

It has been suggested that diver A breathed out before he was found unconscious at 120 feet. It is possible than if he just had residual air, that his lungs would not have inflated to the point of bursting by the time he reached the surface. While that is possible, I prefer another explanation, liquid breathing!

I mentioned that when diver A was back in the boat he vomited copious amounts of sea water. I suggest that for some reason or another, he had a malfunction of his equipment and inhaled sea water. As a result he had two lungs full of sea water, which of course would prevent an air embolism. So here is a new way to prevent someone having an air embolism, drown him first!

Why did diver A not get bent? Perhaps it was because he did not exercise on the way up or in the boat. I think it more likely that some people bend and some people do not for the same exposure. I think that diver B's decompression sickness was just a manifestation of chance.

DIVING ACCIDENTS IN NORTHLAND, NEW ZEALAND

Edgar Johnson

I am a pathologist, so you can imagine the outcome of the cases which I will be talking to you about. However, I do not intend to just discuss a list of tragic misadventures. The reason for giving this paper is to point out one cause of underwater tragedy, and subsequently I would hope to learn the opinion of others.

The northern area of New Zealand is served by two pathologists who come to see all the violent or unnatural deaths. It is about 100 miles to Whangarei, from Auckland, where the Poor Knights islands are offshore, and about 40 miles further on there are the Three Kings islands. There is a population of about 100,000 in this area, jumping in summer to approximately 200,000. Probably the greater part of recreational diving in New Zealand takes place in this Northland area, the reasons being the climate, the clarity of the water and the special attractions.

In 1902 on a calm but foggy day, a cargo-passenger ship was travelling at full speed when it ran slap into a charted rock and sank. The bullion lost ran into millions. Soon after the tragedy, two divers, in an attempt at salvaging on the wreck in 150 feet of water, soon succumbed to a mysterious illness, characterised by muscle and chest pain, subsequently known as the bends, or now as decompression sickness. More recently, about fifteen years ago, Kerry Tarleton began a huge salvage operation which today provides the fortunate diver with the possibility of finding a gold or silver coin in the sand.

Between 1976, when I arrived in Northland, and mid 1982, there were eleven scuba related diving deaths. During this seven year period the national toll was thirty one. But in Northland all these accidents have come through the one centre at Whangarei, I was involved in most, but not all, of the post mortem examinations.

CASE ONE

The first was a young diver who went alone into the water from the beach, from a group of divers. He was found on the bottom in about ten feet of water, with all his diving gear in place. There were no signs of life when he was returned to the beach. At post mortem, his head and neck were blue, and there was filling of his trachea and bronchial tree with the fragments of a very recently ingested meal.

CASE TWO

The next case, in 1977, was due to air embolism, which is the common cause of tragedies of this kind. He was diving from a boat, he surfaced, apparently normally, and waved to his companion in the boat but shortly became very distressed. By the time the companion in the boat reached him he was unconscious and died before being taken to the beach in the boat.

CASE THREE

This man was one of twelve divers on a trip to the Poor Knights Islands in 1977. Following a dive he was noticed to be trembling and a little scared. He was advised by more experienced divers on the boat not to dive if he was anxious. He went over the side ahead of two of the divers. The leader of the party saw bubbles coming up in an area where the water was up to 230 feet deep. The leader immediately donned his gear and dived, but could not find the victim. He was subsequently found about one or two hours later at 220 feet, where he was obviously deceased. When his diving bag was examined by the police, a plastic bag of cannabis was found. Subsequently the blood level of the active ingredients was found to be close to intoxication level. Subsequent examination of lung section, however, brought the conclusion that this man may have inhaled gastric contents whilst diving.

CASE FOUR

Three companions, having completed a dive for scallops, were swimming back to their boat when the first two looked round and found their companion was no longer swimming with them. Just before the disappearance, one of the swimmers thought that their companion was swimming somewhat erratically. He was later discovered, unconscious, but died of drowning.

CASE FIVE

The first case in 1980 was, and still is, a mystery. An experienced diver with several years' experience, was diving at the Three Kings, off the North Cape, with two doctors. He appeared to have swum off in a different direction. Subsequently, the others surfaced and realised that he was missing. After a search lasting three quarters of an hour, he was found amongst shallow rocks on the bottom. No reason at the time, or subsequently, can be found for this loss. There was moderate surf running and he had a small minor bruise on his head.

CASE SIX

An experienced diver, with a number of deep dives to his credit, wanted to dive down to a long, deep trench, down to about 200 feet near the Poor Knights Islands and to rise slowly as he progressed to allow for decompression. About five minutes after entering the water he surfaced, obviously in great distress, and became blue, lost consciousness and was considered dead when pulled into the boat. The post mortem showed signs of acute congestion, characteristic of asphyxiation, and there was acute pulmonary oedema. A lot of food fragments were present in his trachea and major bronchi and many of the minor bronchi. The trachea and bronchial mucosa was deep red, another sign of inhalation of gastric contents.

CASE SEVEN

This man presumably ran out of air whilst tying a load of scallops onto his boat. His companions who had previously been diving could see him, but had exhausted their own air supply and could not go to his assistance. The body was discovered the following day, when the air tank was found to be empty.

CASE EIGHT

In 1981, this body was discovered on the sea bed in about 30 to 35 feet of sea water, after having been missed by his companions. He had previously dived only six or seven times in the sea and had had no formal training. The pathologist had difficulty in deciding just how the man had died, since there were a number of causes for the pulmonary oedema, which was the main finding of the post mortem. There was also a degreding of the tracheal and bronchial mucosa. In fact this man had widespread evidence of aspiration microscopically with proteanaceous pulmonary oedema and fragments of vegetable matter in the peripheral lung tissue.

CASE NINE

During 1982, an experienced diver intended to dive at the Poor Knights to a depth of 180 feet. He descended and rendezvoused with his companions at 100 feet, and they then went on to 180 feet. Almost immediately

one of the party looked up to see the victim drifting very fast towards the surface. The companion followed and saw the deceased roll over backwards with his arms outstretched and hands quivering. The companion reached the deceased but he had floated down in the water and he could get no response from him. He did note air coming out from his mouth piece. We still have no idea why this man decided to ascend in this manner and then apparently drowned. There were no defects in his equipment and no evidence of pre-existing disease. He was 34 years old and so a heart attack was unlikely. A microscopic search of the lungs failed to find any inhaled material.

CASE TEN

A heart attack did occur in this man, who had severe coronary artery atheromatous disease.

CASE ELEVEN

The final case was hit by a speed boat. The diver had no flag.

COMMENTS

Two of the eleven had obvious macroscopic aspirations where the trachea and main bronchi contained white frothy mucus and numerous vegetable fragments, particularly in the lower trachea.

The main points of difference between someone who had drowned and one who has aspirated can be shown. In drowning there is relatively little interalveolar protein and sometimes it is very congested in the alveolar walls. By contrast, in aspiration, there is oedema and debris within the alveoli. In the case in 1981, who was recovered from the sea bed, there was a mass of material, including partly digested muscle fibres, also small fragments of vegetable cell wall, in the distal airways. There were similar findings in the individual with a high cannabis level.

Surprisingly in the two cases where obvious macroscopic inhalation had taken place there were no small fragments in the distal airways. Nor were any vegetable fragments seen in the many seawater drownings.

Over a seven year period, eleven scuba deaths occurred in which two were obvious aspiration of gastric contents and subsequently two more aspirations were detected. That is about 40% of scuba deaths.

Scuba deaths in our area contribute only about two per cent of accidental or violent deaths. Aspiration is a serious possibility, especially in the less experienced diver who is unable to cope with this previously unheralded or perhaps unthought of emergency.

New Zealand deaths associated with scuba diving, from the period from 1961 to 1973 were reported in a paper in the New Zealand Medical Journal by an Auckland pathology registrar. He examined the inquest details of the 21 cases over this twelve year period. The number of cases per year was roughly the same, which to my mind indicates an improvement since scuba diving has become much more popular in recent years. Nine cases ran out of air. Only in two was aspiration poorly but not adequately described. Often histology was not done. There is a strong indication that the causes of death are changing possibly due to better standards of diver education.

Dr Martin Sher

I have heard before of aspiration being the cause of deaths. I wonder whether it should be part of diving courses to learn how to cope with vomiting. If you feel like vomiting you should take your regulator out, as vomiting into the regulator and then breathing it back in may be the cause of aspiration. Talking to divers, many of them are not aware that they should take out their regulators, their only thought is to get out of the water as soon as they can. How to cope with vomiting underwater should be pushed by the instructors and made known in diving courses.

SALVAGE DIVING

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Salvage diving is a fairly broad subject. I will confine my talk to the area that we work in. Our base is in Fiji and we branch out into New Guinea, Australia and occasionally to New Zealand. To the east, we go as far as the group of islands south of Hawaii. Most of the diving we do is in warm water. This certainly makes diving a lot more pleasant and enjoyable. Most of it is also in clear water, so we are normally able to see what we are doing. However, we do run into jobs occasionally that go back to my early training days, which were in the Brisbane river. Once you were 1cm under the surface, it was dark and everything was done by the Braille method. We developed several techniques while we were diving like this. One was to use the stainless steel mesh glove used commonly in abattoirs, to enable us to have the tactile sense that is so necessary to perform useful work when you cannot see. As the various senses go, sight, touch, sound, naturally the diver becomes less efficient. It is amazing the number of little things that have developed in the industry, particularly over the last ten or fifteen years, that have enabled us to achieve more and more in a given time.

One of the problems which we run into in this part of the world is that it gets deep very quickly. We have restricted our diving to compressed air, for the simple

reason that to become involved in mixed gas diving is very expensive. Also, listening to divers talking, I am quite sure that there is a lot still to be learned about it. It is mainly restricted to oil rig diving, which is very well controlled and where finance is not the first problem. There is also the odd occasion, such as the recovery of the gold from HMS "EDINBURGH" where money was not really a problem once the target was located. The diving on that particular job was really quite straight forward, but it was written up in a book, "The Discovery of Stalin's Gold" as being a fantastic feat. From a professional diving point of view, it was the sort of thing that is done every day on oil rigs around the world. Nevertheless, it must have been a tremendous sensation to be picking up these bars of gold.

Our diving here is largely scuba. We do on occasion use face masks, positive pressure systems, if we are using communications. We find that communications can be used quite well with ordinary scuba equipment if you have someone who has been diving with you as a buddy, as the topside operator. It is quite possible to talk with an ordinary water mike. We leave it dangling and when we want to say something, we put it up near the regulator and somehow squawk out a noise. More often than not, the communication that we want is fairly simple such as "up" or "down" when lifting something, or "on" or "off" when using a hydraulic circuit. Quite often we use surface supply to avoid the problems of putting heavy tanks on and of filling them. It is much easier and cheaper to operate on hookah if we are operating in deep water. By deep I mean below 100 feet. Diving with a hose, we use either an ordinary demand regulator or perhaps full face mask. We also use a small bail out bottle to enable us to get back to the decompression chamber or to make a safety stop and carry out decompression with the air that is on our back.

We try to make our system as safe as possible in that the particular diver who is down there working is entirely responsible for his own safety. He may need support for carrying out the particular task, this is in the form of lifting and hydraulic power. But from a safety point of view, I subscribe to the school that every man should be on his own. So many of the accidents that have occurred have been a third party involvement, where they take the wrong mixture down, or something strange has happened, and that has led to an accident and often a fatality. We have done a little bit of experimenting with the fibreglass helmets that have developed from the original hardhat. We do not use them now. We do not need them for protection. We do not need them from the point of view of safety. If you are going into a particularly tight situation where there is a possibility that you may get hung up, the full face mask is more than adequate. The full face mask that we use is a positive pressure system. What would happen if somebody blacked out with a full face mask like that on I cannot say, because I do not know of any case histories. But