin should not dive. However some of the clinicians who care for diabetics are becoming agitated that we do not let their very fit young people on insulin dive. I think there were moves afoot to have a big conference, here in Australia, between diving doctors and physicians who manage diabetics on this very point. Why do we not like diabetics diving? Because of increased platelet adhesiveness, an increase in thromboxane and a reduction in prostacyclin which can cause decompression sickness to occur earlier. When de-

compression sickness does occur in diabetics it tends to be worse than in non-diabetics. The problem of decompression sickness in people who are using insulin is a very real one. Also there can be problems with exercise, from blood sugar level changes and changes in consciousness.

We do not allow people taking antiepileptics to dive because epilepsy can break through what is successful drug management on the surface when underwater, because of the increased partial pressure of oxygen from breathing compressed air at depth and the risk of an increase in arterial carbon dioxide, which often occurs when using scuba gear.

We as diving doctors should be on our guard when asked to see prospective divers who are on any of this range of quite legitimate genuine medication. In very many instances it is probable that they are really not suitable for diving and we should therefore recommend that they do not dive. One can say to them that if they ever consider diving and they went off diving against advice they would be a great liability not only to themselves, but to their diving companions. It is for this reason that we must strongly advise these people not to dive, or they may very soon find that the sun would set quite quickly on their existence.

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### **REASONABLE ASSUMPTIONS AND GOOD INTENTIONS MAY PROVE FATAL**

Douglas Walker

The essentials of this tragedy appear simple, visitors from interstate make a deep dive together and one drowns. The investigation shows that the victim was overweighted and both were very inexperienced though trained and having an advanced diver certification. They had entered a low-air state after a failed search for the anchor and decided to make an open water ascent. The buddy was started to ascend a little ahead of the victim, a routine they had apparently developed on their (few) previous dives (i.e.. during training). Separation occurred when or before the buddy became critically low on air, inflated his buoyancy vest, then ascended rapidly the remaining distance to the surface. The

victim was later found on the sea bed, weight belt on, remaining tank air insufficient to inflate his vest.

Closer examination of the genesis of the case shows a complex interplay of misunderstandings and minor lapses which bypassed the normal safety checks designed to prevent what in fact occurred, two inexperienced divers buddied together for a dive far deeper than one at least had ever previously made.

The string of circumstances began when the two divers found they were to visit another city on business at the same time and decided to arrange to have a dive while there. Their training had been recently completed, apparently from the same dive shop, and they were friends. As both were intelligent men they had impressed their instructor and had managed to take an initial Open Water course which they immediately followed by an Advanced Diver course. Although the rules were probably "bent" somewhat the result was that three weeks from their first instruction in scuba they held certificates which informed both them and others that they were Advanced divers. It is unfortunate that they clearly believed this. They had a total of nine dives logged at this time, all made as pupils, to depths of either 20 or 40 feet except for a single short dive to 80 feet depth. It is probable that the buddy later made an additional dive because they talked later about a wreck dive, talk which lulled others into accepting their apparent status as people who had made 120 feet dives. The dive to be related took place six weeks from their introduction to diving.

In response to their request for a diving contact their instructor phoned one of the dive store's suppliers who lived in the city they were to visit. He correctly stated that they had been good pupils and held Advanced Diver certification, no mention being made of their actual diving experience. Later a phone contact was made with the instructor's acquaintance by one of the divers in order to arrange where they were to meet him and where to hire some scuba equipment. There was some discussion of possible diving locations, without mention of their inexperience surfacing from the conversation. Although this contact, an experienced diver made payment for the boat hire, when the two divers attended at the dive shop they were charged not only for the diving equipment which they were hiring but also for the proposed dive, and the charge was that for a deep dive. Although a check was made to confirm that they held certification of training there was no questioning of their having sufficient experience to make the proposed deep dive. Later the dive shop owner stated that the charge was made in error but this does not alter the facts as here recorded.

The two visitors were surprised when they found there were three other divers coming for the dive, diver friends who their contact knew would also appreciate the opportunity this boat hire presented of making a wreck dive. The chatter while waiting for the arrival of the boat, and while its driver gave details of the wreck, appeared to confirm that they made wreck dives and were experienced divers. Nobody thought to question them on their experi-